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How the community value of ecosystem goods and services empowers communities to impact the outcome of remediation, restoration, and revitalization projects

RESES FINAL REPORT

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Mid-Continent Ecology Division

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How the community value of ecosystem goods and services empowers communities to impact the outcomes of remediation, restoration, and revitalization projects

RESES Final Report

by

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Notice/Disclaimer Statement

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Abstract

Remediation to Restoration to Revitalization (R2R2R) is a place-based practice that requires ongoing communication amongst federal and state agencies, local governments, and citizens. Each of these entities has a different relationship with and responsibility for sites where R2R2R progresses. Sediment remediation and habitat restoration project goals, community planning, and lived experiences diverge depending on the agency or individual, and can make collaboration or communication difficult. To better understand the dynamics of R2R2R in a Great Lakes Area of Concern (AOC), data were collected between June 2015 and December 2016 to examine the collaborations happening in the St. Louis River AOC in Duluth, Minnesota. Participant observation was conducted at AOC management meetings, St. Louis River Habitat Committee, City of Duluth St. Louis River Technical Advisory Committee, and City of Duluth St. Louis River Corridor (hereafter SLR Corridor) park planning public meetings, as well as community group meetings. In addition to regular attendance at meetings and document analysis, ongoing consultation with the Minnesota Department of Natural Resources, City of Duluth, and USEPA Region 5 and Great Lakes National Program Office officials provided opportunities for consideration of partner research interests, as well as dissemination of findings. Data were analyzed to identify forces that shaped decisions, participation, and the inclusion of stakeholder and the public values. The results are the creation of two frameworks that can be used to facilitate interpretation and transparency. One framework can be applied to decision contexts to discuss the who-what-how-outcomes of the decisions. The second framework can be used to interpret distinct values and facilitate communication or comparison across boundaries of experience or responsibility. The frameworks are designed to improve transparency and facilitate conversations about decisions and ecosystem services.

This report was submitted in fulfillment of the Regional Sustainability and Environmental Science (RESES) research program by the National Health and Environmental Effects Research Laboratory Mid-Continent Ecology Division under the sponsorship of the United States Environmental Protection Agency Office of Research and Development. This report covers a period from August 2015 to August 2017.

Foreword

The U.S. Environmental Protection Agency (USEPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, USEPA strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, USEPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Health and Environmental Effects Research Laboratory (NHEERL) conducts systems-based, effects research needed to achieve sustainable health and wellbeing. Research encompasses both human and ecosystem health, in that they are inextricably linked. NHEERL Strategic Goals include leading innovative research and predictive modeling efforts that link environmental condition to the health and wellbeing of people and society; advancing research and tools for achieving sustainable and resilient watersheds and water resources; and translate and communicate integrated environmental and health effects science to impact decisions positively at all levels.

The **Mid-Continent Ecology Division** (MED) conducts innovative research and predictive modeling to document and forecast the effects of pollutants on the integrity of watersheds and freshwater ecosystems, to characterize adverse outcome pathways of toxic exposure at multiple scales and levels of biological organization, and to link environmental condition to human health and wellbeing. One of the MED research areas is the quantification the outputs of freshwater ecosystems and how they contribute to human well-being and social welfare, including developing ecological, biophysical and socioeconomic indicators of ecosystem services. MED researchers contribute to EPA’s EnviroAtlas, create models for translating ecosystem structure and function into services and thence to human benefits, and develop methods to quantify tradeoffs among services resulting from environmental remediation and restoration in Great Lakes AOCs.

This report is a summary of a systematic and comprehensive investigation of Remediation to Restoration to Revitalization (R2R2R) in the Great Lakes region. This report furthers MED’s research in understanding the connections between ecosystem services, human benefits, and decision support.

Dale Hoff, Director
ORD/NHEERL/MED

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Acronyms and Abbreviations

AOC	Area of Concern
AWP	Brownfields Area Wide Plan
BUI	Beneficial Use Impairment
DSRP	Distinctions-Systems-Relationships-Perspectives
DWP	Duluth-Winnipeg-Pacific
EGS	Ecosystem goods and services
FEGS-CS	Final Ecosystem Goods and Services – Classification System
GLNPO	Great Lakes National Program Office
GLLA	Great Lakes Legacy Act
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
HIA	Health Impact Assessment
HIAP	Health in All Policies Coalition
HWBI	Human Well-Being Index
LISC	Local Initiatives Support Corporation
LSNERR	Lake Superior National Estuarine Research Reserve
MED	Mid-Continent Ecology Division
MLT	Minnesota Land Trust
MNDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MVD	Making a Visible Difference
NGO	Non-governmental organization
NHEERL	National Health and Environmental Effects Research Laboratory
NOAA	National Oceanic and Atmospheric Administration
NRRI	University Minnesota-Duluth Natural Resources Research Institute
ORD	Office of Research and Development
PAC	Public or Citizen Advisory Committee
R2R	Remediation to Restoration
R2R2R	Remediation to Restoration to Revitalization
RAP	Remedial Action Plan
RESES	Regional Sustainability and Environmental Science Research Program
SLRA	St. Louis River Alliance
SHC	Sustainable and Healthy Communities (Program)
WNDR	Wisconsin Department of Natural Resources
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fist and Wildlife Service
USGS	United States Geological Survey

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Cover photo credits:

Habitat restoration construction at Radio Tower Bay (USEPA)
Radio Tower Bay (USEPA)

Executive Summary

This report provides an examination of how ecosystem services are valued by agencies, organizations, and individuals in context of program implementation, environmental restoration activity, and lived experiences. This examination was conducted as part of the Regional and Environmental Science and Sustainability research (RESES) Research Program in the St. Louis River Area of Concern (AOC) and Duluth, Minnesota. This site was chosen because the United States Environmental Protection Agency's (USEPA) Great Lakes National Program Office (GLNPO) and Office of Research and Development (ORD) have been working to understand Remediation to Restoration to Revitalization or "R2R2R." The number of ongoing R2R2R-related activities provide an instructive representative case study.

R2R2R2 is a term that is used to characterize the process of remediating contaminated sediments and restoring aquatic habitat to help revitalize coastal communities in AOCs. AOCs are coastal communities identified in the Great Lakes Water Quality Agreement (GLWQA) where environmental conditions impair (or have historically impaired) beneficial uses and diminish ecosystem goods and services (EGS) supply, meaning that historic uses limited the use and benefits of the water bodies and riparian area. ORD is working to understand the R2R2R process because identifying and characterizing the steps between each "R" will enhance the potential to appreciate how USEPA programs (e.g., AOCs and brownfields), community development, and community values result in different R2R2R outcomes.

There were three goals for this research:

- Determine how communities (both local governments and citizens) perceive and value EGS, as expressed through routine activities.
- Determine how EGS or human well-being is incorporated or utilized in the various associated planning and community outreach processes, including EPA and state agency programs, local planning, and agency decision tools.
- Apply this research to create guidance strategies for AOC communities to demonstrate how EGS can be used to advance community revitalization following sediment remediation and aquatic habitat restoration projects. The ultimate goal is to illustrate how knowledge of EGS or human well-being could be used to facilitate two-way knowledge exchange between agencies, community decision-makers, and scientists.

Our results indicate that the value of EGS is context-dependent and changes according to an agency′s, organization′s, or individual′s relationship to an environmental resource. Two conceptual models facilitate the identification of values for organizations and individuals. One model aids in the identification and characterization of who makes decisions, the programmatic mechanism, the project implementation, and the project outcomes. The utilization of this conceptual model creates opportunities for better understanding the research-program-community relationship to promote communication and research application.

A second conceptual model delineates distinct neighborhood components that agencies, organizations, and individuals value or make decisions about in the context of a physical space. Because the conceptual model was built using a neighborhood, it is known as the Neighborhood Model. The model comprises a mix of built environment types, structural dimensions, personal experiences, and human-environment relationships and includes: parks/open spaces, trails or connections, housing, schools, infrastructure, local businesses, macro-economy, natural features, governmental rules or regulations, demographics/crime statistics/health care facilities, safety, self-determination or participation, identity, social cohesion, sustainability, and aesthetics.

This investigation of R2R2R illustrates a complex process with many overlapping sites where decisions were made. This analysis provides tools with which to understand the relationships between USEPA programs, states, and communities to facilitate communication and cooperation. Facilitation is critical in a complex process, like R2R2R, because the goals of the AOC program and community development unfold as parallel processes, thus bridging them meaningfully requires intentional action, network connections, and common projects. Lessons learned in the AOCs can be applied to other programs with USEPA-state agency-local government relationships.

1.0 Introduction

The United States Environmental Protection Agency's (USEPA) Great Lakes National Program Office (GLNPO) uses the term Remediation to Restoration to Revitalization or "R2R2R" to characterize the process of remediating contaminated sediments and restoring aquatic habitat to help revitalize coastal communities. Understanding the process is important because there are 43 geographic areas in the US and Canada that either have in the past or currently fail to meet the objectives of the Great Lakes Water Quality Agreement (GLWQA; Fig. 1) called Areas of Concern (AOC). GLNPO is actively working with state agencies and local communities in the 29 US or bi-national AOCs (Fig. 1) to remediate the contaminated sediment and restore the aquatic and riparian habitat that supports community revitalization through the Great Lakes Restoration Initiative (GLRI).

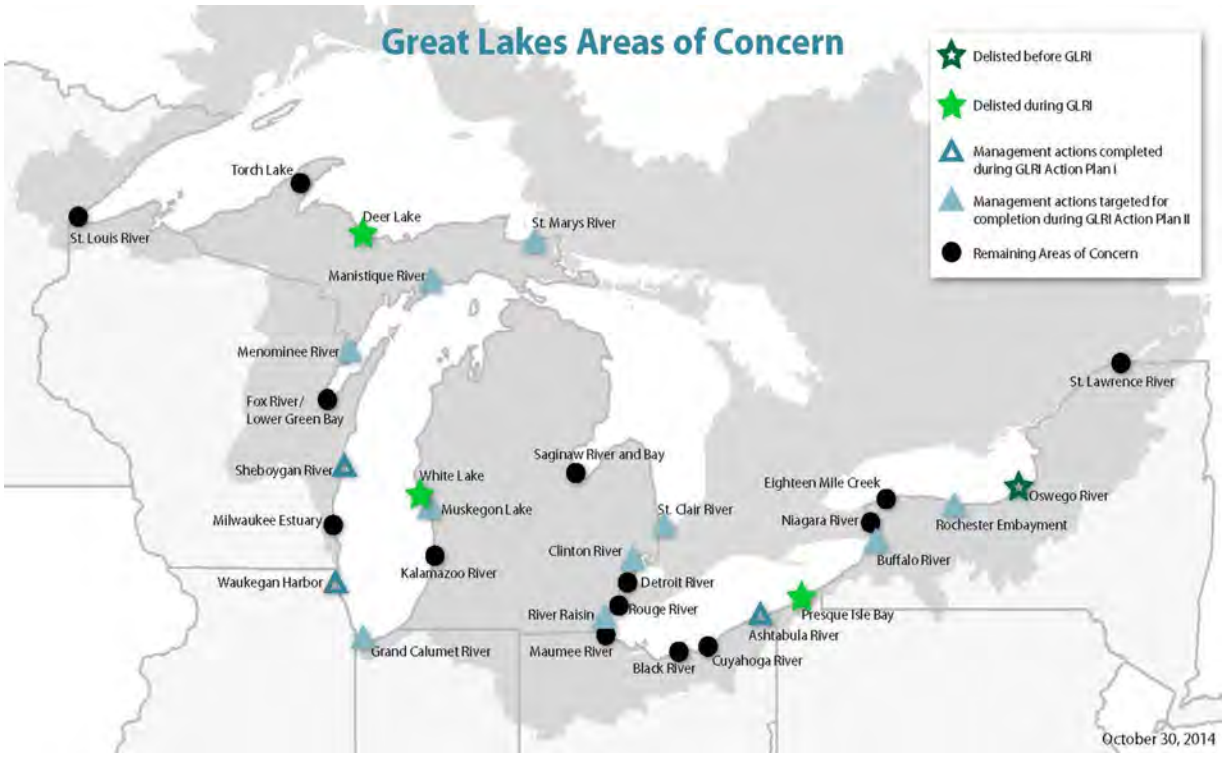

Figure 1. US and bi-national Great Lakes Areas of Concern (Source: USEPA).

1.1 Great Lakes Areas of Concern

According to the GLWQA, an AOC is defined as a geographic area designated by the Parties (i.e., the governments of the US and Canada) where "significant impairment of beneficial uses has occurred because of human activities at the local level" (International Joint Commission, 2012). The GLWQA specified fourteen potential Beneficial Use Impairments (BUI; Appendix A). In the past, Great Lakes coastal communities literally turned their backs on their rivers (Pioneer Press, 2014). For example, Milwaukee Historian John Gurda explained that many buildings in the business district were built with entry doors on the side of the building that did not face the river (Gurda, 2015). Today, however, USEPA and other federal agencies are investing heavily in the remediation of contaminated aquatic sediments and habitat restoration in AOCs through the GLRI and Great Lakes Legacy Act (GLLA) to improve the environmental conditions.

AOCs are a unique construct in which state agencies are the lead, but the public is involved throughout the process, most often through a Public or Citizen Advisory Council (PAC). AOCs were defined in the 1980s; much of the early activity to define the problems and envision potential solutions was conducted in the late 1980s and early 1990s. As part of the process, each AOC developed a set of Remedial Action Plans (RAP) in consultation with stakeholders (i.e., the PAC) that function as guiding policy to restore the impaired beneficial uses (Williams, 2015; Fig. 2). While the cleanup of most AOCs was not completed as quickly as expected, many PACs continued to meet and advocate for Great Lakes water quality, as well as their AOCs.

The state agency is the lead, but AOCs are a cooperative program[1] wherein GLNPO provides technical, logistical, and financial support to implement management actions and remove the BUIs defined in the RAPs and are present at every step in the process.

