Northeastern Minnesota Compensation Siting: Alternative Wetland Mitigation Options



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Abbreviations

ACOE	United States Army Corps of Engineers
BSA1	Bank Service Area 1
BWSR	Board of Water and Soil Resources
DNR	Minnesota Department of Natural Resources
EPA	U.S. Environmental Protection Agency
HUC	hydrologic unit code
MDA	Minnesota Department of Agriculture
MnRAM	Minnesota Routine Assessment Methodology
MPCA	Minnesota Pollution Control Agency
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
Siting Report	*Siting of Wetland Mitigation in Northeast Minnesota*
SWCD	Soil and Water Conservation District
Team	Interagency Northeast Mitigation Siting Team
TMDL	total maximum daily load

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Appendix A includes additional individuals that provided information on the identification of implementation activities provided in this report.

Principal Tetra Tech staff contributing to this project were Jennifer Olson, Andrea Plevan, and John Stein.

Of note, the principal reviewers of this document agree that the scale of analysis in the report is sufficient and, as is, tests the limit of reliability of the underlying data sets. The report provides watershed-based information that can be used to discern how to meet the larger mitigation needs of this area, help guide compensatory site selection and provide a solid template for more project-specific discussions. This document is not a regulation or rule and does not impose any binding requirements on U.S. Environmental Protection Agency, any other federal or state agency, or the public.

1. Introduction and Background

The Interagency Northeast Mitigation Siting Team (Team), composed of the Board of Water and Soil Resources (BWSR), Minnesota Department of Natural Resources (DNR), Minnesota Pollution Control Agency (MPCA), St. Paul District Army Corps of Engineers (ACOE), and U.S. Environmental Protection Agency (EPA) Region 5, developed *Siting of Wetland Mitigation in Northeast Minnesota* (Siting Report) in March 2014, which identified alternative mitigation options that could potentially be used to meet mitigation requirements. The primary authors of the Siting Report were representatives from BWSR, ACOE, and DNR.

The objective of this project is to identify example project opportunities within Bank Service Area 1 (BSA1) that could be considered for alternative mitigation as defined in the Siting Report. This project involves three main tasks:

> Task 1. Research opportunities that could be classified as alternative mitigation options through extensive document review and interviews with recognized experts.
>
> Task 2. Identify potential site-specific projects and provide a landscape-level analysis to inventory potential project opportunities.
>
> Task 3. Rank watersheds based on the availability of potential project opportunities and their preservation or restoration potential.

The project also includes development of a Quality Assurance Project Plan [not included in this document].

The project area is limited to BSA1 (Figure 1), which is in part of the state where greater than 80 percent of the pre-European settlement wetland areas remain. This "greater than 80 percent area" is identified in the St. Paul District Policy for Wetland Compensatory Mitigation in Minnesota[1], which includes special policy considerations. This report presents a summary of information offered by the collective group, which can be shared and referenced by all including the public, state and other federal agencies, tribes, environmental groups, and other stakeholders.

[1] U.S. Army Corps of Engineers, Saint Paul District. 2009. Saint Paul District Policy for Wetland Compensatory Mitigation in Minnesota. 83pp. Available at: http://www.mvp.usace.army.mil/Portals/57/docs/regulatory/MN-Special/Final%20St.%20Paul%20District%20Policy%20for%20Wetland%20Compensatory%20Mitigation%20in%20MNs.pdf

