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# Relationships, Knowledge, and Resilience: A Comparative Study of Stakeholder Participation in Great Lakes Areas of Concern

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RELATIONSHIPS, KNOWLEDGE, AND RESILIENCE:  
A COMPARATIVE STUDY OF STAKEHOLDER PARTICIPATION IN  
GREAT LAKES AREAS OF CONCERN

by

Kathleen Colin Williams

A Dissertation Submitted in  
Partial Fulfillment of the  
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May 2015

ABSTRACT  
RELATIONSHIPS, KNOWLEDGE, AND RESILIENCE:  
A COMPARATIVE STUDY OF STAKEHOLDER PARTICIPATION IN  
GREAT LAKES AREAS OF CONCERN

by Kathleen Colin Williams  
The University of Wisconsin-Milwaukee, 2015  
Under the Supervision of Professor Ryan B. Holifield, PhD

This dissertation investigates the current practices of environmental governance in the Great Lakes region, where at one time the rivers that fed the Great Lakes were choked with debris and on fire. The Great Lakes Water Quality Agreement of 1978 and the 1987 updates inspired collective action to remediate and restore the rivers and nearshore zones of the lakes through the implementation of an ecosystem approach, which included a public participation dimension. While funding and momentum has fluctuated, the constructs – Areas of Concern (AOC), Remedial Action Plans (RAP), and Public Advisory Councils (PAC) persist. In 2010, the Great Lakes Restoration Initiative initiated a flurry of restoration activity throughout the region and revived the AOC process. This study examines several dimensions of activity in the region. First, through a comparative case study of the Milwaukee Estuary, St. Louis River and St. Marys River AOCs this study analyzed how state agencies and local organizations cooperate. Secondly, using a comparative case study of the Michigan and Wisconsin approaches to restoring a beneficial use, this study identified how different approaches to knowledge production could be applied in environmental management. Finally, the study describes how scenario analysis could be applied to produce knowledge across disciplinary natural and social science boundaries to inform Great Lakes policy. The study revealed the organization of Public Advisory Councils and relationships with state agencies created

different opportunities for individuals and organizations to participate in the restoration in AOCs. This study also illustrated that rules and institutional constraints shape how knowledge is produced in Areas of Concern, and describes some of the trade-offs involved with engaging citizens in knowledge production. Finally, the Great Lakes Futures Project demonstrated how constructivist learning methodologies can create an inclusionary environment to produce transdisciplinary knowledge for environmental governance. Furthermore, the study suggests the stories created through inductive scenario analysis reflected shared meanings and a new method for integrating political and cultural concerns into socio-ecological systems research. The study will contribute to the literatures about ecosystem-based approaches in the Great Lakes, geographic literature about knowledge production in environmental management, and the understanding of transdisciplinary knowledge production.

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## LIST OF ABBREVIATIONS

AOC	Area(s) of Concern
BPAC	St. Marys River Bi-national Public Advisory Council
BUI	Beneficial Use Impairment
GLWQA	Great Lakes Water Quality Agreement
GLWQB	Great Lakes Water Quality Board
IJC	International Joint Commission
LSNERR	Lake Superior National Estuarine Research Reserve
MDEQ	Michigan Department of Environmental Quality
PAC	Public or Citizen Advisory Council
RAP	Remedial Action Plan
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
UW-Extension	University of Wisconsin-Extension
WDNR	Wisconsin Department of Natural Resources

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## EPIGRAPH



Milwaukee Inner Harbor, Milwaukee, Wisconsin



St. Louis Bay, Superior, Wisconsin



International Bridge, St. Marys River, Sault Ste. Marie, Michigan

**- Chapter 1 -**  
***Introduction***

This dissertation investigates the current practices of environmental governance in the Great Lakes region in the United States and Canada. Although the lakes are enjoying a significant amount of attention, it was not too long ago that rivers were on fire and clogged with debris. In fact, many people abandoned the rivers in the Great Lakes region because of the levels of pollution. However, the dedication of a committed group of scientists and advocates has made a difference. The first Great Lakes Water Quality Agreement (GLWQA) in 1972 saved Lake Erie from eutrophication. The Agreement was then revised and replaced in 1978 to tackle the problem of toxic substances, recommending the properties of the Great Lakes *ecosystem* be maintained (IJC, 1978). This new approach was a diversion from the traditional command-and-control policies common at the time (Jetoo et al., 2015; Muldoon, 2012).

In 2015 and the Great Lakes community has been energized and is implementing as many restoration projects as possible. In 2010, the Great Lakes Restoration Initiative was funded and kick-started a flurry of restoration activity throughout the region. Furthermore, the Great Lakes Water Quality Agreement was renewed in 2012. Together, these developments indicate that the environmental governance in the Great Lakes region continues to evolve. This study examines several dimensions of environmental governance in the region through an analysis of how state agencies and local organizations cooperate, how different approaches to knowledge production can be applied in environmental management, and how constructivist approaches to learning can inform environmental policy.

## **Cooperative governance and the Great Lakes**

The Great Lakes region has a history of collective management of water resources, including the 1909 Boundary Waters Treaty and other agreements (Linton and Hall, 2012). In 1972, Canada and the U.S. signed the first GLWQA in order to address the “death” of Lake Erie. As a result of the 1972 Agreement, nutrient loading was significantly reduced, and Lake Erie recovered. Following the success of the 1972 GLWQA, Canada and the U.S. signed a 1978 agreement that included the directive of an “ecosystem approach” and public participation as a means to restore the Great Lakes (Botts and Muldoon, 2005).

Although public participation has been cited as an important feature of the Great Lakes Water Quality Agreement, advocates acknowledge that the ecosystem approach and consultation with the public and local stakeholders did not just *become* part of the Great Lakes Water Quality Agreement. Botts and Muldoon (2005) described the additions of the provisions of an ecosystem approach and public consultation as hard-fought victories for advocates and scientists in the "Great Lakes Community." Scientific advisory committees and public advisory committees have kept citizens and scientists close to the process and provided meaningful opportunity to contribute.

Advocacy for inclusion in the International Joint Commission processes regarding the Great Lakes Water Quality Agreement created a tradition of participation in the environmental governance. For example, the Great Lakes Collaboration, a coalition of more than 1,500 governmental (federal, state, local and tribal) agencies, nonprofit organizations and individuals concerned about the health and future of the lakes lobbied President Bush for recognition. One of the victories of the Great Lakes Collaboration is

manifested in the Great Lakes Legacy Act, which has been instrumental in remediating toxic sediments in Areas of Concern. Furthermore, the Collaboration prepared the ground for the largest investment in Great Lakes restoration in the US, the Great Lakes Restoration Initiative (GLRI).

In 2007, the Brookings Institution produced a study and summary report for the Collaboration (Austin et al., 2007 a, b). The documents outlined a plan for restoring the Great Lakes for both preservation and as an investment. The studies estimated cost of the proposed “Great Lakes Restoration Strategy” at \$26 billion (Austin, 2005). The report described the numerous benefits to society resulting from ecological restoration activities. Possible enhancements to the region include healthier fisheries, cleaner waters for recreational boating and swimming, improved property values in the Areas of Concern, and reduced costs for water treatment for municipalities. Subsequently, the GLRI was funded at \$475 million in 2010 (Meeting field notes, 3/2013).

Before 2010 and the GLRI, only four of the 43 Areas of Concern had been removed from the list--three in Canada and one in the US. Since 2010, when the GLRI started investing hundreds of millions of dollars to restore the beneficial uses of the Great Lakes, three Areas of Concern have been delisted, and many beneficial uses restored (USEPA, 2015).

### **Areas of Concern and Remedial Action Plans**

Although the GLRI mobilized action throughout the region, Areas of Concern have been the sites of ongoing and incremental progress for nearly thirty years. The Great Lakes Water Quality Agreement suggested a method of restoration in the region composed of a site description (Area of Concern), checklist (list of Beneficial Use

Impairments), methodology (three-stage Remedial Action Planning Process), and instructions to consult with the public. A complete description of how the ecosystem approach suggested in the Agreement works in practice will be included in Chapter 2.

There are 43 sites where an ecosystem approach was implemented, so a common language is used to communicate about plans, participation, and progress. Here are some of the key terms in this shared vocabulary:

- Areas of Concern (AOC) are 43 historically polluted sites or the geographic sites that fail to meet the standards in the Agreement.
- Beneficial Use Impairments (BUI) are the “beneficial uses” of the ecosystem that could be compromised. The impairments function as a checklist, when all of the uses are no longer impaired, then the Area of Concern is restored. The list of 14 beneficial uses can be found in Chapter Two and Three.
- The International Joint Commission (IJC) is the Treaty Body that administers the Boundary Waters Treaty of 1909 between Canada and the US. The Great Lakes Water Quality Agreement is a standing reference under the Boundary Waters Treaty.
- Public Advisory Councils (PAC) are the most common method of participation in the Areas of Concern. Although they look and operate differently and have different roles in Areas of Concern, every AOC has an advisory committee.
- The Remedial Action Plan (RAP) is the three-step process to restore the beneficial uses and the Area of Concern. The three steps are:
  - Stage One RAP: Where the specific boundaries, environmental problems, beneficial use impairments, and sources of degradation are defined.

- Stage Two RAP: Where the specific management actions needed to restore the beneficial uses, timelines, and responsible agencies are defined.
- Stage Three RAP: Plan for evaluation and ongoing monitoring.

### **Areas of Concern as an Innovation in Sustainability**

The Areas of Concern represent one of the first large-scale experiments in sustainable development. The International Joint Commission (1984: 13) called the 1978 GLWQA “[a] milestone document, one of the first international statements that technical, diplomatic, and administrative approaches to resource management need to be considered in terms of holistic ecological concepts.” Vallentyne and Beeton (1998: 59) argued the Great Lakes were a site where the ecosystem approach could be implemented because “[i]nstitutional arrangements have permitted it to be more fully expressed than in most other parts of the world.” The concept, Areas of Concern, was innovative because although it would be unreasonable to implement ecosystem approaches to the management to the *entire* Great Lakes basin, focusing specifically on degraded areas provided a solution that could be implemented (Mitchell, 2005).

This raises questions about why this sustainable development implementation framework would appear in the Great Lakes region. Hartig et al. (1995) situated the RAPs within sustainable development frameworks and argued that the RAPs empowered local communities and facilitated cooperation across agencies and among diverse interests. On the other hand, Vallentyne and Beeton (1998) described several factors that motivated this development, namely that the lakes are a large and highly valued bi-national resource, the drinking water supply for 23 million residents, and region with common economic activities throughout.



In spite of the optimism behind the early implementers of Areas of Concern and Remedial Action Plans, Slocombe (1993) contended that discussions of process or methodology for implementing ecosystem approaches were often overlooked. The author further cautioned that “[s]ustainability, and integrated environment and development planning to support it, will almost certainly not happen suddenly; rather it will evolve and coalesce from diverse efforts in disciplines and professions<sup>1</sup> mentioned in this article” (Slocombe, 1993: 300).

Recognizing Slocombe’s argument that process and methodology are important, the literature review below discusses participation and knowledge production in the Great Lakes and environmental management.

### **Theoretical Considerations: Participation and Knowledge**

Although the Great Lakes Water Quality Agreement called for an ecosystem approach and public participation, there has been a considerable amount of debate on the value of participation (Hartig and Law, 1994; Landre and Knuth, 1993; Sproule-Jones, 2002). Resource managers and policy experts seem more skeptical of participation in the RAP process, but scholars who study participation find that it facilitates agency coordination and the connection of local and state environmental priorities. After all, “[p]ublic participation is not just an ‘uncomplicated good’ (Cleaver, 2001)” (Petts and Brooks 2006, 1046). A study of Areas of Concern and knowledge creation in the Great Lakes region provides a structured way to consider how participation is complicated, but can be good.

---

<sup>1</sup> Disciplines and professions mentioned in the article include sociology, environmental planning, organizational science, actor systems, development planning, ecology, urban and regional planning, human ecology, cultural ecology, and psychology.

Thus, instead of engaging in a debate about the merits of participation, this study investigates how and what participation contributes to environmental governance in the Great Lakes. For example, Beierle and Konisky (2001) concluded that participation in the Remedial Action Plans resulted in documents that reflected public values, reduced tensions between stakeholders, and increased capacity in agencies and stakeholders to implement the resulting plans. This raises questions about what else participation could add to environmental governance.

Of course, this brings us back to the tensions between agency officials and the participating public in environmental management. Participation is often criticized as inefficient and failing to deliver the promise of sound decision-making (Reed, 2008). However, scholars suggest that alternative methods of connecting with interested publics, like invitations to participate in restoration and citizen surveys, show promise for engaging the public in a constructive way that is more compatible with agency missions and agendas (Eden and Bear, 2012; Gobster and Hull, 2000). In short, participation can add alternative knowledge and expertise to environmental governance.

Finally, an important finding from studies where knowledge about science and policy are produced together is that the process undertaken to engage stakeholders and the public matters. Scholars argue that management and facilitation of the projects was critical for maintaining the relationships that lead to increased trust and legitimacy (Edelenbos et al., 2011; MacKenzie, 1996; Podestá et al., 2013). For example, Dilling and Lemos (2011) found the use of collaborative group processes facilitated mutual learning. Similarly, Newig and Fritsch (2009) found that ongoing discussions, including face-to-face interaction, could resolve differences when they arose.

That is to say, public and stakeholder participation in environmental governance is a complicated mix of process, knowledge, and opportunity. The comparative case study described below delves into how these elements of participation are arranged in three Great Lakes Areas of Concern: the Milwaukee Estuary, St. Louis River, and the St. Marys River.

### **Overview and Findings**

This study has three main objectives that are explored in three chapters. Two of the chapters investigate environmental governance in Great Lakes Areas of Concern. In Chapter Two, I interrogate the most common method of public participation in the region, the Public Advisory Councils that cooperate with state agencies to develop and implement Remedial Action Plans. I found that *how* Public Advisory Councils were organized created different opportunities for individuals and organizations to participate in the restoration in Areas of Concern. Further, the connections between state agencies and local advisory councils influenced how restoration unfolds in place. Lastly, I found that the connection to place makes a difference in articulating a local vision and connecting restoration to the community outside the Area.

In Chapter Three, I compared two different approaches to knowledge production about the aesthetics in the Milwaukee Estuary and St. Marys River Areas of Concern. Wisconsin and Michigan followed different protocols to create knowledge about the Degradation of Aesthetics Beneficial Use Impairment. The states' approaches differed along four axes: the legal framework, collection protocols, knowledge outcomes, and decision process. Trade-offs appeared in each state's approach. For example, the Michigan process was executed more quickly, and the impairment has been removed

from the list of problems. On the other hand, citizens were more engaged in the process in Wisconsin, and the volunteers collected more data in both quality and quantity.

Chapter Four represents a departure from the other two chapters; however, participation and knowledge production remain important themes. In 2011, an engaged collection of scholars initiated a project to create new policy recommendations for the Great Lakes region. The goals of the project were twofold: create new knowledge and initiate a new generation of Great Lakes scholars. The Great Lakes Futures Project became a method to update knowledge about the Great Lakes, create a new understanding about how the parts of the Great Lakes ecosystem interact, and create new policy recommendations based on the findings. The results of the study suggest that the Futures Project incorporated elements of constructivist learning methodologies to create an inclusionary environment. Furthermore, the study suggests the stories created through the process reflected shared meanings and a new method for integrating human concerns like attachment to place and politics into socio-ecological systems research.

### **Significance**

This work will contribute to several literatures. First, this study will contribute to the understanding of ecosystem-based approaches to environmental management in the Great Lakes. Areas of Concern provide a specific model for implementing ecosystem-based approaches, and this study will contribute new understanding about how the associated Public Advisory Councils operate after 30 years. Further, this study will contribute insight into how connection to place has an affective influence on participants in environmental governance.

Secondly, this study will contribute to the literature on knowledge production for

environmental governance in two ways. This study demonstrates that institutional rules shape not only the knowledge produced in environmental management, but also the opportunities for citizen participation. Furthermore, this study will contribute to the discussion of specific trade-offs made when engaging citizens in knowledge production for environmental management.

Finally, this study will contribute to the literature on transdisciplinary knowledge production through a demonstration of how inclusionary methodologies and the application of constructivist learning principles can create dialogue across the boundaries of science, policy, and practice. Furthermore, this study demonstrates a method to bring elements like politics and emotional attachments to place into conversation with socio-ecological systems conceptualizations of environmental change.

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**- Chapter Two -**  
*Connecting organizations and place: The role of local  
organizations in fostering collaboration in Great Lakes Areas of Concern*

**Abstract**

Canada and the United States have been implementing ecosystem approaches to environmental restoration in the Great Lakes region since the mid-1980s through restoring beneficial uses in forty-three historically degraded sites in river mouths and nearshore areas. In 1987, the Great Lakes Water Quality Agreement institutionalized an approach where “Areas of Concern” would be remediated through “Remedial Action Plans” by restoring “Beneficial Use Impairments.” The key innovation in implementing an ecosystem approach was the direction that the public should be involved and consulted throughout the remediation and restoration process. After nearly thirty years, many Public Advisory Councils that assisted in the Areas of Concern program in the 1980s and 90s still exist. Interest in Great Lakes Restoration and the activities of Public Advisory Councils is motivated by a large investment by the US federal government, the Great Lakes Restoration Initiative (GLRI). This study examines how the remedial action planning process to restore the Great Lakes has evolved through a comparative case study of three sites: the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern. This study suggests that the characteristics of Areas of Concern and their associated Public Advisory Councils vary greatly. Further, this study suggests that the relationships between state agencies and local advisory councils shape how stakeholders are able to participate in the process. Finally, this study suggests that a connection to place shared amongst participants or extended to the community beyond the Area are important for motivating action in Areas of Concern.

## Introduction

In the 1985, the Great Lakes Water Quality Board (Water Quality Board) reported to the International Joint Commission about forty-two Areas of Concern where the "environmental quality is degraded and the beneficial uses of the water or biota are adversely affected" (Great Lakes Water Quality Board, 1985:2). The Water Quality Board recognized compromised water quality posed a problem not only for the water and birds, but for the people who lived near and benefitted from the ecosystem.<sup>2</sup> States or Provinces designated the areas because they did not meet the standards of the Great Lakes Water Quality Agreement of 1978 (Agreement).<sup>3</sup> The 1978 Agreement replaced the successful Great Lakes Water Quality Agreement of 1972, which saved Lake Erie from "death" by nutrient overloading. The 1978 Agreement still targeted nutrient loading, but expanded its reach to reduce toxic substances and "maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem" (IJC, 1978). Thus, the International Joint Commission<sup>4</sup> signaled a shift in management practices away from a single organism or problem to consider the entire ecosystem and its interlocking components, including humans.

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<sup>2</sup> The International Joint Commission defined the 14 beneficial use impairments (BUI) in Annex 2 of the 1987 Amendments to the Great Lakes Water Quality Agreement (International Joint Commission, 1987). The BUIs are restrictions on fish or wildlife consumption; tainting of fish and wildlife flavor; degradation of fish and wildlife populations fish tumors or other deformities; bird or animal deformities or reproductive problems; degradation of benthos; restrictions on dredging activities; eutrophication or undesirable algae; restrictions on drinking water consumption, or taste and odor problems; beach closings; degradation to aesthetics; added costs to agriculture or industry; degradation of phytoplankton and zooplankton populations; or loss of fish and wildlife habitat.

<sup>3</sup> The standards of the Agreement are outlined in Annex 1 and define acceptable limits for a list of toxic substances, review procedures, and ecosystem objectives (IJC, 1987).

<sup>4</sup> The International Joint Commission is the international organization formed by the Boundary Waters Treaty between the US and Canada. The Great Lakes Water Quality Agreement is a standing reference under the Boundary Waters Treaty.

In the mid-1980s, the restoration of the Great Lakes was progressing slowly. Thus, the Great Lakes Water Quality Board formulated a set of recommendations to restore Areas of Concern (AOC) through the development and implementation of Remedial Action Plans (RAP). Annex Two of the 1987 Amendments to the 1978 Agreement institutionalized AOCs and RAPs, as well as directed government agencies to consult with the public. Jetoo et al. (2015) argued that the Remedial Action Plan approach represented a departure from traditional command-and-control resource management programs. Although stakeholder and public participation are more common now, the direction to include stakeholders and the general public in environmental planning was an innovation at the time (Muldoon, 2012). Public Advisory Councils<sup>5</sup> (PAC) or similar multi-stakeholder organizations often facilitate participation or consultation in Remedial Action Plans. Many of the original councils still exist thirty years after the Area of Concern restoration program was introduced as a solution to Great Lakes degradation, although other groups have formed more recently.

Much of what we know about Remedial Action Plans and the role of Public Advisory Councils in Great Lakes Areas of Concern originates from research conducted in the early 1990s, soon after the Areas were designated. Many of those studies were collections of case studies or quantitative studies on specific dimensions of public participation. However, circumstances have changed dramatically in recent years, and as a consequence this research needs to be updated. Funding for remediation all but disappeared in the mid-1990s, and little work took place in Areas of Concern between 1996 and 2002, when Congress funded the Great Lakes Legacy Act (Legacy Act).

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<sup>5</sup>Public Advisory Councils are the most common structure for public or stakeholder participation in Great Lakes Area of Concern restoration.

Between 2002 and 2010 the Legacy Act funded the remediation of contaminated sediments at former industrial sites (USEPA, 2015). In 2010, the Great Lakes Restoration Initiative (GLRI) changed the face of environmental restoration in the region through wide-scale investment in outreach and education, research, pollution and invasive species control, and monitoring (USEPA, 2015).

In addition, little research on environmental governance in the Great Lakes has examined how advisory councils operate in practice. Council structures vary from Area to Area and they have distinct relationships both to state agencies and to the local settings of the Area of Concern. To date, there have been no studies that compare the ways that Public Advisory Council structure, state agency – advisory councils relationships, and commitment to place make a difference in the process.

In order to understand how the role of advisory councils in the process to restore the beneficial uses in Areas has evolved, I will answer the following research questions:

- What are some of the elements that characterize differences in Public Advisory Council structures in Areas of Concern?
- How do the following aspects of Public Advisory Councils make a difference in the Remedial Action Planning Process and the outcomes: (a) their structure and organization; (b) their relationship to the lead state agency; and (c) their connection to the waterway, or the sense of place?

Using a comparative case study approach, I analyzed the dynamics of public and stakeholder participation in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern. I contend that Public Advisory Councils are complex and diverse in both structure and operation. Some of the elements that characterize the differences in the

advisory councils structures are the convening organization, tenure, role in Area, and relationship with the state agency. Further, I found that advisory councils might be organized by/as a nonprofit organization, educational institution, or committee.

The differences in advisory council structures are significant for three main reasons. First, I argue that differences in the ways that they are structured and organized create different opportunities for individuals and organizations to contribute knowledge or experience to the remedial action planning process. Advisory councils that are structured as nonprofit organizations or organized by educational institutions allowed for types of stakeholder participation that advisory councils that are structured by state agencies did not.

Secondly, I argue that connections between stakeholders and state agencies influence how the Area of Concern process unfolds in each place. I found the lead state agency has a considerable amount of influence in each of the Areas in my study. This means that some states administer the program from the state level, while others might assign local staff. I found that when the Area process is locally administered instead of centrally administered, there are more opportunities for local concerns and stakeholders to be incorporated in planning. Finally, I argue that a commitment to local relationships and a connection to the place can make a difference by sustaining organization and activity over time, articulating the local vision, proposing or implement projects, or "own" remediation efforts.

This study is a contribution to the literature on ecosystem approaches to resource management in the Great Lakes, more specifically, how the structure and influence of Public Advisory Councils in Areas has evolved over the 30 years since they were

designated. This study also supports one of the early hypotheses in the Area of Concern program. The process was envisioned as one where the Great Lakes would be restored through taking care of the worst parts first. Scholars who theorized about the sites in the beginning noted that sense of place should play an important role in restoration. However, there has been little/no empirical study to investigate this claim. This study demonstrates that connection to place is important and can be reflected in political support, like staff support to Areas and advisory councils.

### **The Great Lakes and the ecosystem approach to resource management**

Although ecosystem-based management is now widely accepted as policy in federal resource management agencies, including the National Oceanic and Atmospheric Administration, the National Forest Service, and the Environmental Protection Agency, it was novel when first introduced in the Great Lakes region in the late 1970s (Malone, 1997; Muldoon, 2012; NOAA, 2004). Christensen et al., from the Ecological Society of America (1996) and the National Oceanic and Atmospheric Administration (2004), detailed in their policy statements that goals of implementing an ecosystem approach include embracing complexity, maintaining ecosystem integrity, and considering humans as part of the ecosystem. Furthermore, the policies highlight the importance of data collection of both ecological and human dimensions and recommend that management plans reflect human values. Thus, ecosystem-based management *should* be based on cooperation within and between agencies and flexible enough to change as needed. The Great Lakes region provides an example of a region-wide experiment in the application of ecosystem-based approaches and provides an opportunity to examine how the implementation of the approaches evolves over time.

The Areas of Concern and Lakewide Management Plans embody the ecosystem approach described by the Great Lakes Water Quality Board. The 1985 Great Lakes Water Quality Board (Board) Report to the International Joint Commission started including descriptions of the sites with compromised water quality in their annual reports starting in 1973. In 1981, the Board recommended a new approach, establishing " 'areas of concern' based on environmental quality data for all media (sediment, biota, and water) and to evaluate these areas with uniform criteria" (31). Additionally, the Board recommended addressing specific sites and a "systematic and comprehensive approach to restoring the beneficial uses in areas of concern and is consistent with an "ecosystem approach" to the protection of the Great Lakes" (44). The systematic approach the Board adopted is now known as the Remedial Action Plans (RAP). Each plan consists of the description of the problem and geographic extent, list of all impaired beneficial uses, pollution sources, list of remedial measures, and an estimated timeline for progress.

The 1987 Amendments to the Great Lakes Water Quality Agreement institutionalized Remedial Action Plans and defined the Areas of Concern (AOC or Area)<sup>6</sup> and the list of beneficial use impairments (BUI or impairment). The Amendments stipulated that Canada and the US, as well as respective state and provincial governments, should ensure the public is consulted "in all actions" (International Joint Commission, 1987). Soon after, RAPs were developed across the region as a three-step process,<sup>7</sup> functioning as blueprints to restore the beneficial uses (Hartig and Zarull, 1992; International Joint Commission, 1987).

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<sup>6</sup> Areas of Concern as the "geographic areas that fail to meet the general or specific objectives of the Great Lakes Water Quality Agreement" (International Joint Commission, 1987).

<sup>7</sup> There are three stages of the RAP process. Stage 1 is where the specific boundaries, environmental problems, beneficial use impairments, and sources of degradation are defined. Stage 2 is where the specific

Public participation is one of the commonly used methods to introduce human values into ecosystem approaches to environmental management (Endter-Wada et al., 1998; Grumbine, 1994). The Great Lakes is one such region where public participation and ecosystem approaches have been closely connected. In fact, Muldoon (2012) calls the Great Lakes a laboratory for policy innovations like the ecosystem approach and public consultation. In fact, the Great Lakes are one of the regions of the world where participation has transformed policy (Botts and Muldoon, 2005; Linton and Hall, 2013). According to Linton and Hall (2013: 234), “with increased public participation comes increased accountability for the two federal governments, and this informed and engaged citizenry had led to improved binational protection of the Great Lakes.”

Early case studies of Areas of Concern explained how the public participated in the remedial action planning process in different Areas. Hartig and Law (1994) and Hartig and Zarull (1992) were enthusiastic about the promise of citizen involvement in restoration planning. The authors were encouraged that citizen groups, like Friends of the Rouge and Friends of the Buffalo River, dedicated time to fundraising to the endeavors. At the same time, Hartig and Law (1994) were concerned about the institutional commitment to the process. The authors were especially concerned that agencies would maintain adequate staffing, funding, and focus.

Hartig and Law (1994) were right to be skeptical about agency support for the Remedial Action Plan process and public participation in it. Although the International Joint Commission encouraged consultation with the public at all stages of the process and

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management actions needed to restore the beneficial uses, timelines, and responsible agencies are defined. Stage 3 is the plan for evaluation and ongoing monitoring.



prescribed the steps in the planning process, they did not offer specific instructions for execution (Sproule-Jones, 2002). Between the lack of directions and lack of universal support among agency staff, Remedial Action Plans were implemented unevenly, and public participation varied significantly (Landre and Knuth, 1993). Botts and Muldoon (2005) contended that varying levels of political support at the state level influenced local RAP development. Landre and Knuth (1993) argued that support for the plans varied between staff and agencies and described that staff was skeptical of public participation. MacKenzie (1997) argued that individual agency staff might personally support the RAPs, but personal support did not necessarily translate into institutional support. On the other hand, Christie (1995) explained that agency adversarialism, or governmental department rules and constituent group conflicts, was the problem.

The lack of directions led to a complicated array of implementation strategies and frustration as described above, but also slow progress (Botts and Muldoon, 2005). Hartig and Law (1994) were especially concerned that the sluggish pace of implementation and results might compromise the potential for success in remedial action planning, and they were not alone. Indeed, the Great Lakes Water Quality Board acknowledged that the RAP process was taking longer than expected. In subsequent reports, the Board acknowledged that it underestimated the level of complexity of the problems, managing participation, and agency collaborations (Great Lakes Water Quality Board, 1989; International Joint Commission, 1996). In response to the complexities, the Water Quality Board, the United States Environmental Protection Agency (USEPA), and Environment Canada argued that "innovation and creativity" should be encouraged. They

further recommended that the lead RAP agency is "not solely responsible for implementing it" (International Joint Commission, 1996).

While the Board, USEPA, and Environment Canada were reflecting on the RAP experiences, other scholars were studying the process as well. MacKenzie (1996) argued that one of the essential features of Remedial Action Plans is that stakeholders, including scientists, natural resource managers, citizens, and policymakers, should participate in all stages of the process. But, as outlined above, resource managers and agency staff were skeptical, and progress was slow. This raises questions about how best to develop and implement a RAP.

A case study of the first delisted Area of Concern illustrates the potential of the program to connect institutions, people, and place in restoration efforts. Krantzberg (2012) detailed the process to restore the beneficial uses at Collingwood Harbor on Lake Huron. Krantzberg led the RAP process as the AOC coordinator and explained that the RAP process started with consulting with "the various sectors of the community that had activities that either would affect or be affected by ecosystem health in the community (258)." The group identified the future uses of the harbor. Krantzberg argued that stakeholder participation fostered a collective understanding of how much the ecosystem had to be restored to accommodate the uses they identified earlier in the process. Krantzberg attributed successful implementation of the RAP to participation by an engaged group of citizens, a sense of place, and the connection between ecosystem restoration and community development plans.

On the other hand, Sproule-Jones (2002) drew academic attention to institutional structures in the Areas of Concern. Although Krantzberg demonstrated that institutions

can and do facilitate community engagement to spur collective action, Sproule-Jones (2002) critiqued the Remedial Action Plan process from an institutional perspective. He conceded that Areas like Collingwood Harbor, successfully implemented an ecosystem approach based on community consultation, creating a shared vision and plan. He even acknowledged improved ecosystem outcomes, exemplified by restored beneficial use around the Great Lakes. However, the author argued that the process was often layered over other existing regulatory or enforcement program. The author argued institutional fragmentation, where each state or jurisdiction independently created and implemented its own restoration criteria, reflected the more common experience, instead of creating a shared vision.

Clearly, the AOC program has both advocates and critics. Scholars who study public participation argue that Remedial Action Plan successes stem from the ongoing communications inherent in the process. Beierle and Konisky (2001) indicated that the plans were successful on several different fronts. Their study demonstrated that participants contributed local and technical knowledge to the process and the subsequent decisions reflected public values. Additionally, they argued that ecosystem-based management in the Great Lakes did reduce conflict through face-to-face interactions, which helped facilitate long-term working relationships. Newig and Fritsch (2009) furthered these findings and explained that interactions between local, state, national and supranational actors can contribute to share understandings of problems and solutions. They illustrated their point with three Areas, Collingwood Harbor, Bay of Quinte, and Ashtabula Harbor. They explained that local actors were willing to contribute their time to a process that would improve the environment, and thus, the economy.

### **Connection to place in Areas of Concern**

In Great Lakes region, participation refers to a complex collection of possible stakeholders, including all levels of government agencies and nonprofit organizations. Scholars argue that the Remedial Action Plans ensure legitimacy and accountability (Krantzberg, 2012; MacKenzie, 1997). Clearly, collective decision-making, legitimacy, and accountability are the dominant themes in the literature related to Areas of Concern.