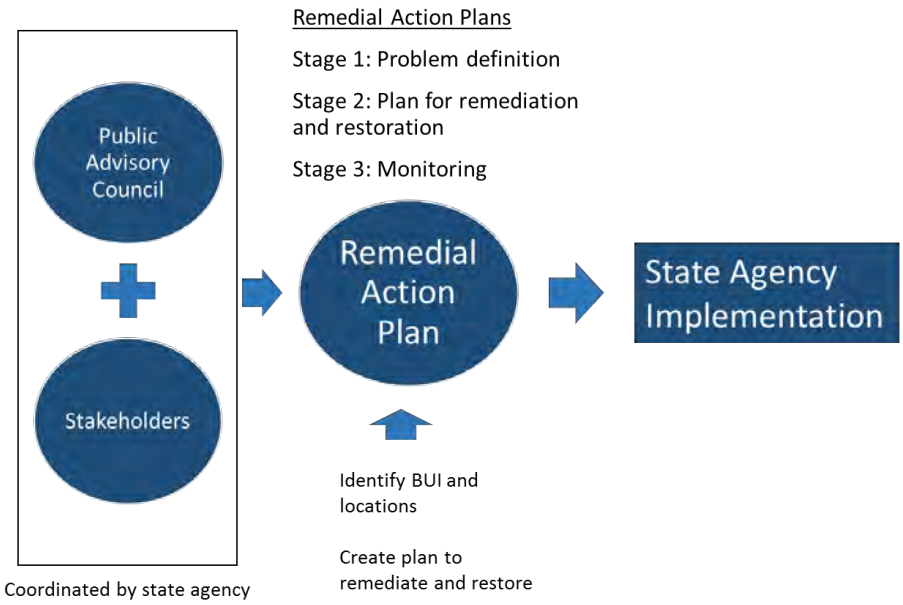

Figure 2. Schematic of how consultation in AOCs, leads to RAPs and implementation by state agencies.

The AOC model provides one of the first methods for considering local concerns in environmental management (MacKenzie, 1997). R2R2R is an evolution of the AOC process, focusing new attention on community well-being and values, as well as ecosystem health and water quality.

1.2 Remediation to Restoration to Revitalization (R2R2R)

The USEPA Office of Research and Development (ORD) and GLNPO started exploring what "revitalization" might look like throughout the Great Lakes at a workshop held at GLNPO in May 2014 (Hoffman et al., 2014). Representatives from GLNPO, ORD in Duluth and Cincinnati, Wisconsin and Illinois-Indiana Sea Grants, the Great Lakes Commission, and US Geological Survey (USGS) discussed revitalization in four AOCs (Fig. 1), including Ashtabula, Ohio; Presque Isle, Pennsylvania; and the cities of Milwaukee, Wisconsin, and Sheboygan, Wisconsin. They concluded that revitalization looked

[1] When GLNPO was asked about this model during the review process, they remarked that this system has been replaced with the "buckets." The bucket system is implemented in each AOC through a modified cooperative model where the state agency presents a list of management actions needed to remove all the BUIs from the list to delist the AOC. GLNPO or ORD may be consulted in the creation of individual lists. The "bucket" represents the expect completion date for the list of management actions (Tuchman, 2016).

different in each AOC: new tourist traffic, a waterfront brewpub, new waterfront businesses, increased fishing, and an open-water swim race. There was no one definition of revitalization, but new activity on the waterfront emerged as a potential indicator of revitalization. The workshop increased interest in R2R2R, as well as collaboration amongst the partners, and the identification of potential project attributes that contribute to R2R2R success.

Effective communication, opportunities for economic development, the geographic setting of associated amenities, and proactive planning for revitalization were identified as factors determining the benefits realized from remediation and restoration projects (Hoffman et al., 2014). The factors are valuable for R2R2R research because as an *aquatic* restoration program, AOC activities are implemented almost exclusively in the water body or riparian areas, while revitalization more often occurs on land and not necessarily adjacent to the water.

1.3 Ecosystem Goods and Services

We hypothesized that ecosystem goods and services (EGS) could be a useful concept for quantifying the contribution to social welfare of Great Lakes remediation and restoration (Hoffman et al., 2014; Wainger & Mazzotta, 2011; Yee et al., 2017). EGS are the biophysical products of ecosystems that contribute to human well-being (Boyd & Banzhalf, 2007; Munns, Rea, Mazzotta, Wainger, & Saterson, 2015). In other words, they are the elements of nature from which we benefit (e.g., shade provided by trees or identity through spiritual connection to wild rice). We expected one of the barriers to implementing comprehensive R2R2R projects to be a lack the tools with which to determine the benefits they derive from the ecosystem and then communicate with different audiences about relative values of EGS upon which revitalization depends. Valuing EGS may be complicated because values may be determined by individual or collective preferences, institutional agendas, or community relationships (Wainger & Mazzotta, 2011; Wegner & Pascual, 2011). We hope that EGS can become a useful common currency for quantifying R2R2R project outcomes and recognition of different perspectives and values of the benefits of R2R2R projects, as well as develop an approach to identify context-relevant opportunities.

1.4 Case Study Research Objectives

R2R2R is a complex process comprised of both AOC activities and community revitalization. The goal of this research is to better understand the relationships between these processes. Therefore, we had several objectives in this Regional and Environmental Science and Sustainability research (RESES) project:

1. To determine how communities (both local governments and citizens) perceive and value EGS, as expressed through routine activities.

2. To determine how EGS or human well-being concepts are incorporated or utilized in the various associated planning and community outreach processes, including USEPA and state agency programs, local planning, and agency decision tools.

3. To create guidance strategies for AOC communities to demonstrate how EGS can be used to advance community revitalization following sediment remediation and aquatic habitat restoration projects. The goal is to illustrate how knowledge of EGS or human well-being could be used to facilitate two-way knowledge exchange between agencies, community decision-makers, and scientists.

MED has been working with GLNPO, USEPA Region 5, and the four AOC coordinators to include EGS consideration of in planning AOC projects for St. Louis River BUI removal and AOC delisting. Through ongoing contacts, EGS became a concept that could have meanings across the normal silos of communication and activity (e.g., writing research outcomes that speak directly to resource management problems). To make the effort more intentional and systematic, scientists are utilizing two concepts to create and apply scientific research that can be utilized by agencies: the co-production of knowledge and boundary work.

Closing conceptual gaps among diverging perspectives (i.e., federal and state agencies, local government, and communities) is important because creating usable information requires navigating and bridging "any differences that might exist between what scientists might think is useful and what is actually useful in practice" (Dilling & Lemos, 2011). Lemos and Rood (2010) argued that "scientists, for example, when choosing the focus of their research, may make an assumption about what they think decision-makers need and hope their work will meet that need. Users, in turn may define their need differently" (p. 673). Including stakeholders, agencies or the public, in the research process offers a potential solution to the disconnect, and may increase the production of usable science. Lemos and Morehouse (2005) and Dilling and Lemos (2011) argued that scientists were both more responsive to the informational needs of stakeholders and scientific results were utilized more often by stakeholders.

2.0 Methodology

An exploratory case study was utilized to understand the complexities of R2R2R through a study of how the process unfolds in an AOC and the adjoining community. A case study approach is a research method that may be employed when the phenomenon under investigation cannot be separated from its context (Yin, 2014). Additionally, exploratory case studies are utilized to answer "how" and "why" questions and to build theories (Yin, 2014). We used an exploratory case study to identify and characterize the elements of the different decision contexts where EGS or human well-being might be discussed in relation to the AOC or community revitalization through an investigation of R2R2R in Duluth, Minnesota. Understanding who makes decision, as well as where and when stakeholders might discuss ecosystem services empowers ORD researchers to address the informational needs of stakeholders. This is important because ecosystem services are often place and relationship dependent. In other words, perceived EGS may change based on the biophysical environment, as well as the perspective of the agency, stakeholder, or community.

Data were collected between August 2015 and December 2016 using ethnographic methods (de Volo & Schatz, 2004; Hoggart, Lees, & Davies, 2002; Laurier, 2006). Participant observation was conducted at regularly occurring and public input meetings related to R2R2R in the St. Louis River AOC. The eight sites where data were collected were:

1. St. Louis River AOC,
2. St. Louis River Habitat Committee (subsequently called the Habitat Committee),[2]
3. City of Duluth St. Louis River Corridor (hereafter SLR Corridor) planning process,
4. City of Duluth Technical Advisory Committee,
5. City of Duluth Comprehensive Planning,
6. Health in All Policies (HIAP) survey,

[2] The Habitat Committee was originally organized by the St. Louis River Citizen Action Committee, now known as the St. Louis River Alliance. It is commonly called "the Habitat Committee" without reference to the parent organization. Currently, the Lake Superior National Estuarine Research Reserve organizes the committee.

7. Community organizations responding to SLR Corridor planning, and
8. GLNPO and 2016 USEPA AOC Conference.

Document analysis was conducted on City of Duluth park and small area plans.[3] For meetings, we analyzed the invitations and agendas to identify who was invited and what was discussed. Data were also analyzed using content analysis and grounded theory (Glaser, 2002; Hsieh & Shannon, 2005). We used guiding questions in the analysis: who is the organizer or author; what did they talk or write about, and were there results. Lastly, initial results were presented to agencies and organizations at the end of the project for collaborative review and advice.

Meadow et al., (2015) identified participatory action research as a model of knowledge co-production where research is meant to provide usable scientific evidence to solve a specific problem, as well as to create generalizable knowledge. This study utilized participatory action research principles (Baum, MacDougall, & Smith, 2006), to ensure regular contact between researchers, agencies, and communities. Ongoing conversations with the Department of Natural Resources (MNDNR), Minnesota Pollution Control Agency (MPCA), City of Duluth, USEPA Region 5, and community groups created opportunities for knowledge co-production and ensured their interests were included in the research project.

Duluth provides an advantageous study site because it is an active and complex AOC, and the City of Duluth acknowledges the AOC in its revitalization efforts. The St. Louis AOC-City of Duluth relationship demonstrates activity in all three R's and had observational and participatory opportunities this study utilized for data collection. Further details of the site follow in the next section.

2.1 R2R2R in the St. Louis River AOC and City of Duluth, Minnesota

Our study site, the St. Louis River AOC, at the far western edge of the Great Lakes, contains several cities, the largest of which are Duluth, Minnesota and Superior, Wisconsin (Fig. 3). Because the St. Louis River AOC is a bi-state, Minnesota (i.e., MPCA and MNDNR)-Wisconsin (i.e., Wisconsin Department of Natural Resources; WDNR) and tribal (Fond du Lac Band) site, there is a significant need to coordinate agencies' activity to ensure integrated progress in remediation and restoration to implement RAP components. Funding for implementing the RAP was provided by multiple federal agencies, including USEPA, National Oceanic and Atmospheric Association (NOAA), U.S. Fish and Wildlife Service (USFWS), and U.S. Army Corps of Engineers (USACE). The AOC has eight BUIs related to industrial contaminants, habitat degradation or loss, and excess nutrients and sediments (Appendix A).

[3] City of SLR Corridor plans can be found at http://duluthmn.gov/st-louis-river-corridor/. City of Duluth small area plans can be found here: http://duluthmn.gov/community-planning/planning-library/.

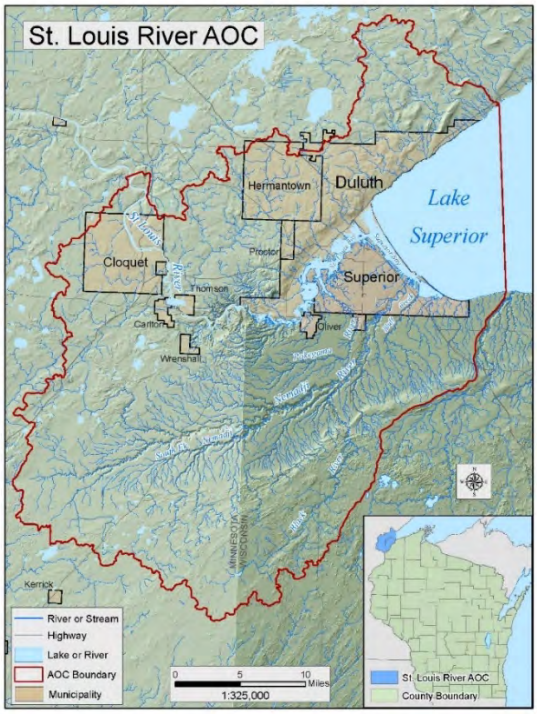

Figure 3. St. Louis River Area of Concern (Source: Wisconsin Department of Natural Resources).

Many AOC decisions are guided by existing polices outlined by two documents, the St. Louis River Area of Concern Implementation Framework: Roadmap to Delisting (Remedial Action Plan Update) (MPCA, 2013) and the Lower St. Louis River Habitat Plan (St. Louis River Citizen Action Committee, 2002). MED scientists contribute regularly to the implementation of the policies through information requests and through the participation on technical teams that inform the removal of BUIs.

Through the AOC process, MED scientists participate in a variety of venues that provide opportunities for creating and sharing usable science. The opportunities facilitate the co-production of knowledge relevant to R2R2R. For example, MED scientists were able to provide the requested model-based estimates of ecosystem service indicators for project alternatives to state agency officials (Angradi et al., 2016). More specifically, the state agency was interested in the production of ecosystem services in two different project alternatives. Thus, MED scientists created a report that outlined how 26 different ecosystem services might change because of potential management actions. The ecosystem services included in the analysis include residential property views, fishing, boating, habitat, wave attenuation, and Native American spiritual use (Appendix B).

Similarly, MED scientists regularly contribute knowledge and expertise to the study and assessment of fish health in the St. Louis River estuary through the assessment teams that create recommendations for the AOC. A five-year study on fish tumors and deformities assisted state and tribal resource managers to assess progress towards the removal of the Fish Tumors and Other Deformities BUI (Appendix A; Blazer, Mazik, & Hoffman, 2017). The impairment was identified based on observations at the time. However, no studies to document the types, severity, or prevalence of fish tumors were conducted until the assessment was initiated in 2011 (Blazer et al., 2014). Collaborators at USGS, MNDNR, MPCA, WDNR, Fond du Lac Band Natural Resources, 1854 Treaty Authority, and MED determined the prevalence of white sucker (*Catostomus commersonii*) fish tumors and deformities, and the risk factors for liver and skin neoplasms. Multi-agency field sampling took place in 2011, 2013 and 2015. The study served to provide the methods for future assessments, and to determine the status of fish tumors and deformities in the AOC.