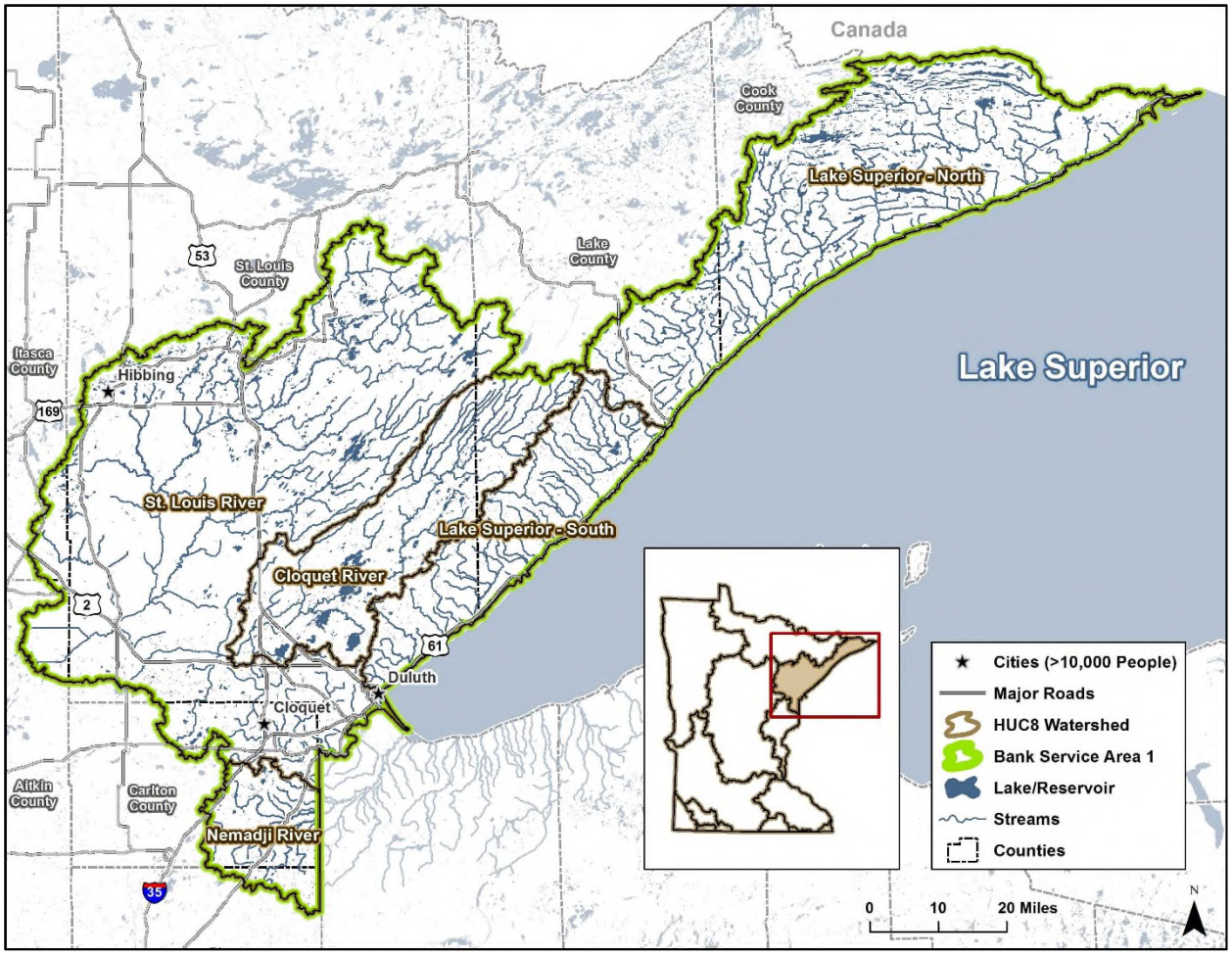


Figure 1. Project area

1.1. Background

Ongoing and projected impacts to wetlands in northeast Minnesota are creating high demand for wetland compensatory mitigation. In Minnesota, wetland restoration is often associated with re-establishing natural hydrology in areas that were previously drained. However, due to the high prevalence of wetlands and the relative lack of typical wetland restoration opportunities in northeast Minnesota, opportunities to meet the demand through traditional mitigation approaches are limited. An interagency effort was needed to evaluate and reconcile federal and state wetland replacement siting requirements and make recommendations for how best to achieve high quality wetland replacement consistent with watershed needs, the federal Clean Water Act, and statewide wetland goals, while maintaining the ecological integrity of watersheds in northeast Minnesota where impacts are permitted.