But a few studies *hint* that something else might compel motivation to participate in RAPs: sense of place (Slocombe, 1998). Within geography, Agnew (1987) defined sense of place as the emotional attachment to place, evoking an ethic of care (in Cresswell, 2004). Tuan (1977:6) argued “Undifferentiated space becomes a place when endowed with meaning.” In fact, this is the conceptualization of place often invoked by environmental managers who suggest that knowledge of and attachment to a place are important motivations to protect or restore environmental resources (Williams and Stewart, 1998).

Thus, attachment and experience with a particular place, like an Area of Concern, plays an essential role in tying people and place together. For example, MacKenzie (1997:178) argued that, “The success of this group exercise depends on the cultivation of an individual and collective sense of place and belonging in the area of concern.” Krantzberg (2012) explained that the connection to place encourages individuals to act collectively. While these studies suggest that place is important, there have not yet been any empirical studies that tie place, as in the emotional connection to place and Areas of Concern.

This literature review suggests that the implementation of ecosystem approaches in the region is a complicated mix of institutional arrangements, political will, and connection to place. To further complicate the matter, the literature review also suggests a diversion in support for the ecosystem approach and public participation. Although resource managers and political experts expressed skepticism about the program, scholars who study participation argued the process can lead to collective actions and Remedial Actions plans that reflect public values. However, we do not know how the process operates in practice or relationships change over time, nor how the practices of participation influence outcomes. I explore these connections below in a comparative case study of three Areas of Concern.

## **Methodology**

In order to understand how stakeholder participation and the implementation of ecosystem approaches in Great Lakes Areas of Concern has evolved, I will answer these questions:

- What are some of the elements that characterize differences in Public Advisory Council structures in Areas of Concern?
- How do the following aspects of Public Advisory Councils make a difference in the Remedial Action Planning Process and the outcomes: (a) their structure and organization; (b) their relationship to the lead state agency; and (c) their connection to the waterway, or the sense of place?

To answer these questions, I conducted a comparative case study of three sites: the Milwaukee Estuary on Lake Michigan, the St. Louis River between Duluth,

Minnesota and Superior, Wisconsin on Lake Superior, and the St. Marys River, the connecting channel between Lakes Superior and Huron, as illustrated in Figure 1. I originally chose the St. Marys and St. Louis River sites because different types of borders would shape the environmental governance at each site, i.e. an international vs. a US state border. Through the course of the study, I found that the borders were important and shaped decisions and stakeholder participation, but were not the driving element of the environmental governance in Areas of Concern. In fact, the relationships among the members of Public Advisory Committees and cooperating agencies seemed to minimize the potential divisions caused by the borders in one of the Areas.

Through the case study that follows, I describe some of the characteristics that define each Area of Concern, as no two Areas are exactly alike. The three sites in this study represent the range of size and complexity in the program. The St. Louis River Area is often called the largest and most complex, while the Milwaukee River Area represents an urban area with more use impairments (than the other two sites). Finally, the St. Marys River is a bi-national AOC in a sparsely populated part of the region.

My personal introduction to each Area provided insight into the activities and roles for each organization. In September 2011, I learned about the St. Louis River Alliance's community outreach on the local television news during a visit to Duluth to attend an unrelated event. The River Alliance was conducting public hearings in Duluth, Minnesota and Superior, Wisconsin to gather input on the aesthetics of the river. The news clip was about a public hearing held in Superior, and indicated that a second hearing would be held in Duluth the following evening. Thus, I was able to attend the hearing and meet the executive committee of the River Alliance. During the visit, I

learned how the organization conducts community outreach and organizes community events to promote interest in the St. Louis River and raise awareness about the Area of Concern. At the end of the visit, I was invited to attend an annual train ride event and learn more about the river and restoration projects.

In January 2012, I started researching the St. Marys River Area of Concern. I contacted the Bi-national Public Advisory Chair (BPAC)<sup>8</sup> and asked if I could attend the meeting. Representatives from the Michigan Department of Environmental Quality gave a presentation about the progress to remove the Bird of Animal Deformities impairment. Discussion between the state agency and BPAC ensued about the applicability of the chosen reference site on Lake Michigan. Representatives from the USEPA also attended this meeting.

Finally, I found out about the activities in the Milwaukee Estuary Area of Concern through one of the organizations conducting volunteer aesthetics monitoring. I was recruited to assist in the aesthetics effort because I was a long-term volunteer for the organization conducting monitoring, as well as researching the aesthetics impairment in other Areas. Thus, I started attending Stakeholder Delegation meetings and *Explore and Restore* educational events in May 2012.

My introduction to each organization afforded insight into the diversity of activity and reach, as well as audience, for each public advisory group. For example, in the St. Louis River Area, the River Alliance tries to engage the community to participate in the Area. On the other hand, the BPAC in the St. Marys River Area is the forum that the

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<sup>8</sup> Although I try to minimize the use of acronyms in this paper, BPAC is one instance where it is impossible. The organization calls itself the BPAC and others in the community know the group as “BPAC.”

state agency uses to inform the public about management decisions. Finally, the Milwaukee Estuary Area engages both the environmental community through personal and professional connections, but also provides education to the larger community.

### Map of the Great Lakes Areas of Concern



**Figure 1:** Map of the Great Lakes and the Areas of Concern. Source: Environment Canada and United States Environmental Protection Agency.

I collected data through three methods: participant observation, semi-structured interviews, and document analysis. I conducted participant observation between September 2011 and November 2014, as outlined below. In order to discern how active each public advisory council was, I participated in or observed as many activities as logistically possible in each of the three AOCs during the stated period.



In the Milwaukee Estuary, I participated as a member of the Stakeholder Delegation, which serves as the advisory council for the AOC. I also attended several *Explore and Restore* events and volunteered as an aesthetics monitor. In the St. Louis River Area of Concern, I attended events sponsored by the St. Louis River Alliance, including events, river clean ups, and canoe tours. I also attended educational events conducted by the Lake Superior National Estuarine Research Reserve (Reserve), including as a presenter at the St. Louis Science Summit in 2012, 2013, and 2014. Finally, in the St. Marys River, I attended the St. Marys River Binational Public Advisory Council meetings and events, including regular meetings between February 2012 and June November 2013, St. Marys River Summit in March 2012 and 2013 and participated in a river clean up with the Students for a Sustainable Lake State.

In addition to participant observation, I conducted 32 semi-structured interviews with AOC Coordinators and advisory council members in each location, and I analyzed the delisting strategy documents, a database of Great Lakes Restoration Initiative grants, and the written requests to the USEPA to remove Beneficial Use Impairments (BUI).

This study is timely because the Great Lakes Restoration Initiative (Initiative), the largest infusion of funding for environmental restoration in the Great Lakes region, has started a flurry of activity throughout the region. The Initiative funds land management, sediment remediation, water quality improvements, state and tribal government capacity building, research, and surveillance. In fact, before 2010 and the Initiative, only four of the forty-three AOCs had been removed from the list, three in Canada and one in the United States. Since 2010, at least 21 beneficial uses have been restored, and three Areas of Concern have been "delisted." Although the Great Lakes Restoration Initiative

facilitates the implementation of remediation and restoration in the Areas of Concern and is an important element of the acceleration of activity, I would argue it was not the defining feature of this particular study. The Initiatives' catalytic effect had the biggest impact in the Areas of Concern where a solid foundation of existing relationships enabled local stakeholders to capitalize on the opportunity. It is safe to assume that nearly all activity reported in this study was funded through the Great Lakes Restoration Initiative.

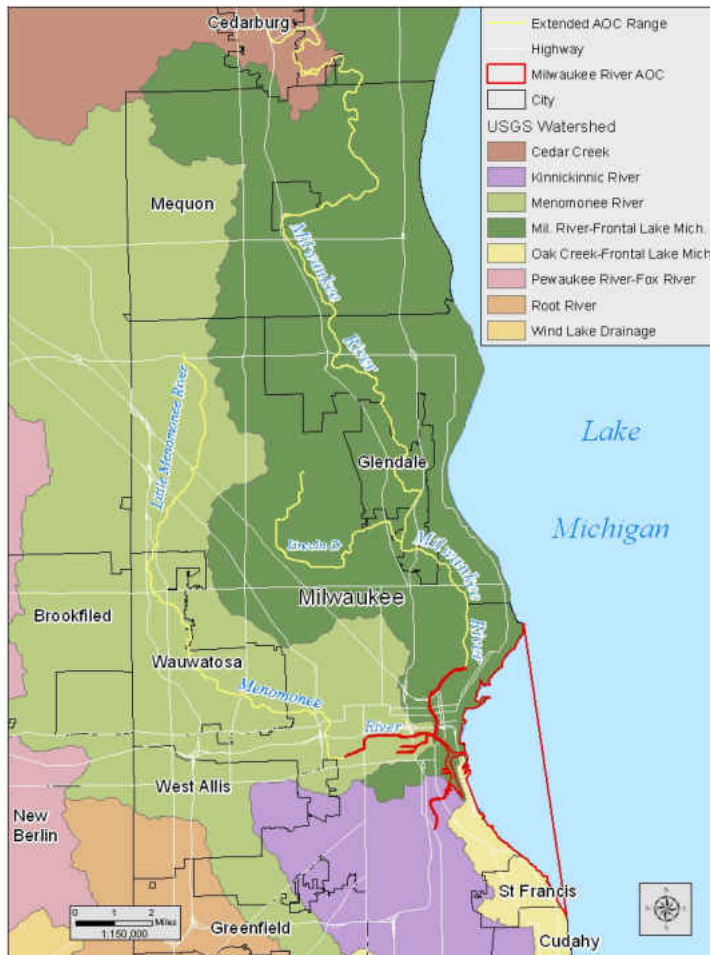
### **Elements of advisory council structure and opportunities for participation**

The purpose of this section is to describe some of the defining elements of Areas of Concern and the Remedial Action Plans. Although all Areas have a few basic elements, namely a geographic boundary description, impairments list, and advisory committee, the fundamental elements are arranged differently at each location. A description of the Milwaukee Estuary, St. Louis River, and St. Marys Areas of Concern follows below.

#### Milwaukee Estuary

One finds the Milwaukee Estuary Area of Concern in Southeastern Wisconsin on Lake Michigan. The original boundaries of the AOC were the lower reaches of the Milwaukee, Kinnickinnic, and Menomonee Rivers. The boundaries were extended to include the degraded upstream sites that contributed contaminated sediments downstream in 2008, as illustrated in Figure 2. Eleven of the fourteen possible use impairments plague the river, including degraded aesthetics and beach closings, degraded fish and wildlife populations, and restrictions on dredging as outlined in Table 1.

## Map of the Milwaukee Estuary Area of Concern



**Figure 2:** Map of Milwaukee Estuary AOC. The AOC includes reaches of the Milwaukee, Menomonee, and Kinnickinnic Rivers. The boundaries were extended to include Superfund sites on the Menomonee and Kinnickinnic Rivers. (Source: University of Wisconsin-Extension)

The Wisconsin Department of Natural Resources assigns a locally based AOC Coordinator, or a public official who is responsible for coordinating Remedial Action Plan in each area. The local coordinators maintain communication between the different partners who are responsible for implementation of different pieces of the plans. Effective coordination ensures that seemingly disparate ongoing regulatory and restoration activities are systematically considered as progress towards restoring the river. For

example, although Total Maximum Daily Load (TMDL)<sup>9</sup> studies are essential for understanding pollution sources and how to control them under Section 303(d) of the Clean Water Act (a regulatory program administered separately from the Areas of Concern program), the TMDL is also a delisting target under the Remedial Action Plan for the area. Thus, it is important to coordinate with the Metropolitan Milwaukee Sewerage District, the lead agency on the TMDL study, to ensure proper integration into remediation plan implementation.

In terms of stakeholder participation, the opportunities for citizens and other actors to participate has evolved. During the development of the original Remedial Action Plan, three different committees consulted with the Wisconsin Department of Natural Resources about the different aspects of the plans (Hartig and Zarull, 1992). The three committees were the Technical Advisory Committee, Citizens Advisory Committee (CAC), and Citizen Education and Participation Subcommittee of the CAC. The advisory committees remained active until the mid-1990s when the original delisting strategy documents, also known as a Stage Two Remedial Action Plan, was completed. The Wisconsin Department of Natural Resources reconvened a Technical Advisory Committee in 2011 and a Stakeholder Input Group. The Stakeholder Input Group consists of a list of interested individuals who are periodically contacted with news about the Area of Concern. The University of Wisconsin-Extension (UW-Extension) organizes a "Stakeholder Delegation" or a smaller group (12-14) of individuals who represent land managers, environmental organizations, and concerned citizens. The Stakeholder

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<sup>9</sup> A TMDL is the acceptable limit of a pollutant into a waterway. When a stream is on the Environmental Protection Agency's list of impaired waters, it is because there is too much of a certain type of pollutant in a river, like sediment, E.coli, or phosphorus.

Delegation meets a couple of times per year and assists UW-Extension with implementing the *Explore and Restore* series of activities. UW-Extension created *Explore and Restore* with two goals in mind: inform citizens about the Area of Concern and health of the rivers in the Milwaukee River Basin, but also to engage citizens in the river through experiences like tours and citizen volunteer aesthetics monitoring.

The UW-Extension has taken an educational approach to the Areas of Concern to build capacity in both citizens and community leaders. Members of the Stakeholder Delegation were invited to all *Explore and Restore* events, but also to other educational opportunities. A wildlife survey at the Grand Trunk Wetland in the Port of Milwaukee is an example of such an opportunity. Delegation members were invited to participate in a wildlife survey based on the rapid ecological assessment methodology<sup>10</sup> that was an opportunity to tour a possible restoration site and assist wildlife technicians. With the Stakeholder Delegation and *Explore and Restore* projects, UW-Extension looked beyond the usual experts and started building a new group of local experts through Area-related activities.

### St. Louis River

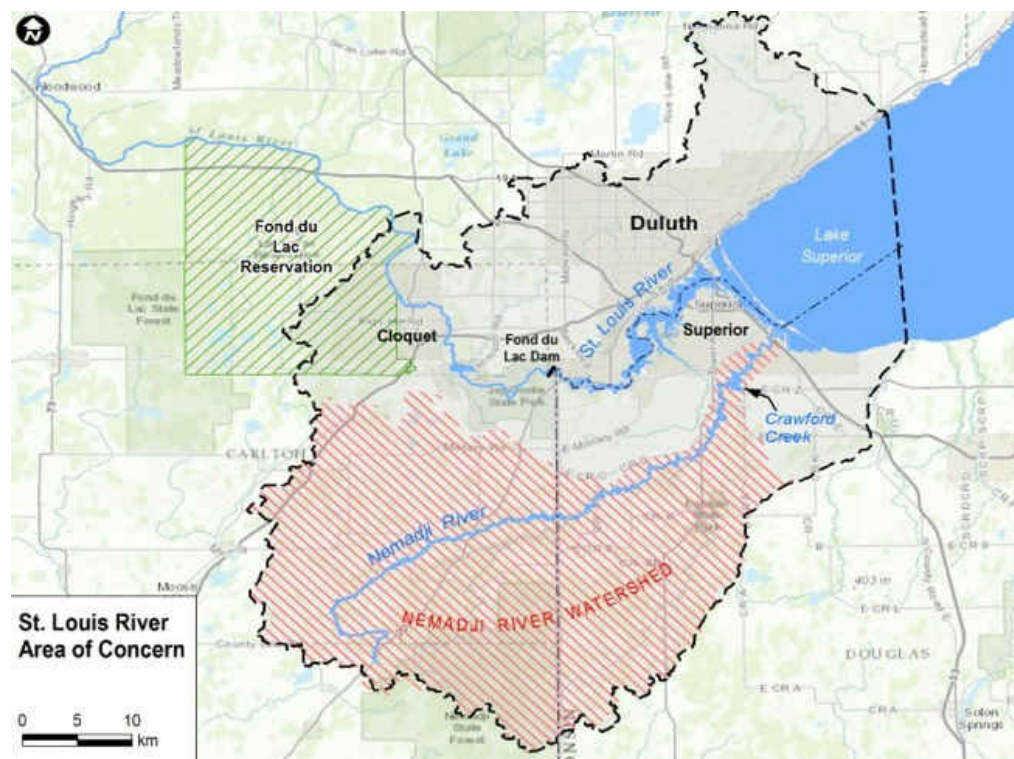
The St. Louis River Area of Concern is located in the southwestern corner of Lake Superior, where the St. Louis River forms the border between the states of Minnesota and Wisconsin. The bi-state Area is the largest and most complex according to one informant, “all of the other AOCs, except for one could fit in the St. Louis River AOC” (Agency program supervisor, 10/12/2012). Although most of the restoration work

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<sup>10</sup> Rapid ecological assessment methodologies are designed to provide an accurate but quick assessment of the wildlife living in a wetland (Fennessey et al., 2004).

takes place in the estuary, the boundaries of the Area include the St. Louis and Nemadji River watersheds, as illustrated in Figure 3. Adding to the complexities, the Port of Duluth-Superior is the largest and busiest port on the Great Lakes (St. Louis River Alliance, 2013). Seven of the fourteen possible use impairments appear in the Area, including the degradation of benthos and beach closings, excessive nutrient and sediment loading, and habitat loss, as outlined in Table 1. Finally, the Area is not only physically and ecologically complex, but is also a bi-state entity. As Minnesota and Wisconsin have different agency organizational schemes, for example, Minnesota has both a Department of Natural Resources and a Pollution Control Agency. On the other hand, Wisconsin has a single regulatory and resource management agency, the Department of Natural Resources.

### Map of the St. Louis River Area of Concern



**Figure 3:** The St. Louis River AOC, including the Nemadji River watershed. (Source: Minnesota Pollution Control Agency)

The level of complexity compelled a conscious effort to foster inclusionary decision-making in the Area. The Minnesota Pollution Control Agency and the Wisconsin Department of Natural Resources are the lead state agencies to implement the RAP in the St. Louis River. The states also provide program funding to an organization that assists the agencies to coordinate efforts across state lines. To ensure collaboration across jurisdictional boundaries, there are four local AOC Coordinators representing the Fond du Lac Band of Lake Superior Chippewa<sup>11</sup> Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, and Wisconsin Department of Natural Resources.

The St. Louis River Alliance (River Alliance) serves as a hub, keeping the independent spokes (the agencies) moving together in the same direction. The River Alliance started as the citizen advisory committee for the St. Louis River Area of Concern. After the Remedial Action Plan was completed in 1996, the organization became an independent non-profit organization called the St. Louis Citizens *Action* Committee to implement the recommendations in the RAP. The River Alliance<sup>12</sup> continues to facilitate cooperation between state and federal agencies. One informant remarked, “Their main purpose was to make sure that the plan was not just put on a shelf” (Stakeholder interview, 10/11/2012).

The River Alliance conducts a variety of activities, including organizing and facilitating meetings between agencies and stakeholders, restoration site tours for school children, outreach to schools and churches, climate change education, canoe tours, river

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<sup>11</sup> The Fond du Lac Band of Lake Superior Chippewa Reservation is on the St. Louis River, and other tribal lands border the Area of Concern. Fond du Lac are active in river restoration and natural resource management in the region.

<sup>12</sup> The St. Louis Citizens Action Committee, now known as the St. Louis River Alliance.

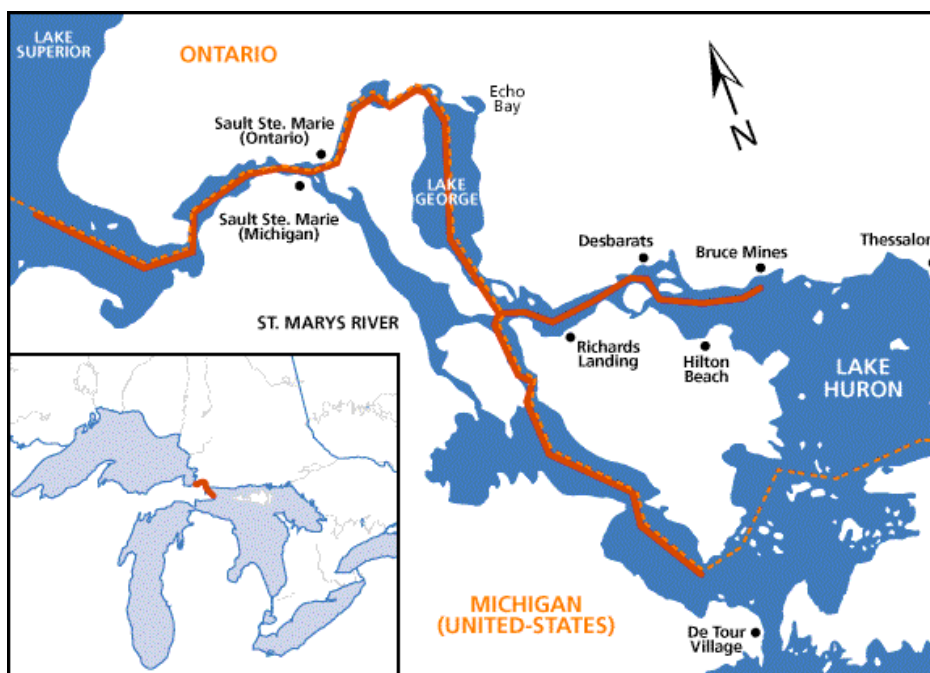
clean ups, and habitat restoration and citizen education. Minnesota and Wisconsin fund the River Alliance in alternating years. They are also contracted to conduct stream monitoring, piping plover habitat monitoring, and other short-term projects for state and federal agencies. Although the state agencies rely on the St. Louis River Alliance to facilitate public outreach, stakeholder consultation, and participation, the funding is somewhat limited.

### St. Marys River

The St. Marys River Area of Concern is located in between the State of Michigan and Province of Ontario in Canada, as illustrated in Figure 4. Shipping, industrial uses, and hydropower diversions have altered the St. Marys River dramatically since Sault Ste. Marie became the first city in Michigan. The area has one population center, and is very close to wilderness areas in Michigan and Ontario. Nine of the fourteen possible use impairments afflict the river, including degraded aesthetics and beach closings, eutrophication and undesirable algae, and fish tumors or other deformities as outlined in Table 1.



### Map of St. Marys River Area of Concern



**Figure 4:** Map of St. Marys River AOC. The AOC runs the entire length of the St. Marys River between Lakes Superior and Huron. The main population center is Sault Ste. Marie, Michigan and Ontario (Source: Sault Ste. Marie, Canada Sustainable Water Portal)

The Michigan Department of Environmental Quality assigns an Area of Concern Coordinator, who often staffs between one and three other Areas of Concern. For example, the AOC Coordinator for the St. Marys River is also the Coordinator for the Kalamazoo River, Manistique River, Saginaw River/Bay, and White Lake Areas. All of the AOC Coordinators work from the Office of the Great Lakes at the Department of Environmental Quality offices in Lansing.

In terms of stakeholder participation, the Bi-national Public Advisory Council (BPAC) in the St. Marys River Area has members from both Michigan and Canada. The membership is made up of volunteers and representatives from municipalities, local agencies, academia, tribes, citizens, property owners, businesses, and environmentalists. An interested person can apply to become a BPAC member by submitting a letter of

request. The Council will vote to accept the application at the next meeting. BPAC meetings are held every six to eight weeks depending on agenda items and members' schedules. Instead of regularly scheduled meetings, all meetings are organized through an informal poll to determine members' availability, and meeting notices circulated by email. If non-BPAC members wish to attend a meeting, they need to contact the RAP Coordinator or a BPAC member to find the time and place. In the St. Marys Area of Concern, Lake Superior State University (US) and Algoma University (Canada) are important as the host institutions for the BPAC. The main administrative support for the BPAC is the Canadian RAP Coordinator, who is housed at Algoma University. In Michigan, Lake Superior State University (LSSU) houses a BPAC resource office, employs a student-worker to organize the annual event, and hosts regular meetings.

The USEPA, Environment Canada, Michigan Department of Environmental Quality, and the Ontario Ministry of the Environment provide the "Four Agency" report for the BPAC to review at each meeting. The BPAC also provides a forum for the agencies to update the community on restoration efforts or other projects. Both the Michigan Department of Environmental Quality and Environment Canada make presentations for the BPAC and ask for support or input on projects. For example, the Michigan Department presented their findings to and recommended removing the Bird or Animal Deformities use impairment from the list of impairments. The BPAC voted to provide a letter of support for the request, as well as a letter of support to remove the Degradation of Aesthetics use impairment.

### Comparison

Table 1 provides a comparison in the levels of degradation in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern. The table below compares the number and types of beneficial use impairments in each Area, which are remarkably similar. Many of the impairments are common to all three Areas, like Degradation of Fish and Wildlife Populations, Beach Closings and Degradation of Benthos. Both Milwaukee and St. Marys River Areas have experience with the eutrophication impairment, while the St. Louis River experiences excess sedimentation.

### **Beneficial Use Impairments in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern**

List of Beneficial Use Impairments	Milwaukee River	St. Louis River	St. Marys River
<u>Restrictions on fish and wildlife consumption</u>	<b>X</b>	<b>X</b>	<b>X</b>
Eutrophication or undesirable algae	<b>X</b>		<b>X</b>
Excessive loading of sediment and nutrients		<b>X</b>	
Degradation of fish and wildlife populations	<b>X</b>	<b>X</b>	<b>X</b>
Beach closings	<b>X</b>	<b>X</b>	<b>X</b>
Fish tumors or other deformities	<b>X</b>	<b>X</b>	<b>X</b>
Degradation of aesthetics	<b>X</b>	Removed	Removed
Bird or animal deformities or reproductive problems	<b>X</b>		Removed
Degradation of benthos	<b>X</b>	<b>X</b>	<b>X</b>
Degradation of phytoplankton and zooplankton populations	<b>X</b>		
Restrictions of dredging activities	<b>X</b>		<b>X</b>
Loss of fish and wildlife habitat	<b>X</b>	<b>X</b>	<b>X</b>
Tainting of fish and wildlife flavor			
Additional cost to industry or agriculture			

**Table 1:** The beneficial use impairments in the Milwaukee Estuary, St. Louis River, and St. Marys River AOCs. (Source: US EPA Great Lakes National Program Office)

Table 2 provides a summary of the differences between the key elements in the Remedial Action Plans and Area of Concern process in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas. The three Areas are remarkably diverse representing watershed with an abundance of wetlands and major port, an urban area, and connecting

channel near wilderness areas. The advisory councils are similarly diverse, with organizational structures ranging from an independent non-profit organization in the St. Louis River, to a well-supported educational effort in the Milwaukee Estuary, to an independent committee in the St. Marys. The next section will explore the relationships between the organizational structures and state agencies and how that enhances or detracts from stakeholder participation.

### Public Advisory Council/Committee organization in Three Areas of Concern

	Milwaukee Estuary	St. Louis River	St. Marys River
<i>How is the PAC organized?</i>	Small “Stakeholder Delegation” organized by UW-Extension	A 501(c)3, nonprofit organization	A committee structure facilitated by the Canadian St. Marys River RAP Coordinator
<i>What role do they have in the AOC?</i>	<ul style="list-style-type: none"> <li>- Outreach and Education</li> <li>- Provide letters of support</li> </ul>	<ul style="list-style-type: none"> <li>- Facilitate meetings between state agencies</li> <li>- Organize meetings to gather public input</li> <li>- Organize outreach and education</li> <li>Stream and wildlife monitoring</li> </ul>	<ul style="list-style-type: none"> <li>- Provide a forum for public input</li> <li>- Outreach and tables at community events.</li> <li>- Host a yearly education for the community at Lake Superior State University</li> </ul>
<i>How long has the PAC been organized?</i>	Three years as a Stakeholder Delegation - The group is researching how to become a PAC (more formal and structured)	18 years as a nonprofit organization	26 years

**Table 2:** Organization of advisory councils and their roles in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern.

### Relationship between the state agencies and public advisory councils

The analysis in this section will examine two key indicators of the relationship between state agencies and local advisory committees. First, according to the Great Lakes Water Quality Agreement, the creation and implementation of restoration plans depends on the participation of local stakeholders. Thus, this section will examine how local stakeholders and information were integrated into the process. Secondly, this section will examine how stakeholders and the public participate in the remedial action planning

process in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern. Three dimensions emerge as the defining characteristics of the local agency-local community relationship: integration of local information into the Remedial Action Plan, creation of meaningful role for local experts and community, and relationships with the larger community outside the Area of Concern.

### Milwaukee Estuary

The Stage Two Remedial Action Plan for the Milwaukee Estuary Area was compiled by the Wisconsin Department of Natural Resources through a local consultant. Although the report was created by the state agency, local sources dominated the knowledge utilized to inform the report (WDNR, 2008). Department of Natural Resources started with the original Remedial Action Plan documents, but then updated them based on the reports from other ongoing projects, including the Milwaukee River Basin Indicators Pilot Project, Metropolitan Milwaukee Sewerage District Corridor Study, and Southeastern Wisconsin Regional Planning Commission Water Quality Plan. Because there was no citizen advisory committee in 2008, a small group of local experts and citizens reviewed the document and provided comments.

Stakeholders participate in the implementation of Remedial Action Plans in two ways. First, the Technical Advisory Council, or "Tech Team" advises the Wisconsin Department of Natural Resources on the two use impairments related to fish and wildlife. The Tech Team provides local knowledge and research to support management action plans and funding requests related to the two fish and wildlife Beneficial Use Impairments. On the other hand, the Stakeholder Input Group has not been invited to participate in the RAP implementation, in the same way. An informant explained that

when the Wisconsin Department of Natural Resources was asked to form a Citizen Advisory Committee, the AOC Coordinator, "Was very reluctant to do so. She formed what was a Stakeholder Input Group because she was willing to take input, but she did not want them – the stakeholders – to feel like they were advising" (Stakeholder interview, 11/9/2012). Thus, a smaller section of the Stakeholder Input Group, the Stakeholder Delegation, assists UW-Extension to develop and implement outreach and education programs and occasionally provide letters of support. Although, the relationship may change, as the new AOC Coordinator has encouraged the Stakeholder Delegation to form a Citizen Advisory Council and take a more active role in the planning process. Finally, some of the organizations that participate on the Tech Team and in the Stakeholder Delegation often implement some of the restoration projects funded by the Department of Natural Resources.

In the Milwaukee Estuary, the Department of Natural Resources created documents and processes that integrate local knowledge into the Remedial Action Plan. The Remedial Action Plan and the Tech Team function as methods to connect existing habitat restoration and water quality improvements into a cohesive vision. The Wisconsin Department can reach out to the community through the outreach and education strategies created by the Stakeholder Delegation. Although the Wisconsin Department has limited the ability of the Stakeholder Delegation (CAC in other places) to influence the RAP, they still actively reach out to the community and extend the reach of the Wisconsin Department. Thus, the Wisconsin Department can use the Area of Concern process as a unifying framework for restoration.

### St. Louis River

Extensive community engagement characterizes the creation of the current Stage Two Remedial Action Plan for the St. Louis River Area of Concern. Minnesota Pollution Control Agency led the effort to compile more specific delisting targets, or “a business plan” to restore the Area (Agency interview, 10/12/2012). The four Areas of Concern Coordinators (Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, Fond du Lac Band of Lake Superior Chippewa, and Wisconsin Department of Natural Resources) and the St. Louis River Alliance Executive Director organized workgroups of stakeholders to review and refine much of the knowledge about the Area. The documents in the review include the original RAP documents, the St. Louis River Action Committee's Lower St. Louis River Habitat Plan; the 1995, 2001, and 2012 Area of Concern Reports; and the Hog Island and Newton Creek Ecological Restoration Master Plans (MPCA, 2013).

Efforts to harness and channel the collective knowledge and vision of the stakeholders in the St. Louis River, demonstrated by the publication of the "Roadmap to Delisting," have accelerated investment in environmental restoration by federal agencies. Both the US Environmental Protection Agency and National Oceanic and Atmospheric Administration have targeted the St. Louis River Area for additional funding and habitat restoration. Further exemplifying an acceleration of collective action, the Degradation of Aesthetics Beneficial Use Impairment was removed from the list a year ahead of schedule (MPCA and WDNR Letter to USEPA, 7/31/2014).

In spite of the perception that “large and complex” might hinder progress, it is evident that efforts to create a collective vision do translate into restoration action.