2.1.1 Habitat Committee

The Lower St. Louis River Habitat Plan (St. Louis River Citizen Action Committee, 2002) is one of the foundational documents in the St. Louis River AOC. The plan was created through a cooperative effort better known as the "Habitat Committee." The Habitat Committee was sponsored by the St. Louis River Citizen Action Committee, now known as the St. Louis River Alliance (SLRA) (Williams, 2015) and largely concluded work after publication of the plan. In 2016, AOC collaborators advocated for the Habitat Committee to start meeting again, and the effort was organized by the Lake Superior National Estuarine Research Reserve (LSNERR). The regular attendees of the meetings include the natural resource management community in the region. Attendees are representatives from Fond du Lac Band Natural Resources, 1854 Treaty Authority, SLRA, WDNR, MNDNR, MED, MPCA, University of Minnesota-Duluth Natural Resources Research Institute (NRRI), City of Duluth Parks, Minnesota Land Trust (MLT), and the USACE.

The Habitat Committee started each meeting with introductions and agency updates. Agencies described land management, fish and wildlife monitoring, other types of environmental monitoring, and progress tracking. Updates included agency progress on BUI removal and park improvements from a slightly different perspective (e.g., the natural resource manager perspective). The land managers were specifically focused on management actions they could employ to reach defined goals that may or may not contribute to AOC delisting criteria. This venue actively brings together researchers and land managers from different agencies and institutions to exchange knowledge about ongoing activities.

2.2 City of Duluth and the SLR Corridor

AOC remediation and restoration projects are an important driver of change in the City of Duluth's effort to revitalize former industrial and commercial areas. Former Duluth Mayor Don Ness remarked, "restoring the St. Louis River is an important part of our vision for Duluth as a premier outdoor city. The health of the river is important to residents and the city is an active participant in these clean-up efforts" (St. Louis River Alliance, 2012, p. 2). To that end, the City of Duluth is implementing a multi-faceted revitalization effort focused on the SLR Corridor, an area that includes neighborhoods (Lincoln Park, Spirit Valley, Morgan Park, Gary-New Duluth, and Fond du Lac), brownfields, and undeveloped areas adjacent to the AOC (Fig. 4).

Figure 4. Map of the St. Louis River Corridor in Duluth, Minnesota (Source: City of Duluth). The Duluth-Winnipeg-Pacific (DWP) is a multi-use trail.

The expectation is that enhanced trail amenities and improved access to the river will spur the development of small shops, restaurants, and related businesses. The SLR Corridor will be a visitor

destination and outdoor recreation hub, as well as spur housing demand. Major activities include developing or upgrading parks and completing city-wide trails, both paved multi-use and natural-surface mountain bike trails. The City of Duluth has demonstrated considerable commitment to implementing this new vision through creating a new tax to secure the bonding to fund the effort.

The SLR Corridor is the industrial heart of Duluth, but also home to a rich outdoor tradition and multiple high-value natural areas. The City's SLR Corridor Plan is intended to achieve six goals: support environmental restoration, enrich neighborhood quality of life, attract new homebuyers, establish a new visitor destination, stimulate appropriate development, and leverage additional funding (City of Duluth, 2017c). Under this effort, Duluth is developing city park and amenity plans to inform development strategies and grant proposals (to federal, state and private funding sources) in the St. Louis River Corridor, as approved in Resolution 16-0455R (City of Duluth, 2016). The City recognizes the ongoing and planned AOC restoration activities in their grant applications, and is leveraging this progress in their quest to revitalize the SLR Corridor, indicating a strong connection between AOC restoration and brownfield redevelopment.

To understand this process better, MED scientists attended City-organized park meetings, as well as obtained and analyzed park planning documents. During the study period timeframe, the City organized the planning and input for at least seven different park projects (as well as the implementation of other parks projects). This number, of seven parks, is conservative, as some projects required far more planning or were more visible than others. A typical mini-master plan was created to update existing park facilities and conditions. The ways stakeholders or communities were identified in City plans varied from general references to "children," "people of all abilities," and "West Duluth residents," to specific user groups. The named user groups included the Cyclists of Gitchi Gumi Shores (COGGS), Duluth Climbers Coalition, Duluth Cross Country Ski Club, and the Duluth Area Horse Trail Alliance.

2.3 Making a Visible Difference, Economic Development and USEPA Region 5

In addition to recreational resource enhancements, the City of Duluth is actively creating plans to reclaim and reuse brownfield sites,[4] as well as consider the future of two Superfund sites. These activities are supported by USEPA Region 5, in contrast to AOC work which is supported by GLNPO. The City of Duluth, was one of Region 5's "Making a Visible Difference" (MVD) communities. USEPA identified 50 overburdened and underserved communities for additional support and coordination to address complex environmental and community goals (USEPA, 2018a). The goal of MVD was to "align community-based activities to provide seamless assistance to communities, both urban and rural, while maximizing efficiency and results"(Performance.gov, 2016). The focus of the MVD initiative in Duluth was to improve water quality and economic development in the AOC and SLR Corridor. Specific neighborhoods targeted in the MVD portfolio of projects included Lincoln Park, West Duluth, Morgan Park, and Gary-New Duluth.

One example of a non-AOC project in the MVD portfolio was a Brownfields Area Wide Plan (AWP). Instead of a piecemeal approach to R2R2R, AWP is a program which "enables communities to research and evaluate brownfields cleanup and reuse opportunities in light of priorities and existing plans, local market, infrastructure, and other conditions, and resource availability" (USEPA, 2012). An AWP was developed for the Irving-Fairmount neighborhoods in the SLR Corridor. The Irving and Fairmount neighborhoods in Duluth contain many formerly industrial sites, or sites that would benefit from

[4] Brownfields are properties that "the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" (USEPA, 2012). https://www.epa.gov/brownfields/overview-brownfields-program.

remediation of environmental conditions. Furthermore, Irving is a neighborhood adjacent to the river, and was significantly impacted by major flooding in 2012. The AWP includes Smart Growth elements, green and sustainable infrastructure needs, and community-identified needs (City of Duluth, 2017b). The AWP was one of the planning projects identified by USEPA Region 5 as one that was important for community participation, thus was observed for this research.

As alluded to earlier, a complicating factor in the implementation of R2R2R is the difficulty in communicating and aligning remediation, restoration and revitalization goals among federal and state agencies, local government entities, nonprofit organizations, and citizens. This disconnect is exemplified in the management of the St. Louis River AOC and SLR Corridor. To illustrate, a map of the MVD projects in Duluth (Fig. 5) was created. MVD projects were coded to reflect whether the project was an AOC project or a community or land-side project. The picture illustrates a story: the AOC ends where it meets land. This observation represents a broad pattern with some exceptions. For example, the Knowlton Creek habitat restoration is considered an AOC project because upland restoration projects contribute to improved water quality and habitat in the St. Louis River (Fig. 5; USEPA, 2018b). Strategic methods targeted at traversing the land-water barrier to create conversation about a comprehensive vision for an AOC and adjoining communities are essential to communicating across program boundaries.

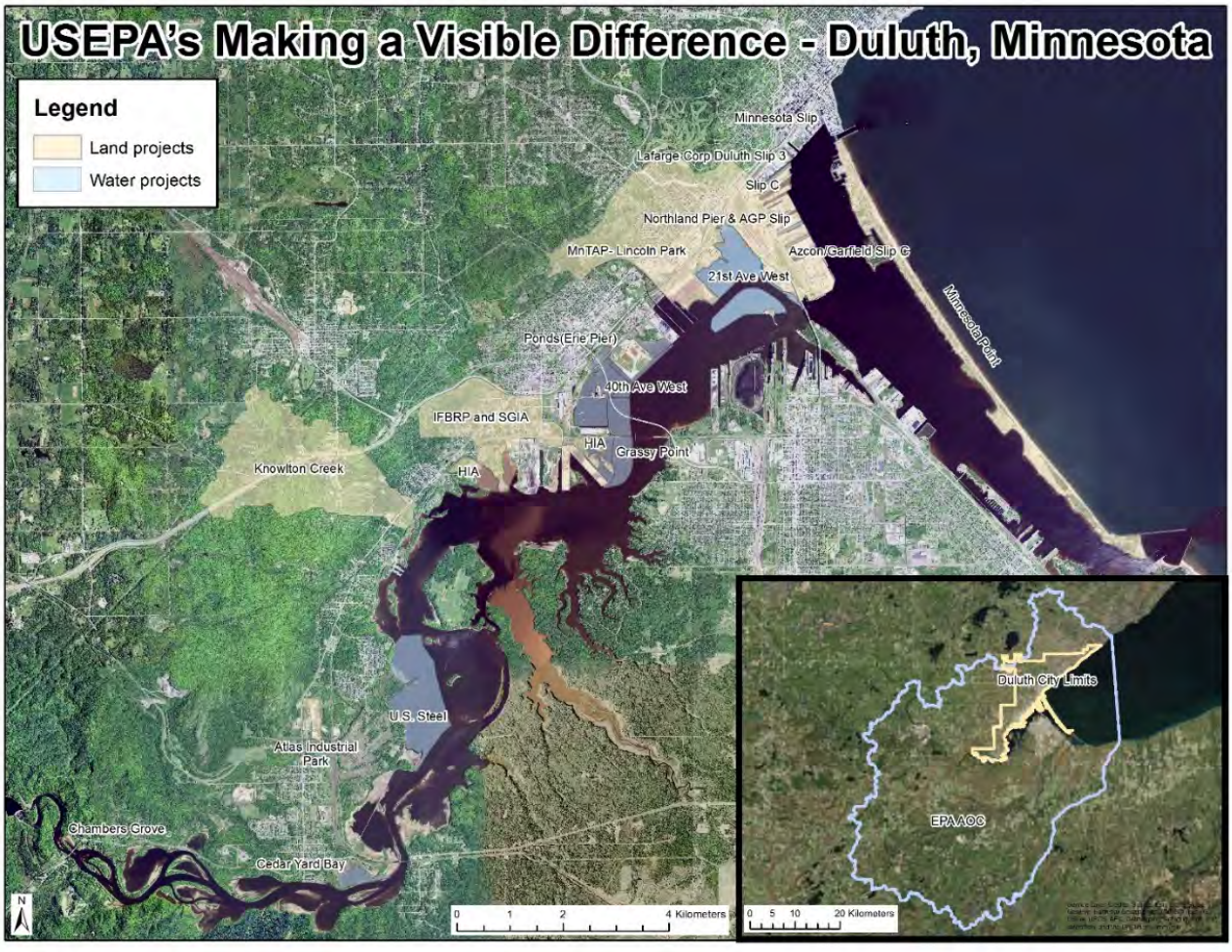

Figure 5. Map of the MVD projects. AOC projects are delineated in blue and other projects are depicted in brown.

To better understand community revitalization efforts undertaken by the City of Duluth, MED

researchers attended and participated in the City of Duluth's St. Louis River Technical Advisory Committee meetings that were organized by the City's Business and Economic Development Department. Attendees in the forum included the state agencies working in the AOC, St. Louis River Alliance[5], Duluth Seaway Authority, Jay Cooke State Park, Duluth Local Support Initiatives Corporation (LISC), and City Departments including Parks, Economic Development and Community Planning. The meetings featured networking, an agenda of rotating topics, and agency updates. Agenda items included updates of park projects in the SLR Corridor, updates on USEPA-funded brownfields projects, progress on the large US Steel Superfund site, and regular RESES research updates.

2.4 Other Study Sites Related to the AOC, SLR Corridor or Community Development

2.4.1 Community Organizations

Although there is support in the western neighborhoods of Duluth for new economic activity (i.e., revitalization), some communities have questioned the City's perceived focus on parks at the expense of other priorities (i.e., housing). More specifically, some conservationists and residents who live in the SLR Corridor were concerned that the City has not adequately included them in planning and have expressed that concern through organizing their own events and opportunities for public input.

Several different groups were active in organizing citizen input about some of the planned projects. For example, one conservation organization organized an event where over fifty people participated and shared their thoughts about the Western Waterfront Trail, one of the SLR Corridor projects. This conservation organization has membership from throughout the area and values the natural areas adjacent to the St. Louis River as habitat for fish, pollinators, and birds. The group organized presentations by natural resource professionals and city officials working on the trail. More importantly, the organization had a grant and contracted with a community design professional to explain the importance of community input in conservation planning (Rader, 2015). The event modeled a community input exercise which participants could share input through verbal, written, or artistic modes.

Citizens who lived in the SLR Corridor responded to the City's Initiative by creating a new organization, which is here identified as "Community Organization." The organization was comprised of residents representing different neighborhoods throughout the SLR Corridor. MED researchers attended meetings of the organization and its committees and took notes. City of Duluth representatives also attended the meetings, as well as other guests. For example, at one meeting a representative from the Duluth Transit Authority shared information about a new bus service specifically planned to provide service between an underserved community and a grocery store.

Citizens expressed concern that the City was developing parks and trails to attract visitors, while failing to market the neighborhoods and ignoring the condition of existing housing and parks. In response to the concerns, the Community Organization met monthly and had three committees representing the most salient issues to the organization: Housing, Marketing, and Parks and Trails. The individual committees organized events and improvement efforts. The Housing Committee organized a housing fair. The Marketing Committee maintained the organizations' Facebook page.