The Team identified several recommendations in the Siting Report to address the need for high quality wetland mitigation sites[2] as described in the following excerpt:

- *Wetland Mitigation Search Criteria – Clarify and better coordinate the criteria used under state and federal regulatory programs to evaluate the acceptability of wetland mitigation proposals. These criteria are important, as they play a role in determining when applicants are allowed to proceed to subsequent steps in the wetland replacement siting sequence (see below).*
- *Alternative Mitigation Options in Northeast Minnesota – Develop an expanded suite of alternative mitigation options for northeast Minnesota aimed at maintaining and improving the aquatic resources in those watersheds. State and federal wetland regulations have an established preference for mitigating wetland impacts in the same watershed in which the impacts occur. However, northeast Minnesota has a relative lack of "traditional" wetland mitigation opportunities such as wetland restoration. The Team recommends the following alternative mitigation options that provide an opportunity to target specific aquatic resource functions that would benefit northeast Minnesota watersheds including: (1) expanding the eligibility criteria for preservation credit, (2) restoration and/or protection of riparian corridors and streams, (3) hydrology stabilization of altered waterways, (4) peatland hydrology restoration, and (5) credit for completion of certain approved watershed plan implementation projects.*
- *Replacement Wetland Siting Sequence – Develop a wetland replacement siting sequence for wetland impacts in northeast Minnesota that addresses northeast Minnesota watershed needs where practicable and otherwise addresses state wetland policy goals. Under current policy, mitigation may be located in a different major drainage basin than the impact when practicable in-watershed options are demonstrated to be not available. In those cases, the link to watershed integrity is lost and there is currently no clear resource-based rationale for the location of the mitigation. The Team recommends a watershed-based replacement siting sequence, consistent with current policy that emphasizes replacement in northeast Minnesota watersheds (beginning with minor watersheds and progressing to the Lake Superior and Rainy River Basins). However, when no practicable mitigation options are available in northeast Minnesota watersheds, the Team recommends mitigation should be located in an area of the state that has been designated as high priority for wetland restoration. As an example, the Team has cited a number of state-level strategies that identify the Prairie Pothole Region of Minnesota as high priority for wetland restoration. Smaller scale high priority areas could also be designated, and the details of a designation process are under consideration. Mitigation projects may be considered in areas of the state not identified as high priority areas but at higher replacement ratios.*

[2] Siting of Wetland Mitigation in Northeast Minnesota, Issues, Recommendations, and Alternatives from the Interagency Northeast Mitigation Siting Team, March 7, 2014.
http://www.bwsr.state.mn.us/wetlands/Siting_of_Wetland_Mitigation_in_%20NE_MN_3-7-14.pdf
http://www.bwsr.state.mn.us/wetlands/wca/NE_MN_mitigation/NE_Minn_Mit_Siting-Main_Concepts_FINAL.pdf

- *Other Recommendations for Program Improvement – Procedural recommendations that include (1) establishing an inventory of siting analyses and potential mitigation sites evaluated, (2) establishing a "rapid response" interagency review team, and (3) promoting private wetland banking.*

In addition to the concepts discussed above, the Team identified for consideration the following alternative mechanisms for accomplishing mitigation that may be more effective than current processes in producing outcomes that maximize public benefits:

- *Northeast Regional Wetland Mitigation Cooperative (Umbrella Bank) -- A partnership between private entities that focuses on establishing in-advance wetland banking credits.*
- *In-Lieu Fee Program – Wetland permit applicants pay a fee to an entity operating the In-Lieu Fee program (a non-federal public entity or a non-profit organization with expertise in northeast Minnesota and other priority areas), which uses the funds to develop the required mitigation credits.*

The Siting Report only addresses aspects of compensatory mitigation and does not affect nor dilute other regulatory requirements such as the need to first avoid and minimize wetland impacts. The Clean Water Act Section 404(b)(1) guidelines outline a three step sequencing process that is required before a 404 permit proposing impacts to wetlands can be issued: (1) avoidance, (2) minimization and (3) compensatory mitigation:

> *The district engineer will issue an individual section 404 permit only upon a determination that the proposed discharge complies with applicable provisions of 40 CFR part 230, including those which require the permit applicant to take all appropriate and practicable steps to avoid and minimize adverse impacts to waters of the United States. Practicable[3] means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. Compensatory mitigation for unavoidable impacts may be required to ensure that an activity requiring a section 404 permit complies with the Section 404(b)(1) Guidelines*[4].