According to the 2014 Progress Report, partner organizations are writing six habitat plans, restoring habitat by removing wood waste, softening shorelines, planting trees, and sharing knowledge through stories. The agencies are busy coordinating the implementation of all of the projects funded through the Great Lakes Restoration Initiative, but they are not alone. The community partners in the St. Louis River Area are equally busy implementing the Remedial Action Plan they helped create.

In the St. Louis River, a long-standing tradition of cooperation and jointly executed remediation and restoration efforts facilitated the current progress in the Area. Furthermore, this cooperation can be directly attributed to the historic efforts of the St. Louis River Alliance and the active participation of the Fond du Lac Band of Lake Superior Chippewa. While the Minnesota Pollution Control Agency is the entity leading the charge to create a collective vision, the St. Louis River Alliance had already met the challenge to keep all of the partners in conversation through the times when resources were scarce, thus ensuring that local knowledge from four state and tribal resource agencies would be included in any restoration plans. Additionally, the Fond du Lac Band of Lake Superior Chippewa are leaders in restoration efforts in two sections of the estuary.

The agencies currently rely on the St. Louis River Alliance for outreach to the community, which extends the capacity of the agencies in two ways. First, because the River Alliance facilitates meetings between agencies, cooperation between them expands what individual agencies can accomplish. Secondly, the River Alliance functions as the public relations entity in the estuary by performing traditional outreach to stakeholders impacted by projects, but also promoting and publicizing the ongoing restoration



projects. Thus, the main role for the River Alliance or Pollution Control Agency is not to solicit local knowledge, but to ensure the constructive engagement of entities across state, tribal land, and agency borders.

#### St. Marys River

The State of Michigan Department of Environmental Quality (MDEQ or Michigan Department) created delisting criteria for all fourteen of the Areas of Concern in Michigan, including the St. Marys River. Michigan Department collected input from other state agencies, federal agencies, and the Great Lakes Commission to inform the standards (MDEQ, 2008). The Department of Environmental Quality consulted with the Statewide Public Advisory and the St. Marys River Binational Public Advisory Councils about the delisting criteria. Finally, although there are three bi-national Areas of Concern in Michigan, statewide delisting criteria refers only to the US side of the St. Marys River Area. In fact, the Department of Environmental Quality makes no reference to neighboring Canada in the guidance.

The State of Michigan coordinates restoration of beneficial uses in the St. Marys River and other Areas. Interviews indicate that the state agency organizes restoration efforts in consultation with the USEPA and "local agencies" (Agency interview, 8/14/2012). The informant described local agencies as municipal governments, conservation authorities, regional economic development agencies, and nonprofit organizations. Consultation with local organizations includes comment on concept plans or other issues in the Area. The state official identified two organizations that the agency consults, namely the Fisheries program at Lake Superior State University and the St. Marys River Fisheries Task Group, a binational organization of fisheries managers. Lastly, the official described the role of St. Marys Binational Public Advisory Council as

to arrange public engagement for the Department of Environmental Quality when the agency needs to consult with a larger group of stakeholders about restoration projects, use impairment actions or other ideas.

In the St. Marys River Area, the Michigan Department of Environmental Quality created Statewide Delisting Standards. Although there is a local delisting criterion for some Areas of Concern, there are not additional criteria for the St. Marys River. It appears that local knowledge is included at the end of the plan design. Although local engagement has extended the reach and abilities of the state agencies in the other two Areas of Concern, it appears the Michigan Department of Environmental Quality has not developed the same relationship with the St. Marys River BPAC.

### Comparison

Each of the three Areas of Concern takes distinct approaches to the restoration of beneficial uses in cooperation with public advisory committees, as outlined in Table 3. The St. Louis River Area based new delisting targets based on existing documents, but also on the extensive engagement of local experts to formulate a collective vision for the river. The St. Louis River Alliance served as an entity integrating disparate interests. In Milwaukee, the state agency also created the RAP delisting targets through an evaluation and compilation of local documentation. However, there was no advisory council to coordinate input from local stakeholders, nor evaluate the document. Thus, the plan reflects an effort to integrate disparate activities into a more cohesive product, but not necessarily a collective vision of restoration in the Areas. Although stakeholders do now contribute to restoration through both a technical committee and a group that organizes outreach and education, these are new developments that can develop into structures to

foster the capacity to develop a collective vision. Finally, the Michigan Department of Environmental Quality drives decisions about all of the Area of Concern restoration in the state. With fourteen (including two delisted in the last year) Areas, it makes sense to implement a systematic approach to restoring beneficial uses. Although the Department of Environmental Quality does reach out to local organizations, they only do so when they need input.

### Overview of the Remedial Action Planning Process in Three Areas of Concern

	Milwaukee Estuary	St. Louis River	St. Marys River
<i>Delisting target document</i>	Wisconsin Department of Natural Resources (2008, updated in 2011)	Minnesota Pollution Control Agency (2013)	Michigan Department of Environmental Quality (2006)
<i>Did PAC contribute?</i>	There was no PAC in the AOC when the Stage II RAP was written. Community leaders contributed in 2011.	St. Louis River Alliance was one of the facilitating organizations for the data collection process for MPCA.	Statewide Public Advisory Council and BPAC provided input.
<i>Who (or what background) informed the document?</i>	Existing reports and data, including RAP, Milwaukee River Basin Indicators Pilot Project, MMSD Corridor Study, SEWRPC Water Quality Plan	- 66 individuals representing 31 organizations reviewed and refined knowledge of the AOC and St. Louis River  - Existing reports include the original RAP documents, the St. Louis River Action Committee's Lower St. Louis River Habitat Plan, 1995, 2001, and 2012 AOC Progress Reports, and Hog Island and Newton Creek Ecological Restoration Master Plans	MDNR, Michigan Department of Community Health, US EPA, US Fish and Wildlife Service, Great Lakes Commission
<i>State agency-local organization relationship</i>	WDNR assigns a local RAP Coordinator, who consults with the Technical Advisory Committee. A Stakeholder Delegation performs outreach and education.  The WDNR funds Tech Team and Stakeholder Delegation members to conduct some outreach projects, as well as habitat restoration.	The St. Louis River Alliance (SLRA) is a 501c3 organization. SLRA facilitates agency cooperation (each agency has a RAP Coordinator) and conducts outreach and education for the AOC.  The States of Minnesota and Wisconsin fund the SLRA on a yearly, rotating basis. The agencies also contract with SLRA to conduct specific activities.	The St. Marys River BPAC regularly meets. State agencies occasionally attend. Agencies (Environment Canada, USEPA, MDEQ and Ontario Ministry of the Environment) send a report.  MDEQ assigns a Coordinator and The Great Lakes Commission provides a grant to the BPAC. Environment Canada supports a RAP Coordinator, who provides administrative support to the BPAC.

**Table 3:** Stage 2 RAP development in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern.

This analysis of Areas of Concern demonstrated that the program can foster cooperation in two ways. First, the program can prompt state agencies to cooperate with local stakeholders in environmental restoration. Cooperation, though, depends on the lead agency taking the proactive step to give local stakeholders a role in the process, as the Minnesota Pollution Control Agency did in the St. Louis River Area. Secondly, the remedial action planning process can provide a mechanism to pull disconnected efforts together towards mutual goals, as the Stage 2 RAP in the Milwaukee Estuary Area connected knowledge and recommendations from regional water quality plans into a cohesive whole.

### **Connection to place and collective understanding**

Hartig and Law (1994) argued that the remedial action planning could function as a site for mutual learning. But, as MacKenzie (1997) explained, problem solving in most AOCs focuses on remediating current conditions, not describing desired future states. This raises questions about what forums might be appropriate to develop mutual understandings of both current and desired future conditions. As illustrated below, educational opportunities in each Area contribute to a collective understanding of current issues and collective commitment to problem solving, but not necessarily connected to the remedial action planning process. These forums create opportunities to share knowledge and build relationships beyond the traditional participants in the RAP process. MacKenzie (1997) argued, “The success of this group exercise depends on the cultivation of an individual and collective sense of place and belonging in the area of concern” (178). This section will examine how individual and collective knowledge about and connection to place are cultivated through educational opportunities.

### Milwaukee Estuary

In the Milwaukee Estuary Area, the Southeastern Wisconsin Watersheds Trust, Inc.<sup>13</sup> (Sweet Water), organizes a yearly “Clean Rivers, Clean Lake” conference. While not an "official" Area of Concern event, it features updates on the Total Maximum Daily Load study included in the Milwaukee Estuary delisting targets. The conference is a single day event, with a mix of plenary and workshop sessions directed towards an audience of municipal stormwater engineers, local officials, environmental nonprofit organizations, and advocates. Many sessions provide guidance for practitioners on the best approaches to pollution control through green infrastructure and other management practices. The conference exposes over 400 to stormwater management, conservation, and engineering solutions for Milwaukee's rivers. Additionally, the conference presentations are archived for the public.

A different educational opportunity is specifically designed to engage a wider public about the history of Milwaukee's rivers was the lecture series, "Built on Water" by local cultural geographer John Gurda. Over 800 attended at least one of the ten lectures around the Milwaukee region. In addition to the lecture, local environmental organizations hosted information tables so attendees could ask questions about the Area of Concern, water management, environmental restoration, or urban gardening. The attendees were invited to sign up for more information and participate in the Stakeholder

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<sup>13</sup> Sweet Water is a regional non-profit environmental organization that endeavors to improve water quality in Southeastern Wisconsin through advocacy, collaborative decision-making, and connecting partners to complete water quality improvements and habitat restoration. Sweet Water partners include local governments, nonprofit organizations, and individuals from academia, industry, and agriculture (Sweet Water, 2014). The Metropolitan Milwaukee Sewerage District is a major funder of the organization.

Input Group. Additionally, "Built on Water" is available online and part of the *Explore and Restore* educational effort that engages citizens with Milwaukee's rivers.

In the Milwaukee Estuary, local relationships and connections to the rivers are evident in educational opportunities in two ways. Clean Rivers – Clean Lake, as public education opportunity, represents a large regional entity informing and engaged public about their ongoing efforts, where stakeholders in the Area and beyond are invited to learn and possibly volunteer with local organizations. On the other hand, *Explore and Restore* builds new connections with the river by fostering a sense of place through active engagement with the rivers in the Milwaukee region. The *Explore and Restore* series is designed to put people in kayaks and snowshoes and out on the river. Instead of just sharing information about the rivers, the series creates opportunities for citizens to experience them and create a connection with the resource.

At any rate, the educational opportunities in Milwaukee reflect that water quality improvements in Southeastern Wisconsin are not developed collectively. Clean Rivers-Clean Lakes and *Explore and Restore* were organized for different reasons and targeted different audiences. They emphasize providing education and offering opportunities to join *existing* activities, not necessarily developing a collective understanding of the challenges to improving water quality in Wisconsin.

### St. Louis River

In the St. Louis Estuary Area of Concern, the Lake Superior National Estuarine Research Reserve (Reserve) has organized a St. Louis River Summit for each of the last four years. The Planning Committee for 2014 included representatives from state and federal agencies, as well as academia. Most of the presentations at the two-day

conference reflected the breadth and depth of the research and management activities conducted in the St. Louis Estuary, both in and beyond the Area of Concern. However, because the conference organizers create specific sessions that respond to agency or stakeholder-identified dilemmas, the Area was in the spotlight. Almost three-quarters of the talks at the Summit reflected research directly related to the Area of Concern.

Although academic presentations dominated the conference schedule, the Summit organizers integrated opportunities for discussion and mutual learning. For the last two years, the lunch sessions consisted of facilitated discussions to elicit what participants' knowledge and questions about current research interests in the St. Louis Estuary. The facilitator also took notes of the discussion to share with the Summit Program Committee. The knowledge created in the lunch discussions helps the Committee evaluate the Summit, plan sessions for the subsequent year, as well as design outreach and education opportunities. The proceedings of the Summit, including all of the abstracts and discussion summaries, are distributed to all participants and digitally archived in the University of Wisconsin System Library.

The evolution of the role of St. Louis Summit represents advancement in the conversation about natural resources and the community in the region. Although it started as a forum to share research, it has become an ongoing community dialogue where knowledge is both shared and created. As many participants both live and conduct research in the region, place is both a personal and professional attachment. When asked about the river and sense of place, one of the Summit participants who lives near the river explained he can look at the river in the morning, and it shapes his outlook for the day. This suggests that the river is not just a backdrop or professional obligation, but also a

part of lived experience. In fact, the attachment to the water resources translates into professional and political will to cooperate. Resource and program managers indicated in interviews that a feeling of responsibility for Lake Superior was a reason for so much cooperation in the St. Louis River Area.

Place is an integrating concept that animates programming at the Lake Superior National Estuarine Research Reserve. As described above, the Reserve programs foster a sense of place by sharing knowledge and enhancing relationships through the St. Louis River Summit. Staff also conducts teacher and community education programs that actively encourage everyone to go outside and play, canoe, or hike. All of the programs are designed to give citizens a chance to experience the river and the estuary. One representative explained, "To get people out on the river, to have first-hand knowledge helps them to care more. It helps them to see how it [the river] is connected to their lives (Stakeholder interview, 9/12/2012).

### St. Marys River

In the St. Marys River Area, the Binational Public Advisory Council (BPAC) has organized an Environmental Summit for eleven of the last twelve years. In 2013, the Summit was held on March 16 at the Cissler Center on the Lake Superior State University Campus. The theme of the Summit was "Connecting Science and Community." The BPAC organized the Environmental Summit around the relationship between science and community in response to a negative public reaction to potential restoration project. The BPAC invited speakers to explain approaches to invasive species control, applications of social science research to outreach programs, place-based education, and messaging strategies.



Compared to the educational events in the other Areas of Concern, the Environmental Summit was much smaller. In addition to the speakers, including government agencies, nonprofit organizations, the high school environmental club and tribal governments all hosted information tables. Although small, the event participants represented the interests, knowledge, and concerns of the BPAC. The BPAC organizes the day to energize and mobilize the environmental community in and around Sault Ste. Marie (Personal communication, 3/16/2012). Although the Summit reaches the targeted audience, the educational event demonstrated that the BPAC is a self-sustaining organization that is less connected to other institutions and the community than the advisory committees in other Areas. Furthermore, most of the citizens engaged in fostering a sense of place around the St. Marys River are the Lake Superior State University professors who use the river as a classroom extension.

#### **Comparison of Educational Opportunities in the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern**

Area of Concern	Educational Opportunities for Stakeholders	Knowledge Applied to Delisting the AOC?	Community Education
Milwaukee Estuary	Clean Rivers – Clean Lake Conference: Sponsored by regional environmental organization.  Focus: Stormwater management and management practices	Not directly	Explore and Restore: Place-based outreach and education to connect citizens to the rivers  Focus: Area of Concern
St. Louis River	St. Louis River Summit: Sponsored by Lake Superior National Estuarine Research Reserve (LSNERR)  Focus: Academic and applied research on the St. Louis River and Bay and progress in the Area of Concern	Yes	LSNERR: Teacher education program (Rivers2Lake); Postcards from the Estuary (community art outreach); Know your Estuary (field trips); River Talks (speaker series) Focus: St. Louis River  St. Louis River Alliance: Canoe trips, Clean-ups, Climate change workshops, Citizen plover monitoring Focus: Area of Concern
St. Marys River	St. Marys River Environmental Summit: Sponsored by the BPAC  Focus: Forum for local stakeholders to share information	No	One course at Lake Superior State is based on developing a sense of place around the St. Marys River

**Table 4:** A comparison of the educational opportunities in three Areas of Concern.

## Comparison

An analysis of the educational opportunities in each Area demonstrated that agencies and public advisory councils, academic institutions, and other organizations actively engage in the exchange of knowledge about a specific place, their Area of Concern. But, this raises questions about how Areas of Concern might get to look beyond the immediate problems and create a vision document like St. Louis River Area of Concern's "Roadmap to Delisting."

These three cases illustrate three steps on a progressive path towards developing a collective vision based on a sense of place, exemplified in connections to the resource and other actors in the Area. Perhaps we can see the first step in the experience of St. Marys River, where the BPAC struggles to reach the community but is actively creating a shared vision among Council members. Their connection to the river inspires connections within the committee to advocate for it. A second step in the progression might be reflected in the experience of the institutions in the Milwaukee Estuary where the Department of Natural Resources connects disparate activities through the Remedial Action Plan, and UW-Extension then invites citizens to learn about the rivers and restoration efforts. The process enables engaged local experts to engage with others in sharing knowledge about the water, plant and animal resources. At the same time, UW-Extension is reaching out to establish new connections between the communities around the river and the water. The successes of the first two steps, based on advocacy and knowledge about the place, the Area of Concern, create the trust, mutual respect, and connection with and around the rivers.

The experiences in the St. Louis River Area of Concern embody a third step in the process to create a collective vision based on connections to resource and other individuals. Agencies and individuals have demonstrated that developing a collective vision is a long-term, conscious endeavor that requires not only commitment to reviewing past results to apply towards developing a shared understanding of the problems, but also a commitment by individuals and agencies to stay in conversation with each other. The participants in the St. Louis River have demonstrated a willingness to stay engaged and look forward to not only continuing progress on current efforts, but also look beyond the immediate problems to begin conversations about how the river should look when it is "restored."

### Discussion

Diversity defines the Areas of Concern in the Great Lakes, where no two Areas of Concern are exactly alike. The three Areas in this study represent the range of size and complexity in the program. The St. Louis River Area is often called the largest and most complex, while the Milwaukee River Area represents an urban area with more use impairments (than the other two sites). Finally, the St. Marys River is an Area in a sparsely populated part of the region. The characteristics of the public advisory councils are equally diverse.

Through this study, I demonstrated that differences in the structure and organization of Area of Concern create different opportunities for individuals and organizations to contribute knowledge or experience to the remedial action planning process. UW-Extension organizes a "Stakeholder Delegation" to plan and implement outreach and education about the attributes and restoration of the Milwaukee,

Menomonee, and Kinnickinnic Rivers. UW-Extension's approach as a facilitator means that members of the stakeholder delegation have considerable influence over outreach and education decisions and opportunities to implement the efforts. In the St. Louis River, the River Alliance organizes stakeholder engagement, hosts events, and conducts other projects for the state and federal agencies in the Area of Concern. Of all of the public advisory councils in this study, the River Alliance is the one most integrated with the management actions in the Area of Concern. Unfortunately, River Alliance dedication to agency operations and dependence on agency contracts might threaten the Alliance's ability to diversify into other areas of programming. In the St. Mary's River, on the other hand, the Bi-national Public Advisory Council operates independently and has less influence on the restoration of beneficial uses. Although the BPAC regularly meets, agency representatives do not always attend. In the St. Marys River region, agencies often ask for feedback and support, but they appear to consider consultation at the end of the process, thus limiting the influence of local stakeholders.

Further, this study demonstrates that connections between stakeholders and state agencies influence how the Area of Concern process unfolds in each place. As the lead implementers of Remedial Action Plans, state agencies create the opportunities for public advisory councils or stakeholders to participate in the process. What that means in practice is that stakeholders participate in each Area of Concern in different ways. In the Milwaukee Estuary, the Department of Natural Resources assigns a local AOC coordinator, who enjoys a relationship with the stakeholders participating on the advisory bodies. In the Estuary, non-state agency actors contribute to the restoration of beneficial uses through their participation on the Tech Team or the Stakeholder Delegation. The

Tech Team advises the Wisconsin Department of Natural Resources on the Fish and Wildlife use impairments. UW-Extension organizes the Stakeholder Delegation to create and implement outreach and education. UW-Extension creates their plans in consultation with the Department of Natural Resources but works independently in their Area of Concern program implementation. UW-Extension does build local capacity and extend program reach by funding local non-profit organizations to conduct outreach projects that benefit the Area of Concern and engage citizens in Milwaukee's Rivers.

In the St. Louis River Area of Concern, channeling the restoration activities of three state agencies and a Native American tribe in the same direction can be a complicated endeavor. The St. Louis River Alliance, as an entity, is "like Switzerland," providing a forum where potentially competitive agencies can meet and develop a collective understanding of the river and how to restore the beneficial uses (Stakeholder interview, 2012). The agencies not only look to the Alliance to organize meetings and organize project-specific stakeholder outreach, but they also fund the River Alliance's work. The political will to cooperate is not left to the River Alliance alone, however. The Minnesota Pollution Control Agency exhibited leadership by engaging agencies, nonprofit leaders, and researchers to develop the "Roadmap to Delisting" or business plan to delist the Area of Concern.

Further, I found that state administration of the program shapes local implementation. For example, when the process is locally administered instead of centrally administered, there are more opportunities for local concerns and stakeholders to be incorporated in planning. Empowering the River Alliance to manage stakeholder

participation in the Area of Concern both builds capacity in the River Alliance and expands the capabilities of the agencies through community partnerships.

The situation in the St. Marys River Area of Concern demonstrates that the Remedial Action Process is only empowering when state agencies consider local stakeholders as team members working towards the same goals. The Department of Environmental Quality administers the Areas of Concern program from the state capital the AOC Coordinator with less staff support than the other Areas. The Department of Environmental Quality is committed to removing beneficial use impairments. On the other hand, the Binational Public Advisory Council loves the St. Marys River and regularly meets to consult about the resource. The mismatch in interests, combined with a focus on efficiency at the state level means that the BPAC is limited to providing input on state-organized restoration projects. The experience in the other two AOCs demonstrates that limiting a role for the BPAC may be limiting the capabilities of the state agency, as well.

Finally, this study explains how local relationships and a connection to the place can make a difference in articulating the local vision and connecting the AOC to the community. In the Milwaukee Estuary, stormwater management dominates local efforts to restore beneficial uses. At the same time, UW-Extension recognizes the disconnect between people and place and is actively trying to restore the connections through the Explore and Restore outreach program. In the St. Marys River, the dedicated BPAC members organize events to build local capacity, thus enhancing their ability to articulate their understanding of problems and the river.

Of the three sites, the St. Louis River demonstrated some of the hopes articulated by the scholars who studied the Areas of Concern in the early stages. In fact, restoration efforts extend beyond the Area as the City of Duluth is commencing a large-scale revitalization effort in the neighborhoods adjacent to the river (City of Duluth, 2012). Furthermore, the broad base of participation and cooperation among institutions translates into ongoing cooperation to define the problems in the Area of Concern and collaboration in implementing remedial actions. Stakeholders and the agency representatives cited their love of the river and Lake Superior as the motivation to cooperate. As the top of the system, the people in the St. Louis River feel a responsibility to preserve and restore the river.

### Conclusion

My own experience as a participant observer in these three different Areas of Concern were instrumental in understanding the complexities of the state-local agency relationship that shape not only how the beneficial uses are restored in the Great Lakes, but also how local agencies and stakeholders articulate their vision for these formerly degraded areas.

This project demonstrated that local stakeholders would both contribute to the restoration of their rivers and local environment and expand the capacity of state agencies when given the chance to do so. This study could focus on the state agency-local organization relationships because often-cited barriers to cooperation, like lack of funding and time, did not play a huge role. Specifically, this research started right after the implementation of a large infusion of federal funding, the Great Lakes Restoration Initiative (GLRI), which has minimized barriers and spurred action.

In fact, I would argue that the funding solidified existing patterns and relationships. For example, the Metropolitan Milwaukee Sewerage District was already the leader in water quality remediation in the Milwaukee Estuary, and they were able to secure funding to implement existing efforts or plans. At the same time, the partners in the St. Louis River were able to take ideas from their “wish lists” to apply for habitat restoration funds. Ongoing consultation in a number of settings ensures the partners can continue to build their restoration momentum.

I would contend that this study suggests that funding and policies cannot “fix” problems, in and of themselves. The leaders in the St. Louis River Area of Concern have been able to articulate a local vision because of the foundation built by St. Louis River Citizens Action Committee and the commitment that the original remedial action plan did “not just sit on a shelf.” The successes are, in essence, the results of nearly twenty years of consistent relationship building and agency commitment to negotiation around the river.

There were some limitations to this study. First, participant observation is a powerful method to observe cooperation and dissent, but as a researcher who resided in one Area and traveled to the other two, it was difficult to be present at all meetings and events. Secondly, I studied only three US-based cases on two Great Lakes and a connecting channel, but the ecosystem approach was introduced in thirty-nine other areas, five other states, and two provinces in Canada. Further, one of the Areas, essentially had two Remedial Action Plans (one in the US and one in Canada), and I only studied the US process. Still, this study suggests that a richer consideration of the



relationships between agencies, people and place would be valuable to furthering progress in Areas of Concern.

Another potential limitation of this study was perhaps one of the most illuminating. The St. Louis River Area experience may not be representative of other Areas of Concern, but could be an example for other sites for two reasons: its location on Lake Superior and the concentration of educational institutions. First, experts perceive that the citizens around Lake Superior are more dedicated to their lake than in any other part of the Great Lakes, which means the connection to place might be more evident and influential here than in other Areas of Concern (Futures Project interview, 10/2013). Secondly, there is an extraordinary concentration of academic and research institutions in Duluth-Superior. The Twin Ports are home to two universities, three associated research institutes, a federal research laboratory and three NOAA-University cooperative programs, thus it would be reasonable to suggest that participants have more curiosity and a willingness to work through problems because many stakeholders can transcend agency affiliations.

This study points to further areas of research. It appears on the surface that the Wisconsin and Minnesota have (or have started to) embraced an ecosystem approach, characterized by the integration of public involvement in the Remedial Action Planning process. However, the Michigan experience suggests that participation in AOCs is more complicated. At least in the St. Marys River, the Michigan Department is appears more reluctant engage in more collaborative governance. Hartig and Law (1994) noted the same phenomenon. There is some irony in the finding, as Botts and Muldoon (2005) described how important the advocates in Michigan were to insist upon public

consultation with the International Joint Commission. On the other hand, the Michigan Department has been remarkably productive, removing over 20 impairments and delisting two Areas of Concern since 2010. Exploring the complex relationships between the local and state agencies might help both public advisory council members and state agencies identify and implementing a collective vision of restoration not just in Michigan, but throughout the Great Lakes.

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**- Chapter Three -**  
***Who knows beauty? A comparison of two approaches to creating  
knowledge about aesthetics in the Great Lakes region***

**Abstract**

It makes sense to rely on experts to make determinations about water quality like the how safe the water is for drinking or bathing. But, what about aesthetics? It is difficult to argue that only experts can determine that a river or lake is clear of debris, foam, and algae. Yet, that is a current topic of conversation in the Great Lakes region. According to the Great Lakes Water Quality Agreement, the Degradation of Aesthetics is one of the beneficial uses of the ecosystem that should be restored. The problem is - how do we create knowledge to determine when the aesthetics are no longer degraded? Using a case study approach, I compare how knowledge was created to say the aesthetics were restored in two areas on the Great Lakes, the St. Marys River in Michigan and the Milwaukee Estuary in Wisconsin. The state processes differed in a number of different ways – they responded to different environmental conditions and different rules shaped how knowledge was produced. Michigan utilized staff to conduct monitoring, while Wisconsin trained and deployed volunteers. The analysis revealed the potential trade-offs related to citizen participation in knowledge creation in environmental management. I found that although staff observations were a more efficient approach, there was a higher risk of alienating citizens. While it is less efficient to involve citizens, there are more opportunities for citizen education and integrating citizen concerns into resource management earlier in the process.

## Introduction

During the summer of 2014, a toxic algae bloom in western Lake Erie left the city of Toledo with undrinkable water for several days (Lee, 2014). While the water was bright green with algae, it was water testing by the City of Toledo identified a toxin that could not be removed through the city's water treatment system. Clearly, it makes sense that scientists and water utility managers should make the decisions about whether water will be safe to drink. But, what about the aesthetics? It is difficult to argue that only the experts could readily identify and describe the adverse aesthetic impacts of the normally clear water that grew thick and became a shade of vivid green with suspended algae.

Whether or not the aesthetics are degraded seems like exactly the kind of knowledge citizens can contribute to environmental management without advanced, specialized education efforts. The 1987 Amendments to the 1978 Great Lakes Water Quality Agreement named "aesthetics" as one of the beneficial uses that could be degraded or impaired in Areas of Concern (AOC)<sup>14</sup> (IJC, 1987). When Degradation of Aesthetics was added to the list of impairments, citizens and advocates were concerned about highly visible problems like giant algae mats, oil slicks, and floating sanitary debris (Botts and Muldoon, 2005). If citizen concern helped direct attention towards this dimension of Great Lakes restoration, it seems like a natural connection to involve citizens in the efforts to remove the aesthetics beneficial use impairments (BUI)<sup>15</sup> where

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<sup>14</sup> Areas of Concern are the geographic areas where one or more of the beneficial uses fail to meet the standards of the agreement. There are 43 named AOCs and seven have been "delisted."

<sup>15</sup> A beneficial use impairment is a "change in the chemical, physical, or biological integrity of the Great lakes system sufficient to cause any of the 14 beneficial use impairments, including restrictions on fish and wildlife consumption, tainting of fish and wildlife flavor, degraded fish and wildlife populations, fish tumors or other deformities, bird or animal deformities or reproductive problems, degradation of benthos, restrictions on dredging activities, eutrophication or undesirable algae, restrictions on drinking water consumption or taste/odor problems, beach closings, degradation of aesthetics, added cost to industry or agriculture, degradation of phytoplankton and zooplankton populations, or loss of fish and wildlife habitat.



they occur in an AOC. But, it also raises the question: how should we approach creating knowledge about degraded aesthetics, in ways that can inform decisions about restoration and remediation?

There is considerable debate about the best methods to create knowledge to inform environmental governance (Backstrand, 2003, Petts and Brooks, 2006, Reed, 2008). Much of the literature has focused on the different ways of conducting meetings or soliciting comments from stakeholders and the public (Irwin, 2005; Petts and Brooks, 2006). Fortunately, scholars are starting to study the role that citizen surveys or citizen science could play as a method of producing knowledge for environmental governance (Daniel et al., 2013; Haywood, 2014). However, no one has compared different approaches to aesthetics monitoring. Comparing the knowledge creation processes in aesthetics could be productive because aesthetics are often considered more “subjective,” but also a problem that would lend itself well to lay or citizen participation. In addition, it could provide an opportunity to shift the conversation about lay or citizen participation towards the knowledge produced when citizens participate in the process. This shift is needed because there has been insufficient attention to (a) the environmental and institutional constraints that help determine approaches to participation in knowledge production for resource management; and (b) the ways that different approaches to participation unfold in practice and influence the outcomes: both the knowledge produced and the decisions it supports.

Currently, the problems of aesthetics, participation, and knowledge production intersect in the Great Lakes region. Prompted by a large investment by the federal government to remediate the AOCs, there is we are in the midst of an effort to remove as

many impairments and delist as many AOCs as possible. In many AOCs, the Degradation of Aesthetics impairment is one of the first targets to try to remove, as it is viewed as the “low-hanging fruit.”<sup>16</sup> There is, however, no uniform approach to producing knowledge to support the request to remove this impairment in affected AOCs. As a result, there is a range of approaches in the region to monitoring and addressing aesthetics.

In order to analyze and evaluate this variation, I will compare two AOCs that have taken very different approaches to citizen participation in the production of knowledge about aesthetic degradation: the St. Marys River, which is the connecting channel between Lakes Superior and Huron and between the Upper Peninsula of Michigan and Canada, and the Milwaukee Estuary in Wisconsin on Lake Michigan. More specifically, I will address two questions:

- 1) How did St. Marys AOC and Milwaukee Estuary AOC differ in their approaches to conducting monitoring to produce knowledge to support delisting of the aesthetics Beneficial Use Impairment?
- 2) What are some of the trade-offs in different approaches to engaging the public in aesthetics monitoring for environmental governance?

In this study, I found that the approaches taken at the two AOCs responded to two different sets of environmental conditions and two different sets of rules and legal frameworks at the state level. At St. Marys River AOC, the local environmental and institutional conditions contributed to the decision to institute a staff-conducted approach, with limited data collection and an emphasis on efficient delisting. At the Milwaukee

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<sup>16</sup> This is an assertion that was shared by advocates in different settings ranging from small meetings to large conferences. The comments may not have been on the record, but were shared so often, they almost appear to be a universally held belief.

Estuary AOC, the local conditions contributed to the decision to enroll and train citizen volunteers, with more extensive and detailed data collection forms as a part of a larger education and outreach program with an emphasis on fostering a sense of place.

Further, I argue that the more extensive public participation or consultation in aesthetics monitoring in Milwaukee provided valuable knowledge that the less participatory approach at St Marys could not provide, such as seasonal variation in the amount of debris; that it addressed concerns about bias in innovative ways; and that it has generated community engagement. However, relying on volunteers for data collection has also proven to be less efficient, and the managers give up some control in the data collection process. Relying on staff meant that the Michigan Department of Environmental Quality was able to request removal of the impairment, a request that was granted by the USEPA.