The Parks and Trails Committee was the most active, in part, because of the amount of park planning activity happening in Duluth. In particular, the Parks and Trails Committee created a website about their proposed alternative trail alignments for a regional trail and provided maps and videos of the experience (Trails, 2017). Their research included consulting with experts about safety issues and counting the

[5] The St. Louis River Alliance was formerly known as the St. Louis River Citizen Action Committee.

number of times a trail alignment crossed city streets. The information was shared with the City of Duluth Parks Department through phone calls, emails, and appearances at public meetings. The City responded to citizen activism in different ways. For example, the City Parks Department sent a representative to update the community organization about the progress of projects in the SLR Corridor. Moreover, after the election of a new mayor in November 2015, the Parks Department adopted a new approach and started to more actively solicit public input.[6]

2.4.2 Comprehensive Planning and Community Participation

Comprehensive plans are typically created through long and intensive processes, which include consultation with residents, stakeholders and other professionals (Hoch, Dalton, & So, 2000). In June 2016, the City of Duluth Planning Department implemented extensive community outreach campaign to support the development of a new comprehensive plan called *Imagine Duluth 2035* (City of Duluth, 2017a). *Imagine Duluth 2035* had engaged the community at a wide range of events including annual neighborhood gatherings, community club meetings, professional organization meetings, and regional planning collaboration meetings. Between June and the official Comprehensive Plan kick-off event in September 2016, City of Duluth Community Planning Department staff (hereafter Community Planning) attended over 60 events, with an average of four events per week. The outreach effort continued into 2017, with regular events and focus group meetings continually scheduled (City of Duluth, 2017a).

Twelve principles guided the planning effort (City of Duluth, 2017a), including:

1. Reuse of previously developed lands.
2. Declare the necessity and secure the future of undeveloped places.
3. Support existing economic base.
4. Support economic growth sectors.
5. Promote reinvestment in neighborhoods.
6. Reinforce the place-specific.
7. Create and maintain connectivity.
8. Encourage a mix of activities, uses and densities.
9. Support private actions that contribute to the public realm.
10. Take actions that enhance the environment, economic, and social well-being of the community.
11. Consider the education system in land use actions.
12. Create efficiencies in delivery of public services.

In addition to these twelve principles, Mayor Emily Larson asked Community Planning to add two new principles: fairness and health. Planning for land use or economic development is normal practice, thus

[6] Per City of Duluth officials during the presentation of results in August 2017.

Community Planning staff elicited feedback from the public through the community survey and comprehensive plan kick-off events about meanings of health and fairness, as well as their community priorities.

At the Comprehensive Plan Kick-off Meeting on September 21, 2016 at Denfeld High School, participants were asked to submit sticky notes with their interpretations of health in one exercise, and fairness in another. Community Planning transcribed the comments and shared them with MED. MED analyzed the data using conventional content analysis (Hsieh & Shannon, 2005) and Nvivo software (QSR International, 2016) to identify major themes in the data. MED staff researchers then created recommendations for the City based on the analysis of citizen comments and the use of data tools (Appendix C).

The analysis revealed that some participants felt there were barriers to fairness (e.g., housing discrimination, lack of participation opportunities, and unequal economic opportunities) and signaled a desire for access to social and environmental resources (e.g., health care, housing, education, parks). The analysis demonstrated that participants identified specific vulnerable populations (e.g., families with children, people of color, and those with a criminal background). Lastly, participants made policy recommendations to achieve fairness (i.e., equitable distribution of investments, inclusive decision-making processes).

Furthermore, the analysis illustrated that most participants were concerned with a lack of opportunities in employment, housing and education for persons who may be socioeconomically vulnerable because of factors outside of their control (i.e., race or color, family status, or disability). Recent research demonstrates that these individual factors can impact income and wealth disparities, as well as incarceration status (Kochhar & Fry, 2014; Vogel & Porter, 2015; Williams, Priest, & Anderson, 2016). Moreover, participants' comments reflect that respondents thought that everyone should have access to the building blocks of a good life, regardless of race, age, gender or income. In other words, people should have access to "affordable and equitable housing – should be no more than one-third of income, safe, modern, up-to-date living spaces" and that "landlords need to be held accountable for housing upkeep."

In addition to housing, participants felt that neighborhood quality was important, and "all residents deserve to reside in locations that provide a sense of place."[7] This means, "some green space, trees, views and architectural beauty should surround them or be within walking distance." Moreover, affordable housing should not be limited to particular neighborhoods. Participants felt that efforts should be made to "increase opportunity and access to affordable housing in all areas of Duluth."

Participant comments provided a spatial dimension to fairness (e.g., distribution of affordable housing and parks). The spatial dimension of fairness is important because public health researchers find links between where people live and health disparities which result from an unequal distribution of wealth, power, goods and services (Marmot et al., 2008; Morello-Frosch, Zuk, Jerrett, Shamasunder, & Kyle, 2011; White & Borrell, 2011).

Recognizing that there are equal opportunity laws and policies, but that unfair conditions persist implies that intentional effort is needed to avoid compounding structural inequalities, or the inequities produced by society (Gee & Ford, 2011). One place to start is recognizing that some neighborhoods are home to

[7] All quotes in the paragraph are from participant submissions about health and fairness from the September 2016 Imagine Duluth event.

more vulnerable populations, and these neighborhoods are some of the places with the highest needs. One participant cited the need "equity – matching resources to needs, not equally."

2.4.3 Health in All Policies Campaign

Some community members did not recognize their own life experiences reflected in the initial City survey results. Consequently, the Health in All Policies (HIAP) Campaign met with the City. They were concerned because the survey results would shape policy through the Comprehensive Plan, including how the concepts health and fairness would be included in the plan. The Mayor's interest in "fairness" in the provision of city services (including planning, parks, infrastructure) or development is well supported in the public health literature. Scholars argue there is a strong relationship between where one lives and her or his health and well-being outcomes (Cummins, Curtis, Diez-Roux, & Macintyre, 2007; Ellen & Turner, 1997; Kramer & Hogue, 2009; Morello-Frosch & Lopez, 2006).

To ensure that the voices of the Duluthians who may have not been heard during the survey and public input process were included in the comprehensive plan process, HIAP contacted the Community Planning Department to conduct their own survey. The Community Planning Department was supportive of the suggestion and referred HIAP to ORD as a technical resource. Scientists at MED offered technical assistance in survey creation, data analysis, and reporting. HIAP conducted about 500 face-to-face surveys, through door-knocking. Because their survey was conducted as an interview with open-ended questions, MED helped to create a data analysis tool that would function as the qualitative analysis software they use (Appendix D) and then reviewed and provided editorial comments on their report.

HIAP organized an event in March 2017 to present the results to the community and city officials. The event was created to be inclusive, and included a welcome; a youth-delivered spoken-word poetry; the survey results; and a panel with the canvassers who conducted the survey. HIAP then presented their recommendations for a principle on fairness. City officials agreed to share recommendation with the policy-making bodies (e.g., Planning Commission and Vision Committee for the comprehensive plan).

The final recommendations adopted by the Planning Commission and City Council to inform the Comprehensive Plan (City of Duluth, 2017a) are:

> <u>Principle #13 - Develop a healthy community.</u>
>
> Supporting health and well-being is a priority. The City will actively promote access for all to health resources, quality food, recreation, social and economic opportunities, and a clean and secure environment. Investments and polices will advance and maximize health and healthy equity in the city.
>
> <u>Principle #14 - Integrate fairness into the fabric of the community.</u>
>
> All people will have equitable access to resources and opportunities that stabilize and enhance their lives. The City recognizes historical and current disparities and will actively promote inclusive and participatory decision-making that addresses systemic barriers to success. Investments and policies will advance and maximize equity in the City.

The important observation between the health and fairness principles is that they mirror and reinforce each other. In other words, the City recognizes that fairness and access to resources are integral to achieving health and health equity.

2.5 Collaboration with GLNPO

In May 2014, GLNPO leadership and ORD scientists conducted a workshop and invited representatives from Wisconsin and Illinois-Indiana Sea Grants, the Great Lakes Commission, and industry to discuss the observation that sediment remediation and habitat restoration might be providing economic and social benefits in AOCs (Hoffman et al., 2014; Section 1.2). In December 2015, a two-day meeting to build on the earlier work and plan further R2R2R case studies was held in Chicago, Illinois. Participants were USEPA Region 5, GLNPO, ORD, and the Deputy Director of the ORD Sustainable and Healthy Communities (SHC) Research Program. The goal of the meeting was to develop a GLNPO-ORD strategy to address revitalization. The workshop included sessions on problem framing, current approaches to contaminated sediment remediation and habitat restoration, as well as potential approaches to investigating community revitalization. As a result, GLNPO invited MED to organize a session at GLNPO's annual AOC conference the following year.

2.5.1 2016 Great Lakes AOC Conference

Scientists from MED organized a session at the 2016 Annual Great Lakes AOC Conference in Dearborn, Michigan.[8] Participants in the session included community members, state and federal agency staff, and technical advisors who work with and support the AOC program. Instead of a traditional conference session with a panel of speakers who give presentations, this session was organized as an interactive discussion about brownfields and revitalization. The scientists utilized an instructional technique to guide learning about the connections between brownfields and community revitalization and AOC remediation actions. An experiential learning approach gave participants a chance to reflect on their own experiences while exploring new ideas through discussion (Baker, Jensen, & Kolb, 2005; Kolb, Boyatzis, & Mainemelis, 2001).

This method was chosen based on experiences working with AOC professionals. Because the AOC program is an *aquatic* program, agency officials often are reluctant to address or consider land-based activities (Fig. 6). To mitigate this reaction, the questions were structured to invite participants to share their observations and ask them to explain their local experiences. Utilizing a similar approach to a classroom discussion, the session included a short introduction and thought-provoking questions. The list of questions was based on brownfields revitalization literature and R2R2R field research. Questions were constructed to encourage participants to reflect on their own observations of their AOCs so they would identify the potential relationships between cleaner water and community revitalization.

One of the major observations of the session was that most participants felt that water quality had improved in their AOC (Fig. 6). In addition to improved water quality, participants discussed increased recreational use of the water and riparian zones. Riparian uses identified by participants included trails, retail and other businesses, as well as new housing developments or improvements in the built environment. Participants further noticed increased kayaking and stand-up paddle boarding. Moreover, participants felt that there was a lot of cooperation in the AOC to attract sustainable businesses and to negotiate with industry to restore waterfronts (Williams & Hoffman, in review).

[8] The conference agenda can be found at https://www.epa.gov/sites/production/files/2016-02/documents/aoc-conference-agenda-2016.pdf.

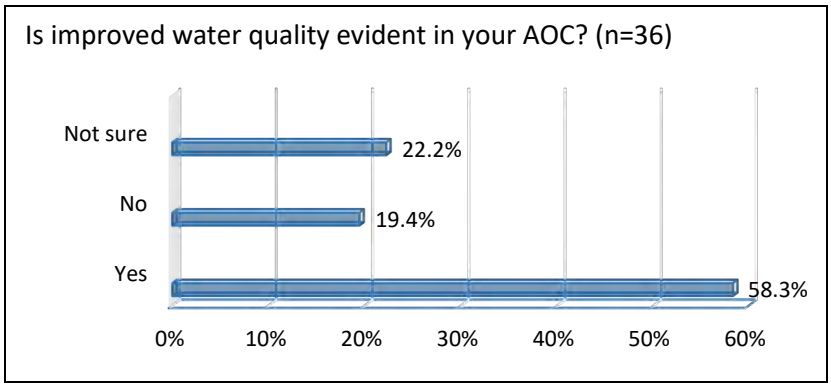

Figure 6. One of the questions from the ORD-organized R2R2R session at the 2016 AOC Conference held in Dearborn, Michigan (Williams & Hoffman, in review).

Two patterns were identified through researching the observations shared by participants. While the AOC program is similar in structure in every AOC (i.e., a state agency leads the effort, a PAC participates, and GLNPO works with the state agencies), the R2R2R process looks different in each location. Contextual factors appeared to influence how AOCs are revitalized. Participants in urban AOCs such as Cuyahoga River, Buffalo River and St. Louis River recognized more successes and different types of development. The representatives from rural AOCs described more social and economic challenges and fewer successes. This observation raises research questions about how AOC size, location and resources (e.g., human, institutional, economic) influence R2R2R outcomes.

A second observation was the divergence in activities and decisions between the aquatic restoration and the land uses adjacent to the AOCs. The divergence confounds traditional ideas of success. For example, success in AOCs, from GLNPO's perspective, is normally measured in cubic yards of sediment removed and acres of habitat restored, which is applied to AOC metrics (Tuchman, 2016). Communities, on the other hand, are making entirely different decisions. For example, they are responsible for the amenities that improve access to the newly restored resources and facilitating economic development in neighborhoods (Fig. 7)

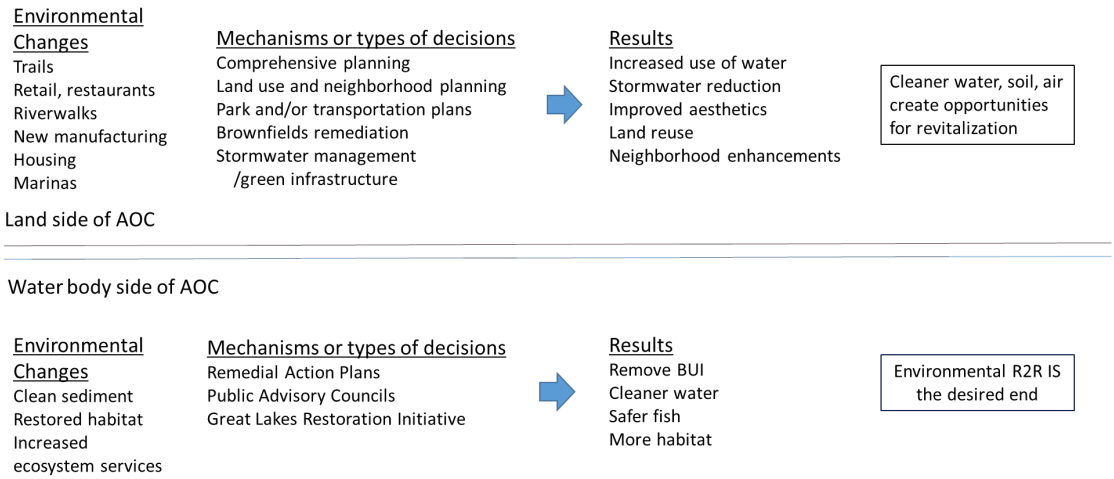

Figure 7. The figure illustrates a synthesis of the potential differences in the types of R2R2R decisions and results in AOCs and adjacent communities, as identified at the 2016 AOC Conference. R2R is used to demonstrate that remediation and restoration are the desired end.