In general, state and federal wetland regulatory programs require applicants to first search for mitigation sites close to the impact site before allowing mitigation to move farther away, outside the major watershed or bank service area boundaries. Applicants must demonstrate they have conducted a thorough, watershed-based analysis for locating compensatory mitigation before moving outside of the watershed of impact. Clarification on wetland sequencing criteria is another recommendation identified in the Siting Report.

[3] This definition was developed primarily for the evaluation of alternatives during the review of Clean Water Act Section 404 permit applications but has also been incorporated into the process for identifying mitigation sites.
[4] 40 CFR 230.91(c)(2)

1.2. Alternative Mitigation Options

The Team recommended five alternative mitigation options that would benefit northeast Minnesota watersheds and are being considered in this evaluation (in no specific order):

- **Expanded Use of Preservation** – Clarify for applicants and staff that preservation is a viable and accepted mitigation option in northeast Minnesota and expand eligibility criteria to allow credit for larger amounts of upland areas that provide habitat connections and/or water quality benefits to aquatic resources.
- **Restoration and/or Protection of Riparian Corridors and Streams** - Allow mitigation credit for the preservation or restoration of buffers adjacent to trout streams and other sensitive northeast streams, and for stream restoration projects that include such actions as re-meandering lost channels, streambank stabilization, and day-lighting buried/piped streams.
- **Stabilization of Natural Hydrology** - Restoring and stabilizing the natural hydrologic regime of altered waterways can restore the functionality of adjacent or nearby wetlands.
- **Peatland Hydrology Restoration** - The hydrologic restoration of partially drained peatlands through strategic ditch blocks can improve the affected peatland and provide downstream water quality and quantity benefits.
- **Approved Watershed Plan Implementation Projects** - Allow wetland mitigation credit for the completion of certain approved watershed plan implementation projects as a means to address water quality within northeast Minnesota.

Traditional wetland mitigation opportunities have been previously documented in northeast Minnesota[5]. There is a need to first evaluate traditional wetland mitigation opportunities, specifically wetland restoration, enhancement, preservation, and creation, prior to considering alternative methods. Alternative mitigation options may be exercised in concert with traditional mitigation options in the watershed of impact to gain additional credit (traditional mitigation plus alternative mitigation equals full mitigation package) and implemented when other traditional wetland mitigation options are not available or practicable. Alternative forms of mitigation are considered to ensure that compensatory mitigation projects are sited within the same service area where the impact occurs in order to address identified watershed functional needs.

Functional replacement is a fundamental objective of compensatory mitigation per the Federal Rule and compensatory mitigation must be, to the extent practicable, sufficient to replace lost resource functions[6]. This project gives consideration to aquatic resource functions as part of the site-specific analysis while the watershed specific analysis is driven by a watershed approach. The analysis attempts to consider the full range of factors involved with siting compensatory mitigation as listed in the Rule including sources of

[5] Northeast Minnesota Wetland Mitigation Inventory and Assessment Phase 1: Final Inventory Report, January 2009. http://www.bwsr.state.mn.us/wetlands/wca/NE_MN_mitigation/NE_Inventory_Phase1-Report.pdf.

Northeast Minnesota Wetland Mitigation Inventory and Assessment Phase II: Final Assessment Report, January 2010. http://www.bwsr.state.mn.us/wetlands/wca/NE_MN_mitigation/NE_Assessment_Phase_II-Report.pdf.

[6] 40 CFR § 230.93(f)

watershed impairment, identification of aquatic resource needs within watersheds and the protection and maintenance of terrestrial resources, such as non-wetland riparian areas and uplands, when those resources contribute to or improve the overall ecological functioning of aquatic resources in the watershed[7].

Table 1 details the implementation activities that may be considered for each of the five alternative mitigation options. For each alternative mitigation option, different project types were identified in coordination with the Team. These project types are examples that may be creditable under the rule; each project type has the potential to replace lost wetland functions.