This study will contribute to the geographic literature in two ways. First, this work demonstrates how institutional constraints and rules shape how knowledge is produced, as well as the opportunities for citizen participation. Secondly, although the literature in environmental governance suggests that trade-offs are an important component of environmental decision making, there has been less attention paid to the specific trade-offs related to citizen participation in knowledge production. This study provides empirical evidence of the trade-offs that may be made in choosing methods to create and apply knowledge in environmental management or natural resource management.

### **Participation and knowledge production**

Stakeholder participation in environmental governance gets mixed reviews in the literature. On one hand, it is held up as necessary to ensure legitimacy and support

decision-making, or at least prevent opposition (Backstrand, 2003; Reed, 2008). At the same time, participation is often criticized for failing to live up to the promise of supporting sound decision-making, taking a long time, and “diluting” management (Reed, 2008). Geographers who study stakeholder participation in environmental management explain that there may be a number of reasons that stakeholder engagement based only on collecting public input and not on deeper, more meaningful types of participation may fail. For example, Petts and Brooks (2006) and others have argued that stakeholder engagement is often highly structured and organized so that the process simply fulfills agency requirements by streamlining the collection of public input. Scientists or agency representatives might use methods to limit participation because they may feel input from the based on local experiences would contradict their findings (Petts and Brooks, 2006; Robbins, 2004).

A number of studies demonstrate that citizens are actively involved in restoring their beloved natural areas, but do not necessarily participate as “stakeholders” in formal deliberative processes. Eden and Bear (2012) explained that it is possible to overlook interested publics by engaging only with “stakeholders.” Stakeholders are those who “have a stake” in the outcome of a decision-making process, or as the publics who live near a proposed management action, have some specific knowledge, or benefit in some way from the resource (i.e. a business owner). They are the usual targets of outreach by environmental resource managers and educators. Eden and Bear (2012) illustrated their point that it is possible to overlook interested publics by using the example of a group of recreational fishermen. This group of fishers had intimate knowledge of the river and spent a considerable amount of time in hands-on restoration of the river, although they

rarely attended meetings. In a similar vein, Paul Gobster of the US Forest Service has a long history of research on volunteers in restoration of parks and natural areas. His research has documented how people are attached to natural areas and expresses the attachment to the natural areas through volunteering (Gobster, 2001; Gobster and Hull, 2000). Further, Ryan, Kaplan, and Grese (2001) demonstrated that the public performs hands-on restoration of streams and natural areas, illustrated the willingness to develop skills and knowledge to perform the management tasks. Thus, the reliance on meetings or efforts to gather “input” from pre-defined “stakeholders” may leave out important constituents who have time and talents to share and are willing to learn management practices (Eden and Bear, 2012; Gobster; 2001).

Restoration activities like the ones Eden and Bear (2012) and Gobster (2001) discuss are linked with other hands on activities, like citizen science, through educational approaches based on creating an emotional connection to a place through learning (Semken, 2005; Williams and Stewart, 1998). As Haywood (2014) argued, sense of place approaches, including public participation in science, can contribute to the goals of both environmental education and ecosystem management. Sense of place-based outreach and education activities connect two key ideas: one, that a mere site becomes a meaningful place when endowed with value; and two, that experiential learning, as a cycle in which concrete experience and reflection create understanding, empowers the learner to apply the information (Williams and Stewart, 1998). Citizen science is one of the educational methods that connects people and place and increases scientific and environmental awareness.

Questions arise, though, about how educational approaches or citizen science might be applied towards creating knowledge that informs environmental management efforts, or if particular elements of the environment could act as indicators of both citizen knowledge and ecosystem health. In the next section, I will provide a review of the literature on aesthetics, including a discussion of how aesthetics are important in the Great Lakes.

### **The many meanings of aesthetics**

Aesthetics degradation is an interesting lens to examine the question of participation in knowledge production. At one time, the aesthetics of the Great Lakes and its rivers and bays were dramatically degraded. While there are still harmful algal blooms on Lake Erie, it was not that long ago that the algae mats were bigger and more widespread throughout the region. In the 1960s and 1970s, oil slicks were on fire in the rivers, while trash and floating debris marred others (Annin, 2007; Botts and Muldoon, 2005). From Lake Superior to Lake Ontario, industrial waste, toxic sludge, grain dust, and sanitary sewer overflows were common. It would not be an exaggeration to say that the Great Lakes and the rivers that fed them were a mess that was obvious to citizens, scientists, and policy makers. The *visible* problems reflected even larger systemic problems like “dead zones<sup>17</sup>” and the accumulation of toxic sediments (Annin, 2007; Dworski, 1988). The blatant pollution on both sides of the Canada-US border, in the words of Great Lakes historian Paul Muldoon, had “reached a point where political attention was expected and needed” (Muldoon, 2012: 51).

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<sup>17</sup> The low oxygen and highly polluted areas in coastal and freshwater estuaries are sometimes called “dead zones” because of the large algae outbreaks and resulting fish and shellfish kills (Ecological Society of America, date unknown).

In spite of the successive versions of the GLWQA, and National Environmental Protection (Canada) and Clean Water (US) Acts, remediation in the Great Lakes remained slow until the mid-1980s (G. Krantzberg, personal communication). In hopes of stepping up the environmental rehabilitation, the Great Lakes Water Quality Board (WQB) suggested new mechanisms to improve water quality in the Great Lakes, like the AOCs and the list of beneficial use impairments (GLWQB, 1985). As the former Director of the International Joint Commission's Great Lakes Regional Office explained,

In the mid 80's the governments were dissatisfied with the degree of progress associated with the 1978 Great Lakes Water Quality Agreement. The WQB took it on to devise a way to accelerate clean up at particularly degraded locations ... At the time, oil slicks, floating waste, foaming from CSOs and such, marred aesthetics. So that was put on the table. (G. Krantzberg, personal communication)

Thus, aesthetics became part of the amendments to the GLWQA, recognizing that the aesthetic impairments could impact resource use. Further, aesthetics are important for this study because the term has numerous meanings. For example, as mentioned earlier, the GLWQA considers aesthetics a "beneficial use" of the ecosystem. In other International Joint Commission documents, though, aesthetics are an "indicator." According to the Sediment Priority Action Committee of the GLWQB, indicators are:

measurable features which provide communities, scientists, and resource managers with useful information on the state of the ecosystem, environmental quality or trends, and the status of programs and activities directed at rehabilitating the Great Lakes ecosystem. Indicators measure progress toward community-based and/or government driven management goals (GLWQB, 1999: 5).

In this context, degraded aesthetics were considered an indicator of sediment health and stability (GLWQB, 1999:6). Thus, indicators are an important signal of progress in restoring areas on the Great Lakes.

These definitions suggest that aesthetics are not only an important symbol of ecosystem health, but also readily visible to the untrained observer. This suggests that harnessing lay or citizen knowledge of aesthetics would be beneficial in environmental governance, which is explored in more detail below.

*Knowledge and aesthetics: Connecting knowledge and citizens*

A number of scholars recognize aesthetics and sense of place as ecosystem services, similar to the beneficial uses outlined in the Great Lakes Water Quality Agreement. The difference is that these cultural ecosystem services are understood as a way that people connect to the environment, thus serve as a way to describe the emotional attachment to nature (Daniel et al., 2013). Understanding the links between aesthetics and ecology is important not just for ecological restoration, but also to understand the motivations behind public support for restoration (Kovacs et al., 2006). Most often, the aesthetic-ecology relationship is examined through the lens of landscape management (Gobster et al., 2007; Yang et al., 2014).

This raises the question, what motivates participation in restoration or environmental management? Kovacs et al. (2006) suggested that “beauty bias” influences ecologists’ site selection, and might impact a scientist’s objectivity (2006). At the same time, they found that the public shared a similar beauty bias (Kovacs et al., 2006). Meanwhile, geographers Brace and Geoghegan (2010) offer the suggestion that lay knowledge of the landscape can offer new understandings of how environmental change is “observed felt and sensed” (2010: 296). The entirety of this literature review suggests that lay people can provide valuable knowledge of the landscape and the aesthetics, but aesthetics can be an object that connects the interests of citizens, managers, and scientists.



What is less clear is how aesthetics might connect these interests. The case study below examines these issues in more detail by comparing the differences between staff and lay knowledge of aesthetics.

### **Methodology**

I will identify the elements that shape knowledge production and outcomes in environmental governance, through a comparative case study of the efforts to remove the Degradation of Aesthetics impairment in the St. Marys River and Milwaukee Estuary AOCs. Through this case study, I will answer two questions:

- 1) How did St. Marys AOC and Milwaukee Estuary AOC differ in their approaches to conducting monitoring to produce knowledge to support delisting of the aesthetics impairment?
  
- 2) What are some of the trade-offs in different approaches to engaging the public in aesthetics monitoring for environmental governance?

I collected data in both sites over a roughly two-year period, from February 2012 through February 2014. I used a multi-dimensional strategy to collect data, including participant observation, interviews, and document analysis. I conducted participant observation at the St. Marys River Bi-national Public Advisory Council (BPAC) meetings in Sault Ste. Marie, ON/MI, as well as Milwaukee AOC Stakeholder Delegation meeting in Milwaukee. In Sault Ste. Marie, I was an observer and guest of the BPAC. In Milwaukee, though, I am one of the participants in the Milwaukee Stakeholder

Delegation, or our PAC. Further, I was a volunteer aesthetics monitor in Milwaukee. Participation as a volunteer aesthetics monitor meant attending trainings, conducting monitoring, and attending the season-end potluck dinner.

Finally, document analysis included the packet that the Michigan Department of Environmental Quality submitted to the USEPA to request removing the Degradation of Aesthetics impairment. The documents included all of the knowledge about the aesthetics created by the Michigan Department to support the request. In the Milwaukee AOC, document analysis included the forms that the volunteers returned for the river monitoring sites in 2012 and 2013. More specifically, I analyzed the answers to the question, "Overall, how aesthetically pleasing do you find the site?" Document analysis was supported with semi-structured interviews of the staff of the monitoring programs.

The two sites provide an interesting comparison because the impairments in the aesthetics were similar. The original Remedial Action Plans described the aesthetic impairments as follows:

In the St Marys River AOC:

Floating scum along the North Shore of Sugar Island in Michigan is periodically reported. In Ontario, mats of oily fibrous material mixed with wood chips occasionally occur between Sault Ste. Marie and the Lake George Channel. As well, oil slicks appear from time to time downstream from the Algoma Slip and Terminal Basin. Since March 1990, no complaints of floating oil has been received. This may be a result of improvements made at Algoma Steel (St Marys River Stage I RAP, MDEQ).

While in the Milwaukee Estuary AOC:

The aesthetics of the AOC are impaired because of poor water quality. After storms, considerable debris can be seen near all of the combined sewer overflow outfalls. MMSD operates a skimmer on the rivers throughout the summer. In addition, flushing tunnels on the Kinnickinnic and Milwaukee rivers flush debris from the river system as well as introduce higher quality lake water into the AOC. The Milwaukee flushing tunnel pumps about 58,800 millions gallons per year and

the Kinnickinnic flushing tunnel pumps about 25,500 million gallons per year (Stage I RAP, WDNR).

The impairment sources for both sites were mostly industrial point-sources and combined sewer overflows. While the aesthetic impairments were similar, the two sites are also fairly different.<sup>18</sup> The St. Marys River AOC is the 70 mile-long connecting channel between Lake Superior and Lake Huron. It is located in a sparsely populated area of the rural Upper Peninsula of Michigan and Northern Ontario. The impairments in the AOC were concentrated in the population center of Sault Ste. Marie. The Milwaukee Estuary AOC, on the other hand, is an urban AOC spread over three rivers and the nearshore area of Lake Michigan. Although there are areas where the aesthetics are more degraded than others, for the most part, impairments can be found throughout the AOC.

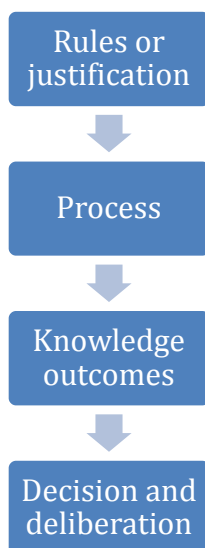
### **Conceptual framework and empirical analysis**

An analysis of the data revealed there were four dimensions along which the Wisconsin and Michigan processes differed, as outlined in Figure 5. My data analysis and discussion will be organized according to this framework. Those four dimensions are the rules, or the legal reasoning behind their respective approaches to the problem; the process each agency followed; the knowledge outcomes produced in the process; and what each state did with the data in deliberations and decisions. It is important to note here that this study focuses on the state process in the AOC because it is the state agency that organizes and executes the management actions, including research, to remove impairments.

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<sup>18</sup> I used past tense in relation to the aesthetics impairment because the BUI was removed in the St. Marys River AOC.

### Conceptual framework for analysis



**Figure 5:** Conceptual framework for the analysis of knowledge production to remove the Degradation of Aesthetics impairment in the St. Marys River and Milwaukee Estuary AOC.

#### Rules

Michigan and Wisconsin organize and administer their AOC programs differently. The differences start with how each state charts the path towards delisting for each AOC. In Wisconsin, there are five AOCs on Lakes Michigan and Superior in Wisconsin. Each AOC has its own Remedial Action Plan<sup>19</sup> (RAP), and its own delisting criteria.<sup>20</sup> This means that each AOC has a document attached to it that describes all of the impairments, and what needs to be done to remove all of the Beneficial Use Impairments from the list

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<sup>19</sup> Remedial Action Plans (RAP) and Lakewide Management Plans shall embody a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in Areas of Concern or in open lake waters (IJC, 1987). RAPs are organized and administered by state agencies and local public advisory councils or committees (PAC).

<sup>20</sup> Delisting criteria in the AOC program is analogous to a task list. When all of the management actions in an AOC are completed and all of the monitoring to ensure the AOC has been restored is completed, the AOC will be “delisted.” Within the delisting criteria, there are standards for each individual BUI, like the degradation of aesthetics. For example, when the aesthetics reach the standard outlined in the delisting criteria, then the BUI can be removed from the list.

in order to delist the Area of Concern. It almost works like a task list; as conditions improve, impairments can get removed from the list.

In Michigan, there are fourteen AOCs on four Great Lakes and three connecting channels. As in Wisconsin, each individual AOC still has its own list of impairments and documentation describing why each impairment was added to the list of impairments. However, in order to manage the program, Michigan has developed statewide delisting criteria, which includes both the statewide standards and additional instructions for some AOCs.

In both sites, delisting criteria mandate that the Degradation of Aesthetics, or floating debris, odors, oil slicks or algae, should not interfere with the designated uses. But “designated use” differs between the two states, which anchor their aesthetics delisting criteria to different uses of the waterways. The Michigan aesthetics delisting criteria are tied to “designated uses” including agriculture, navigation, industrial water supply, public water supply, warmwater fishery, other indigenous aquatic life, body contact, or coldwater fishery as outlined in the Michigan Water Quality Standards (MDEQ, 2008: 41). On the other hand, Wisconsin ties its removal criteria to the Public Trust Doctrine, or the public access and enjoyment of the waterways.

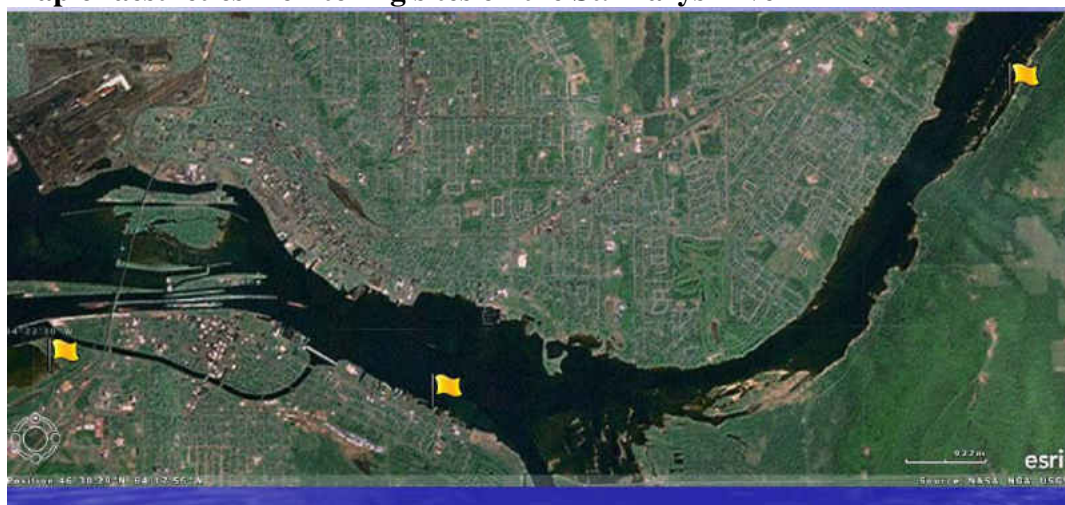
The different rules meant that different questions organized what knowledge was created in each state. The forms and knowledge collection are outlined in the next section.

### Process

At the most basic level, the knowledge creation processes in Wisconsin and Michigan were similar. Both states utilized forms, observations, and photos. In Michigan, though,

professional staff created the knowledge about aesthetics, following the standard state protocol.<sup>21</sup> In order to implement the protocol, staff conducted one site visit in the St. Marys River in each of two successive years. They used clear jars to measure water clarity, took photos, and completed the monitoring form, which I will describe in the next section. Two years of observations resulted in two sets of observations overall. The sites where the Michigan Department conducted observations are illustrated in Figure 6. Finally, there were three observation sites. Two of the sites were sites cited in the RAP documents, while the third site was chosen because it had public access. The BPAC, or Binational Advisory Council, was consulted in site selection.

#### **Map of aesthetics monitoring sites on the St. Marys River**



**Figure 6:** Aesthetics monitoring sites on the St. Marys River. Sault Ste. Marie, Michigan is located on the south bank of the St. Marys River. The monitoring sites are (from left to right) Ashmun Bay, Aune-Osborn Park, and Sugar Island Township Park. Source: Michigan Dept. of Environmental Quality, Presentation to BPAC.

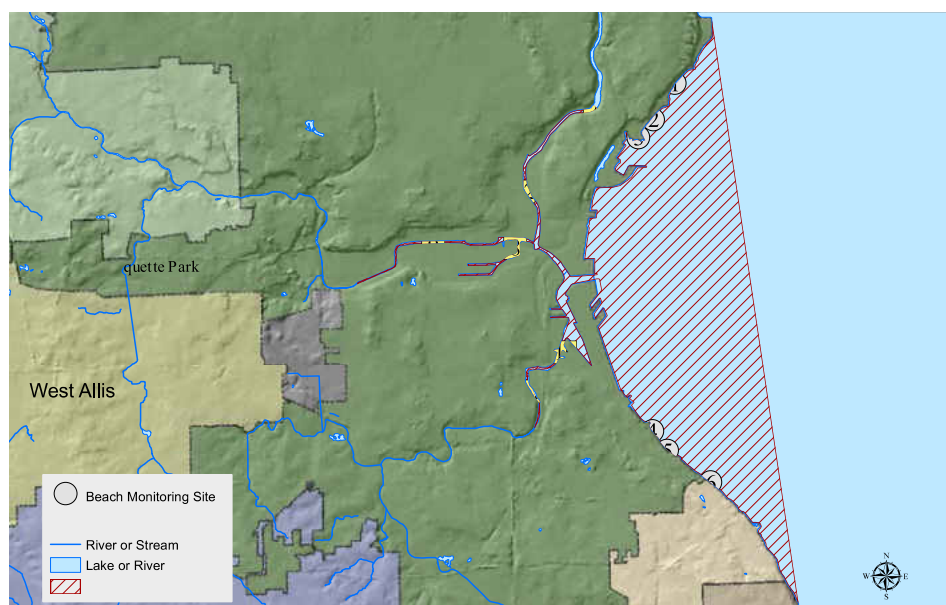
The Wisconsin process was different, in part because it was also part of an extensive outreach and education strategy called “Explore and Restore.” UW-Extension and

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<sup>21</sup> Staff for the Michigan AOC Program is centrally located in the Office of the Great Lakes in the Department of Environmental Quality. Each AOC Coordinator is the staff person for 2-3 AOCs. There are no local AOC staff members in the Michigan program. In Wisconsin, there is a local AOC Coordinator in each of the five AOCs.

community partners implemented a series of events, tours, and lectures designed to introduce citizens to environmental restoration and connect them with the rivers. Citizens Aesthetics Monitoring Program (CAMP) is an integral part of the strategy because citizens learned about the AOC program and get to take an active role in the delisting process. Thus, instead of staff completing the forms, volunteers collected all of the data. I was able to both observe and participate in the operation as one of the volunteer aesthetic monitors. Staff at a local environmental agency trained us to conduct the monitoring. During the training, we learned about the AOC program, why we were conducting the monitoring, and how to complete the forms. There were twelve monitoring sites, six on rivers and six on Lake Michigan as identified in Figure 7. Sites were chosen in part because there was public access, and in part because they were sites that might have impairments. The Milwaukee Stakeholder Delegation was consulted and suggested sites for monitoring

### **Milwaukee Estuary Area of Concern Aesthetics Monitoring Sites**



**Figure 7:** Map of the CAMP aesthetics monitoring sites in the Milwaukee Estuary AOC. Source: UW-Extension.

An examination of the two sets of forms illustrates that two different questions guided knowledge creation at the two sites. As mentioned above, the knowledge creation in Michigan was guided by the question, “Are there any designated uses that may be impaired in your judgment due to aesthetics conditions?” The single-page form asked questions about the color, odor, and clarity of the water. The form also asked the observer if she/he thought the site met the delisting criteria.

In Wisconsin, the volunteers were asked to complete a three-page form. On the first page, volunteers were asked “Overall, do you find this site aesthetically pleasing?” On subsequent pages, the volunteers were asked questions about the water’s color, clarity, and odor, as outlined in Table 5. Volunteers were also asked to identify the color and types of algae, amount and types of debris, and presence of wildlife.

#### **Data collection methodologies in the Milwaukee Estuary and St. Marys River AOCs**

Site	Data collected
St Marys River (1 page survey)	Water quality details: <i>clarity, color, odor, visible debris/pollution</i> <u>Other questions:</u> 1. Are any designated uses impaired? 2. Are impairments persistently-high or temporary and transient? 3. Does the site meet delisting criteria? 4. Additional comments
Milwaukee Estuary (3 page survey)	Water quality details: <i>clarity, color, odor, objectionable materials on or in the water</i> <u>Objectionable deposit details:</u> 1. Amounts of garbage 2. Color and type of algae and 3. Types and numbers of invasive species 4. Number and types of dead animals 5. Number and types of live nuisance animals <u>Other questions:</u> 1. How aesthetically pleasing is the site? 2. Has the volunteer surveyed the site? 3. What was the most difficult part of the survey to answer?

**Table 5:** Outline of the data collected through aesthetics monitoring surveys in the St. Marys River and Milwaukee Estuary AOCs.



### Knowledge outcomes

Perhaps the most striking difference between the two processes was the amount of knowledge produced to support decisions about whether to remove the Degradation of Aesthetics impairment. In the St. Marys, the Michigan Department collected observations at three sites over two years. In addition to the attributes listed in the previous section, Michigan Department also collected GPS coordinates, weather conditions, water temperature, took five photos at each site, recorded wildlife and evidence of any recreational activities (most often fishing) in order to complete the forms. They noted that they did not find any of the historically occurring impairments. In contrast, at the Milwaukee Estuary, the volunteers recorded over 110 observations at the six sites on the rivers, where volunteers recorded their observations about the attribute outlined in Table 5 and described in Table 6 in more detail.

Another major difference in knowledge outcomes between the two sites was the answer to the question of whether the site was “aesthetically pleasing.” In their presentation to the Bi-national Public Advisory Council, the Michigan Department explained that they limited the observers to only a few staff members. They argued that opinions about what constitutes “aesthetically pleasing” was subjective and could vary from person to person. Michigan Department explained that in order to control for the bias that might accompany subjective judgments, they limited their observers to designated staff.

On the other hand, the question of whether the site was “aesthetically pleasing” produced a much larger dataset in Wisconsin. In order to determine whether answers to this “subjective” question would show a pattern or a consensus at the Milwaukee Estuary,

I analyzed the answers to the question, “Overall, do you find this site aesthetically pleasing?”

While there was variation in the answers, there were patterns as well. At each site one or two elements emerged as important. For example, in Table 6 the responses at Barnacle Bud’s Marina showed that nearly all (13 out of 14) of the respondents mentioned trash or debris as an issue. Volunteers also frequently mentioned features in the built environment that degraded the aesthetics, like the noise of the fans at the Main Post Office across the river from the Harley Davidson Museum site, or the Marcus Center retaining wall. Foliage and plantings were repeatedly cited as enhancements to the aesthetics (i.e., the leaves at North Avenue Pedestrian Bridge or the plantings at the Harley Davidson Museum site). In other words, in spite of the “subjective” nature of aesthetics, there was a significant amount of agreement about what made the sites more or less pleasing.

### Citizen aesthetics survey results

Site	No. of Surveys	Description of the site from the volunteer
Barnacle Bud’s Marina	14	<ol style="list-style-type: none"> <li>1. Trash and debris almost always present (13)</li> <li>2. Industrial area (4)</li> </ol>
Emmber Lane Canoe Launch	22	<ol style="list-style-type: none"> <li>1. Trash and debris almost always present (13)</li> <li>2. The industrial features of the area were noted as a negative, like crumbling concrete and noise (8)</li> <li>3. Many comments that mentioned birds considered them a nuisance (9)</li> <li>4. Native birds (martins) were noted as a positive (2)</li> </ol>
Harley Davidson Museum	30	<ol style="list-style-type: none"> <li>1. The Post Office has a rusty exterior and very noisy fans that detracted from the aesthetics (18)</li> <li>2. The green and plantings of the Harley Museum enhanced the aesthetics (19)</li> </ol>
Lincoln Avenue Bridge	15	<ol style="list-style-type: none"> <li>1. Vegetation is often mentioned, but the importance is less clear. Sometimes vegetation is mentioned as something that enhances aesthetics, sometimes as a something that detracts (9)</li> <li>2. Trash is often a feature in the responses (4)</li> <li>3. Water color is often cited as a problem (4)</li> </ol>
North Avenue Pedestrian Bridge	14	<ol style="list-style-type: none"> <li>1. Trash mentioned in many spring responses (4)</li> <li>2. Trees mentioned in summer and fall (5), and trash not mentioned at all</li> </ol>
Pere Marquette Park	17	<ol style="list-style-type: none"> <li>1. Often called "nice" or "pleasant" or "lovely" (7)</li> <li>2. Volunteers said the concrete wall on the east side of the river needs repair (6)</li> <li>3. Occasional odor (3)</li> </ol>

**Table 6:** Results from citizen aesthetics surveys in Milwaukee River Estuary AOC. This table demonstrates that

One source of variation in the impression scores appears to be based on the season or weather conditions. An analysis of the impression scores in Table 7 demonstrated a pattern where the spring impression scores were lower than the other seasons. The comments from the volunteers were consistent about the elements that contributed to their opinion of the aesthetics. As a volunteer aesthetics monitor, I can concur that the impression scores would be lowest in spring. Spring in Milwaukee can be cold and gray, and windy. More importantly, there is much more debris as the snow melts and leaves behind the trash hidden beneath the snow.

The scores in summer and fall were much higher, but it is more difficult to discern a pattern. Volunteers described leaves, flowers, and warmth in their positive descriptions of the aesthetics of nearly all of the sites. The variations in the answers reveal that each site has its own character. Barnacle Bud's and Emmer Lane are both considered more pleasant in summer, while Lincoln Avenue Bridge was more pleasant in fall. The three sites located in parks, North Avenue Pedestrian Bridge, Pere Marquette Park, and Harley Davidson Museum were considered equally aesthetically pleasing in both summer and fall.

#### **Seasonal variations in impression scores of citizen surveys**

Site	Spring	Summer	Fall	All Seasons
Barnacle Bud's Marina	2	3.7	3	
Emmer Lane Canoe Launch	1.8	2.8	2	
Harley Davidson Museum	2.8	3.7	3.8	
Lincoln Avenue Bridge	2.3	3	4.3	
North Avenue Pedestrian Bridge	3.4	4.5	4.3	
Pere Marquette	3.5	4	3.8	

**Table 7:** The variations in seasonal impression scores by site in the Milwaukee Estuary AOC. The spring scores are the lowest, reflecting common spring conditions (cold, grey, and likely presence of debris).

The pattern of seasonal variation was reinforced by an analysis of how the impression scores varied according to the weather. Some of the volunteers cited weather conditions in their explanations of what made the site aesthetically pleasing. An analysis of the comments where weather was mentioned exhibited an interesting pattern. When a volunteer mentioned cold, cloudy, or rainy in the description of the aesthetics of the site, the scores were a little lower than the seasonal average. For example, one volunteer included “Cloudy, windy, 57 degrees” in the comment. The volunteer’s impression score for the site was 1.7 points less than the seasonal average for the site. In another example, a volunteer described, “Looks dirtier. But, probably season and light more than the actual debris.” The volunteer’s score for the site that day was 0.8 points lower than the seasonal average.

On the flip side, as one could imagine, when examining the scores where sunny or warm weather was mentioned, the impression score were higher than the seasonal average. For example, where one volunteer shared, “The sun shining...Sunny, 78,” the score was 1.2 points higher than the seasonal average. Similarly, another volunteer explained, “Because the weather was beautiful, the visit was extra wonderful.” The volunteer’s score for the site was 1.58 points higher than the seasonal average. The idea that the volunteer-driven process to this “subjective” question actually produced new knowledge about bias itself – i.e., those perceptions of aesthetic degradation are sensitive to seasonal and weather conditions. The Michigan Department process didn’t produce enough observations to bring out this point.

The analysis of the question, “Overall, how aesthetically pleasing do you find this site?” revealed a consensus about what made a site more or less aesthetically pleasing.

Trash, debris, nuisance birds, noise, cold and gray weather, and crumbling concrete were universally considered elements that detracted from the aesthetics of a site. Conversely, native birds, native vegetation, leafy trees, and sunny or warm weather were universally the elements that volunteers cited as the elements that made a site aesthetically pleasing. When it comes to the “subjective” nature of aesthetics, we should not assume that every individual is going to have an entirely different opinion. It also does not mean that biases are not going to be recognized at all – in fact, conversely, embracing the “intersubjectivity” in the approach can help us understand what generates bias.

### **Deliberation and decisions**

How and where the knowledge was applied in the deliberation and decision making process is final and important difference between the Michigan and Wisconsin approaches to removing the aesthetics impairment. In Michigan, after completing their monitoring protocols, the Michigan Department of Environmental Quality concluded,

No unnatural odors were detected, no foams or oil sheens were observed, and only minimal discarded debris was found. Occasionally, the monitoring crew saw minimal floating trash that had washed ashore. It is the opinion of MDEQ staff that the US side of the St. Marys River AOC is no longer aesthetically impaired, following two rounds of monitoring.

As a result of the findings, Michigan Department commenced the process to remove the impairment. The next step in the process was to consult with the public, St. Marys River AOC Bi-national Public Advisory Council (BPAC). Michigan Department presented the information to the BPAC at a meeting on July 31, 2012 at Lake Superior State University, Sault Ste. Marie, Michigan. The BPAC contended that two observations, neither of which took place in wet weather, were not adequate to support the assertion that the impairment no longer existed. They believed that the Michigan

Department had ignored a history of sanitary and related debris that often washes up on Sugar Island after significant wet weather events. The BPAC subsequently sent a letter to the Michigan Department requesting another year of monitoring, specifically to include wet weather events (BPAC letter to MDEQ, 2/13/2013).

The Michigan Department rejected the request for monitoring after a heavy rain, arguing any degradation of aesthetics would be temporary and transient, thus not meeting the condition “persistent and high” (MDEQ, 2008). The Michigan Department supported their decision to forgo further monitoring by citing a surveillance report focused on Sugar Island debris,

This summary indicates that in 2009, just two incidents may have occurred that included unnatural physical properties causing localized concerns. The fact that this occurs at all is regrettable, but again, potentially four incidents discovered over a two year period of intensive monitoring cannot be considered to be of a persistent, high level or long enough in duration to interfere with one of the state’s designated uses (USEPA letter to MDEQ, 1/27/2014).