Through this exercise, MED researchers identified potential revitalization indicators. The indicators

reflected new uses of the water ways in the Great Lakes, including high-tech or advanced manufacturing, higher education or medical facility expansion, and land and water-based recreation. Much of the redevelopment appears to be occurring in urban environments. Comprehensive and other land-use plans appear to be the mechanism through which changes are initiated (Williams & Hoffman, in review).

3.0 Analysis

3.1 Who Participates in R2R2R?

The St. Louis River AOC is an ideal place to investigate R2R2R because of the number of activities in different sites to investigate. While not exhaustive, this investigation created a list of at least eight sites where distinct dimensions of R2R2R may be discussed or decisions made (Section 2, Methodology). Recognition of the different sites may serve as a step towards understanding the unique conceptualizations of the benefits ecosystems provide.

MNDNR also understands that there are multiple kinds of connections to EGS and benefits. To find out more about how different stakeholders are connected to the St. Louis River, MNDNR organized a visualization exercise at the St. Louis River Summit, a regional research conference organized by the LSNERR, to determine how people relate to the St. Louis River by occupation and activity (Appendix E). MNDNR created a poster as a method to capture how participants identify themselves and their personal or professional relationship with the river. Some people self-identified multiple roles and answered more than once (Appendix E).

Most of the presentations at the two-day conference reflect the breadth and depth of the research and management activities conducted about the St. Louis River, both in and beyond the AOC (LSNERR, 2017). Although decisions are not made there, the St. Louis River Summit serves as a rare opportunity for individuals in research and management across agencies, academia, and industry to network and share information (Appendix E). The exercise illustrates the importance of recognizing different audiences and that the audiences may not be connected to one another.

Thus, a challenge to involving stakeholders is that their interests are nearly always context dependent. One observation from this research is that sometimes people and activities related to R2R2R might overlap, but it is not necessarily the norm (Appendix E). Table 1 outlines in the broadest terms how participation in R2R2R changes among settings arranged by the City of Duluth and the AOC planning projects. Particularly, the state and federal agencies that are most responsible for natural resource and environmental management are largely absent from City of Duluth activities, and City officials are absent in most AOC discussions. Citizens participate in City planning processes, but appear to be absent from most AOC activities. One explanation for this discrepancy is the City of Duluth park or other types of planning meetings are open to and organized for the public to inform or gather input. Many AOC meetings are more technical and not necessarily open to a general audience.

Table 1: Matrix identifying which groups participate in R2R2R decision or information sharing contexts. USEPA is the consistent participant in all decision contexts.

Group/ Setting	AOC Mgmt.	Habitat Committee	St. Louis River Summit	St. Louis River Technical Committee	Park Plan[9]	Comprehensive, Brownfields or Other Plans
State agencies	X	X	X	X		X (brownfields plan only)
Federal agencies	X	X	X	X		
USEPA	GLNPO ORD R5[10]	ORD	ORD	ORD R5	ORD	ORD R5
NGOs	X	X	X	X	X	X
City agencies		X (Parks)		X (Economic Development, Parks, Community Planning)	X (Parks)	X (Economic Development, Community Planning, Parks)
Researchers	X	X	X			
Citizens					X	X

The City of Duluth makes an intentional effort to bridge the AOC-City of Duluth divide through the St. Louis River Technical Committee organized by the City's Business and Economic Development Department. The group meets every two months and participants include: USEPA Region 5 and ORD, several City of Duluth departments (i.e., Parks, Community Planning and Engineering), MPCA, MNDNR, a representative from Jay Cooke State Park, SLRA, MLT, and the Duluth Seaway Port Authority. The group's purpose is information sharing, the agenda typically includes updates about City-led initiatives and an opportunity for participants to share their organization's updates.

Although Table 1 is meant to depict a broad pattern, it also attempts to capture nuance to agency participation. For example, USEPA plays a unique role in the distinct decision contexts. ORD participates in each of the decision contexts, and often contributes research-based knowledge to discussions. GLNPO and Region 5 participate in AOC and St. Louis River neighborhood decision contexts, respectively. Furthermore, MVD created a connection for Region 5 to AOC projects (Fig. 5). Similarly, the City of Duluth is not a single entity. Parks, Economic Development, and Community Planning all have distinct responsibilities. Therefore, it becomes very important to ask who is participating, because existing relationships influence how stakeholders are identified and subsequently invited to participate.

When Table 1 was presented to one of the stakeholders, she was surprised and challenged the finding that the public was only involved in city processes, because she expected that participation was more universal. This particular stakeholder, an agency official, noted that she does interact with the public, but

[9] The nongovernmental organizations (NGO)s who participate in City of Duluth planning activities are not the same as the ones who participate in AOC-related events. The environmental NGOs with extensive technical knowledge (e.g., a land trust) participate in AOC activities. The NGOs who participate in City-related activities are more often focused on health and quality of life. Some environmental groups do participate in City planning.

[10] USEPA Region 5 officials are involved in AOC activities through MVD, not usually at the project level.

often informally. This table demonstrates that most AOC and planning contexts are organized by and for technical purposes, it is not clear that there are opportunities for the public or residents to participate.

3.2 What Types of Decisions are Made in Different Contexts?

This report has established that R2R2R decision processes overlap, but might also be disconnected because of institutional, agency, or structural perspectives or connections to place. The disconnection is to be expected, as the AOC, City of Duluth, and public all have particular decisions to make with unique starting points. For example, most of the decisions in the AOC are project-based, because the policy that guides the AOC implementation already exists (MPCA, 2013). Most of the decisions that remain are about *where* and *how much* sediment or substrate to remediate, *what kind* of habitat to construct and the site designs. The details matter and EGS may inform the decisions because they are large and complex sites (e.g., the US Steel Superfund site 600 is acres, requiring both river sediment and land cleanup; MPCA, 2018), where the design will impact the amount and type of EGS that result from the management actions.

In contrast, the City of Duluth is both developing policies and plans, as well as implementing them. Examples of policy-making decisions by the City of Duluth include the development of a new Comprehensive Plan to guide land use and service provision throughout the City. Examples of implementation include the remediation of brownfields and the building of trails. For the City, decision scales range from remediating individual brownfields to city-wide policy creation. The EGS decisions can have a large impact because City resources are in neighborhoods where people live, so people access them more easily.

This contrast between the two settings presents two epistemic challenges for ORD as we investigate how EGS might become a common language or bridging concept for decision makers who operate in different spheres of influence. The first challenge is to learn how EGS might inform a decision. Figure 8 illustrates a framework for understanding how differences in the decision processes are created by different actors initiating a decision (who), program opportunities (what), management options (how) and desired endpoints (outcomes). The framework further illustrates that EGS knowledge plays different roles in the decision process for the AOC and the City of Duluth.

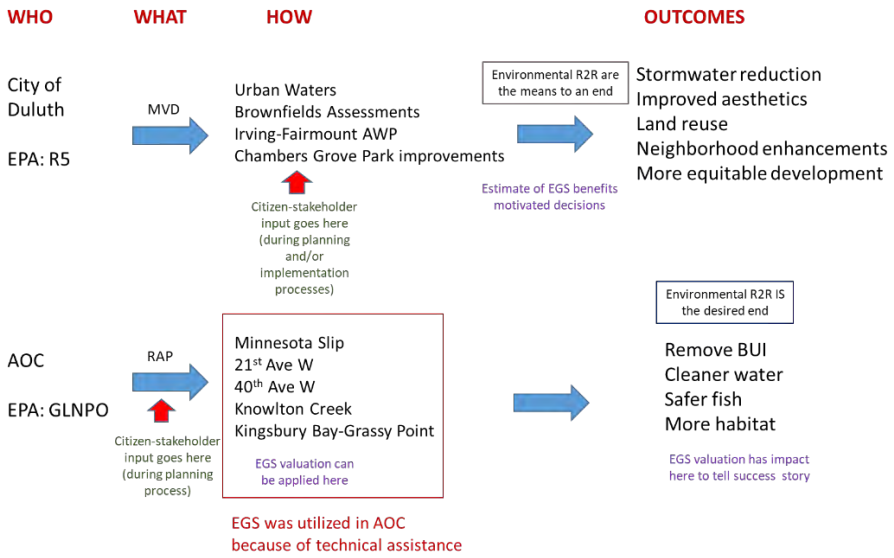

Figure 8. Comparison of the AOC decision-making process and the City of Duluth decision process. Each decision context interfaces with different USEPA offices; consults with the public at different points in the process, and use ecosystem services for distinct reasons.

In this analysis, MVD and the RAP serve as cohesive strategies to accomplish complex goals restoring both the AOC and the SLR Corridor neighborhoods. For purposes of comparison, both the City and AOC managers have lists of projects that will eventually lead to a set of desired outcomes, but EGS play distinct roles in each process. For the AOC, ecosystem benefits are the *outcome* of R2R projects. In other words, project managers might request EGS data for the AOC. In other contexts, EGS might help explain the benefits of R2R, or be an *input* to a desired public or ecosystem service. The City assumes that clean soil becomes a development opportunity and access to natural areas yield recreational assets. This contrasts with the AOC, where the clean sediment is the end goal. Utilizing this framework will empower ORD to better identify and characterize the impact of EGS research will have in different types of decision contexts.

3.2.1 Policy or Implementation?

One goal of this research was to determine community values of EGS in R2R2R. One of the results of observing community groups is that housing, trails, and parks motivate action, but community input does not always have an impact from the community's perspective (Section 2.4.1). Moreover, citizens are not present in all decision contexts (Table 1). By comparing the activity of the citizen groups that mobilized in response to the SLR Corridor initiative and the comprehensive plan we can discern a pattern. First, the SLR Corridor initiative was in the implementation stages when citizen input was solicited (Section 2.4.1). One interpretation from this experience is that even if input is gathered during the project design phase, it cannot address the public's concerns if they did not have input to the policy or plan that was in the implementation stage.[11]

In contrast, the Comprehensive Planning and HIAP experience illuminates some possibilities to better appreciate how input can be meaningfully integrated into an existing policy creation effort (Fig. 9). This analysis should be transferrable. For example, RAPs might be considered analogous to the comprehensive plan because they were created through an iterative process and serve as the policy each AOC follows (Section 1.1).

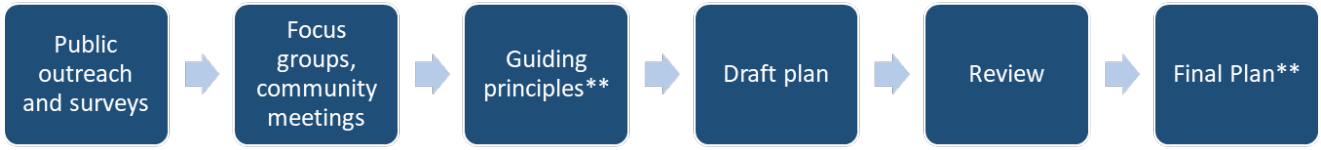

*Figure 9. Process diagram for the Imagine Duluth 2035 planning process. **Denotes where the plan was reviewed and revised before passing on to a subsequent step or final approval.*

Community planning used an iterative process to revise the Comprehensive Plan. The first step for Community Planning was outreach and attendance at community events throughout the City of Duluth and collection of over 4000 surveys. The kick-off event collected additional input, which was analyzed by staff to inform subsequent steps in the process. Focus groups both informed policy recommendations and presented a sounding board for Community Planning staff. A Vision Committee with a broad representation of the community provide oversight for the entire process. Public input is the foundation

[11] This observation was presented to the activist community group that organized around the City's SLR Corridor project plans in August 2017 and they agreed this was the case. They further expressed concerns about what they perceive as inadequate maintenance of the existing facilities in Western Duluth neighborhoods.

for the Comprehensive Plan, where the Community Planning staff took input from diverse sources, including the HIAP and USEPA reports, and translated the values and experiences into policy.

3.3 Neighborhood Model

We used the idea of R2R2R as a complex system of overlapping decisions to identify who made decisions, where, and who was involved. This report demonstrates the complication of integrating such different perspectives. To better characterize the values and interests of these different perspectives, we have treated them as an addition problem, and created a mental map to accommodate as many of the values and constraints that motivate agencies, organizations, and individuals to act.

For example, natural resource managers desire to improve habitat for fish and wildlife; the City has the responsibility and obligation to improve the environment and foster economic opportunities; and citizens organize to support trails and amenities that reflect their interests. City officials (e.g., mayors) create and implement policies that city staff must implement. The biophysical environment creates constraints and opportunities for EGS creation and access. The development of a relational model to translate across perspectives creates opportunities to examine the relationships between actors (i.e., city officials and citizens) and the landscape.

The Neighborhood Model (Fig. 10; Appendix F) utilizes approaches rooted in conflict resolution theory and systems thinking. The DSRP or Distinctions-Systems-Relationships-Perspectives heuristic (Cabrera, Cabrera & Powers, 2015) guided the development of the framework. The DSRP model explains how people think, more specifically that we each have our own perspective, make distinctions, and identify part-whole relationships. Thus, we created a method to capture different perspectives to identify and explain relationships among them. The model is specifically designed to capture what is important to different individuals or organizations but might be difficult to quantify, including elements in the environment that contribute to personal identity or organizational mission, safety and connection to place, or professional ethic. The model enables researchers to compare perspectives and identify multiple conceptualizations of value.