Table 1. Types of potentially creditable implementation activities under each alternative mitigation option

Alternative Mitigation Option	Type of Implementation Activity	Description
Expanded use of preservation	Permanent protection of large tracts of land	Permanent protection of large tracts of land focused on sensitive species habitats, aquatic buffers, shoreline habitat (lake and river fringe wetlands), upland high priority areas, areas with significant natural heritage value such as wild rice lakes, and high-conservation-value upland-wetland mosaics.
Restoration and/or protection of riparian corridors and streams	Restoration of riparian buffers, corridors, and shoreline	Restoration activities within the stream corridor, specifically natural buffer restoration.
	Stream restoration and restoration of natural stream hydrology	Restoration activities within the stream channel and corridor that will restore hydrology such as re-establishing lateral connectivity where a stream is incised and re-connecting floodplains with streams. Activities could include the restoration of natural channel design (i.e., establishing appropriate stream pattern, profile and dimension) and streambank stabilization or restoration.
	Improve natural hydrologic conditions and aquatic habitat	▪ Improve fish passage (e.g., replace undersized culverts that restrict fish passage) ▪ Replace culverts that contribute to stream instability, erosion, and bank/bluff failures) ▪ Reconstruct road embankments by replacing road bed with more porous medium to allow hydrologic connectivity (for example, a road along a stream where the road cuts the stream off from its floodplain, or where a road transects a wetland and cuts off hydrologic connection) ▪ Re-establish lateral connectivity where streams are incised ▪ Modify or remove dams
	Miscellaneous	Other types of projects not specifically listed above in the stream channel and corridor that will provide benefits to the watershed and potentially replace lost wetland functions.

[7] 40 CFR § 230.93(c)(2)

Alternative Mitigation Option	Type of Implementation Activity	Description
Stabilization of natural hydrology	Restoration of large-scale wetland hydrology	Using ditch blocks or similar, which may restore hydrology and natural fluctuations in the water table over a large area. Retaining runoff in areas with excessive drainage to protect/restore hydrology downstream.
Peatland hydrology restoration	Restoration of peatland hydrology	Using ditch blocks or similar to restore hydrology to peatlands. Eliminating or complete filling of ditches
	Restoration of peatland vegetation	Vegetation restoration activities (e.g. addressing plant diversity and/or invasive species coverage).
Approved watershed plan implementation projects		Projects that do not fit within any of the above categories and have been identified in a watershed or state plan or by an agency or organization that is familiar with the watershed.

2. Methods and Approach

The overall approach to this analysis is to first identify potential alternative mitigation activities at both a site-specific and at a HUC12 watershed scale. This inventory is then paired with an analysis of watershed restoration or preservation needs to create a final watershed ranking. Higher ranking watersheds would be good candidates for an agency or permittee to further evaluate for potential alternative mitigation options.

2.1. Inventory of Potential Implementation Activities

Two approaches were used to inventory implementation opportunities for each of the alternative mitigation options including (1) identifying site-specific implementation activities from existing watershed plans, studies, and other sources of information and (2) landscape-level modeling to inventory broader implementation opportunities at a watershed scale. Information was gathered from the Team, state and federal resources, recognized experts, and outside parties including tribes, universities, and non-governmental organizations to identify implementation activities that could be used as alternative mitigation options.

2.1.1 Site-Specific Implementation Activities

Site-specific implementation activities that could potentially be used as alternative wetland mitigation were compiled through review of plans, reports, and studies and through interviews with members of the Team and other interested parties. These projects have varied level of detail available and have known locations.

An inventory of potential implementation activities was compiled from the following plans, studies, and reports:

- Carlton County Comprehensive Local Water Management Plan, 2014-2020
- Cook County Comprehensive Local Water Management Plan, 2014-2024
- Deer Creek Turbidity TMDL Implementation Plan, 2013
- Economic Assessment of Green Infrastructure Strategies for Climate Change Adaptation: Pilot Studies in the Great Lakes Region, 2014
- Ecosystem Analysis of the Sand Lake/Seven Beavers Project Area, in the Upper St. Louis River Watershed, MN, 2005
- Fisheries Management Plan for the Minnesota Waters of Lake Superior, 2006
- Fond du Lac 2008 Integrated Resource Management Plan
- Grand Marais Area Storm Water Management Plan, 2001
- Great Lakes Restoration Initiative Action Plan, 2010
- Knife River Turbidity TMDL Implementation Plan, 2011
- Lake County Local Water Management Plan Update, 2006-2015
- Lake Superior Basin Plan
- Lake Superior Lakewide Management Plan, 2008
- Lower Poplar River Watershed Sediment Source Assessment, 2013
- Minnesota Statewide Conservation and Preservation Plan, 2008
- Northeast Minnesota Wetland Mitigation Inventory and Assessment, Phase 2, 2010
- North Shore Management Plan Update, 2004
- Planning for the Forests of the Future: Updating Northeast Minnesota's Forest Management Strategies, 2011
- Poplar River Sediment Source Assessment, 2010
- Poplar River Turbidity Assessment, 2008
- Poplar River Water Quality Restoration: Implementation Plan for Turbidity Reduction, 2014
- St. Louis County Comprehensive Water Management Plan, 2010-2020
- St. Louis River Area of Concern Implementation Framework: Roadmap to Delisting (Remedial Action Plan Update), 2013
- Two Harbors Storm Water Management Plan, 2001

Staff from the following entities were contacted and interviews were conducted with those who responded: ACOE, BWSR, DNR, MPCA, United States Forest Service, EPA Mid-Continent Ecology Division, South St. Louis County Soil and Water Conservation District (SWCD), Lake County SWCD, Cook County SWCD, Carleton County SWCD, St. Louis River Alliance, Fond du Lac Band of Lake Superior Chippewa Reservation, Grand Portage Reservation, and United States Fish and Wildlife Service (see Appendix A).

Each potential implementation activity was assigned wetland functions that would likely be replaced based on the available project descriptions. The following wetland functions, which are adapted from BWSR's Minnesota Routine Assessment Methodology (MnRAM), are assigned to the relevant site-specific projects:

1. Maintenance of characteristic vegetative diversity/integrity
2. Maintenance of hydrologic regime
3. Flood/stormwater attenuation
4. Downstream water quality
5. Maintenance of wetland water quality
6. Shoreline protection
7. Maintenance of characteristic habitat (wildlife habitat structure, fish habitat, and amphibian habitat)

Whereas these functions apply directly to wetlands in MnRAM, here the functions are considered in terms of how they apply to water resources in general. For example, for the "downstream water quality" function, the end result is the same if the function is applied to wetlands or other types of water bodies. For example, a wetland can provide storage for settling of particulates and a stream restoration project can reduce sediment loading; in both cases the sediment load to downstream water bodies is reduced. Some wetland functions such as those related to habitat would provide similar but not the same functions in a stream or lake environment, depending on the type of flora or fauna that are present.

Assignment of these functions was conservative and is a matter of project interpretation based on interviews and document review, and will need to be re-visited when project specific proposals are developed. For example, many streambank stabilization projects will ultimately improve aquatic habitat; however, the habitat function was assigned to an implementation action only if habitat improvement or fish passage improvement was explicitly mentioned as a project goal.

2.1.2 Watershed Scale Project Activities

Landscape-level modeling techniques using GIS were used to inventory potential project opportunities at a HUC12 watershed scale. Specific project locations are not provided due to scale and resolution of datasets, but HUC12 watersheds with the greatest level of opportunity for each potential project type are identified. The following project types were evaluated:

- Permanent protection of large tracts of land
- Restoration of riparian buffers, corridors, and shoreline
- Stream restoration and restoration of natural stream hydrology
- Improve natural hydrologic conditions and aquatic habitat
- Peatland hydrology restoration

Two project types were not considered in this analysis due to lack of available datasets: restoration of large-scale wetland hydrology and restoration of peatland vegetation. These project types could be evaluated in the future as new datasets are developed and made available. Several spatial datasets (Table

2) were used to identify the watershed-scale project activities. These datasets vary in resolution, which is taken into consideration when presenting results later in this report. Specifically, the use of the National Land Cover Database (NLCD) has been found to have errors of omission and commission which can lead to misrepresenting land cover, particularly woody wetland and forest classes. The NLCD is also based on a 30-meter grid, therefore errors in land cover classification are more likely in smaller areas (less than 30-meters square). It is due to these potential errors that many of the results are aggregated and presented at a HUC12 watershed scale and not at a smaller site-specific scale.