The BPAC did finally send a letter of support to the Michigan Department in September 2013. The USEPA granted the request to remove the impairment in January 2014.

The Wisconsin aesthetics monitoring plan is still a work in progress, and will be for some time. Although Wisconsin is still executing its protocol for delisting the impairment, there is a clear difference in the citizen role in the process. In the Wisconsin process, citizen participation is not limited to a confirmation of staff generated results, but are a key element in defining the problem as outlined in the December 2012 RAP update:

Benefits of this approach include expanding public participation in AOC activities, generating needed data at minimal cost, and incorporating public perceptions in evaluation of this BUI (beneficial use impairment). The Urban Ecology Center and

Alliance for the Great Lakes Adopt-a-Beach program assisted in developing the project and the initial volunteer base. Results will be incorporated into the BUI removal strategy for this BUI (WDNR, 2012).

In Wisconsin, the Wisconsin Department of Natural Resources and UW-Extension started to build relationships around the river and create knowledge with citizens before making the recommendation to remove the impairment as a part of a larger ongoing outreach and education strategy.

### **Discussion**

On the one hand, the basic elements used to create knowledge about the aesthetics in the St. Marys River and Milwaukee Estuary AOCs were remarkably similar. In both AOCs, the observers who created knowledge about the aesthetics followed a protocol that included completing forms and taking pictures. In both AOCs, the observers noted the color, clarity, and odor of the water, as well as recording comments about the surrounding environment. However, the process of knowledge production at the two sites took place under very different institutional conditions between the state agencies that conducted the aesthetics monitoring. At the St. Marys River AOC, the rules and frameworks that govern the course of AOC delisting—and the limited definition of “designated use” that they incorporate—contributed to the decision to institute a staff-conducted investigation of the aesthetics, including limited data collection and an emphasis on efficiency. In Milwaukee, the delisting criteria were anchored to a different set of rules, the Public Trust Doctrine, and thus to a broader conception of “designated use.” The rules in Wisconsin informed a decision to enroll and train citizen volunteers,

with more extensive and detailed data collection forms, as a part of a larger education and outreach program with an emphasis on fostering a sense of place.

The most significant difference between the processes was the amount of knowledge created. I found the extensive public participation, arguably a form of public consultation in aesthetics monitoring, in Milwaukee provided valuable knowledge that the less participatory approach at St Marys River could not provide. The process in the Milwaukee AOC was able to uncover seasonal variation in the amount of debris, as well as the specific elements that made the landscape more or less aesthetically pleasing. Further, it addressed concerns about bias in an innovative way, both by producing knowledge intersubjectively and by having volunteers themselves reflect on what might bias their own observations. Finally, the Citizens Aesthetics Monitoring Program generated knowledge of the AOC program and community engagement.

However, relying on volunteers for data collection has also proven to be less efficient. One of the challenges of the Milwaukee AOC Citizen Aesthetics Monitoring Program (CAMP) is that the managers had to give up some control in the data collection process. Unfortunately, interviews indicate that not all involved with the program were comfortable with that trade-off, thus the program is currently under review.<sup>22</sup> Other problems include the length of time, volunteer management (which takes a lot of time and expertise), and the lack of time to interpret the qualitative data in the open-ended questions.

The Michigan process was different in that relying on staff meant that the Department of Environmental Quality was able to quickly follow the monitoring

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<sup>22</sup> The UW-Extension CAMP was under review for the 2014 monitoring season. There are plans to reinstitute monitoring in the 2015 season with revised forms.



protocol, create the needed knowledge, and request removal of the impairment. The Michigan Department was able to complete the entire process in about three and one-half years, as opposed to the five-year monitoring requirement in the Wisconsin Department process. The Michigan Department maintained control over the data collection at all times, which could be considered important in a site like the St. Marys River Area of Concern, where a narrow focus on a specific environmental problem by local stakeholders can derail restoration efforts. In fact, marginalizing local concerns almost did derail the request to remove the impairment.<sup>23</sup> The Michigan Department made the initial presentation to the BPAC in July 2012, but the BPAC did not vote to grant a letter of support until September 2013 (USEPA letter to MDEQ, 1/29/2014).

The Michigan Department made the decision to maintain control over data collection, in spite of offers from BPAC members to help with additional monitoring.<sup>24</sup> Although the knowledge to remove the Degradation of Aesthetics impairment was created by staff based in Lansing and not local representatives, the concerned public of the St. Marys River did have an important role in producing knowledge in the Area of Concern. The BPAC forced the Michigan Department to clarify their request and respond directly to local concerns. Although Michigan Department declined additional monitoring, they did have to conduct additional research of the AOC to justify their position.

An analysis of these cases suggests that while citizens can provide valuable knowledge about the aesthetics of the landscape, such knowledge is not an uncomplicated

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<sup>23</sup> A common belief among residents of Sault Ste. Marie, Michigan is that sanitary debris washes up on a local beach. This belief has led to numerous studies, work groups, and a variety of other interventions, most of which found no evidence to support the claim. Still, the idea that sewage is a problem on Sugar Island continues unabated.

<sup>24</sup> Many of the BPAC members are natural science academics and resource agency staff, many who cooperate with state agencies on other data collection projects.

good. This case study demonstrates that there are trade-offs in the choices agencies make to create knowledge to inform environmental governance. Agency control in knowledge creation can mean a more efficient process, but it can also mean alienating local stakeholders. Involving local lay people in data collection can create a relationship between agencies and citizens where citizens learn knowledge creation processes, as well as how science informs policy and management. Agencies can learn about citizen or public perceptions of the resources, like the rivers in Milwaukee Estuary Area of Concern's aesthetics monitoring program.

This research is important because the Great Lakes Water Quality Agreement directs Canada and the US to consult with the public about ecosystem restoration. Thus far, this policy is implemented much as Michigan implements its Area of Concern program. In the current model, consulting with the public usually comes at the end of the process. But, what if there were a way to integrate lay knowledge or expertise earlier in the process?

Reflecting on my experience as a volunteer aesthetics monitor and this analysis, I would argue the Wisconsin model could and should serve as a method to integrate lay or local knowledge into the Area of Concern process, or environmental management more generally, at an earlier stage. The Wisconsin model was conceptualized for both the creation of knowledge through citizen involvement, and to apply the knowledge to identify potential management actions<sup>25</sup>. An area of further research would be how the knowledge created in the citizen aesthetics monitoring or another similar program could be used as an indicator of both an environmental attribute and citizen knowledge of water quality, habitat quality, or other research need (Friedman et al. 2014).

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<sup>25</sup> Gleaned from conversation during a Stakeholder Delegation Meeting in May 2014.

## Conclusions

My own experience as an aesthetics volunteer was valuable for understanding the complexities of applying citizen knowledge in environmental governance. I contributed knowledge and I learned about the AOC and the rivers. As a volunteer, I stopped to look at landscapes that were complicated, like the Lincoln Avenue Bridge site, pictured in Figure 8. The bridge is a perfect example of a site that is full of debris and sometimes smells, but it changes throughout the year. It is also a site that looks terrible in spring, but as I spent more time there, I learned it looks much nicer in fall. I can honestly say that by participating in the CAMP program, I learned that the Kinnickinnic River was no longer an ugly waterway to avoid. I noticed that the water color and clarity changed from season to season. And now I regularly stop to look at the water and trees that line the bank. That was one of the goals of the effort, to connect citizens to the waterways.

### View from Lincoln Avenue Bridge Aesthetics Monitoring Site



**Figure 8:** Volunteer aesthetics monitoring on the Kinnickinnic River at the Lincoln Avenue Bridge. My comment about whether or not the site was aesthetically pleasing, “It is hard to look at a river that does not have trash and has plants growing along the banks and say it is not at least somewhat pleasing. The rough-looking warehouse and phragmites detract, though.”

This project demonstrated that it is possible to create citizen aesthetic monitoring protocols that satisfy program goals, like delisting a beneficial use impairment. As Eden and Bear (2010) and Gobster (2001) argued, interested citizens are willing to take time and learn management practices. Because State of Wisconsin has not completed the protocols, it is impossible to know if the Wisconsin protocol can avoid the disagreement and controversy experienced in Michigan. I would suggest it is possible.

This study points to further areas of research. While it appears on the surface that the Wisconsin process contributed a new way to create knowledge about aesthetics, further research is needed on how else the knowledge could be useful in other ways to inform environmental governance. Brace and Geoghegan (2010), along with cultural ecosystem services scholars suggest alternate applications of the types of knowledge gathered in the aesthetics monitoring forms include resource assessment, restoration project selection, outreach and education programming, and management action trade-off assessment. I would argue that the Wisconsin process could provide a model for the implementation of the theoretical suggestions in the literature (Daniel et al. 2013).

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**- Chapter Four -**  
*Constructing stories: A case study of transdisciplinary  
knowledge production in a large socio-ecological system*

**Abstract**

Transdisciplinary knowledge production for environmental governance in socio-ecological systems can be challenging, as researchers must integrate both social and natural science research to create policy recommendations. Socio-ecological systems (SES) approaches to knowledge creation bring natural and social science knowledge together to inform environmental management. However, critical social scientists argue that SES methodologies fail to consider vital elements of human existence, like politics or social relations. Scenario analysis has been presented as a possible approach to foster an environment where transdisciplinary knowledge can be co-produced among natural and social scientists and practitioners. The Great Lakes Futures Program connected diverse communities of participants, including natural scientists, social scientists, graduate students, and practitioners in a scenario analysis process conducted over one and one-half years. The Futures Project leadership team utilized inclusive strategies like constructivist learning methods and student writing teams to produce knowledge across disciplines. The Futures Project produced not only a collective understanding of current policy and possible ecosystem outcomes, but also a method for richer consideration of social and political dimensions in SES research. While the activities fostered an inclusive and collaborative environment to create the stories, the process might have been limited by its sampling method. The study will contribute to the literature on transdisciplinary knowledge production and scenario analysis, as well as the integration of political and social dimensions of socio-ecological systems.



## Introduction

Producing transdisciplinary knowledge<sup>26</sup> for environmental governance in large socio-ecological systems (SES) can be a challenge in any SES, but especially one as large and complex as the Great Lakes region. Although policymakers and practitioners now widely recognize the need for knowledge that draws on both natural and social sciences, different methodologies, values, and languages in these broad fields of knowledge still pose significant barriers to collaboration (Lélé and Norgaard, 2005; Robinson et al., 2012). In the Great Lakes, for example, observers have noted how frequently natural scientists start the conversation with the “resource,” while policy makers and social scientists start with the “social consequences” of a policy (Krantzberg, 2004; McLaughlin and Krantzberg, 2006; Laurent et al., 2015b). Different starting points and different views of human activity can lead to misunderstandings between collaborators and frustration with the process, and can also make it difficult to create realistic goals or expectations (Giebels et al., 2012; Slocumbe, 1998).

One process that has been applied to overcome such problems and co-produce transdisciplinary knowledge for environmental governance is scenario analysis: an analytical tool through which social and natural sciences can be woven together in order to produce new knowledge about the complex interactions within an SES (Bowman et al., 2013; Nakicenovic and Alcamo, 2005; Rasmussen, 2005). Scenario analysis has been used to visualize system change since just after World War II, but has only been applied to socio-ecological systems in the last ten years (Maack, 2001). Scenarios are created by both organizers and participants who collaboratively create a shared understanding of an

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<sup>26</sup> Transdisciplinary refers to the ability to address issues from more than one perspective and provide knowledge that is “contextualized, useful and socially-acceptable” (Eden et al, 2006: 1064, Pohl, 2005).

SES through a set of steps that include defining potential drivers of system change, collective knowledge production and assessment to inform scenarios, story creation, and assessment (Laurent et al., 2015a, 2015b).

Studies of scenario analysis have demonstrated that it is an important method for creating knowledge across disciplines and other boundaries. SES theorists who use scenario analysis as a methodology argue that scenarios are an inclusive method to integrate natural and social knowledge, at least in theory (Swart et al., 2004; Walker et al., 2006). However, scholars have paid less attention how the production of knowledge in scenario analysis unfolds in practice. Bowman (2013) echoed this concern when he argued that studies of scenario analysis have understudied *how* scenarios are created. This raises a few questions. Do scenario analyses live up to their promise as a means of producing truly transdisciplinary knowledge? If so, how do they work in practice? Or are there limitations that keep them from going beyond other approaches to transcending the divides between natural and social scientists?

A case study of a scenario analysis process provides an opportunity to study how it might work in practice to produce knowledge across the boundaries of natural and social sciences. The Transboundary Research University Network organized the Great Lakes Futures Project (Futures Project), a watershed-wide scenario analysis process to identify deficiencies in current environmental (and other) policies. The goal of the project was to produce policy-relevant knowledge for the Great Lakes based on scientific research (Laurent et al., 2015a, 2015b). The scenario method was conceptualized as a means to encourage transdisciplinary and bi-national cooperation through the engagement of a large community of stakeholders, including natural and social science

faculty, graduate students, and practitioners. Through this case study, I answer two fundamental questions:

1. How did the Great Lakes Futures Project scenario analysis work in practice in order to produce transdisciplinary and holistic knowledge? What were the primary strengths and limitations in the project's design and implementation for supporting the production of transdisciplinary knowledge?
2. What kinds of knowledge did the Futures Project produce?
  - a. More specifically, how did the content of the scenarios reflect the goal to produce holistic and transdisciplinary knowledge?

My position as one of the graduate student scenario writers was an advantageous vantage point from which to examine the Futures Project as a participant-observer. I was able to assess how the organizers structured the process, facilitated workshops, and supervised the students in order to create the stories and policy recommendations. Through the process, the participants co-created a new understanding of the Great Lakes ecosystems that reflected the knowledge and experiences of the participants.

First, I argue that in order to create transdisciplinary knowledge between traditional "divides" like junior and senior scholars, scholars and practitioners, and natural and social scientists, the Futures Project incorporated elements of constructivist learning methodologies to create an inclusive environment and create the conditions to promote transdisciplinary and holistic thinking and ensure that the contributions of all participants were "welcomed" (Management team member, 11/14/2013). In spite of the efforts to create an inclusionary environment, efforts may have been limited by the invitation method, which I will describe in greater detail below.

Second, I argue that the scenarios, as the “mixing” point of physical science and social knowledge, revealed four diverging narratives of the Great Lakes region. An analysis of the scenario stories exposed a collective understanding of the impacts of climate change, prevalence of harmful algal blooms, and the potential threat posed by invasive species. On the other hand, the stories also introduced new ways to imagine elements of human experience normally neglected in SES models, like political struggle and attachment to landscape. Although the social science scholars and practitioners affected the stories and introduced new elements through the scenario stories, their participation in greater numbers at the end of the process might have limited their influence.

This study will contribute to the literature on transdisciplinary knowledge production through a discussion of how interdisciplinary collaboration implemented through constructivist learning techniques can bridge different languages, concepts, and methodologies. Finally, this study will contribute a method to analyze scenarios and demonstrate scenarios as a method to integrate essential components of the human experience like politics, power, and social movements in SES research.

### **Knowledge, management, and socio-ecological systems**

Knowledge creation in order to understand resilience is an especially daunting task in a socio-ecological system (SES), since by its very definition it requires contributions from social and physical scientists. Socio-ecological systems are complex systems, composed of linked sub-systems of human and ecological elements like resource units, institutions, and users (Ostrom, 2009). Researchers investigate both the biophysical and the social components of the system, and use models in order to understand and explain

the relationships between the interconnected parts (Young et al., 2006). Some of the variables included in the model include the climate, governance systems, soil resources, wealth and infrastructure, community income (Chapin et al., 2009).

Similarly, scholars most often define resilience as the ability of individuals, groups, or a system to absorb a disturbance, cope, and maintain the system function (Adger, 2005; Schmidt, 2014). Thus, scholars utilize SES approaches to environmental governance to raise questions about how to develop resilience, including how best to conceptualize and navigate the relationships among stakeholders, policy, science, and communications (Adger, 2005, Adger & Jordan, 2009).

Although SES approaches to environmental governance provide a common framework for understanding and explaining complex systems, the integration of social dimensions into socio-ecological systems remains poorly defined and contested (Brown, 2009, 2014). Common critiques of resilience thinking are that SES scholars limit their study of social systems to questions of scale, governance, and institutions (Brown, 2014; Turner, 2013). Some geographers contend that SES approaches rooted in systems thinking reflect a modeling 'culture' that limits the consideration of the social elements of the system to dynamics that can be represented through abstractions and explained by rational-choice theory, ecological economics, and institutional dynamics (Evans, 2011; Cote and Nightingale, 2012; Turner, 2013).

Another common challenge to SES models by critical social scientists is that they ignore relations of power, diverging interests, and social identities (Brown, 2014; Turner, 2013). Currently, social SES work "focuses on the functionality of institutions and considers normative issues (or the how and why) as outcomes," instead of an integral part

of the system (Cote and Nightingale, 2012: 480). The focus on 'getting the rules right,' can sometimes limit the governance options available to those that can be explained as ecological, technical, or economic options, rather than political or ethical decisions (Adger, 2009; Brown, 2014; Cote and Nightingale, 2012).

The divergence between SES scholars and critics is partly methodological. Whereas SES scholars build models that rely on abstract conceptualizations of societal interactions, geographers and political ecologists try to understand the “complex interactions of history, human livelihood practices, and ecological response in particular places” (Turner, 2013: 621; Welsh, 2014). At the same time, others challenge the SES attachment to enhancing resilience based on ethical and moral positions that rely heavily on technical and market-driven solutions, and its normalization of uncertainty emblematic of the neoliberal logic. The fear is that normalizing uncertainty and complexity while focusing on resilience reorganizes our current notions of responsibility through abstracting causal relations and shifts the responsibility for adaptation down to the individual and communities, while relieving the state of its responsibility for collective security (Evans, 2011; Schmidt, 2014; Welsh, 2014).

This raises the question: are there ways to address the critiques and bring a richer consideration of the range of human experience and potentialities? Schmidt (2014) argues that many of the existing critical discourses of resilience leave little room for considering the transformative potential of resilience thinking, thus suggesting that new ways of conceptualizing socio-ecological systems would be welcomed. Further, Cote and Nightingale (2012) argue that reconciling the differences between systems and constructivist approaches might not only be possible, but also productive. Engaging with

constructivist approaches, or the approaches that conceptualize nature and science as socially constructed, could result in a richer consideration of the range of human experience in socio-ecological systems research, and thus a larger range of potential political solutions and recommendations (Cote and Nightingale, 2012; Evans, 2011). Turner (2013) echoed this optimism and argued that while political ecologists are critical of resilience approaches, they may also be the ones in the best position to collaborate.

Where could such collaborations could begin to create conversation across the different methodologies, values, and languages in the natural and social sciences that currently act as barriers (Lélé and Norgaard, 2005; Robinson et al., 2012)? Studies of integrated assessment processes, where knowledge is created to in order to share with policy and decision-makers, illustrates how to begin collaborations between disparate disciplinary communities (Dilling and Lemos, 2011; Edelenbos et al., 2011). For instance, Lemos and Morehouse (2005) demonstrated how research approaches could be applied to facilitate dialogue between scientists and members of society to create science and policy through an iterative process (Lemos and Morehouse, 2005). The authors argued that the knowledge co-produced between scientists, practitioners, and end-users was important for changing participants' perceptions and behaviors. Scientists learned more about society, and policy makers learned more about the science of climate assessments.

Integrated assessments provide a model for a way to integrate social knowledge into environmental management. However, because integrated assessments by their nature are developed to address a specific concern like climate change or ecosystem-based management, they are limited in scope and function. On the other hand, through inductive

methodologies like scenario analysis, participants can inject consideration of the full range of human experience like the political dimensions and lived experiences.

### **Scenario analysis as a process to construct knowledge and meaning**

Scenario analysis is an approach to co-producing transdisciplinary knowledge in the form of stories, developed through collaboration between natural and social scientists, as well as other stakeholders, such as practitioners and other decision-makers. Scenarios provide a method of visualizing environmental system change over an extended period of time (Bowman et al., 2013; Nakicenovic et al., 2005; Rasmussen, 2005). In order to create scenarios, organizers gather qualitative data regarding social conditions and policy knowledge from stakeholders (McKenzie et al., 2012; Walker et al., 2006). Swart, Raskin, and Robinson (2004) argued that scenarios are important because they can ease communication with non-scientists and enlist different audiences in scenario design and refinement. Walker et al. (2006) found that an important function of scenarios is that they geographically bound and frame problems. Bounding and framing allows researchers to elicit local knowledge from participants on important elements of the ecosystem. From there, social data, local knowledge, and preferences can be integrated with quantitative analyses of ecosystem functions, in order to create stories of potentially diverging futures (Swart, 2004; Walker et al., 2006).

Swart et al. (2004) argued that scenarios should be “coherent and plausible stories, told in words and numbers, about the possible co-evolutionary pathways of combined human and environmental systems” (139). In order for scenarios to be plausible, they should be rooted in current conditions, reflect a current understanding of scientific information and policies, and be internally consistent (Honton and Huss, 1987;



Laurent et al., 2015a; McKenzie et al., 2012). For example, if a dramatic change is introduced in a scenario, the change should be consistently applied throughout the analysis. Because the scenarios take the form of stories and include fictitious elements, they offer the opportunity to interject surprises, events, or unanticipated disruptions, much like an ecosystem might experience some kind of abrupt change (Frittaion et al., 2010; Bowman et al., 2013).

Creative stories about how sudden changes might reverberate through a large system can provide valuable insight in order to support decision making for natural resource management in a region like the Great Lakes (Laurent et al., 2015a). As a creative process, scenario analysis provides stakeholders the opportunity to create the narrative by defining the strategic directions in the analysis. The process can capture diverse perspectives, because knowledge is solicited and created through the process as it is conducted in multiple stages (Alacamo et al., 2003; Maack, 2001). The stories generated in scenario analysis create a shared “memory of the future” among the participants (Rasmussen, 2005).

Many of the stories are framed in terms of SES research or applications, and are often model-driven, but not all. Bowman et al. (2013) argued that the storytelling dimension of scenario analysis is particularly useful for creating meaning amongst diverse participants. The authors found an inductive approach to creating scenarios improved long-term strategic thinking between “silos,” like natural and social sciences, and the storytelling process created and maintained meaning over time. Rasmussen (2005) argued that the scenario stories with the richest details are those constructed by multi-disciplinary groups.

The process of creating the stories and “future memory” produce both new knowledge and a new understanding of challenges through the potential for transformative learning inherent in scenario analysis. Echoing the findings of the scholars who study integrated assessment processes, scholars who study scenarios explain the mechanism that creates shared knowledge and values as experiential or constructivist learning. Constructivist learning forms an integral component to building scenarios and enables participants to construct new meanings (Kolb and Kolb, 2012; Tsai, 2000). Constructivist approaches to learning are distinct from traditional models of education rooted in deficit-models. Instead of focusing on the transfer of information, constructivist approaches are more akin to guided discovery. Educators or facilitators create structured activities where learners will be able to create meaning through the interaction between what they already know and new events and ideas (Tsai, 2000). When applied to scenario planning, Chermack and van der Merwe (2003:448) argued, “[p]articipants in scenario planning are constantly taking in new information and modifying or changing it” in order to create new meanings.

In review, SES approaches to resilience have made progress toward integrating societal concerns into knowledge creation for environmental governance. Political ecologists argue that SES approaches could benefit from a deeper engagement with normative issues and a richer consideration of human affairs. At the same time, it appears that scenario analysis could provide a method for this deeper engagement. The case study below identifies the specific components of an inductive scenario analysis process that fosters transdisciplinary knowledge production and a deeper consideration of elements normally ignored in SES processes.

## **Methodology**

What follows is a case study of the Great Lakes Futures Project (Futures Project), a multi-stage scenario analysis process where knowledge was co-produced between scholars and graduate students, natural and social scientists, and practitioners. In this case study, I will answer the following questions:

1. How did the Great Lakes Futures Project scenario analysis work in practice in order to produce transdisciplinary and holistic knowledge?
2. What kinds of knowledge did the Futures Project produce?
  - a. More specifically, how did the scenarios reflect the goal to produce holistic and transdisciplinary knowledge?

In order to answer the questions above, I used a case study approach to analyze participant observation findings in order to understand the complexities of the Futures Project process (Davies et al., 2002; Laurier, 2006). My participation as a member of a graduate student writing team afforded the opportunity to observe how the Futures Project fostered transdisciplinary knowledge production through the creation of scenario stories.

As a scenario-writer, I attended four Futures Project workshops or meetings, three in person and one by teleconference, between January 2012 and October 2013, as illustrated in Table 1. As mentioned earlier, I prepared one of the four scenarios with another graduate student. Data included personal notes from workshops, as well as the program materials that were distributed to all participants. Observation was supplemented with other materials collected during the project, including the meeting notes compiled by the Futures Project leadership team, attendance records, and the scenarios developed

by the other graduate student writing teams. I also conducted 14 semi-structured interviews of the Futures Project leadership and other scenario-writing students, as well as a group interview with members of the leadership team, between mid-October and mid-November 2013. Semi-structured interviews were valuable to capture in capturing the experiences of the participants through conversation (Longhurst, 2006). Interviews lasted between twenty minutes and one and one-half hours. Interview questions included how participants got involved in the Futures Project, disciplinary affiliation, and challenges in working across disciplinary lines, and lessons learned.

I analyzed the materials and results of the Futures Project in a couple of different ways. Participant affiliations from meeting notes and attendance lists were coded as representing a natural science scholar (biological sciences, geological sciences, engineering), social science scholar (law, policy, planning, geography, human dimensions of natural resource management, communications), or practitioner (Glaser and Holton, 2004). The practitioners were the participants who were not academic researchers or graduate students, and represented environmental organization professionals, elected officials, governmental officials, foundation representatives, trade organizations, and intergovernmental organizations.

The scenarios were analyzed in order to identify common themes in the stories (Glaser and Holton, 2004). Finally, meeting notes and interviews from the entire process were analyzed through a process of triangulation, or corroboration of details across several sources (Cresswell, 2012).

### Background

The scenario analysis process was conducted between March 2012 and October 2013 (Laurent et al., 2015b). The scenario process unfolded as a series of four workshops and an additional policy meeting as outlined in Table 8, where each workshop or meeting served as a site to shape a shared understanding of the issues. The project's bi-national and multi-disciplinary leadership team facilitated data collection for the process in two main ways. First, they chose, organized, administered, and analyzed the activities that elicited knowledge from assembled participants. Secondly, the leadership team recruited, organized, and supervised graduate students for two phases of the project. The leadership team also assigned mentors, thus ensuring that the graduate students would have support and guidance in completing their assignments.

#### **Great Lakes Futures Project Timeline**

<b>Workshop Date</b>	<b>Workshop Location</b>	<b>Activity</b>
<b>March 30, 2012</b>	Western University, London, Ontario	Identify the drivers of socio-ecological system change in the Great Lakes
<b>January 9, 2013</b>	University of Michigan, Ann Arbor, Michigan	1. Presentations of the background knowledge by a cohort of graduate students 2. Identify the critical uncertainties, or the framework to create the stories 3. Define the axes, or the directions of environmental and social change that shape the scenario stories
<b>March 13, 2013</b>	Detroit Airport, Detroit, Michigan and teleconference	Discussion of policies that impact the Great Lakes region and their status
<b>June 10-11, 2013</b>	McMaster University, Hamilton, Ontario	Presentation of the scenarios as drafted by the graduate students and subsequent policy brief
<b>October 3, 2013</b>	University of Buffalo, Buffalo, New York	1. Presentation of shared principles and policy recommendations, or the final results of the scenario analysis 2. Evaluation of the results by the stakeholders

**Table 8:** The general timeline for the Great Lakes Futures Project. The leadership team organized each meeting to stimulate conversation and create knowledge about the region.

The project leadership team consisted of two Canadian co-leaders, two American co-leaders, and one Canadian postdoctoral associate. The team's academic specializations reflect disciplines common in SES research, including physical geography, watershed science, ecotoxicology, governance and policy, law, engineering, and modeling. In addition to scholarly research, two of the co-leaders had extensive government agency leadership experience. To illustrate each leader's influence on the process, each of the leadership team members organized at least one meeting and invited her or his network to participate in the workshops.

Over the course of the Futures Project, twenty-nine graduate students were chosen to produce written products, either background research or scenarios. In the scenario phase, ten students constructed the four scenarios that informed the policy recommendations. We learned about the Futures Project through a variety of means, although student responses suggest that students, departments, or advisors were connected to one of the leadership team members or Great Lakes research, more generally. About half of scenario writers came from natural science disciplines, including fisheries biology, meteorology, environmental science, and freshwater sciences. The other half of the students came from the social sciences, including communications, natural resources, human geography, policy, and economics. One student could easily wear both natural and social science hats, as he was in a freshwater sciences program and also a journalist. The leadership team created bi-national teams with a PhD student, and someone with a social science specialty or communication specialty ensured we had the potential to be creative and flexible and would have to work across disciplines to create stories that represented the concerns of both society and ecosystems.

In the sections that follow, I identify and discuss the specific elements of the process that supported the collaborative creation of knowledge about the Great Lakes. First, I outline the process the leadership team utilized to harness the collective knowledge of the stakeholders, or the natural and social sciences scholars (including graduate students), policy experts, and practitioners. Secondly, I detail the process the scenario writing students used to negotiate the boundaries of science and policy to imagine alternative futures for the region. Finally, I examine the outcomes, analyze the scenarios, and demonstrate that the stories contain elements of both systems and more political interpretations of environmental change.

### **A story about the stories: Findings from the Futures Project**

#### *Inclusion through collaborative learning*

The leadership team used scenario analysis as a structured way to assemble individuals from various backgrounds to participate in a process to co-produce knowledge of current ecosystem conditions and craft potential policy recommendations (Laurent et al., 2015). Instead of relying on invitation alone to create an inclusive environment, the management team utilized strategies where multi-disciplinary groups were invited to work through specific problems. This practice was designed to foster an environment where an individual's disciplinary or professional knowledge was valued and contributed to the creation of an integrated knowledge product. The leadership team's experience in scenario analysis enabled them to plan the macro-level data collection strategy that would best inform the scenarios and research process, as well as manage individual workshop activities to elicit expert and lay<sup>27</sup> knowledge.

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<sup>27</sup> "Lay" is a term used here to indicate an individual who is not a scholar.

A typical workshop included several parts. First, the leadership team would give an introduction to the project and a summary of the previous step in the process. The update would be followed by an introduction to the activity of the day, followed by a presentation of new knowledge. Participants would then be asked to apply the new knowledge through participation in an exercise. For example, in the workshop at the University of Michigan (see Table 8 for dates and activities), after the introduction, the student researchers presented the summary of their research on the drivers of change in the Great Lakes Basin. Subsequently, participants were asked to identify which of the drivers caused the greatest uncertainty, where their responses would reflect the new information integrated with their own knowledge. The model utilized at the University of Michigan workshop mirrors the experiential learning cycle (Kolb and Kolb, 2012), where learners assimilate new information and apply it in order to create new knowledge.

Next, the leadership team members facilitated small group conversations with a mix of participants. For example, in one group the assembled collaborators included political leaders, graduate students, natural scientists, foundation officials, nonprofit officials, and others. Everyone was asked to contribute to the discussion. First, everyone was asked to introduce her- or himself, then the facilitator went around the table and asked everyone to identify and contribute the “most important” and “most uncertain” drivers of change in the Great Lakes Basin. After everyone contributed her or his knowledge, the discussion became less structured. In each group, the graduate student scenario writers recorded all responses. As scenario writers, we simultaneously recorded information as completely as possible and assimilated the information into our own consciousness so we could apply it when it came time to write our scenarios.



In addition to the learning processes inherent in scenario analysis, confidentiality and transparency in knowledge collection developed into an essential theme throughout the process. In fact, the leadership team was conscious of maintaining the integrity of individual responses throughout the process, both through capturing all responses and maintaining confidentiality. Using the example above, because the scenario writing students were new to the process and knew only the advisors, we were able to record responses and maintain the confidentiality (inadvertently) of the respondents. The leadership team used other methods to simultaneously record knowledge and maintain confidentiality in other workshops. In interviews, leadership team members shared that the assurances of confidentiality granted participants a candor that would otherwise not have been possible, especially in circumstances where a contributor's personal perspectives differed from the official positions of her or his agency.