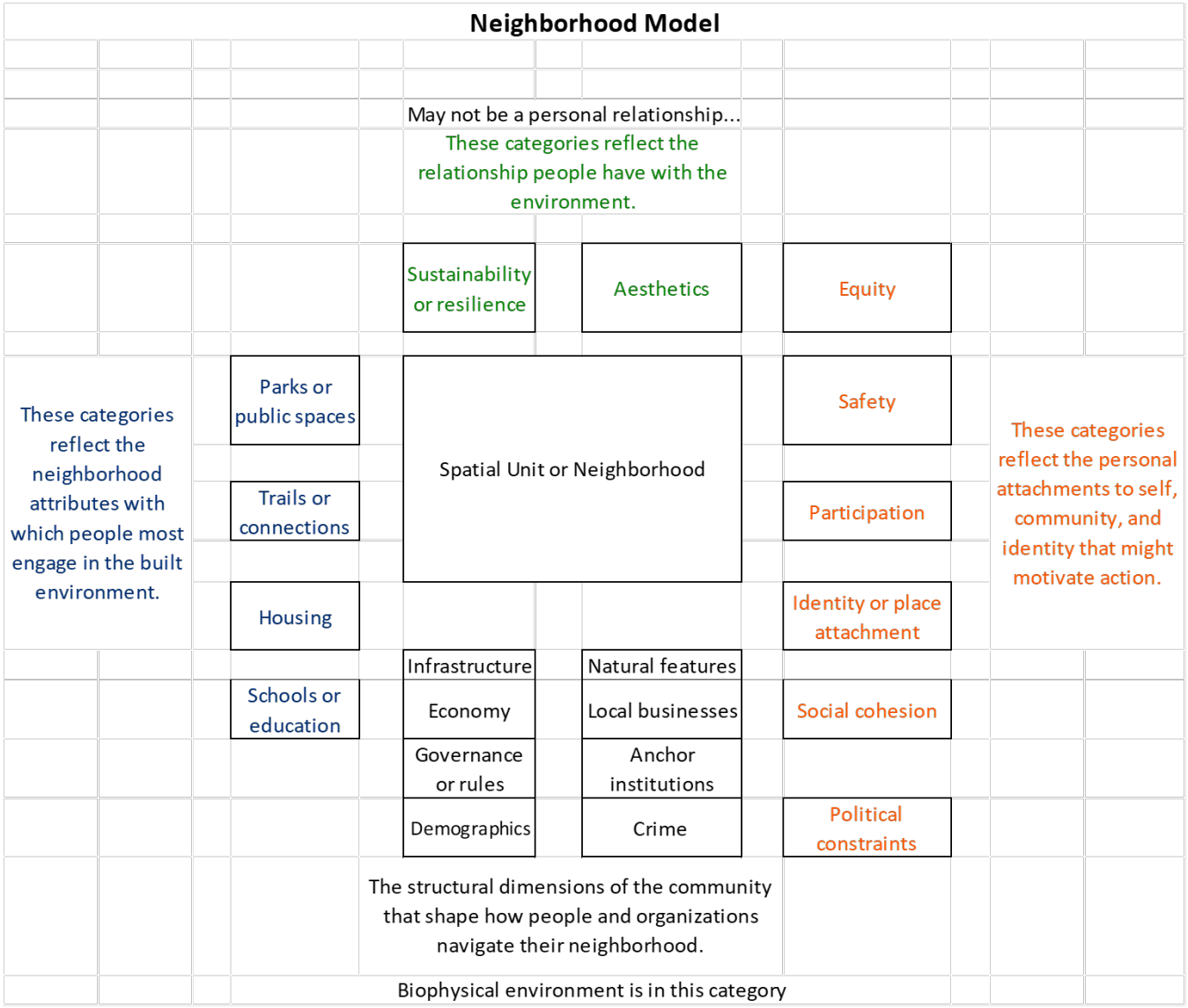

Figure 10. The Community framework, also known as the Neighborhood Model. The colors represent how individuals might interact with individual attributes. Blue attributes are representative of the built environment, the reasons that individuals might choose their neighborhoods, or what cities plan to change. Black attributes are structural dimensions, or the important elements that are fixed part of larger process, or expressed in statistics. Orange characteristics reflect personal attachments, values, or motivations of individuals. Green attributes represent human-environment relationships.

The model was built by treating the themes identified in the R2R2R case descriptions as an addition problem (Section 2; Johnston et al., 2017). There are four dimensions: the built environment; human-environment relationships; personal attachments to self and others; and structural dimensions (Fig. 10; Appendix F). The community organizations organized around and the City of Duluth plans for parks, trails, housing. Communities advocated for equity, safety, participation, place, social cohesion. Political constraints were discussed often as a motivation, and sometimes as a deterrent. Management decisions were based on improving the economy and infrastructure, as well as altering natural features. The decisions were based on data about economic data, demographics, and crime statistics. Two additional categories have been added to the earlier version of this model based on input from the stakeholder groups: equity and political constraints. One stakeholder group appreciated a framework that could make their concerns more visible because they are often marginalized. Another stakeholder group stated that political constraints can drive activity in agencies, and staff needs to adapt to changing leadership.

The conceptual model is meant to disentangle and classify some of the place meanings that are embedded in speech and practice to better understand how the environment influences (positively or negatively) community life, and how environmental attributes might be valued by individuals or entities. The model is designed to identify and describe the value of the resources or EGS based on what the resource provides to different groups – including agencies, local governments, and the public. We applied the model by using it to answer the question, "What does a resource (a trail, river, vegetation) provide to an individual or organization (e.g., sense of place, fish to catch, agency goals)" (Appendix F).

The components of the Neighborhood Model are dimensions or features of nearly every city, town, village, or neighborhood. While every community is a unique mix of components, the components themselves are universal. Components of human well-being and EGS are embedded in these individual neighborhood components. For example, parks are an important pathway through which people experience nature EGS (Buchel & Frantzeskaki, 2015; Landers & Nahlik, 2013).

4.0 Conclusion

This research characterized and embraced the complexity of R2R2R in the Great Lakes Region through a case study of the process in the St. Louis River AOC. ORD and GLNPO endeavor to understand the relationships among the three R's in R2R2R because AOCs and their adjoining communities throughout the Great Lakes region are interested in revitalizing. The case study in Duluth established that the City identified outdoor recreation as a desired benefit of the natural assets next to the restored AOC, and is creating and implementing plans to achieve that goal. Outdoor recreation or visitor destination will not be the economic answer for every AOC, but what this study demonstrates is that it is possible to identify the institutional context for remediation and restoration, as well as community revitalization goals.

We examined the overlapping dimensions of R2R2R and identified eight institutional contexts where different dimensions of remediation, restoration, or revitalization were discussed. The sites were organized or convened by USEPA offices (GLNPO and Region 5), state agencies (AOC meetings), research partners (LSNERR), the City of Duluth, and local citizens. They were organized for specific purposes and often discussed EGS as it related to project goals or outcomes or personal experiences. Research and community participation informed different parts of the R2R2R process when it directly answered the problem the agency was trying to solve.

Case studies are valuable for building theories or hypotheses. The outcomes of this study include the development of two conceptual models (i.e., theories) to help interpret individual decision contexts. Because R2R2R is a complex system comprising USEPA entities, tribal agencies, state agencies, local governments, NGOs, and citizens, this research presents a possible model that demonstrates how the entities work together that should be transferrable to other sites. Identifying who can initiate an action, what policies and programs are appropriate, and how to implement through specific projects, can facilitate the application of research and integration of desired outcomes into management actions and decision-making.

The second conceptual model can be used interpret the value of the environment or modifications to it from different perspectives. The model uses systems thinking to determine how agencies, organizations, and individuals benefit from EGS by interpreting relationships with resources. The model is intentionally broad to capture many dimensions of environmental management (e.g., legal frameworks and funding mechanisms), biophysical environment, and emotional attachments to place.

The conceptual models developed in this research should be tested to evaluate applicability to different USEPA programs and Regional Office-defined problems. This case study started with a description of AOCs as a collaborative approach to environmental management executed by federal and state agencies and local communities to remediate and restore ecosystems. We demonstrated how this approach has created improved environmental conditions, and that communities recognize them and wish to utilize these newly available EGS. We also demonstrated that USEPA supports state agency and local government efforts to remediate and restore the EGS in the aquatic resources (AOC) and on land (revitalization). In the words of one stakeholder, "EPA helps to solve locally-defined problems."

Finally, this research study has informed partners throughout the process and will continue to be applied. For example, MED has communicated with USEPA's Region 5 and GLNPO contacts throughout the study to ensure Regional research needs were met and to extend opportunities for collaboration. In another example, USEPA Region 5 was invited to participate on the Leadership Team for MED's Health Impact Assessment (HIA)[12] on an AOC project. Furthermore, the findings of this report were applied to the scooping phase of the HIA to identify an appropriate project. This report outlines the broad findings, but there are further plans to make these findings useful to SHC, USEPA Region 5, and GLNPO. Future applications include developing applicable fact sheets for specific program elements (e.g., MVD and brownfields) and testing the frameworks in ongoing SHC research areas.

[12] A Health Impact Assessment (HIA) is "a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects" (National Research Council, 2011).

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6.0 Appendices

Appendix A: Beneficial Use Impairments (BUI)

Table 2: List of BUIs (International Joint Commission, 2012).

Beneficial Use Impairments
Restrictions on fish and wildlife consumption
Tainting of fish and wildlife flavor
Degraded fish and wildlife populations
Fish tumors and 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 of aesthetics
Added cost to agriculture or industry
Degradation of phytoplankton and zooplankton populations
Loss of fish and wildlife habitat

Appendix B: Trade-off Analysis to Inform AOC Projects

The table below was submitted to MPCA to inform project designs related to Spirit Lake restoration. The data is not the focus of this demonstration, it is the illustration of how EGS research was organized and presented to a decision-maker to respond to state agency management needs (Angradi et al., 2016).

Table 3. Ecosystem services trade-off analysis created to inform habitat restoration in Spirit Lake for MPCA.

Ecosystem service *	Alternative 8	Alternative 12	Explanation **
Residential-property views			The CDF in Alt 8 blocks river views for a small number of property owners; Alt 12 does not change views.
Fishing from boat or ice			More deep water favored by anglers results from Alt 8; Alt 12 only increases shallow areas.
Human-powered boating			New open water for human-powered boating results from Alt 12; Alt 8 removes open water
Nitrogen processing			Denitrification rates are higher in deeper water provided by Alt 8.
Power boating			Alt 8 provides deep water accessible to power boats.
Esocid spawning			More shallow vegetated habitat favored for spawning results from Alt 12
Wave-energy attenuation			For northeast winds, more wave-energy-reducing shoals result from Alt 12.
Waterfowl hunting			Waterfowl hunting not permitted on MN side of SLRE
Dredged sand for industrial reuse			Service not relevant in project area
Deer hunting[1]			More upland area results from Alt 8; land lost with Alt 12
Aquatic-terrestrial connectivity[2]			More new aquatic-terrestrial interface results from Alt 8
Semi-aquatic fur-bearer trapping[2]			More new aquatic-terrestrial interface results from Alt 8
Native-American spiritual/ceremonial use			Tribes objects to river-adjacent placement of CDF in Alt 8
Wild-rice harvesting			Shallow area created with Alt 12 more favorable to emergent vegetation
Park and trail recreation			Created land (CDF) could be developed for trails; land lost with Alt 12
Waterbird nesting			Riparian CDF resulting from Alt 8 provides potential nesting habitats; Land lost with Alt 12
Fishing from shore			More deep water favored by fisherman results from Alt 8

*= Ecosystem service research

** = State agency management information need

Appendix C: Use of ORD Decision Tools

Decision tools have an impact on local decisions when the tool can be applied to the problem the decision-maker needs to solve. What follows is a discussion of how an ORD tool was applied to support the recommendations made to the City of Duluth's comprehensive planning process. We used the tools to provide evidence about the ecosystem service engagement with nature and social vulnerability which were connected to the comments participants submitted about health and fairness.
We should note that the tools were useful because our relationships with the City of Duluth staff provided opportunities to share ORD tools by creating examples based on their data and information needs.

C.1.1 Application of Eco-Health Browser

The City of Duluth's Comprehensive Plan afforded a chance to demonstrate how the Eco-Health Browser might be applied to create evidence-based recommendations. As described in Section 2.3 and 4.2, the data analysis provided to the City of Duluth was based on a qualitative analysis of submitted public comments that revealed access to social and environmental resources were important to those who participated in the *Imagine Duluth* event. In a report to the City of Duluth Community Planning, MED scientists shared a demonstration of the Eco-Health Browser with the analysis of public input. MED scientists explained that the tool might be useful in the community planning context because open space and conservation of nature was a major focal area for the Comprehensive Plan.

Figure 11 uses "aesthetics and engagement with nature," one of the ecosystem services contained the Eco-Health Browser, as an example. The figure illustrates how the ecosystem is comprised of environmental components (wetlands, urban ecosystems, forests, and agroecosystems; delineated with green arrows), but the availability or absence impact specific dimensions of health (delineated with blue arrows).

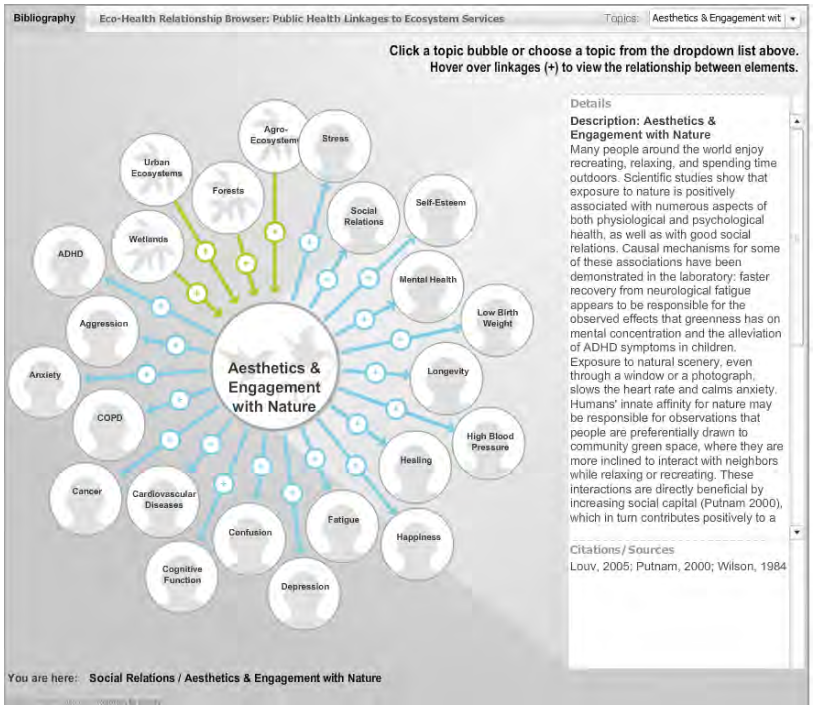

Figure 11. Eco-Health Relationship Browser, illustrating the ecosystem elements that constitute the service Aesthetics and Engagement with Nature and the dimensions of health and well-being to which the service contributes, including mental health. (Source: USEPA, 2017).

MED scientists suggested that the Eco-Health Relationship Browser might be particularly useful because several respondents in the health-fairness exercise specifically suggested that the physical environment of the City could impact health outcomes. In particular: “city environment that reduces stress” and “well planned…and land use provides mental health and quality of life.” MED further explained that the ecosystem service contributes to the improvement of a few health states or conditions, including COPD and cardiovascular disease, anxiety and stress, social relations, high blood pressure, and mental health.

Appendix D: Health in All Policies (HIAP) survey analysis instrument

To support the HIAP efforts to conduct and analyze a survey, MED worked with them to co-produce an analysis instrument that would function similarly to qualitative analysis software. The codes were established by conducting a conventional content analysis (Hsieh & Shannon, 2005) on a sample of the returned surveys. The instrument was refined through consultation with the HIAP members who would be analyzing the survey. HIAP members analyzed the remaining surveys.

The list below represents the codebook that resulted from the HIAP survey analysis.

Housing Questions

Current housing situation
Check all that apply.

- o Apartment
- o Not Affordable
- o Can't afford to move
- o Formerly homeless
- o Through Employment
- o Manufactured housing
- o Own home
- o Problem with landlord
- o Problem with other tenants
- o Smaller than desired
- o Student loans barrier to better housing
- o Subsidized housing
- o Other:

What would be more fair in housing
Check all that apply.

- o Accept pets
- o Accountability for landlords
- o Affordable
- o Allow smoking
- o Assistance to save/get ahead
- o Maintained well
- o More choices
- o Not having to beg
- o Safe
- o Other:

What is not fair in housing
Check all that apply.

- o Housing discrimination
- o Long wait lists/not enough subsidized housing
- o Other:

Transportation Questions

Current transportation situation
Check all that apply.

- o Walk
- o Bus
- o No driver's license
- o Old car
- o Own car
- o Parking tickets
- o Taxi
- o Walk
- o Other:

What would be more fair in transportation
Check all that apply.

- o Allow pets on public transportation
- o Case manager services
- o Grocery bus
- o Lighting for pedestrian and bike routes
- o Lower insurance premiums
- o More bus routes or longer hours
- o More services
- o Protected bike lanes
- o Safe pedestrian routes to schools
- o Sidewalks better maintained
- o Other:

What is unfair in transportation
Check all that apply.

- o Limited bus schedules/routes
- o Other:

Economic Opportunity Questions

Current economic situation
Check all that apply.

- o Background makes it hard to change jobs
- o Disabled
- o Employed
- o Employed in different field (than trained or previous career)
- o Looking for work
- o Lack of degree makes it hard to change jobs
- o Social Security or other Fixed Income
- o Unemployed
- o Use free bus pass
- o Other:

What would be more fair in economic opportunities
Check all that apply.

- o Benefits such as sick-time
- o Child care - affordable, available, easier to access
- o More (Employment) opportunities for young people
- o Equal opportunities
- o Living wages
- o Libraries distributed throughout city
- o More services/support
- o Neighborhood technology centers
- o Resources for entrepreneurs
- o Other:

What is unfair in economic opportunities?
Mark only one oval.

- o Option 1

Open Space Questions

Current situation with open spaces
Check all that apply.

- o Visit Canal Park
- o Use Lakewalk
- o Not accessible
- o No problems
- o Pollution can wreck them
- o Pretty fair and equal
- o Spend time outside - NOT in parks
- o Other:

What would be more fair in open spaces?
Check all that apply.

- o More ATV trails
- o Don't use or don't use in winter
- o More Events
- o More green space
- o More police/security
- o Equitable Neighborhood park maintenance
- o Neighborhood recreation opportunities
- o Police/DPD can be unreasonable
- o Transportation/Easier to get to

How Housing, Transportation, Economic Opportunities, and Open Spaces Impact Health

Check all that apply.

- o Absence = negative impact

- Access --> improves health
- Access = less stress
- Housing = not homeless
- Jobs --> access to basic necessities
- No impact
- Open space --> enjoy nature, people, good for mental health
- Transportation --> access food, medicine, visit family, get to work
- Other:

Demographics

Enter Demographics here

Gender

Mark only one oval.

- Female
- Male
- Other:

Age

Mark only one oval.

- Under 20
- 21-30
- 31-40
- 41-50
- 51-60
- 61-65
- 65+

Ethnicity

Check all that apply.

- Asian
- Black or African American
- Latino/a
- Native American
- Pacific Islander
- White or Caucasian
- More than one of the above
- Other:

Zip Code

Mark only one oval.

- 55802
- 55803
- 55804
- 55805
- 55806

- o 55807
- o 55808
- o Other:

Household Income
Mark only one oval.

- o 0-$10,000
- o $10,000 - $20,000
- o $20,001 - $30,000
- o $30,001 - $40,000
- o $40,001 - $50,000
- o $50,001 - $60,000
- o $60,000+

Identification Information

Appendix E: Social networks in the St. Louis River community of knowledge

Although academic presentations are most numerous on the conference schedule, the St. Louis River Summit organizers support alternative opportunities for discussion and mutual learning. For example, the MNDNR organized a poster at the 2016 Summit to capture participants' relationships with the river. As many participants both live and conduct research in the region, place is both a personal and professional attachment, and an attribute that the agency wished to know more about. MNDNR posted a timeline of the St. Louis River AOC, from the time it was listed until 2050 (Fig. 12). They asked participants to describe their relationships with the St. Louis River AOC as a scientist, manager, educator, media, recreationalist or citizen (could answer more than once) and their specific activities. MNDNR approached scientists at MED for assistance in analyzing the data about how participants describe their role in the AOC and relationships to the river. Although the poster was not conducted as a scientifically-designed survey, there are several observations that surface.

Figure 12. MNDNR poster from 2016 St. Louis River Summit asking participants about their role in, connection to, and activities in the St. Louis River and AOC.

To analyze the submissions, all answers were transcribed and entered into a spreadsheet. The data were then analyzed quantitatively using Node XL (Smith et al., 2010), which is used to visualize basic networks. The data were analyzed along several dimensions, including identity and role (Fig. 13). When examining the results for identity, two trends stand out. First, those who identified as recreators, educators, and citizens nearly always named a second role. In contrast, about half of the scientists and managers did not identify other relationships with the AOC or the river. One observation that can be made from this chart is that in the St. Louis River Summit Community, there appears to be a disconnect between knowledge producers (scientists), knowledge users (managers), or those who might use the resource (recreators, educators, or citizens).

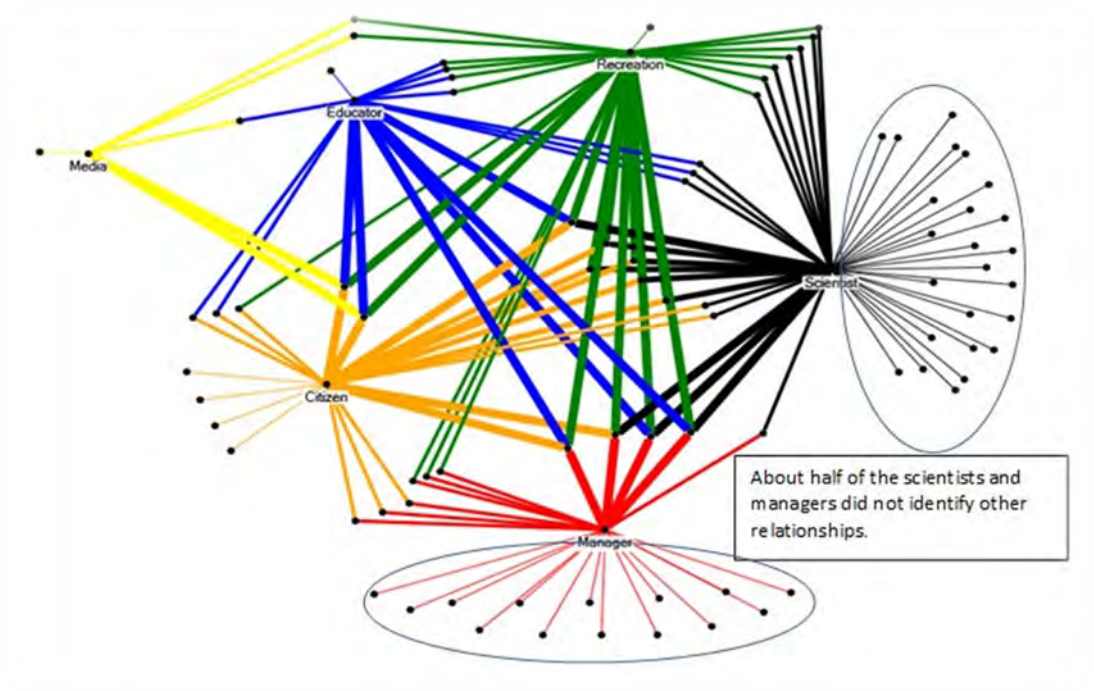

Figure 13. Network nodes in St. Louis River AOC by self-identified role. About half of the scientists and managers self-identify only in a professional role.

Identifying the connections and disconnects is important to MNDNR because of their determination to work collaboratively with other partners in the AOC. They believe that reaching agreements contributes to their ability to connects organizations and agencies, programs, and funding to achieving mutually beneficial goals, as well as plan for the future (MacGregor, Williams, & Bolgrien, 2017).

Appendix F: Neighborhood Model Tool: Mapping the Human Ecosystem for a Place (Reprinted from Johnston et al., 2017)

Overview

The Neighborhood Model is an interpretive or translational tool designed to help identify how elements of the environment (built, social, or natural) contribute to well-being. In this case, the environment may consist of more than the biophysical elements.

> "Furthermore, engaging in environmental restoration work may provide benefits to workers beyond simple employment, including exposure to and interactions with nature, which is a limited "commodity" in many urban locations. In short, *cities are habitat for people*, so the urban design process should *include city residents and integrate a social component* into design objectives and actions."
>
> (Childers et al., 2015, p. 3778; emphasis added)

The neighborhood model is an organizational tool to sort and classify data collected through inductive research methods such as document or archive analysis or participant observation (Fig. 14). Inductive methods facilitate the identification of lived experiences, or day-to-day practices that might be taken for granted, through the participation in events or collection of materials that were created for a purpose important to the organizers or authors. Cheng, Kruger, and Daniels (2003) argued that the physical environment is "not an inert, physical entity 'out there'…but a dynamic system of interconnected, meaning-laden places," (p. 96). The tool is meant to disentangle and classify some of the place meanings to better understand how the environment influences (positively or negatively) community life and how environmental attributes might be valued.

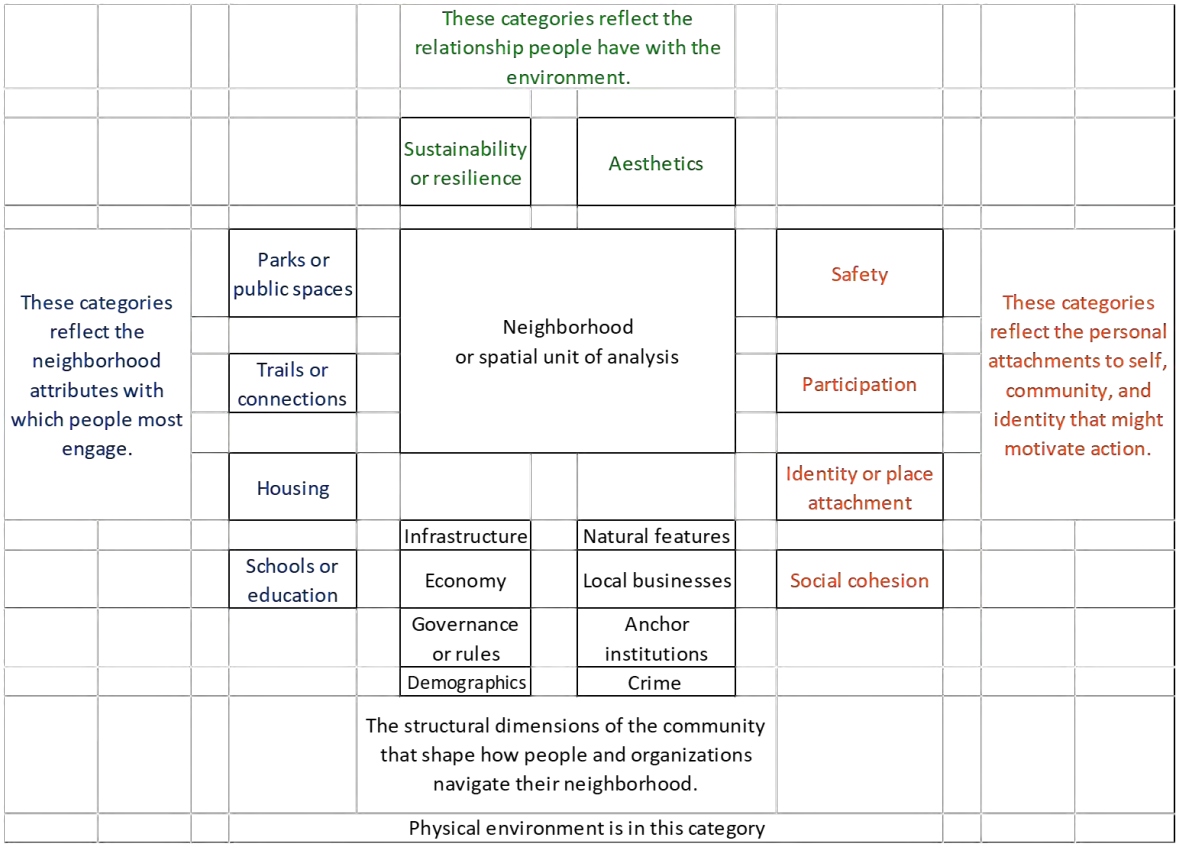

Figure 14. The Neighborhood Model.