Other common impediments to transdisciplinary knowledge production, like different languages between disciplines or discomfort with the subject matter, were reduced through other inclusionary practices. Both high- and low- tech approaches assisted in traversing barriers. For the low-tech approach in the Hamilton workshop, all participants and graduate students were asked to record responses on post-it notes and anonymously post them as answers to specific questions on a white board. For the high-tech approach, the management team asked participants to evaluate the results of the Futures Project through the use of "clickers," devices integrated with the presentation technology that recorded and tallied all responses. In the exercise, a participant could share her/his opinion, without revealing her/his identity.

An analysis of the stakeholder participation dimension of the Futures Project suggests that the graduate student, International Joint Commissioner, bureau chief of the government science office, evolutionary biology professor, biogeochemical engineer, and policy expert were all able to contribute knowledge to the process and all of the knowledge was treated equally in results calculation through the application of diverse methodologies such as constructivist learning methodologies, technology, and data collection transparency to instill trust and ease with the process. Confidentiality freed individuals from perceived or potential conflicts of interests. Many of these practices are considered best practices for inclusive facilitation. Nevertheless, inclusion was limited to those who participated. More specifically, relying on the networks of the leadership meant that the International Joint Commissioner and Senior Advisor to the Administrator of the Environmental Protection Agency were both present, but this raises questions about who was missing. Later, I will address this question and explain how expanding the base of participation might have changed the outcomes.

*Student teams: where science and policy mix*

The participants had activities and technology to mediate potential conflicts arising from diverging interests or experiences. The student scenario teams, however, had to confront disciplinary barriers more directly, and as a result functioned as the blenders where natural and social knowledge were mixed to create something new. As teams, we were charged with integrating the synthesis research developed between the first and second phases of the process (scientific information), and the policy background developed at a subsequent workshop (see Table 8). As mentioned earlier, students who crafted the scenarios represented a diverse range of disciplinary backgrounds. Further,

student teams were intentionally assigned to teams to take advantage of disciplinary diversity to produce compelling stories (Leadership Team Interview, 11/15/2013).

Although, in some scenario analysis processes, the “stories” might be generated through computer models (Walker et al., 2006), the Futures Project employed creative storytelling. Project leaders charged the scenario writers with the task to creatively illustrate how the Great Lakes region might change between 2013 and 2063, considering both the ecosystem and society. Each team was assigned one of the four contrasting futures, where each individual scenario was the product of the constituent components of its quadrant. The definitions of the axes can be found in Table 9, and the definitions of the quadrants can be found in Table 10.

#### Descriptions of the Futures Project axes

Axis	Definition
<b>X-axis:</b> <b>“Human Capacity for Change Governance”</b>	The measure of how well the human systems can adapt to changing socioeconomic and geopolitical realities. Capacity is enhanced when there is shared decision making, consensus, similar world views and ethics, dialogue, formulation of solutions, and an ability to implement those solutions (3).
<b>Y-axis:</b> <b>“Economy-Environment in Balance”</b>	A measure of how well these two systems are in balance, as determined by society. Both systems are complex in their own right and neither is under complete control by individuals or institutions. We chose this axis because the integration of these two complex systems is the hallmark and challenge of sustainability, and we believe that is more relevant for today’s challenges and opportunities in the Great Lakes-St. Lawrence River Basin (3).

**Table 9:** The description of the endpoints for each axis in the Futures Project reflects the effort to envision societal and environmental change.

### Futures Project story descriptions

Scenario Title	Definition
<b>Thriving and prosperous: How we rallied to confront collective challenges</b>	There is capacity for humans to adapt to change AND the economy and environment are balanced.
<b>Living on the edge: How we converted challenges into profitable opportunities</b>	There is a lack of capacity for humans to adapt AND the economy and environment are balanced.
<b>Out of control: How we failed to adapt and suffered the consequences</b>	There is a lack of capacity for humans to respond to change AND economy and environment are not balanced, or are both in decline.
<b>Trying hard to adapt: How complex challenges overwhelmed best intentions</b>	There is capacity for humans to adapt to change AND economy and environment are not balanced, or are both in decline.

**Table 10:** Definitions of the scenario stories are the products of the endpoints of each axis in each respective quadrant.

Only brief descriptions of the scenario stories are included in this dissertation chapter, as well as some of the unique elements that changed the trajectory of the stories<sup>28</sup>. Two scenarios featured an economy and environment in balance. In "Thriving and prosperous: how we rallied to confront collective challenges," cooperation between residents, academia, government and industry resulted in international agreements on sustainable resource use. The team used near-utopian cooperation, the integration of the precautionary principle into decision-making, and Lake Erie as a model of water management as devices to create the story (Comer et al., 2015). The authors of "Living on the edge: How we converted challenges into profitable opportunities," used very different devices to move their story. In their scenario, cooperative federalism collapsed, and the high costs of natural resources forced efficient use, thus limiting environmental impacts. The team incorporated dramatic examples of how an unchecked market-driven

<sup>28</sup> A full copy of "Trying hard to adapt: to a chaotic world: How complex challenges overwhelmed best intentions" is included as an appendix to this dissertation.

economy could compromise the region's quality of life. In one dramatic example, an entire baseball stadium fell ill because a combined sewer overflow contaminated a drinking water source (Steenberg et al., 2015).

Two scenarios featured an economy and environment out of balance (or both declining). In "Out of control: How we failed to adapt and suffered the consequences," economic inequality and insecurity led to public cynicism, and eventually the collapse of bi-national agreements. Additionally, uncertainty fueled accelerated resource dependence and environmental degradation. The team used international conflict, trade imbalance, and sudden climate change as reasons to accelerate resource extraction binges, resulting in collective social despair (Kalafatis et al., 2015). Finally, in "Trying hard to adapt to a chaotic world: How complex changes overwhelmed best intentions," social transformation forced institutional reform. In spite of the human capacity for change, persistent pressures from climate change and economic crisis meant constantly adapting to change. The team's approach assumed that strong human capacity for change and economic/environmental imbalance could not co-evolve, something would need to force the divergence between a capable society and economy/environment imbalance. Thus, the deterioration of environmental conditions led to a loss of a collective sense of place, and sparked a social transformation throughout the region (Orr et al., 2015).

Although all scenario teams started with the same instructions and parameters, two different approaches to integrating natural and social science knowledge emerged. In one approach, a team member took the lead and integrated the work of others into a cohesive whole. Teams who reported choosing this approach cited time, difficulties in collaboration, and different starting points as reasons to adopt a primary writer model of

cooperation. A lead writer may have diminished the integrative potential of the process, as both teams reported that the lead writer had more of a voice in the process. For one team, that lead voice was not always the same person.

On the other hand, two teams chose a process that was more functionally integrative. The other two teams reported developing a storyline and major components, then weaving the “details,” or the background from the drivers around the story frame. On one team, a graduate student described a process where s/he “pushed” the others to consider ideas or details that might have been considered too “dramatic” or unusual, thus stretching the team members beyond their comfort zone. The other team reported resolving differences through reviewing their story paragraph-by-paragraph to ensure differing perspectives were represented fairly in the story.

In the next section, I will test the hypothesis that inclusionary knowledge co-production through the combination of constructivist learning strategies and creative student storytelling introduced new (social) constructivist perspectives into SES approaches for understanding the possible effects of environmental change.

### **Learning from the stories: reflecting on the outcomes of the Futures Project**

For the simple reason that the axes were framed in terms of socio-ecological systems language and many participants contributing to the process were experts on the impacts of environmental change, a reasonable hypothesis would be that more congruence might be found in the environmental impacts identified in the stories. Indeed an analysis of the scenario stories reveals that nearly every story included a mention of climate change, and three of the stories included explanations of how society would adapt to or cope with the impacts of climate change, like unpredictable lake water levels and

more intense episodic precipitation events. Another common theme was the interaction between climate change and larger harmful algal blooms in Lake Erie, i.e. that increasingly intense storms would fuel the blooms. Finally, all four stories described some type of Asian carp invasion.

The next part of the analysis will identify how the *socio-* of socio-ecological systems is represented. An analysis of the stories demonstrates that elements of traditional abstract conceptualizations of society's response to change, such as reliance on technology to "fix" problems, rational choices will drive change, and governance as a solution were common elements in the narratives. But the stories also unveiled some richer considerations of societal dynamics, such as political and interest group struggle, human livelihood practices, and societal or ecological response in particular places.

In several ways, the stories reflected SES-based conceptualizations of change, like the reliance on new technologies, consumer choices, and institutional harmony (Comer et al., 2015; Kalafatis et al., 2015; Steenberg et al., 2015). For example, Steenberg et al. (2015) explained that new technologies would be a solution to population growth and agriculturally-driven water shortages,

The increased demand for safe and reliable water supplies shifted the Great Lakes region industrial capacity from serving mainly the demand for green energy to also creating and exporting smarter blue infrastructure, such as self-healing pipes, aquaponics systems, novel genomic techniques, and – critical for millions around the planet - low-technology water treatment, micro-irrigation, and shallow groundwater pump and aquifer monitoring systems... (154).

This raises the question, what it would look like if more details about society were included in the scenarios. As an illustration, three of the stories (at least minimally) introduced ways to conceptualize how relations of power, social identities, and other normative aspects might be woven into the stories, as illustrated in Table 11. For

example, the stories illustrated how power might shape resource use and stifle innovation (Out of control); how social movements might rise up and force institutions to change (Trying hard to adapt); and how politics might be utilized to undermine the best policies, as illustrated in Table 11 (Living on the edge) (Kalafatis et al., 2015; Orr et al., 2015; Steenberg et al., 2015). In this sense, then, the scenarios are able to move beyond some of the often cited limitations of models grounded in the SES approach. These examples illustrate that the rules can only be as effective as the social relations that shape or actively undermine them.

### **Power, political pressure, and social movements in the scenario stories**

<b>Scenario</b>	<b>Quote</b>
<b>Out of control (-/-)</b>	This results in the power of that industry stifling the political process and limiting diversified economic development. The decision to commodify the Great Lakes was destined to become more controversial over the years as direct benefactors became entrenched supporters and dissenters lacked formal recourse against this accelerating practice (Kalafatis et al., 2015: 26).
<b>Living on the edge (+/-)</b>	When it became clear that the other states party to the Compact would not allow Waukesha's diversion request because of dissatisfaction with the inadequacy of its proposed water conservation plan, the president intervened by issuing an indefinite stay of the EPA radium deadline. Eschewing regulation, he instead provided a financial compensation package for the city to offset anticipated radium treatment costs (Steenberg et al., 2015: 152).
<b>Trying hard to adapt (+/-)</b>	This had been a long process through which both Aboriginal and local community groups had built momentum during the 2010s and 2020s. First Nations and Native American tribes had been organized and managing natural resources, nearly invisibly, for many years. Iceless hockey rinks, nurtured by the efforts of native peoples and local community leaders, provided forums to connect a strong network of advocates from both sides of the border. (Orr et al., 2015: 144).

**Table 11:** Examples of quotes that demonstrate how the stories considered relations of power, political pressure, and social movements.



The stories did also illustrate how people might visualize environmental change in places. Two of the stories provided such an example, like Orr et al., (2015) who explained that environmental change would look differently throughout the region,

In truth, there was no single catastrophe - just a series of small ones on every lake. Lake Superior lost or experienced reduced ice cover, winter recreation was compromised, and coldwater fish populations declined; Lakes Huron and Michigan experienced increasingly unpredictable water levels, resulting in exposed beaches and increased shoreline erosion, the loss of waterfront properties and declining property values; algal blooms led to a ban on boating and fishing in Lake Erie; and Lake Ontario faced population pressures and increases in consumptive water use (144).

Instead of treating climate change as a monolithic entity that would change the Great Lakes “region,” the authors illustrated that the changes would impact the defining land and water uses around each lake.

Although it is difficult to argue that “human livelihood practices” can be studied in a highly industrialized region, like the Great Lakes, it might be possible to use indicators to understand how individuals might connect with the landscape. The scholars who study cultural ecosystem services argue that cultural services, like aesthetics and sense of place, are significant and should be integrated into research, because they inspire people to protect ecosystems (Daniels et al., 2012; Gobster, 2007). In the stories, aesthetics and connection to place were important because they compelled some type of action towards the ecosystems, including exploitation because of degradation, preservation for commercial reasons, or conservation, as illustrated in Table 12.

### Aesthetics and sense of place in the scenario stories

Scenario	Quote
<b>Out of control (-/-)</b>	Already decreasing lake levels began to decline more rapidly, providing new opportunities for invasive species, increased localized contamination, decreased tourism, and, for many, even less incentive to see them [the lakes] as much more than freshwater banks (Kalafatis et al., 2015: 21).
<b>Living on the edge (+/-)</b>	Wind farms changed the aesthetic of the lakes, particularly in the southern basin of Lake Michigan and the Golden Horseshoe area of Lake Ontario, but also resulted in the enhanced protection of wind power free regions in the northern stretches of Lake Superior, whose northern shore's change in climate opened up the region into a veritable mecca of tourism and commerce (Steenberg et al., 2015: 152).
<b>Trying hard to adapt (+/-)</b>	Throughout the Great Lakes-St. Lawrence River basin, biodiversity declined and the character of the landscape slowly changed...biodiversity was greatly reduced by pressures from climate change and pollution. ... Iceless hockey rinks came to symbolize the loss of lake and landscape, their love of the lakes, and a desire to act to protect their vibrancy (Orr et al., 2015: 144).

**Table 12:** Representative quotes from the scenario stories about how aesthetics and sense of place translate into (in)action toward environmental conservation in the region.

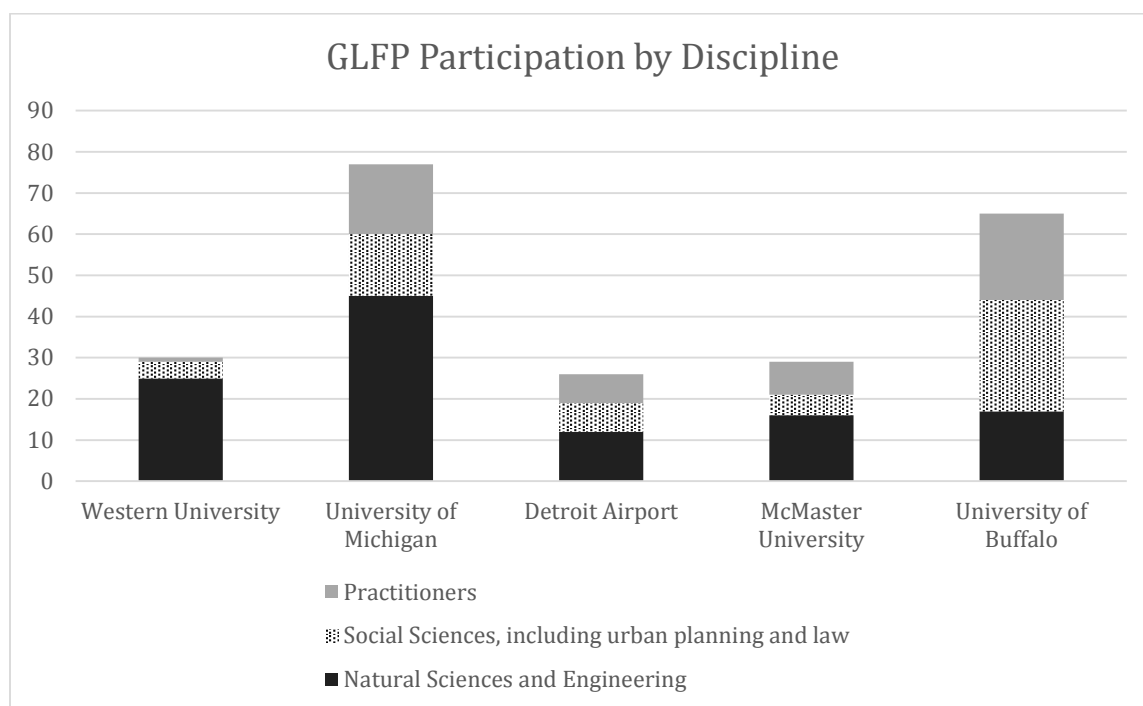
This section demonstrates that inductive scenario analysis, a method in which knowledge is constructed through an iterative process, can create a space to consider political and social concerns, thus potentially expanding the range of solutions available for consideration beyond what a standard SES model might suggest. The next section addresses the question of exactly how inclusive the Futures Project was, and how a more inclusionary process might have influenced the outcomes.

*How inclusive was The Futures Project?*

As suggested in earlier sections, the Great Lakes Futures Project leadership team consciously endeavored to create an inclusive environment to facilitate the co-production of transdisciplinary knowledge for those individuals present at events. What this does not tell us is *who* exactly participated in the process. Although, it appears at first glance that the process was inclusive and extended participation in the Great Lakes, we do not know if that was the case. An analysis of the participant lists of the process suggests that the circle of participation was widened, regional social and natural science networks were connected, and a new group of students were introduced into the Great Lakes community. However, the *distribution* of new participants was not even through the process, which may have influenced the outcomes and recommendations.

This raises the question about how we would know if different participants would change the knowledge produced in the process, and thus the outcomes. A short analysis of the participation patterns sheds some light on the subject. To start, participation in the Futures Project was somewhat fluid. While there was a core of 25 participants that consistently contributed to the process, many only participated in one or two of the five workshops or meetings in the process. Overall, over 135 participated over the duration of the one and one-half year endeavor, while 30-80 individuals participated in each phase. As a reminder, the stakeholders or participants included natural and social science scholars, graduate students, and practitioners. The number of participants and disciplinary distribution changed in each workshop as illustrated in Figure 9. The striking finding of the figure is that it illustrates a pattern where the majority of the participants in most workshops were natural scientists. Furthermore, the figure demonstrates that the

composition of the assembly at the University of Buffalo workshop was dramatically different. As opposed to the other workshops, only a little more than one-quarter of the participants were natural science scholars. Additionally, at least twelve *more* social science, planning, and legal scholars took part in the workshop. Furthermore, the practitioners at the University of Buffalo workshop were different than at other workshops and included trade representatives, non-profit organization professionals, and planners, as opposed to the mostly environmental agency officials and policy experts from earlier meetings.



**Figure 9:** Participation by site location and discipline in the Futures Project. In three of the five workshops, natural scientists constituted the majority of the participants. The experience in Buffalo represented a departure, a little more than one-quarter of the participants were natural science scholars.

Thus, this suggests that examining the stakeholder response to the results of the University of Buffalo provides a method to evaluate the knowledge produced in the

Futures Project. More specifically, shared principles and policy recommendations were based on the transdisciplinary knowledge produced throughout the entire process, so the results should reflect the shared values and collective understanding of the science and policy in the region. Evaluation by a greater number of social scientists and practitioners will reveal how well the principles and recommendations integrate the gradients of difference in society including diverging interests and political concerns. The new and more diverse voices provide a way to “check” the validity and plausibility of the recommendations.

As mentioned earlier, the results of the scenario process were presented at a workshop at the University of Buffalo in October 2013, where participants at the workshop evaluated the shared principles and policy recommendations arising from the Futures Project (Friedman et al., 2015; Laurent et al., 2015). Participants evaluated each individual recommendation and principle using an electronic response device (clicker), where the results were recorded instantaneously. The facilitator then moderated a larger group conversation to identify points of dissent or clarification.

Above all, one decisive finding was that very few overtly negative or dismissive comments arose in the discussion. Most negative comments signaled not rejection of the recommendation, but a fear that the idea would be coopted and diluted by more powerful interests. The critical comments in the conversations about shared principles or recommendations seemed to fall into three main themes – framing/agenda setting, politics (or questions of relationships or equity), and process. For example, one agency representative expressed concern that the process was not very inclusive, noting that First Nations and Native American Tribes were notably absent. In another example, one of the

stakeholders asked, “How do regional identities get created?” Finally, in response to the principle, “Strengthen resource, compliance, and accountability capacity,” one respondent asked, “Accountability to whom?” Instead of questioning the integrity of the principles and recommendations, the participants were asking *how* the ideas might translate into policy or practice.

Because the participants in this meeting represent a departure from those in earlier parts of the process, the results of this section suggest that the process might not have been as inclusionary as hoped, and yet still more inclusionary than earlier research efforts. For instance, scholars have argued that one of the legacies of the Great Lakes Water Quality Agreement is a scientific network of researchers, resource managers, and advocacy organizations (Botts and Muldoon, 2005; Linton and Hall, 2013). The inclusion of more social science scholars could actually be an indication that the circle of participation in the Great Lakes is widening. One of the program leaders noted in an interview that there are "a number of scientific networks in the Great Lakes, but there has been a deficit in research on policy or the social aspects, although a research network on policy is emerging (Management Team Co-leader, 11/14/2013)." The co-leader further explained that the Futures Project helped connect the social and natural science networks.

Still, the results of this section suggest that inclusion of social science scholars and other practitioners earlier in the process might have changed the outcomes. In fact, the participants raised questions about framing, identity, and process, or the very concerns that political ecologists raise about socio-ecological systems approaches to building knowledge and policy recommendations. Thus, it is plausible to argue that the earlier introduction of the scholars and practitioners who have the knowledge of key

concerns – strategy, inclusion, and process – could have changed how the problems were framed, the components of inquiry, and who was included, thus expanding the policy recommendations.

### **Observations and Conclusions**

In the words of one Futures Project co-leader, “I can’t think of another time when so many people working on the Great Lakes really took a step back and took a look at all of the drivers, not just the usual suspects that we always worry about, like chemical contaminants and invasive species, but the broader set that we looked at, like we did. It puts it in a perspective that is unique (Leadership team member, 11/12/2013).” Was that really the case?

Scholars argue that cooperation to create transdisciplinary knowledge in environmental research depends on the will to do so (Adger and Jordan, 2009). The will to cooperate was one of the essential elements in the Great Lakes Futures Project. As one member of the leadership team shared, “The willingness of a bi-national group of scholars and practitioners to work as a team focused on the Great Lakes, and not on their country, was really exciting (Leadership team member, 11/14/2013).” Leadership team members and participants alike were motivated to attend and contribute because they shared a concern for the Great Lakes. The leadership team stated that they cast “a wider than usual” (Leadership team member, 11/15/2013) net in order to engage the Great Lakes community. One of the leadership team members noted, “Participation was welcomed from all sectors” (Leadership team member, 11/15/2013) and further explained that individuals asked to participate after hearing about the Futures Project.

Although willingness to participate and contribute constituted foundational elements in the Futures Project, the strength of exercise emanated from the willingness to develop a comprehensive model to co-produce knowledge among different disciplinary communities. Through the implementation of constructivist and experiential learning principles, participants, students, and co-leaders alike were able to learn from each other and contribute to a larger experiment. The social and natural science graduate student scenario writing teams ensured that different types of knowledge would be represented in the stories because both the knowledge and the scholars who knew how to represent the knowledge in the story were present in the exercise. The students integrated some of the elements of human society often excluded by SES scholars, like politics, process, and place.

In spite of best intentions, a potential limit to the applicability of the Futures Project might be its limited inclusivity. This finding is not surprising, as the project started as an effort to connect faculty and students with policy makers and industry to protect water resources in the Great Lakes region. This analysis demonstrates that while it is important for academia to reach out to the community, it is harder to do than anticipated.

I would suggest, in spite of the limitations, that the Futures Project started to respond to the suggestion that political ecologists engage more directly with social and political concerns of equity and diverging interests, not through rigorous theoretical engagement, but through storytelling and using educational strategies to build a shared understanding of science and policy. I am not suggesting that a rigorous engagement between SES and social theory is unnecessary. On the contrary, I would suggest the



development of both theoretical engagement and the scholars who can translate the theory into practice. Currently, resilience studies are not confined to the academy alone. In fact, theories of resilience are being constructed through both research and practice. In order for political ecologists, or critical social scientists, to engage with SES and resilience scholars, we need to meet them where they are – in the field - where we can construct theory and meaning with them.

Perhaps the most valuable contribution of the Futures Project to the environmental governance of the region was to give passionate scholars and practitioners an opportunity to “do something” about the Great Lakes. While the Futures Project was not a perfect project, it still mobilized, and possibly re-energized, a community developed in an earlier era through the invitation of a new generation of scholars and the opportunity to write new stories about the future.

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**- Chapter Five -**  
***Conclusion***

This dissertation presents a new look at an "old" problem: the environmental governance of a shared resource, the Great Lakes. Although the region has a history of innovations and a willingness to experiment with sustainable environmental management, exemplified by the ecosystem approach, most research and theorization about Areas of Concern (AOC), Remedial Action Plans (RAP), and participation was conducted in the mid-1990s. This research revisits these structures to uncover new lessons.

The study is timely, as the Great Lakes Restoration Initiative has reinvigorated the Great Lakes community. Not to minimize the impact of such a large investment, I would argue nevertheless that the tradition of participation and connection to the Great Lakes were the drivers of success, as much as the funding. One of the early intentions of the RAP process was to build capacity in local stakeholders to confront the complex challenges in Areas of Concern. Program founders intended that residents and agencies would develop an ability to identify and describe problems, develop action plans to address them, and assemble the resources to confront the challenges (Hartig et al., 1995). The scientists and activists who remained dedicated to the environmental problems in the Great Lakes never stopped organizing, and the continuous activity created a unified message which eventually led to the authorization of the GLRI.

The actions of the dedicated advocates and scientists matter because the GLRI has animated the restoration progress throughout the region. As discussed in Chapter Two, those most organized - those Areas with existing relationships and restoration plans - were able to capitalize on the opportunity and are implementing restoration plans and reaching out to the community beyond the AOCs.



In Chapter Two, a comparative case study of the Milwaukee Estuary, St. Louis River, and St. Marys River Areas of Concern demonstrated that the areas display diversity in both size and complexity. In spite of the fact that Areas of Concern have an underlying common organization and administrative structure, each state outlines its own process, resulting in distinct state agency-local organization relationships. These relationships shape the opportunities that local stakeholders have to participate in the RAP process. I found local stakeholders are willing to contribute time and local knowledge to the process, and in many cases extend the capabilities of the state agencies. However, the ability of the stakeholders to contribute to the process is limited to when the state agency grants the opportunity to do so. Finally, I found that attachment to place - and the opportunities to create and share knowledge about their rivers - motivated participants and stakeholders to cooperate and create a common vision.

In Chapter Three, a comparative case study of knowledge production to remove the Degradation of Aesthetics Beneficial Use Impairment in the Milwaukee Estuary and St. Marys River Areas illustrated *how* diverging state rules and institutional constraints can shape the process to construct knowledge, as well as the knowledge produced. This chapter demonstrates, again, that the state agency creates the opportunities for local organizations and individuals to participate in the Remedial Action Plans, or other projects in the Areas. This chapter also discussed the trade-offs inherent in engaging citizens in producing knowledge in environmental management. For example, Michigan limited citizen input to site selection and a request for support to "remove" the Beneficial Use Impairment from the list of impairments. Also, the process was executed more quickly, and the management action completed. On the other hand, Wisconsin took the

opportunity both to collect knowledge from citizens and to connect citizens to the Area of Concern process, but the process is taking much longer.

Chapter Four presents a different set of questions and methods for creating a shared understanding of complex problems. Instead of focusing on the problems in a particular place, like an Area of Concern, the Great Lakes Futures Project tackled the challenge to analyze how current Great Lakes, environmental, and other policies might influence environmental outcomes in the entire region fifty years in the future. Utilizing inductive scenario analysis and storytelling, the Futures Project developed a shared understanding of environmental problems, as well as potential solutions and recommendations. However, one of the limitations of the project was that the introduction of new voices, especially the social scientists, was limited to the end of the project.

#### Major Themes and Contributions

One of the major themes that arose across the chapters in this dissertation was the significance of *the processes* undertaken to include stakeholders in environmental governance. While stakeholder involvement is not universally accepted as a policy or practice, it is commonly utilized. Furthermore, the USEPA considers local support a critical component and may not fund restoration in Areas of Concern without it (Meeting notes, 11/2014). Therefore, I would suggest serious consideration of the shape and implementation of public participation processes would be both prudent and productive.

As a result of this research, I suggest that there are three components to effective participation in Great Lakes Areas of Concern. First, the state agency needs to create the opportunity for the local organization to contribute. Of course, this is a process that

should be negotiated based on agency agenda and local capacity. Secondly, there should be a *meaningful* way for citizens or advisory councils to contribute. The chapter on aesthetics monitoring demonstrated it was possible to develop protocols that satisfy agency requirements, but also expand the opportunities for citizens to participate. Finally, there should also be opportunities for mutual learning. The Futures Project demonstrated that inclusive learning techniques could be applied to research and analysis activities to construct both new knowledge and shared understandings.

One of the key ideas that runs through this entire project is the potentially transformative role of educational opportunities in the Great Lakes region. Because the opportunities present themselves in different forms, it is easy to dismiss the efforts as disconnected and limited in scope. However, I would argue that there is a latent culture of learning that currently animates the Great Lakes processes. Some of the opportunities are networking events, some are conferences where new knowledge is shared, and some are experiments in engaging citizens in the Area of Concern process through new and creative methods. The methods of learning and the multiplication of educational opportunities are important for two reasons. First, the opportunities communicate an intention to create a shared understanding of the problem. Secondly, the opportunities signal the intention to translate the shared understanding into collective action through jointly-undertaken restoration projects. This effect was especially evident in the St. Louis River Area, but a similar coalescence is emerging in the Milwaukee Estuary Area.

Taken together, these findings suggest that it is possible to approach restoration, community building, sustainability, or environmental governance in Areas of Concern

with more explicit intention and thoughtful design, where purpose-practice-and desired outcomes can be more closely aligned.

### Reaching out to practice

One of the most useful contributions of this research might have been the most the most personally difficult to untangle. Although some critical geographers contend that environmental and socio-ecological systems research would benefit engagement with social constructivist approaches, most of the discussions reflected advocacy for the position but failed to suggest concrete steps to forge collaborations or translate critical approaches into practice. This raises questions about *how* critical approaches can improve socio-ecological systems or environmental research if the focus is on the theory or argument, instead of the project, resource, or tasks important to our colleagues.

Not all geographers uncritically accept the perceived disengagement of human geographers from policy and practice (Blomley, 2006, Woods and Graham, 2011). In fact, the current structures of academia make it difficult to transverse the social-natural science and practice-research boundaries. Although I understand the barriers, my fear is that the retreat of geographers does a disservice to both potential collaborators and the discipline. Research, theory, and reflection about race, culture, justice, and social inequalities equip geographers to contribute valuable normative and ethical insights to policy and transdisciplinary research (Burgess, 2005; Woods and Graham, 2011). As the challenges we face as a society grow more complex, we should be willing to participate in the negotiation of knowledge production, where our insights can influence policy (Woods and Gardner, 2011).

I contend that this research project demonstrates that social constructivist approaches can contribute new and usable knowledge in environmental research, including applied research. However, the approaches represent a significant departure from deductive approaches often applied in the sciences, environmental social sciences, and resource management. Thus, the methodologies might be perceived as difficult to understand or rejected. I would suggest constructivist (both educational and social) experimentation with applied and interdisciplinary research demystify the process and make the methodologies more accessible. Further, I would advocate for a less rigid view of applied human geography and consciously train more scholars who are willing to wade through the murkiness of applied research to contribute to environmental (or other complex issues) research.

### Limitations

In addition to the limitations described in earlier chapters, one of the most significant limitations to this study was the amount of time it took to construct a "thick" description of environmental governance. For example, I started conducting fieldwork in the St. Marys River Area in February 2012, and I was still participating in Milwaukee Estuary Area Stakeholder Delegation in 2014. In another example of a long-duration project, the Great Lakes Futures Project was conducted over one and one-half years, and the results of the study were only just published in March 2015. Although I made every attempt to attend as many events as possible between 2012 and 2014, the St. Marys River and the St. Louis River Areas were 7-7.5 hours driving distance from Milwaukee. Luckily, Algoma University made a telephone line available to attend BPAC meetings by teleconference, which made attending some meetings more feasible.

Participant observation as a primary methodology has limitations. Although it was possible to confirm some observations with interview or document data most of the time, this was not always the case. Although I was able to spend a considerable amount of time in each Area and with the Futures Project, I was only able observe where I was present. While I was able to spend time with participants in various processes outside of regular research visits, it was likely not enough. Furthermore, interviews may not have been as revealing as hoped in all cases, as some respondents may not have strayed from agency talking points.

Moreover, although this study makes a strong case for additional in-depth research in Areas of Concern, or other environmental constructs based on sustainable development models, the Areas chosen for this study may not be entirely representative. The St. Louis River Area is large and complex, but displays a remarkable level of cooperation that might be difficult to achieve in other Areas. The Milwaukee Estuary Area is home to an emerging partnership between the regional wastewater treatment entity, academia, and other partners to improve water resources and technology throughout the region. Again, motivations to cooperate in the Milwaukee Estuary Area are more evident and possibly difficult to replicate. Finally, the St. Marys River is an isolated Area with a small population center and somewhat transient population employed at federal facilities. There are few Areas of Concern, especially in the US that would display those characteristics.

### Future work

This study points to a few further areas of research. First, this research suggests further theorization of the Areas of Concern model would be productive. For example,

the discussion in this research could be used to determine how the key components of the Areas of Concern (geographic definition, systematic remediation plan development, list of possible problems, and public participation mechanism) are transferable to other sites.

Furthermore, an expansion of this study to Areas of Concern beyond Lakes Michigan and Superior might add more complexity to the understanding developed here. The most industrial of the Areas are located on Lakes Erie and Ontario, in Michigan, Ohio, and New York. Thus, opening the study would likely reveal a more contentious picture of participation in Areas of Concern.

This study demonstrates experiments with citizen science to create knowledge can satisfy state agency agendas and engage citizens in the Area of Concern process. This research focused on the results citizens produced, but a study of the change in citizen perceptions would shed light on the transformative educational potential of citizen participation in the process. Furthermore, a future area of research would be the application of similar surveys to produce knowledge for the other Beneficial Use Impairments.

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## APPENDIX

Great Lakes Futures Project scenario story

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## Trying hard to adapt to a chaotic world: How complex challenges overwhelmed best intentions<sup>☆</sup>



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### ABSTRACT

In this future, citizens of the Great Lakes-St. Lawrence River basin recognize their dependence upon and became united around a common vision for a thriving Great Lakes basin. However, in 2063 the environment and economy are out of balance; citizens are constantly forced to make difficult trade-offs. Climate warming, geopolitical pressures such as environmental refugees, an aging population, and a sluggish economy have overwhelmed the region's efforts to find a balance that would have ensured human prosperity without diminishing the integrity of the Great Lakes basin. This narrative illustrates the time period 2013 to 2063, depicting how the collision of multiple drivers of change cause declining social and environmental conditions, and force a gradual transformation in societal values. While society was initially complacent, the groundwork for social transformation was laid over three decades. Impacts of education programs, opposition to environmentally degrading natural resource extraction, and widespread effects of both failing social services and physical infrastructure galvanize grassroots mobilization of communities around "iceless hockey rink" meetings. These meetings act as a catalyst, translating this social movement into governance that works towards a common vision based on shared values. However, despite innovative technologies and cohesive efforts, it becomes obvious that attempts to oppose the complex and interrelated forces driving changes in the Great Lakes region are limited. These efforts come at huge economic costs, and the harsh reality forces people in the region to make difficult decisions that threaten some facets of economic, social and environmental well-being while protecting others.

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### Introduction

The Great Lakes-St. Lawrence River basin is of vital importance to millions of Canadians and Americans because it provides for their social and physical well-being. However, planning for the future is challenging because envisioning future conditions is complex and uncertain. Scenario analysis provides a structured approach to explore highly uncertain future conditions through plausible narratives (Schwartz, 1996). Narratives that describe scenarios allow readers to suspend their disbelief in alternative future conditions and enable them to consider how

present decisions may affect the future. Careful consideration of these decisions and their potential long-term impacts enables us to better formulate informed and effective policies. The purpose of this future history is to present one of four plausible scenarios of the Great Lakes region from 2013 to 2063 as part of a collaborative process to inform policy.

This future history, "Trying Hard to Adapt," represents the scenario that occupies the lower-right quadrant of a two-dimensional coordinate plane, with the horizontal x-axis representing the human capacity for change and the vertical y-axis a balanced environment and economy (Laurent et al., 2015). We present a plausible narrative of how the Great Lakes region came to be characterized by a strong imbalance in the desired mix of environmental and economic conditions, while society in 2063 is able to adapt, having developed a strong human capacity for change. Imbalance between the environment and economy, as defined by society, manifested in diverse ways throughout the region: society is degrading ecological services, it is trying to improve environmental conditions by limiting economic growth, or both socioeconomic and

<sup>☆</sup> The Great Lakes Futures Project brought together graduate students and expert mentors from universities and institutions in Canada and the United States. Each paper required collaboration between a number of authors with many of them sharing co-leadership that we denote using a †

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environmental conditions are relatively degraded. This narrative illustrates the social and environmental transformation experienced by residents of the Great Lakes region in five chapters.

### Scenario overview

The global context within which the Great Lakes region is situated evolved rapidly in the 50 years since 2013; human civilization needed to be agile and adaptable to keep up. Globally, climate change and human actions wreaked havoc on the world. In 2063, a struggling global economy is only one of many worries. Global sea levels rose and extreme events devastated several major coastal cities, inundating the Great Lakes region with environmental refugees. Poor living conditions and a lack of basic needs, such as food and clean water, have exacerbated geopolitical tensions and contribute to instability in an interconnected world. Global society has risen to these challenges. A restructured United Nations (UN) created the United Nations Environment Organization (UNEO), endowing it with the necessary capacities and institutional structure to initiate unprecedented global cooperation and action, something its predecessor had been incapable of achieving (Ivanova, 2005). However, these efforts have not been enough to resolve social pressures from increasing population and consumption or to allow peoples of the world to find a balance that will ensure human prosperity without diminishing the integrity and vibrancy of the world around them.

Within the Great Lakes region, citizens have been desperately trying to address economic and environmental problems in a rapidly changing regional and global context. They have been constantly trying to adapt to their changing social and physical context, but have been faced with new challenges much like the mythical Sisyphus, who was cursed to push a boulder up a hill only to repeat his toils when it would roll back to the bottom (Camus, 1955). The Great Lakes region has remained vulnerable to geopolitical, economic, demographic and climate pressures. Citizens have been unable to balance economic activity and environmental integrity within natural constraints, despite strong political will and human capacity to effect change. Citizens have been trying hard to adapt to environmental and economic changes, but the reality is that they have not been able to keep up (Fig. 1).

In this scenario, the year 2063 is characterized by a strong human capacity for change. Governments and stakeholders on both sides of the border support a binational vision of a healthy Great Lakes basin, recognizing it as the region's life support system and source for both social and economic prosperity. The result has been strong implementation of policies that further this vision. All levels of authority in both countries approach governance of the Great Lakes basin from the perspective of maintaining the ecosystem services that the lakes provide for society's physical, cultural and spiritual sustenance, rather than merely as a resource to be used and consumed for shipping, power generation, commercial fishing, agriculture and consumptive uses. Having learned from past difficulties implementing policies, the US and Canadian governments developed a cohesive approach to Great Lakes basin governance based on the need for adaptation strategies. These efforts were responsive to citizen demands, incorporating extensive consultations with local, tribal, and provincial governments.

While governance capacity has grown and matured, the economy and environment have remained out of balance. In 2063, large shocks to the economy and environment threaten to cause the entire socio-ecological system to sink further into a degraded state. Climate warming and human impacts have caused water level and growing season changes, accompanied by an explosion of invasive species (Appendix A). Degradation of the environment has created feedbacks that stress both the economy and the environment. Population pressures and increasing consumption have continued to exacerbate an already unbalanced system while technological and economic fixes have remained futile. Dedicated funding and careful planning have been insufficient for the plethora of new problems that continually emerge. These problems include the costs of adapting to the impacts

of climate change, which have been immense and have drained the economy. Severe floods and droughts, the disappearance of reliable winter snows, the drying up of harbors, and outbreaks of disease have impacted many economic sectors and features of life in the Great Lakes region. Changes have been too great and too rapid for human efforts to keep pace.

### Scenario narrative

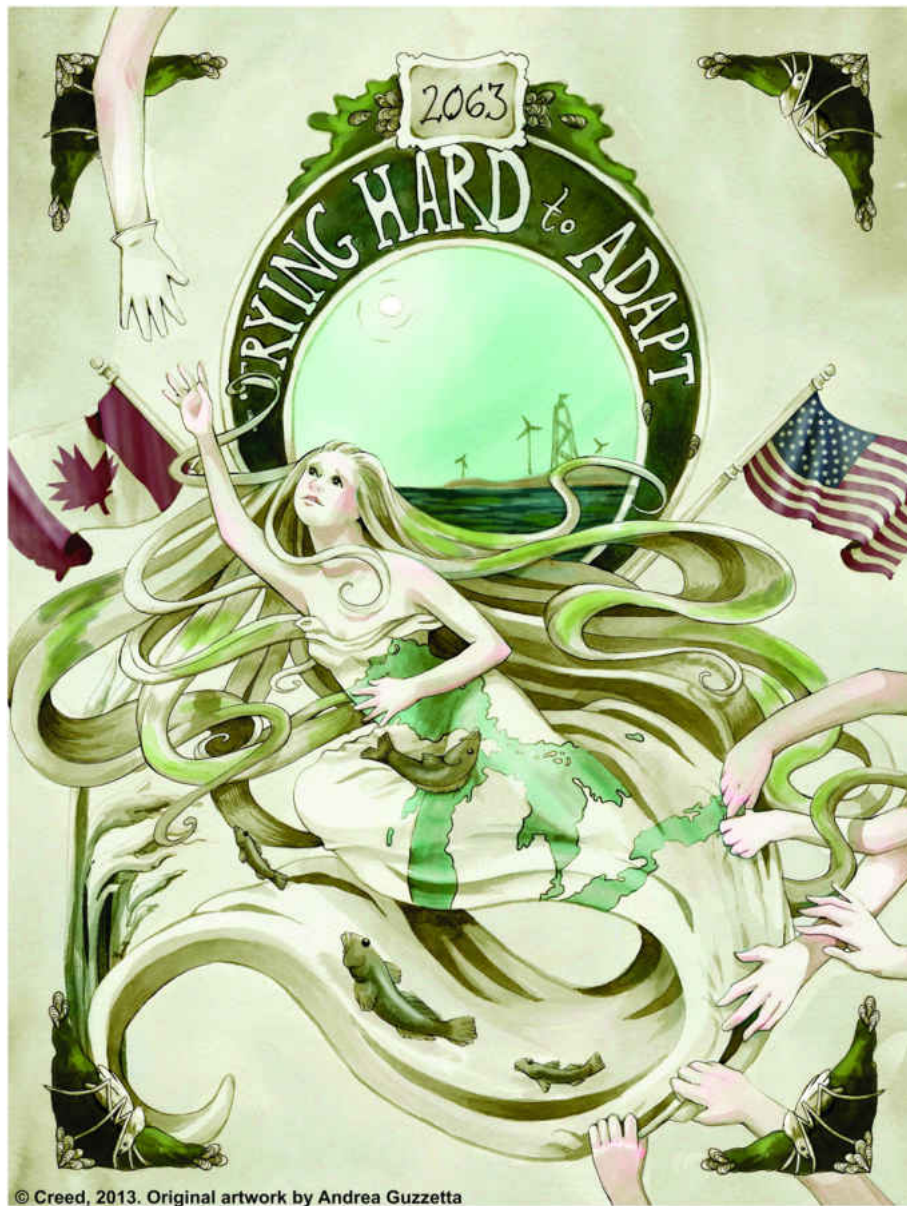
*Cracks in the foundation: how the Great Lakes region's early warning systems failed (2013–2023)*

"If you drop a frog in a pot of boiling water, it will of course frantically try to clamber out. But if you place it gently in a pot of tepid water and turn the heat on low, it will float there quite placidly. As the water gradually heats up, the frog will sink into a tranquil stupor, exactly like one of us in a hot bath, and before long, with a smile on its face, it will unresistingly allow itself to be boiled to death." – Quinn (1996, p. 258)

From the perspective of the year 2063, some might ask how we ended up in the world we live in today. Why did we not clue into what was to come fifty years ago? The answer to the second question provides some insight into the first: in 2013, we recognized that there were many problems, but we did not recognize their full extent, their interconnected nature, or the need to act. Politicians remained reactive, refusing to make policies to anticipate problems and prevent them. We kept hitting the snooze button in spite of the subtle signs of change that were all around us.

Citizens of the Great Lakes region ignored symbolic landmarks along with the rest of the world, including when the global population surpassed seven billion people and atmospheric CO<sub>2</sub> levels surged past 400 parts per million (NASA, 2013; PRB, 2012). Meanwhile, Earth's sixth mass extinction loomed like a foreboding cloud over many of the planet's diverse ecosystems, including the Great Lakes native fisheries, which threatened to disappear forever (Barnosky et al., 2011; Worm et al., 2006). Unsettling alarm bells kept going off, one after the other, but it always seemed as though we could get things back under control. For example, 2013 was a good year for maple syrup and wild rice causing us to quickly forget that both had failed in 2012 (Myers, 2012; WZZM, 2013). West Nile Virus was repeatedly found throughout the southern Great Lakes region, but was largely ignored because it affected birds far more than humans (Githeko et al., 2000; OSUE, 2008). Some places enjoyed extended skiing seasons only to be forced to plant crops a month late as a result of unseasonably late snows (Curtis, 2013). In 2017, lake water levels hit record lows for the second time in a decade (Fig. 2). Local governments began lobbying the International Joint Commission to implement a solution, although they failed to agree on what that solution should be (GLSLC, 2013). Shoreline property owners were inconvenienced but inactive, as *Phragmites* invaded the shores of the Detroit River, Georgian Bay and Green Bay, obstructing views and lowering their property values. Meanwhile, lake water levels retreated and beaches were exposed. Each time we hit the snooze button. Each time we went back to sleep.

Citizens remained unengaged while governance in the Great Lakes region was left fragmented and complacent. Although well-crafted policies held promise to protect the Great Lakes region's water resources, unfortunately, the care and attention that went into crafting policies were not translated into policy implementation. The political sensitivity and potential for failure of key policies such as the Great Lakes-St. Lawrence River Basin Water Resources Compact (the Compact) and the Great Lakes Water Quality Agreement (GLWQA) were overlooked or ignored until crises became apparent (JJC, 2012; USFC, 2008). For example, the first challenge to the Compact was an application for a water



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**Fig. 1.** Citizens have been trying hard to adapt to environmental and economic changes, but the reality is that they have not been able to keep up. Original artwork illustrates the “trying hard to adapt” scenario for the Great Lakes-St. Lawrence River Basin in the year 2063.

diversion from Waukesha, Wisconsin submitted in 2013. Although it met the requirements for a diversion of water out of the Great Lakes basin, the issue became highly politicized and polarized. US governors who wanted to protect the region opposed the application for diversion, while others interpreted its rejection as an assault on economic growth. Polarization over the decision to not approve the diversion fomented political conflict over resource use in the Great Lakes region, resulting in negotiations that lacked political support and legitimacy.

Meanwhile, to implement the 2012 GLWQA, both national governments relied on competitive strategies such as the Great Lakes Guardian Fund and the Great Lakes Restoration Initiative to finance restoration projects in Canada and the US, respectively (Ontario Ministry of the Environment (OMoE), 2010a; USFG, 2010). The number of requests for funds far outstripped the amount of funds available, pitting communities and institutions against each other and contributing to the uneven restoration of the Great Lakes basin (Lemos and Agrawal, 2006; USEPA, 2013). Increased production of commodity crops was fuelled by demand for ethanol from corn as well as heightened global food prices. As a result, agricultural pollution began to stress the water quality of the

lakes. Fragmented US agricultural policies further exacerbated problems of water quality. As early as 2015, provisions for funding conservation practices for farmers, including conservation easements, set-asides, and other measures were dramatically reduced. The result was the increased tillage of land in sensitive areas, leading to increased nutrient loading of lakes and large algal blooms in Lake Erie. Dead zones in Lake Erie increased and reached beyond near-shore areas to cover over 775 km<sup>2</sup> (Hunt, 2013; NOAA, 2013). Ironically, on the Canadian side of Lake Erie, conservation authorities had begun implementing best management practices to control nutrient loading, but suffered closed beaches despite their efforts. This example demonstrates how environmental policies that impacted the same resource had become incongruent. US agricultural policy had reduced funding for land and water conservation, while the Government of Ontario had increased funding. Both policies impacted Lake Erie, but their effects were counterproductive, resulting in deteriorated water quality in the Great Lakes region.

While the US and Canadian governments struggled to manage environmental problems and maintain fish stocks, indigenous peoples set an



alternative example of how to manage our relationship with nature according to traditional methods that balanced human and environmental health rather than solely pursuing economic growth. By the beginning of the 2020s, Native American and First Nations communities had begun more consolidated and focused resistance to mineral extraction and conventional fisheries management practices. This resistance was based on spiritual tradition, scientific evidence, and lessons learned throughout the last decade. For example, in Northern Wisconsin near Lake Superior, a mining dispute prompted the collection and documentation of endangered plants and animals, as well as extensive wetland mapping (SWE, 2013). Much of this data, collected by biologists from Native American tribes, as well as conservation officers and scientists, was widely and publicly disseminated. Another example that spurred this movement was when First Nations on the eastern side of Lake Superior legally challenged the Canadian government on their water management practices and the resulting loss of fisheries (SooToday.com Staff, 2013). These efforts introduced different ways of thinking, demonstrating alternative approaches to resource use (contrary to resource exploitation for economic gain), as well as resource management strategies for long-term rather than short-term benefit (Appendix A).

These initiatives, combined with extensive outreach and education activities, began fostering a shared identity, as well as a social connection to, and engagement with the Great Lakes as a region. NGOs, educational institutions and activists initiated a broad array of educational efforts to engage citizens of all ages. Initiatives ranged from birding and canoe trips to projects that engaged citizen scientists. Education efforts initiated through university partnerships used education to connect students to their waterways and develop capacity in teachers. Place-based education, a pedagogical approach, provided an avenue for citizens to learn about their watersheds through experience, creating understanding of, and emotional attachment to, the Great Lakes basin (Semken and Freeman, 2008). These efforts used streams and lakes as classrooms, engaging students to ask questions, collect data and present results (Fig. 2). Other educators worked in communities to bring people to their rivers through trips, lectures and citizen science training. These experiences laid the early groundwork for more widespread changes to come.

#### *Rude awakening (2023–2033)*

“Our complete negligence has been matched only by our ignorance. We have sat idly by while the walls of our home have crumbled around us. Only when drops from above dampen our mood do we glance skyward and realize that the roof is also gone.” – Winter Boisvert, Green Party of Canada 2032

The 2020s saw the collision of multiple forces and resulted in a rude awakening for citizens of the Great Lakes region. They woke up almost scalded to death, like the metaphorical frog in a pot while the heat is slowly turned up. A morass of climate change, environmental crises, demographic transition, and geopolitical pressures combined in a melting pot of disaster throughout the 2020s. For example, scientists could only watch, slack-jawed in horror during the summer of 2024 as the Arctic sea ice completely melted (Derksen et al., 2012; Fig. 2). Melting permafrost in Canada's north sent environmental refugees trickling south, as traditional native lifestyles became unviable. The Great Lakes region became one of the main destinations for those displaced within North America and from abroad. Many tried to settle in and around Lake Ontario, hoping to find employment. The economy, not yet fully recovered from the recession during the 2010s, provided few refugees with desirable jobs and local residents did not welcome increased competition for employment. At the same time, there were no provisions in the Canadian Immigration and Protection and US immigration laws to provide for environmental refugees that entered from abroad. Refugees

and governments were forced to navigate these challenges to ensure newcomers were able to integrate. While immigration policy in the 20th Century was based on economic opportunity, immigration in the 21st Century came to be based on environmental conditions such as the availability of clean water and a temperate climate (Appendix A).

Meanwhile, aging baby boomers retiring in droves became an increasing drain on the economy. A flood of retirees strained pension and healthcare systems (Echenberg, 2012; SC, 2013). As increasing numbers of individuals grew older, they began filling retirement housing beyond capacity; the Great Lakes region had failed to plan for such a large wave of retirees. At the same time, insufficient pensions and savings forced many of traditional retirement age to continue working. Expectations that high retirement rates would liberate jobs for younger generations had been overestimated as those reaching retirement age were forced to continue working to support themselves. With ominous rumblings, these examples heralded the enormity of the problems that the Great Lakes region was not prepared to face.

Governance in the Great Lakes region was particularly unprepared for the extent, the interconnectedness and the complexity of the problems it faced. Its inability to adequately deal with these problems was rooted in policy failures that haunted it from the past. Decision-makers assumed that existing policies, including the GLWQA, the Clean Water Act, and the Canada–Ontario Agreement Respecting the Great Lakes basin would be enough to protect the lakes (IJC, 2012; Ontario Ministry of the Environment (OMoE), 2006; Ontario Ministry of the Environment (OMoE), 2010b). However, continued divergence of Canadian and US policy directions, as well as divergence between each county's own levels of government, left voids in responsibility. For example, revisions to the Canadian Fisheries Act reflected a national retreat from waterways protection, while the Great Lakes Guardian Fund demonstrated Ontario's commitment to remediation and habitat restoration in the basin (GC, 2013). In the US, the Great Lakes Restoration Initiative demonstrated the federal commitment to habitat restoration, while several states gutted their environmental protection laws. These divergences between policies, combined with a lack of resources, meant that policies such as the Compact acted as legal shields, allowing inaction by appearing to address a need that they were incapable of fulfilling.

Multiple interrelated factors caused the failure of the Compact, which in turn caused cascading impacts. Starting in 2026 and continuing into the 2030s, global food prices were pushed high in response to global shortages and drought in Central and South America. Combined with warmer growing conditions, agricultural production and export became increasingly profitable across the US and in Canada's prairie provinces. However, continued withdrawals from aquifers across North America led to increasing water shortages and conflicts in the Great Plains states and provinces. Economic and political pressures to export water to these areas mounted. Although the Great Lakes Compact had protected the lakes from water exports until then, the economic case to export water to thirsty states that once relied on the Ogallala Aquifer became too strong to not pursue (Fig. 2). The Canadian government, infuriated by the sale of a shared water resource, restricted its sale of some mining products to the US, precipitating a crisis in many industries. Failure of the Compact meant not only falling lake water levels but also strained trading relationships through deliberate violation of international trade agreements.

Erratic and extreme weather events – floods and droughts – placed increasing pressure on agricultural systems and infrastructure. Changes in the US Farm Bill meant that riparian buffers of the past were long gone. Erosion and nutrient loading into Lake Erie from the US overwhelmed the effects of best management practices being implemented in Canada. Decreased lake water levels, accompanied by increases in periodic rainfall and warmer temperatures, meant the continued re-emergence of the anoxic region in Lake Erie every August. Algal blooms of 300–1000 km<sup>2</sup> became common, making it increasingly expensive to treat water in the western Lake Erie basin. Unable to

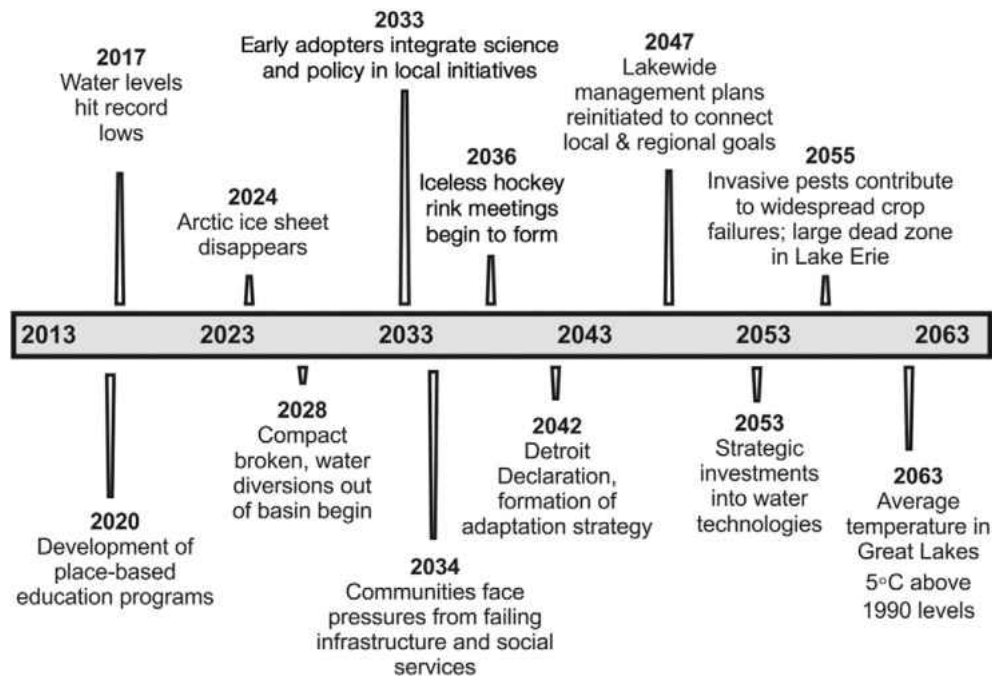


Fig. 2. Time line of the events occurring from 2013 until 2063 within the Great Lakes-St. Lawrence River basin under the “trying hard to adapt” scenario.

handle increased demands on their infrastructure, several cities' water treatment and supply systems failed, requiring boil water advisories.

Inadequate funding, monitoring, and regulation exacerbated problems of integration and accountability. For example, the breeding population of Asian carp that started reproducing in the tributaries of the Sandusky River in the early 2010s went unaddressed in the Great Lakes basin, becoming more established as state and federal agencies wrestled with questions of accountability. The US federal government priority for keeping navigable waterways open clashed with individual state desires to prevent the invasive fish from spreading further in the lakes. Once introduced, lack of clarity on state, provincial and federal government roles and responsibilities delayed decisions and actions to address the problem. Delay of political action allowed time for the fish to establish a breeding population.

As if sensing such widespread governance failure, and responding to the rapid deterioration of the Great Lakes basin before their eyes, there was an emergence of local engagement. Communities experienced a ‘quiet revolution,’ a further shift towards building community capacity, and recognition of the dependence of both ecosystems and society on the Great Lakes region, as well as the rivers that flow into them. These changes were driven by pull factors, such as indigenous-community partnerships that had emerged during the previous decade, as well as push factors, such as the loss of social and municipal services. Citizens began to re-examine their assumptions about the roles of state and citizens, paying closer attention to their own obligations. In many instances, municipal infrastructure had deteriorated, while funding cuts to services affected most citizens. Community volunteer groups performed stewardship, adopting parks and natural areas that had been suffering from decades of systematic under-funding. This movement, having started in isolated pockets earlier in the 2000s, gathered momentum as municipal resources evaporated. Where floods had occurred, neighbors donated time and labor, repairing homes in their communities house by house. Volunteers began contributing to experiential education programs, and networks increasingly connected people with their waterways and neighborhoods, fostering the creation and sharing of local knowledge. Many of the services that citizens had relied on governments to provide became crowdsourced, fostering

strong community identities as a result (Zook et al., 2010). Citizens of the Great Lakes region recognized that their former connections to communities, embedded in public spaces and natural areas such as parks and the lakes, were being lost.

#### *A movement materializes: love for the Lakes (2033–2043)*

“It took us a while to clue in. When we couldn't make an outdoor skating rink anymore, it seemed to hit home. Suddenly, everybody and their neighbor got the picture. That's when the iceless hockey rink meetings started spreading like wildfire, and before you knew it we had a movement on our hands.” — Marguerite Bloom, community organizer, Cleveland 2040

In the 2030s, changes to the Great Lakes themselves – most notably the reduction of ice cover, increasingly erratic changes in lake water levels, and more frequent storms – became more visible to the citizens, municipal governments, and policy makers in the Great Lakes region. However, existing policies were inadequate to deal with the web of interconnected problems.

Disaster relief and responses to climate catastrophes boosted global and local economies. Contractors, consulting engineers, and disaster aid organizations received increased financing as a result of frequent flooding that constantly needed government intervention, but in truth no one was better off (Strömberg, 2007). Infrastructure was repaired, but costs were too high, and insurance companies began to limit their coverage. Losses became great. Homeowners, especially those who had built on floodplains and in locations once thought to be safe distances from the flooding, were left vulnerable and reliant on limited disaster relief provided by governments. Policy-makers continued to pander to specific economic interests rather than meet the needs of citizens, using scarce resources for infrastructure projects that favored industry and business needs.

As the climate warmed, the effects of climate change became visible in many places within the Great Lakes region. For example, Madeline Island, Wisconsin could no longer depend on the ice road which had been

a vital transportation route connecting Madeline Island to Bayfield, Wisconsin on the mainland. At the same time, education initiatives, such as the extensive outreach programs run by the National Parks Service in the Apostle Islands, helped residents along Lake Superior begin to understand the mechanics of climate change and what it would mean to them. Changes that would affect residents directly were made apparent: their dependence on seasonal activities would continue to change, coldwater fish species would likely decline, and the magnitude of changes would have significant economic impact (WICCI, 2011). For example, winter activities that had made up a large portion of some communities' economies threatened to virtually disappear; snowmobiling, skiing, or ice cave exploration were unlikely to be predictable, or profitable in the future (WICCI, 2011).

A few communities were examples that foreshadowed a more widespread transformation in society. These communities began integrating science and policy, and initiating education efforts in attempt to confront the hard trade-offs that they faced. Understanding the mechanics of climate change provided an important basis for making local policies. Communities around Lake Superior turned to arts and cultural resources, bolstering their economies despite the decline in many winter activities that had previously supported them. Communities also advocated increased public funding to upgrade storm water management systems since continued losses, as early as the 2010s, had forced them to consider the necessity of best management practices (Kraker, 2013). In many instances, these early-adopter communities worked with educators or were inspired by the efforts of aboriginal groups.

In other parts of the lakes, communities took longer to start discussing how to adapt to climate change. Around Lakes Michigan and Huron, climate change was most obvious in the form of increasingly unpredictable lake levels, as a result of more extreme precipitation fluctuations (Maghrebi et al., 2015). In some years, boaters could not reach their docks because water levels were too low, while in others they sustained boat and pier damage because of high water. However, the most vocal interests were cottagers along the north shore of Lake Huron who wielded limited political force compared to other economic interests. As a result, policy-makers were slow to act. When initiated, discussions failed to connect lower lake levels to climate change and decisions were not based on a collective understanding of science.

At the eastern end of the Great Lakes region, around Buffalo, Hamilton and Toronto, more waves of environmental refugees inundated the region. By the beginning of the 2030s, global sea level had risen more than 0.2 m and places such as the Maldives and Bangladesh were forced to initiate large-scale relocations. More melting permafrost in Canada's north had similar effects, increasing pressures on urban infrastructure, local economies and social services. Discussions on what to do with environmental refugees became heated.

These problems became so widespread that they affected every community across the region; they could no longer be ignored (Fig. 2). In truth, there was no single catastrophe - just a series of small ones on every lake. Lake Superior lost or experienced reduced ice cover, winter recreation was compromised, and coldwater fish populations declined; Lakes Huron and Michigan experienced increasingly unpredictable water levels, resulting in exposed beaches and increased shoreline erosion, the loss of waterfront properties and declining property values; algal blooms led to a ban on boating and fishing in Lake Erie; and Lake Ontario faced population pressures and increases in consumptive water use.

Throughout the Great Lakes basin, biodiversity declined and the character of the landscape slowly changed. Wetlands that once consisted of diverse plants had become seas of garlic mustard and multiflora rose. Exposed shallow bays became infested by large stands of *Phragmites*. The tall reeds grew thick, blocking both views of and access to the lakes. Coldwater fish species in Lake Superior, such as siscowet lake trout, were slowly becoming less numerous, while the

populations of warmer water species, such as lean lake trout and wall-eye, increased (Cline et al., 2013). Native biodiversity was greatly reduced by pressures from climate change and pollution. While citizens had adapted to changes in their environment, they sensed that the character of the region had changed. Native species had contributed to the vitality and vibrancy of the Great Lakes region, and residents' sense of place within it.

We often do not recognize our attachment to a place until it is threatened or lost (Williams and Stewart, 1998). This happened in the Great Lakes region. The region had changed to the point where citizens felt that they were losing it. The parks, ponds, and community spaces where people met had become nearly unrecognizable. Iceless hockey rinks came to symbolize the loss of lake and landscape, love of the lakes, and a desire to act to protect them.