Attribute definitions

The neighborhood model tool identifies many neighborhood components that individuals, organizations, or local governments may discuss in the context of their community. The characteristics are a mix of built environment types, structural dimensions, personal experiences, and human-environment relationships. The assemblage of attributes functions as a framework and can be broken into four broad categories. Definitions for each type of attribute are listed in the Methodology section.

Role of critical questions

Critical questions are guiding questions meant to direct the analyst's attention toward the reasons that a particular item might have been included in a document (i.e., they have particular meaning for the neighborhood, organization, document author or other entity in question). Recognition and documentation of such details in environmental research might be a way to integrate local knowledge into inquiry. The application of the framework is meant to shift the discussion away from residents want "x," to why "x" is important for residents. Changing the direction of the conversation is important because "x" is often context dependent – as in the context of the neighborhood or geographic area. The item in question is attached to something else that is an essential element to how "x" is perceived to be important for residents. A set of critical questions for each attribute are listed in the Methodology section.

Methodology

A two-step process can be used to guide in the coding of text-based data:

1. Decide to which broad category, and the subsequent attributes, a piece of text data belongs: (1) engaging attributes (parks, trails, housing, schools); (2) physical environment attributes (infrastructure, economy, anchor institutions, governance, including rules, politics, program requirements ,natural features, demographics, crime); (3) personal attachment attributes (safety, identity, self-determination or participation, identity or character, or social cohesion); or (4) relationship with the environment attributes (sustainability, aesthetics).

2. Conduct a content analysis on the answers to the critical questions for each category. The pattern that emerges reflects what the identified element contributes to well-being as defined by the source of the text data.

ENGAGING ATTRIBUTES IN THE BUILT ENVIRONMENT

Parks

People visit parks to relax, commune with nature, find peace, be with friends, play sports, or experience other recreation (Chiesura, 2004). Parks are an integral part of a sustainable city. Access to quality parks and greenspace is often cited as a positive contributor to health and well-being.

Critical questions:

- What do residents/the authors/document say about the parks?
    - Are they a place to gather?
    - A place to avoid?
    - A place for events?
- What do people do in the parks?
    - Both positive and negative

Trails or Connections
Trails can connect neighborhoods to each other, as well as amenities and other destinations. Trails can be considered both linear parks and infrastructure for transportation. "The cities that are deemed most vibrant and alive are the ones where large numbers of people move around outside their cars in the public realm (Erickson, 2006, p. 139)."

Critical questions:

- What do residents/the authors/document say about the trails?
    - Are they for transportation?
    - Do they link the neighborhood to important things?
        - Businesses
        - Features or points of interest
        - Important resources (water, scenic places)
        - Cultural resources
    - Something to avoid?
        - Go by dangerous/undesirable sites
        - Not enough lights
        - Trash, debris, industry (smells bad)
        - No
- Important for visitors
    - Both positive and negative
    - From the suburbs or somewhere else nearby
    - From far away (tourist destination)

Housing
Community advocates argue that overburdened neighborhoods are impacted by multiple environmental stressors (Morello-Forsch et al., 2011). Community leaders further contend that social factors including *housing quality* and neighborhood composition may impact long-term well-being. "We conclude that current environmental policy…should be broadened to take into account the cumulative impact of exposures and vulnerabilities encounter by people who live in neighborhoods consisting of largely racial or ethnic minorities or people of low socio-economic status (Morello-Forsch et al., 2011, p. 879/abstract)."

Critical questions:

- What do residents/the authors/document say about housing?
    - Is the housing adequate?
    - Does the document refer to the demographics of the residents?
    - Talk about foreclosures/tear-downs?
- Does the document mention vacant lots?
- Opportunities for building?
- Substantial repair?
- What is the voice of the document?
    - Protective of the neighborhood?

- A need to change or improve the neighborhood?

Schools/Education
Schools are a critical community resource for learning, community cohesion and sometimes other basic needs. Schools are the place where children spend a lot of time – in class and in after-school activities. Additionally, schools can be important to the identity of the neighborhood, especially through sports. Scholars argue that the quality of schools is often linked to the quality of the neighborhood.

Critical questions:

- What do residents/the authors/document say about the schools?
  - Are they a place to gather?
  - A place to avoid?
  - A place for events?
  - A place to learn?
  - A place to access services?
- What do people do in the schools?
  - Both positive and negative
- Do they (the source of the documents or notes) mention intergenerational programming?
- Are the schools a source of pride?
- Is there a neighborhood school or is the school somewhere else?

PHYSICAL ENVIRONMENT ATTRIBUTES

Infrastructure
Infrastructure shapes and facilitates how people move around their neighborhood. Roads, sidewalks, water/sewer, street lights, interstates, ports, pipelines can enhance or detract from connectivity and/or quality of life in the neighborhood.

Critical questions:

- What do residents/the authors/document say about infrastructure?
  - It is in good/bad repair?
  - It works well/does not?
  - It enhances/detracts from the neighborhood?
  - Infrastructure serves…residents? Industry?
  - It directs users to or away from the neighborhood?

Natural Features
The dominant natural features shape neighborhood layout, experience, and affect (or disaffect). Parks are often the access points to natural features such as hills, grasslands, rivers and streams. Natural features include topography, water, vegetation, and climate. In Sustainable and Healthy Communities research, natural features may be an ecosystem service or an indicator of an ecosystem service.

Critical questions:

- What do residents/the authors/document say about natural features?

    - Water bodies, rivers/streams, rocks (including bedrock), mountains, soil
- Do they mention natural features?
- Does the neighborhood have access or do they want it?
- Is the natural feature a positive feature?
- Is it or has it been a hazard?
- Why was it mentioned?
- What do they want to do with it?

Government (any level) or Rules
Government might be local, state, or federal governments. These governmental entities might be impacting the neighborhood in positive and/or negative ways. Government may be repairing something in the landscape (e.g., road, park, water/sewer line, interstate highway), creating plans (e.g., land use, site, neighborhood) for the neighborhoods or whole city. A short hand for knowing whether government is the right category is if there is something wrong – is there an office that someone might call to get the problem resolved?

Critical questions:

- What do residents/the authors/document say about natural features?
    - Water bodies, rivers/streams, rocks (including bedrock), mountains, soil
- Do they mention natural features?
- Does the neighborhood have access or do they want it?
- Is the natural feature a positive feature?
- Is it or has it been a hazard?
- Why was it mentioned?
- What do they want to do with it?

Demographics & Crime
Demographics and crime (i.e., statistics, numbers, or objective data) are generally large datasets that summarize the characteristics that can be counted and aggregated for a geographic area. The most common source of demographic data is the U.S. Census Bureau. The Pew Research Trust, the Centers for Disease Control, and the National Oceanic and Atmospheric Administration, as well as state and local governmental entities, have all analyzed the data to produce demographic products (i.e., the Social Vulnerability Index).

Critical questions:

- What do residents/the authors/document say about demographics or crime?
    - It is in good/bad for the neighborhood or geographic area?
    - It enhances/detracts from the neighborhood?
    - It directs visitors or residents to or away from the neighborhood?
- Why was it mentioned?

Economy
Economy in the context of document analysis might include: discussion of the macro-economy (e.g., national economy and how it impacts the neighborhood – such as the loss of large industrial

manufacturers); local economy and local businesses; the purchasing behavior of residents; development of industrial sectors (e.g., tourism, retail, agriculture, or manufacturing); and/or property values.

Critical questions:

- Do residents/the authors/document discuss any economic indicators?
    - Discussed as a positive or negative for the neighborhood or geographic area?
    - It enhances/detracts from the neighborhood?
    - It directs visitors or residents to or away from the neighborhood?

Health Care and/or Facilities (Anchor Institutions)
The presence of health care facilities and pharmacies in a neighborhood is an important indicator of access to care for families and the elderly (less mobile). At the same time, the presence of such facilities is considered assets. Place-based enterprises, including universities, hospitals and cultural institutions, are important foci of community redevelopment efforts.

Critical questions:

- What do residents/the authors/document say about health care facilities?
    - It is in good/bad for the neighborhood or geographic area?
    - It enhances/detracts from the neighborhood?
    - It directs visitors or residents to or away from the neighborhood?
- Why was it mentioned?

PERSONAL ATTACHMENT ATTRIBUTES

Safety (lighting, traffic, etc.)
Safety, a rather large concept, is "the condition of being safe from undergoing or causing hurt, injury, or loss" (Merriam-Webster Dictionary, 2017). In a neighborhood, there are any number of conditions that could cause harm: environmental conditions that promote the growth or movement of disease vectors; exposure to risk (e.g., air or water pollution); inadequate lighting; poorly maintained infrastructure; hazardous traffic conditions. In many ways, safety issues are the conditions that cause residents or other stakeholders to contact governmental entities. If crime is mentioned and coded in this section, it means the author/speaker feels that their personal safety is threatened by perceived crime.

Critical questions:

- What do residents/the authors/document say about safety?
    - It is in good/bad for the neighborhood or geographic area?
    - It enhances/detracts from the neighborhood?
    - It directs visitors or residents to or away from the neighborhood?
- Why was it mentioned?

Participation (desire to/opportunity for/capacity to)
Participation or participatory democracy is often held up as a method for improving environmental decisions that impact the public by giving residents a voice in the process. In short, citizens often (not always) want a voice in their own neighborhood's development. In fact, the outcome may not matter – a seat at the table and knowing they were heard is sometimes enough.

Critical questions

- Do residents/the authors/document mention a desire to participate?
- If so, why?
- Are they asking for any particular "thing" or are they asking to be part of the process?

Identity and Place Attachment

Identity is complex and can include the personal, political, social, or organizational. Identity is a function psychological processes, but might manifest themselves in a number of ways in neighborhoods or communities. Identity with a neighborhood or place can be affective, reactionary, and protective based on the type of connection to the place.

Identity and place are also contested terms and might result in competing definitions of the potential value of a place. For the purpose of this guide, identity will refer to how a group (neighborhood or otherwise) describes itself or origin; how the place is rooted in history; and/or how the group identifies the space they claim.

Critical questions

- How residents/the authors/document describe themselves?
    - Do they articulate a "claim" for a particular place (e.g., this neighborhood is…)?
    - How/do they describe history?
    - What do the residents/authors/document want to protect?

Social Cohesion (Local Groups, Organizations, Churches)

Local organizations, including service and advocacy groups, are important resources in a community. They are potential community assets, knowledge brokers, gatekeepers and collaborators. Religious communities, libraries, block groups, park organizations, cultural or neighborhood groups might all be reflections of collective action in the area.

Critical questions

- Are local organizations mentioned by residents/authors/document?
- Are these groups considered stakeholders?
- How are they described? What are their roles?

RELATIONSHIP WITH HUMAN-ENVIRONMENT ATTRIBUTES

Sustainability

Sustainability could mean sustainability in the intergenerational equity sense (Summers & Smith, 2014), or might mean how the neighborhood can be sustained and less vulnerable to elements such as pollution, flooding, loss of jobs or food insecurity. Sustainability can refer to how a neighborhood enhances its own sustainability or builds resilience including neighborhood beautification, other placemaking activities, community gardens, or green infrastructure.

Scholars debate sustainability, but many are beginning to recognize that sustainability is a process that is or should be inclusive, interdisciplinary, and intentional. Sustainability might be reflected in any strategy that attempts to improve well-being of both humans and the environment simultaneously.

Critical potential indicators (not an exhaustive list):

- Food security or community gardens
- Green infrastructure
- Floodplain enhancement
- Trees/shade/temperature control
- Targeted plantings
- Improving ecological function for the human population

Aesthetics (i.e., how the neighborhood should look)
One definition of aesthetics is the governing principles that define an idea of beauty at a particular time or place (Random House, 2016). Furthermore, landscape ecologists have argued that what makes a landscape pleasing is context dependent and limited to the "human perceptual realm" (Gobster, Nassauer, Daniel, & Fry, 2007).

Critical questions

- Do residents/the authors/document mention changing the landscape to change their experience with some element in the neighborhood?
    - It could be positive…want to enhance views of a feature
    - It could be negative and framed as a buffer to some element that detracts from the neighborhood experience, (e.g., a buffer for noise, sound, smells)
- If so, do they describe why the enhancement would be important?

> "The environment is not an inert, physical entity "out there" with trees, water, animals, and the like, but a *dynamic system of interconnected, meaning-laden places*. Biophysical attributes may be the most obvious features of places; however, those attributes are constantly altered by social and political processes (e.g., *personal experiences, community uses, regional economic production, national conservation policies*) and vary greatly in their social and cultural significance."
>
> (Cheng, Kruger, & Daniels, 2003, p. 96; emphasis added)

Example
As an example, a set of comments from a neighborhood planning exercise were sorted according to the model. All comments regarding how participants felt the neighborhood *should look* were coded as "aesthetics", one attribute within the broader category of human-environment relationships. The source of comments is provided at the end of each comment.

Aesthetics
Cohesion and design

- Consult local organization/urban design student plans for reuse site. (Stakeholders)
- Major arterial road lacks the presence of businesses that provide "cues" to the proximity of the nearby trail system. (Technical advisors)
- Major arterial road needs an "amenity plan" that extends from the business area down to the recreational hubs further to the west. E.g., banners. (Technical advisors)
- Entrance to arterial highway has blight and lots of scrub vegetation….if this were cut down and cleaned up, it would make a more inviting entrance to the regional recreation area. (Conservation organization)

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