During the winter of 2036, outdoor rinks did not freeze along the southern shores of Lakes Ontario and Erie (Fig. 2). Meanwhile, hockey rinks in several small communities along the shores of Georgian Bay and Lake Huron were forced to shut down under tightening municipal budgets. As people began realizing how these changes affected their lives, communities began to coalesce around a common identity and vision. The birthplaces of this common identity and vision were the iceless hockey rink meetings that began in outdoor venues and community centers devoid of ice. Iceless hockey rink meetings were the incubators of a pervasive social transformation that reached into every home across the Great Lakes region. These meetings overcame the limitations of small-scale deliberations because they were integrated into governance networks that linked local and regional scales. Local organizers engaged and mobilized their communities around a common connection to and love for the lakes, communicating local concerns, but also securing commitments to solutions that required difficult trade-offs and local compromises to address both local and regional issues. Organizers gathered observations and ideas from citizens through diverse methods such as talking circles and participatory geographic information systems, and connected to each other through regional associations that aggregated the data to inform policymaking at all levels. The urgency of problems throughout the region meant that regional advocacy groups gained widespread local support and membership, and that members recognized the complex nature of local problems, as well as their connections to regional issues. Leveraging the strengths of advocacy networks and local communities, specific concerns were integrated with those of scientists and experts, and drove support from all levels of government.

This had been a long process through which both Aboriginal and local community groups had built momentum during the 2010s and 2020s. First Nations and Native American tribes had been organized and managing natural resources, nearly invisibly, for many years. Iceless hockey rinks, nurtured by the efforts of native peoples and local community leaders, provided forums to connect a strong network of advocates from both sides of the border. This network included citizens and activists, local governments and businesses, scientists and experts, as well as non-profit and indigenous groups. Intense discussions around community, but also regional planning began in earnest as towns and cities realized that many of the economic activities that had supported their livelihoods in the past had changed dramatically. People across the Great Lakes region acknowledged a need to take action.

Environmental refugees were welcomed into the hockey rink meetings, as well as larger dialogues. Many came from coastal regions and recognized the importance of protecting the lakes as a vital source of their livelihoods. These dialogues helped to integrate them into their new communities and fostered shared values concerning the lakes. This united movement began to pressure policy-makers to create state, provincial, and national policies that would complement, rather than oppose local priorities.



*Turning ideas into actions: all the king's horses and all the king's men... (2043–2053)*

“What is good government? It's the same old government in a helluva fright.” — Speth, *Global Environmental Challenges: Transitions to a Sustainable World* (2004, p.171)

The social transformation of the 2030s drove an evolution in governance throughout the 2040s. Iceless hockey rink meetings were pivotal to the translation of societal values into a transformation of governance, and to the mobilization of both technological and human resources towards its end. As the number of iceless hockey rink meetings grew, the communities strengthened binational networks based on sharing information about social, economic, and ecological conditions, thus developing regional strategies.

Strong pressure from citizens, First Nations and tribal governments, as well as scientific and expert communities, inspired the Windsor–Detroit Summit, which was co-sponsored by the Canadian and US governments, as well as states and provinces. The summit scrutinized key policies, including the GLWQA and the Great Lakes–St. Lawrence River Basin Water Compact for ways to improve governance. Outcomes included the understanding of why past policies failed, namely the lack of political will to implement agreements. Although policies contained good ideas, they lacked proper mechanisms for implementation, including resources such as expertise, funding, monitoring, and enforcement. Fragmented policy that had catered to political interests during the drafting and implementation of some of the original Great Lakes agreements was no longer accepted by the engaged public participating in the process.

The Detroit Declaration (Fig. 2) laid the foundation for a comprehensive ongoing adaptation strategy for the Great Lakes region. The joint US–Canada Great Lakes Adaptation Strategies (GLASS), the series of adaptation strategies under the GLWQA, was initiated in 2047. Loadings of nutrients, metals, and toxic substances into the environment, such as mercury, were virtually eliminated under GLASS. Unlike earlier agreements that had included the reduction of contaminants of mutual concern, GLASS also included enforcement mechanisms, which gave it the teeth that earlier policies had lacked.

GLASS built on the strengths of earlier agreements. Its use of an ecosystem approach was more clearly defined to focus on ecosystem integrity, recognizing that ecosystems have benefits for society as a whole, rather than just those typically identified by stakeholders. The agreement embraced the heterogeneity of the Great Lakes, renewing the idea behind the Lakewide Management Plans (LaMPs): citizens and stakeholders around each lake would meet annually to share scientific and community learning, creating networks for data collection by engaging citizen scientists (Fig. 2; Hartig and Zarull, 1992). In contrast to the original LaMPs, GLASS redefined the roles of secretariats, articulated goals and implementation targets, required ongoing monitoring and networking, provided funding, and ensured enforcement. The secretariat provided a support function for local governments, including First Nations and Native American tribes, to ensure that they were connected to the resources and information needed to adapt to changing conditions. Secretariats also shared their experience with other communities to facilitate dissemination of knowledge and adaptation strategies.

Governance in the Great Lakes region gained renewed purpose despite continued assault from external forces. Following its restructuring, the United Nations designated the Great Lakes region a “Priority Region for Maintaining Stability.” Recognizing the Great Lakes region's irreplaceable resources, designation was accompanied by funding for climate adaptation initiatives such as GLASS. However, in return for its assistance, the United Nations required the Great Lakes region accept an increased number of environmental refugees. The region faced

increased numbers of immigration applications and pressure to accept refugees, especially from the far north of Canada and the southwestern US. These pressures threatened to overwhelm immigration and social service programs, limited the availability of jobs, increased demand for natural resources, and further taxed infrastructure that was already strained.

Networks, built through the iceless hockey rink meetings and fostered by GLASS, generated partnerships and sparked innovations in communication. Processes that facilitated collective problem definition, solution development and provided a structured series of steps to their implementation began to gain traction in the region. For example, one process involved citizens learning about community development through ongoing study and reflection, the results of which they shared with local governments. Local governments in turn, integrated citizen initiatives into regular operations (James and Lahti, 2004). Iterative processes based on mutual learning enabled improved citizen–government dialogue and allowed corporate businesses to better contribute to policy development and implementation of adaptation initiatives. In these ways, GLASS provided a forum for shared learning that sparked cross-sector innovation. Through the development of this model of adaptation strategies and the creation of forums for learning, the Great Lakes region directed investment to develop technologies that would help meet collective needs.

Collaborations attempted to address simmering challenges that were symptoms of the imbalance between the economy and environment. Although coal-fired power generation was completely phased out and green energy manufacturing was being rejuvenated, the region remained dependent on oil and natural gas from hydraulic fracturing. Sale of water out of the Great Lakes basin was stopped as a result of GLASS, but the region suffered from the loss of potential revenue. Finally, construction began on a binational high-speed rail from Montreal to Chicago in 2049, intended to significantly increase trade and tourism in the region, and help cope with rising gasoline prices. Through governance driven by a mobilized citizenry, society in the region was attempting to adapt.

*Human hubris: ...couldn't restore the Great Lakes to how they'd once been (2053–2063)*

“We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.” — Aldo Leopold, *A Sand County Almanac* (1948, p. xviii–xix)

Despite our most innovative technology and most cohesive human efforts – all the king's horses and all the king's men – it became obvious that our attempts to oppose the complex and inter-related forces driving change in the Great Lakes region were limited, or outright futile. Citizens of the Great Lakes region were faced with the harsh reality of trade-offs. Social, economic, and environmental conditions within the region had degraded to the point that making improvements to one would often be detrimental to the others. Despite good governance, new problems continued to surface, overwhelming efforts.

Strong human capacity for change gave citizens of the region the tools they needed to adapt to new problems, but not the ability stop them from occurring. Comprehensive community planning incorporated extensive consultations and enabled communities to identify and implement their own solutions to respond to regional and global threats. However, local plans were unable to anticipate or prevent these problems from occurring. These included the collapse of fisheries, lost recreational opportunities, changes in tourist seasons, compromised harbors, spreading diseases, disabling heat waves, and rising energy costs.



One example of the inadequacy of adaptation strategies was the City of Milwaukee. Having lost much of its manufacturing base early on, Milwaukee recognized a need to invest in new industries. The result was a multi-sector cooperation between the city, industry and the university, capitalizing on one of the region's best assets, Lake Michigan (Appendix A). Making strategic investments in water technologies, Milwaukee became a laboratory where green infrastructure solutions were developed, and later disseminated throughout the Great Lakes region. Although Milwaukee was held up as an example of how a vision, combined with partnerships, strategic investment, and research might succeed, the city faced crippling infrastructure problems. Its economy continued to struggle in the face of environmental conditions that progressively deteriorated. Extreme flooding caused extensive damage to sewers, roads and streams. It was impossible to upgrade infrastructure enough to protect water quality or ecosystem integrity.

This pattern of limited success was seen throughout the region. Around Lake Erie, nutrient loading was reduced through novel green infrastructure designs intended to absorb nutrients, but its dead zone persisted because agricultural inputs continued to supplement already high concentrations of nutrients in the lake (Appendix A). Around Lake Ontario, burgeoning invasive fish populations provided low-wage jobs for immigrants from Asia, including the Maldives, Bangladesh, and Vietnam, who had come from fishing cultures and had started their own businesses. Commercial fishing and processing industries resurfaced. However, in other parts of the Great Lakes region, massive fish die-offs prompted the development of an aquaculture industry. Although these changes provided food and limited employment opportunities, in light of declining human prospects and biodiversity losses, the region's vibrancy was diminished.

In other aspects, prospects looked even more dismal. Although agriculture was often thriving in the 2040s as a result of expanded ranges and a longer growing season, by the mid 2050s increased crop yields in some areas were being offset by failures in others. Conditions were aggravated by invasive pest and plant species, which caused widespread crop failures by the end of the decade (Fig. 2). The unpredictability and instability of crops exacerbated nutrient runoff. Eutrophication that had plagued the area since the late 2020s spread like a plague across Lake Erie, with algal blooms that rivalled 2011.

Climate change was undeniably upon us. Extreme events had begun to pummel the region and temperature within the Great Lakes region had increased by nearly 5 °C above 1990 levels (Fig. 2, Appendix A). Almost no winter ice covered the lakes except intermittently on Lake Superior. Still more environmental refugees fled to the Great Lakes region. Across the Great Lakes region, shallow bays and coastal areas dried up, damaging critical marshland habitats (Appendix A). Fish populations plummeted as shallow spawning areas disappeared. Regulations implemented to protect native fish species attempted to prevent overharvesting of the small remaining populations.

Impacts to people were no less severe. Some towns lost access to their harbors and many waterfront property owners complained that water levels dropped so much they were no longer waterfront properties. More frequent heavy storms added to the amount of sediment entering the lakes. Shallow shipping channels and harbors combined with lower water levels resulted in increased dredging costs. Both the shipping industry and coastal communities faced economic hardships because there was less water. One benefit was that lower lake levels exposed beaches, and rising temperatures meant there was a longer summer tourist season. A longer summer tourist season almost compensated for the loss of winter recreation opportunities including skiing, snowshoeing and sledding.

In 2063, environmental, geopolitical, demographic, and economic pressures continue to disrupt and overwhelm the region's best, most ambitious efforts. Numerous problems drain economic resources, while environmental changes continue to impede economic stability, let alone provide for a healthy economy (WB, 2012). While economic

and environmental conditions are not compromised everywhere, the hopeful instances represent a 'silver lining' within a larger picture of a degraded environment and economy, neither of which is able to support the betterment of itself or the other.

## Conclusion

Upon reflection, education measures and adaptation strategies implemented in the 2040s and 2050s were too little too late. The 50 years since 2013 taught citizens of the region that avoiding past mistakes was not enough. Education and policy strategies are not normative; they are effective only insofar as they are guided by moral principles and values. An ethic of compassionate retreat incorporates two considerations: First, we have moral obligations to the home we inhabit, along with respect for what makes that home, not only inhabitable, but a place to cherish. The need for a compassionate approach embodies respect and reciprocity for both human and nonhuman species' needs to survive. Second, within this home, nature has limits, many of which may have already been surpassed (Rockström et al., 2009). An attitude of humility recognizes that we may have already surpassed the limits of nature to provide for human demands and that our only option is to retreat (Brown and Schmidt, 2010). To incorporate an ethic of compassionate retreat, governance solutions should carefully consider the diversity of local, regional, and community problems, embracing the need to weigh both facts and moral considerations (Ostrom et al., 2007; Brown and Schmidt, 2010).

Incorporating values into everyday practices and institutions may have sounded idealistic in 2013. However, values are always embedded in decisions, whether implicitly, or articulated explicitly. Aboriginal culture provides a prime example of how values can be embedded within management practices and daily activities while still adhering to accurate knowledge and understanding of the world. Some First Nation and Native American hunting and fishing practices incorporate moral considerations, including humility towards and respect for nature based on an understanding of how other species provide for their livelihoods (Berkes, 2008). When the values that guide our decisions no longer match our understanding of the world, the ideals of society may be transformed through gradual social movements shaped by many interconnected internal and external forces, as illustrated throughout this scenario.

In this light, it seems obvious that societal values guide governance and implementation. In 2063, people in the Great Lakes region recognize that it is imperative to change, not only their policies and actions, but also the values that define their relationship with nature. Although they possess immense capacity to define how they live on this world, its complexity and uncertainty mean that limits exist to human understanding and control. Acknowledging human limitations requires that they approach this relationship with humility and openness to alternative beliefs, local conditions and local communities, recognizing the needs of both human and nonhuman species alike.

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## Appendix A. Drivers of change

**Table A1**

The state of each driver of change for the Great Lakes region in 2063.

Driver	Description
Aquatic invasive species	Ranges of vector-borne diseases have expanded northwards into the Great Lakes region. Climate stress on native plants has resulted in the invasion of many non-native species. Quagga mussels and Asian carp are prevalent.
Biological and chemical contaminants	Anoxic region caused by nutrient loading persists in Lake Erie. Increased temperatures and extreme weather facilitated accelerated toxin circulation, such as mercury, through the environment.
Climate change	Global surface temperature is + 3 °C above the 1990 levels and in the Great Lakes region the temperature is + 5 °C above 1990 levels, resulting in frequent and intense droughts and floods.
Demographics	Population is 67 million, older and more diverse. Growth is uneven throughout the region. Canadian cities on Lakes Erie and Ontario grew quickly through the immigration of environmental refugees.
Economy	Growth is slow and the economy continues to degrade the environment. Manufacturing, agriculture and services are the most important sectors.
Energy	Demand has increased despite increases in efficiency and diversification of energy sources. Hydraulic fracturing supplies a large proportion of energy; coal was eventually phased out. Renewable energy comprises a greater proportion.
Governance and geopolitics	Binational cooperation and a common vision drive policy. Pressures from environmental refugees and demand to export water are met with binational, cooperative strategies rather than the divergence of policies of the past. All stakeholders are involved in decision-making. Policy integrates public values and is based on science.
Societal values	A vision of a healthy Great Lakes region is based on the recognition of human and ecological interdependence, and an understanding that humans are a part of nature, not separate.
Water quantity	Water levels are low and fluctuate widely. Ships are forced to carry lighter loads. New waterfront property exists in some places, but has been lost in others because of receding waters.
Technology	Technology advancements are insufficient to solve problems caused by an economy at odds with the environment. While not one of the initially identified drivers, it was an important influence.

### A.1. Drivers of change in the year 2063

#### A.1.1. Aquatic invasive species

A decline in native species has been accompanied by northward range expansion of disease vectors and invasive species (WICCI, 2011). Increased temperatures stress many native plant species, but have brought hospitable conditions for invasive species from warmer climates; it is impossible to control most invasive species. The West Nile Virus is ubiquitous, and sporadic outbreaks of malaria occur during hot, wet summers (Pachauri and Reisinger, 2007). Ballast water regulation has been effective at limiting invasions of new species from Europe and Asia, while the biggest threat is live trade. Meanwhile, species such as Quagga mussels and Asian carp have long since invaded the Great Lakes basin (Pagnucco *et al.*, 2015).

#### A.1.2. Biological and chemical contaminants

Dealing with biological and chemical contaminants in the Great Lakes basin has been an uphill battle; natural processes have overwhelmed human efforts. Warmer waters and a longer growing

season have increased the speed through which contaminants move through biotic and abiotic systems (Cornwall *et al.*, 2015).

#### A.1.3. Climate change

In 2063, the worst climate predictions by the Fifth Intergovernmental Panel on Climate Change (IPCC) released in 2013 have become a global reality. To date, average global temperature has risen by 3 °C above 1990 levels and sea level has risen 0.45 m (Bates *et al.*, 2008; Pachauri and Reisinger, 2007). Changes within the Great Lakes region have been less catastrophic than changes on a global scale. However, the average temperature in the Great Lakes region has increased by more than 5 °C (Bartolai *et al.*, 2015); the region has benefited from a longer growing season, but suffered from ice cover loss (GLISA, 2012).

#### A.1.4. Demographics

The population in the Great Lakes region is now 67 million, up from 48.5 million in 2013 (Méthot *et al.*, 2015). In the US, population grew moderately, from 31 to 40 million, while population on the Canadian side grew at a proportionally larger rate, from 18 to 27 million. The population is considerably older and more diverse while the number of people over the age of 65 has doubled since 2013 (Méthot *et al.*, 2015; USCB, 2012).

#### A.1.5. Societal values

In the 2010s and 2020s, values were competitive and individualistic. The values of Native Americans and First Nations became more influential, especially in resource management (Berkes, 2008). By the 2030s, mounting climate, economic, geopolitical and demographic pressures had propelled a dramatic shift in values towards recognizing our shared identity, interdependence and vision of a healthy Great Lakes region. A loss of the sense of place in the Great Lakes region drove this transformation in values (Williams and Stewart, 1998).

#### A.1.6. Economy

Growth is slow or nonexistent, with manufacturing, agriculture and services the most important sectors (Campbell *et al.*, 2015). Manufacturing has reached low but stable levels following the green energy boom during the 2040s. Trade had declined because falling lake levels have reduced shipping capacity, while increased fuel prices have made truck transport less profitable (Millerd, 2007).

#### A.1.7. Energy

In 2063, the energy sector is searching for new forms of energy. Demand increased despite improved efficiency and diversification of energy sources (Kelly *et al.*, 2015). Hydraulic fracturing continues to supply much of our energy needs. A green energy boom combined with research in renewable energy technologies during the late 2040s helped the region transition away from fossil fuels and completely phase out coal. More efficient energy storage and transmission hold promise, but overreliance on fossil fuels early in the century both depleted water supplies and suppressed valuable research opportunities.

#### A.1.8. Governance and geopolitics

Citizens, businesses and governments have found new ways to live, work and make decisions together based on a common vision and an understanding of shared resources and natural limits (Adger and Jordan, 2009). Historically opposed interests have become engaged in data collection and policy development, fostering trust and lending legitimacy to scientific findings (Lemos and Morehouse, 2005). Citizen science is important for connecting experts and communities (Bonney *et al.*, 2009). Public involvement in understanding problems and monitoring interventions has resulted in improved scientific models, and continued support for research.

The Great Lakes region faces external geopolitical pressures, but is stable within. Historical divergence of policies between the US and

Canada has been replaced by binational cooperation (Sandlos, 2013). Immigration of environmental refugees inundates the Great Lakes region. Meanwhile, the region faces pressure from the Great Plains states to export water. The United Nations is active in climate adaptation measures following its restructuring (Ivanova, 2005). The Great Lakes Compact remains together but under intense debate – it was broken in the 2020s and reinstated in the 2040s (Jetoo et al., 2015).

#### A.1.9. Water quantity

Lake levels have repeatedly fallen to record lows in recent decades, while water levels are not always low, they do reach lower lows. In some parts of the Great Lakes-St. Lawrence River basin, shallow bays and coastal areas have dried up, damaging critical marshland habitats (Fracz and Chow-Fraser, 2013). Fish populations have plummeted as their shallow spawning areas have disappeared. Both the shipping industry and coastal communities face economic hardships (Miller, 2007).

#### A.1.10. Technology

Society has made incredible advancements but technological fixes remain insufficient to solve problems caused by an economy at odds with the environment. Water conservation and waste removal technologies developed in Milwaukee have been adopted throughout the Great Lakes region and have helped minimize human impact on water and fisheries (Schmid, 2009, 2013). Some former manufacturing facilities have been transformed to green energy facilities. New technologies for creating biomass energy from some invasive species were developed (Zimmerman, 2013).

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Curriculum Vitae**Kathleen Colin Williams**

University of Wisconsin – Milwaukee,  
 Dept. of Geography, PO Box 413, Milwaukee, WI 53201  
 kcw2@uwm.edu

Education

*University of Wisconsin – Milwaukee – Milwaukee, WI*

Doctoral Program, Geography, May 2015

Advisor: Ryan Holifield, PhD

Dissertation title: *Relationships, knowledge, and resilience: A comparative case study of stakeholder participation in Great Lakes Areas of Concern*

Masters of Arts, Geography, August 2009

Advisor: Christopher A. De Sousa, PhD

Thesis title: *Volunteers in Milwaukee County Parks: A case study, a critical examination of the role of volunteers in managing parks*

*Carroll College - Waukesha, Wisconsin, 1994 (100 N. East Avenue, Waukesha, WI)*

Bachelor of Arts, 1994 in Physical Geography & Environmental Science

Teaching and Research Experience

Instructor, Fall 2014 - present

Conservation and Environmental Science 461 (Undergraduate/Graduate)

- Developed course reading list
- Developed course activities and assignments based on experiential learning principles

Research Assistant, Summer 2013 – February 2014

University of Wisconsin Sea Grant Institute

National Weather Service Impact-Based Warnings Evaluation

- Evaluated severe weather communication for client
- Employed surveys and focus groups to analyze user group differences

Student Scenario Writer, March 2013-March 2014

Great Lakes Futures Project, Western University, London, Ontario

- Integrated social and natural science research into compelling story of environmental change
- Developed assigned scenario based on input from stakeholders
- Corresponding author

Research Assistant, Fall 2011 – Spring 2013

Institute for 21<sup>st</sup> Century Studies Project: “Escaping Flatland: (Re) Writing the Histories, Geographies and Borderland Ecologies of Water,” a trans-disciplinary study

Teaching Assistant, Fall 2009 – Spring 2011 / Lead TA Fall, 2010 – Spring, 2011

Conservation and Environmental Science 210: Introduction to Conservation and Environmental Science

- Developed syllabus, learning objectives, lesson plans for course discussion

- Managed service learning component of course
- Collected data on student learning outcomes for analysis and publication

Teaching Assistant, Fall 2007 – Spring 2009:  
Geography 125: Environmental Geography

### **Peer-Reviewed Publications**

Williams, K.C., (2015). Building Bridges in the Great Lakes: How Objects Facilitate Collaboration Across Boundaries. *Journal of Great Lakes Research*. 41(S1):

Orr, C.J., **Williams, K.C.**,\* Laurent, K.L., Friedman, K.B., Krantzberg, G., Scavia, D., Creed, I.F. (2015). Trying Hard: How Complex Challenges Overwhelmed Best Intentions. *Journal of Great Lakes Research*

Holifield, R. and **Williams, K.C.** (2014) “Urban parks, environmental justice, and voluntarism: The distribution of Friends of the Parks groups in Milwaukee County” *Environmental Justice*. 7(3): 70-76.

Yong, P.L., Boyle, J., Ballow, M., Boyle, M., Berger, M., Blesing, J., Bonilla, F.A., Chinen, J., Cunningham-Rundles, C., Fuleihan, R., Nelson, L., Wasserman, R.L., **Williams, K.C.**, Orange, J.S., (2010). Use of intravenous immunoglobulin and adjunctive therapies in the treatment of primary immunodeficiencies: A working group report of and study by the Primary Immunodeficiency Committee of the American Academy of Allergy Asthma and Immunology. *Clinical Immunology*. 135 (2): 255-263.

### **Reports and Other Publications**

Harrison, J., McCoy, C., Bunting-Howarth, K., Sorensen, H., Williams, K., Ellis, C. Social Science and Severe Weather: Evaluating a New Tornado Risk Communication Tool. (June 2014). Wisconsin Sea Grant Publication WISCU-G-14-008

Harrison, J., McCoy, C., Bunting-Howarth, K., Sorensen, H., Williams, K., Ellis, C., Evaluation of the Impact-Based Warning Tool for the National Weather Service. (April 2014). Wisconsin Sea Grant Publication WISCU-T-14-001.

Williams, K.C. (2011). Book Review of *Governing sustainability* edited by W.Neil Adger and Andrew Jordan. *Environment & Planning C: Government & Policy*, 29(1): 188-189.

### **Presentations and Conference Participation**

#### **Invited Presentations and conference participation**

Documenting Beauty: What we can learn from documenting aesthetics about what the public knows about rivers in the Great Lakes. Presentation to Milwaukee Estuary AOC Joint Technical Team- Stakeholder Delegation meeting. October 8, 2014.

Williams, K.C., Lots of volunteers in Milwaukee County's Parks: a discussion. Park People Annual Friends Group Meeting. Milwaukee, WI. May 30, 2013.

Williams, K.C., Place-based education as a means to connect science to community. St. Marys Environmental Summit. Lake Superior State University. Sault Ste. Marie, MI. March 16, 2013.

Williams, K.C., When Students Begin to Think Critically: Integrating the Essential Learning Outcome (ELO) into Disciplinary Course Design. Panel member, UWM Center for Instructional and Professional Development workshop, February 25, 2011.

Teaching One Session at a Time. Panel presentation for TEACHING @ UWM: University-Wide Orientation and Teaching Conference for New Teaching Assistants and Teaching Academic Staff, Lubar School of Business, University of Wisconsin-Milwaukee, August 24, 2010.

Organized sessions

Williams, K.C., Antunes, P.A., Barrett, C.A., New Frontiers of Great Lakes Policy: Where Science and Stakeholders Meet. International Association of Great Lakes Research. West Lafayette, IN. June 5, 2013.

Covington, R. and Williams, K., Borders, nature and environmental governance I & II. Session organizer, Association of American Geographers Annual Meeting. Los Angeles, CA, April, 2013.

Conference Presentations

Williams, K.C., Making connections: How volunteer monitoring creates relationships to rivers and agencies in the Milwaukee Estuary Area of Concern. Poster presentation in UW- Milwaukee Urban Studies Conference. Milwaukee, WI. April 26, 2014.

Williams, K.C., (Is beauty) In the eye of the beholder? Three approaches to public participation in the removal of the Degradation of Aesthetics Beneficial Use Impairment. St. Louis Estuary Summit. Superior, WI. February 26, 2014.

Williams, A.B. and Williams, K.C. Placing Literature. Presentation in Reintegrate: Reintegrate: Enhancing Collaborations in the Arts and Sciences. International Festival of Arts and Ideas. New Haven, CT. June, 19 2013.

Orr, C.J., and Williams, K.C., Swimming Upstream: A future scenario for the Great Lakes region 2010-2016. Presentation to Great Lakes Futures Project. Hamilton, Ontario. June 11, 2013.

Williams, K.C., Nurturing a Sense-of-Place: New Pathways for Participation in Great Lakes Areas of Concern. International Association of Great Lakes Research. West Lafayette, IN. June 5, 2013.

Williams, K.C. and Ehlinger, T., High-impact practices in developing critical thinking skills in environmental science. OPID Spring Conference. Madison, WI. April 19, 2013.

Holifield, R., Williams, K., Covington, R., Bridges and barriers: Exploring stakeholder participation in the borderlands. Presenting author. Association of American Geographers Annual Meeting, Los Angeles CA, April, 2013

Williams, K.C., What does environmental governance look like in Great Lakes Areas of Concern. St. Louis Estuary Summit. Superior, WI. February 26, 2013.

Williams, K.C., Resilience in Areas of Concern: A comparative study of the engagement of stakeholders in environmental governance of Great Lakes coastal zones. Presentation at St.Louis River. St. Louis Estuary Summit, University of Wisconsin-Superior, March 8, 2012.

Active Learning Strategies for Geographic Education 1. Panel session for the Association of American Geographers, April 14, 2011.

Governance of the coasts: does meaningful stakeholder engagement in environmental

decision making mean more resilience to hazards?. Presentation for University of Wisconsin-Milwaukee, Geography Department Colloquium, March 18, 2011.  
 Environmental Equity and Park Maintenance: The Changing Role of Volunteers. Presentation at 17<sup>th</sup> Annual Mini-Conference for Critical Geography, University of Wisconsin-Milwaukee, November 6, 2010.  
 Volunteers in Milwaukee County Parks: A critical examination of the role of volunteers in managing parks. Presentation for the Association of American Geographers, Environment. Local Management and International Perspectives Session, March 23, 2009.

### **Other teaching or outreach experience**

Introduction to Great Lakes Area of Concern. Presentation to Ecocentrism course at UW-Parkside, April 3, 2014  
 Social Science & Severe Weather: Tornado Risk Communication. Presentation to Greater Milwaukee Chapter of the American Meteorological Society. March 26, 2014.  
 Introduction to Qualitative Research. Training for Sea Grant Great Lakes Social Science Network. July 23, 2013.  
 Can it Happen Here? Lecture for Geography 110, May 2, 2013  
 Public Policy and the Environment. Lecture for Introduction to Conservation and Environmental Science (CES 210), May 10, 2011  
 Sustainability and How Change Happens. Lecture for CES210, December 7, 2010.  
 Climate Change and Lake Superior. Lecture for CES210, December 2, 2010  
 The Case of the Aral Sea: Can it Happen Here? Lecture for CES 210, December 1, 2009.  
 Landscape Ecology. Lecture for Biogeography (Geography 340), November 19, 2009.

### **Awards, Grants and Honors**

#### **Fellowships**

University of Wisconsin-Milwaukee, Advanced Opportunity Fellowship, 2011-14  
 Title VIII Fellowship to study Romanian at Indiana University Summer Workshop in Slavic, Eastern European and Central Asian Languages, Summer, 2011

#### **Grants and Awards**

Summer 2013, UW-Graduate School Travel Award  
 Spring 2013, 2012 & 2009, Mary Jo Read Travel Award, UWM Department of Geography  
 December 2012, Great Lakes Futures Project, Scenario Writer  
 November 2012, New Haven Council of the Arts, *Reintegrate* Place as Character: Placing Place in Literature and Landscape
 

- Art-science collaboration to connect place and experiential learning theory with literature that resulted in creation of literary mapping app (<http://www.placingliterature.com>)

 AY 2012-13, Mary Jo Read Continuing Fellowship  
 Spring, 2012, International Association of Great Lakes Research, Paul W. Rodgers Scholarship  
 Spring, 2011, Edwards Travel Award, UWM Department of Geography  
 Fall, 2010, Center for Instructional and Professional Development Grant



- For revision of discussion syllabus and service learning assignment in Conservation and Environmental Science 210: Introduction to Conservation and Environmental Science

Spring, 2009, Honorable Mention, Geography Department Service Award

### **Service**

2013-present, Board Member, The Park People, Friends Group Committee Co-Chair

2012-present, Member, Milwaukee Estuary AOC Stakeholder Delegation Member

2007-present, Board Member, South Shore Park Watch (Secretary/Treasurer – 2010-11)

2008 – 2013 Member of UWM Geography Department Colloquium Committee

AY 2011-12, Graduate Representative to Geography Faculty

### **Professional Society Membership**

Association of American Geographers

International Association of Great Lakes Research

### **Relevant Professional Experience**

March 1998 – 2011: Metropolitan Milwaukee Fair Housing Council (Milwaukee, WI)

Program Services, Program Services Coordinator & Investigations Coordinator/Investigator

- Coordinated and analyzed investigations of housing discrimination in Madison, Wisconsin rental and sales markets and predatory lending in Milwaukee, WI

Summer 2009: Student Conservation Association, Crew Leader (Milwaukee, WI)

- Supervised a crew of city high-school students in an summer program focused on environmental stewardship, job training and financial literacy.

Summers 2005 – 2009: South Shore Farmers Market, Market Manager (Milwaukee, WI)

- Supervise volunteers, vendors and programs in the execution of weekly farmer's market; troubleshoot onsite issues and maintain weekly reports.

December 2005 – August 2007: Executive Director, Inc./American Academy of Allergy, Asthma and Immunology (Milwaukee, WI) Program Manager, Education

- Coordinate the development of educational sessions for large scientific meeting of a medical specialty society including soliciting topics from volunteers, managing the competitive review process according to session needs and managing speaker audio-visual needs.
- Coordinate efforts of scientific committee

February 1997–September 1997: Illinois State Senate, Sen. Debbie Halvorson, (Chicago Heights, IL) Director of Constituent Service

- Created office operation procedure for newly elected legislator.

5/1994 – 2/1997: City of Country Club Hills, (Country Club Hills, IL)

Communications Director/Student Intern: May, 1994 - February, 1997

- Edited and supervised the production of the community's quarterly newsletter, organized special events, staffed City committees and regional fair housing efforts.