The level of opportunity in each HUC12 was ranked into five groups (high, moderate-high, moderate, moderate-low, and low) to identify watersheds according to both the area or length and density of opportunity. The inventory approach and maps are presented in the following sections; they are combined with other interim maps to produce the final suitability results maps in Section 3.2.

Table 2. Secondary datasets

Data type	Source	Description
Geography and physical		
Aerial imagery	Multiple agencies	Google Earth Pro (2013, 2014)
Land use and land cover	Multi-Resolution Land Characteristics Consortium	2011 National Land Cover Database (NLCD)
Geology	Minnesota Department of Natural Resources	Biwabik Iron Formation, Current and Future Auxiliary Mine Lands
Ecology	Minnesota Department of Agriculture	AgroEcoregions
	Natural Resources Research Institute and Board of Water and Soil Resources	Ecological Ranking Tool
	Minnesota County Biological Survey	Sites of Biodiversity Significance
Hydrology and hydrography		
Streams	Minnesota Department of Natural Resources	24K Streams
	Minnesota Department of Natural Resources	Trout Stream Designation
	Minnesota Pollution Control Agency	Altered Watercourses
	Minnesota Pollution Control Agency	Impaired Streams, Draft 2014 List
	Minnesota Department of Natural Resources	Stream Routes with Strahler Stream Order
Lakes	Minnesota Department of Natural Resources	24K Lakes
	Minnesota Department of Natural Resources	Trout Lake Designation
	Minnesota Pollution Control Agency	Impaired Lakes, Draft 2014 List
	Minnesota Department of Natural Resources	Wild Rice Lakes Identified by Minnesota Department of Natural Resources
Wetlands	United States Fish and Wildlife Service	National Wetland Inventory
	Board of Water and Soil Resources	Minnesota Wetland Banking Program Easements (5/11/2015)
Dams	Minnesota Department of Natural Resources	Inventory of Dams
Other		
Roads	Minnesota Department of Transportation	Route Segments
Watershed boundaries	United States Geological Survey	HUC8 and HUC12 Watersheds
Land ownership	Minnesota Department of Natural Resources	GAP Stewardship 2008
Administrative boundaries	Minnesota Department of Natural Resources	Boundary Waters Canoe Area Wilderness Boundary (1978), State Wildlife Management Areas, Scientific and Natural Areas, State Forest Boundaries, State Administered Lands with Minnesota Department of Natural Resources Interest
Administrative boundaries	United States Forest Service	National Forest Boundaries

Permanent Protection of Large Tracts of Land

Preservation through permanent protection of large tracts of upland areas that provide habitat connections or water quality benefits to aquatic resources is one of the alternative mitigation options under consideration. Large tracts of undeveloped privately- and county-owned lands were identified and evaluated for proximity to existing protected habitat areas and habitat quality to determine which HUC12 watersheds have the highest opportunity for permanent protection.

The following steps were used to inventory watershed opportunities for permanent protection of large tracts of land:

1. Private land, county-owned land, and school trust lands were selected using DNR GAP Stewardship GIS data and State Administered Lands with DNR Interest layers. Other public lands were not considered because of the low likelihood that they would be eligible for purchase for permanent protection. Tax forfeit land might be eligible for purchase; however, because these lands couldn't be spatially identified, they were not incorporated into the analysis.
2. Undeveloped upland, consisting of all land covers (2011 NLCD) minus developed, agricultural, barren, wetlands, and open water were selected. Wetlands were not considered because this alternative option seeks to expand upon the preservation of wetlands, which is currently allowed under mitigation policy, to include the preservation of uplands.
3. The Biwabik Iron Formation spatial layer was removed plus a 2-mile buffer which was extended to include current and future auxiliary mine lands to account for a portion of the auxiliary lands that are or could be used for stockpile or basin purposes. Removal of these lands from the analysis does not suggest that permanent protection of uplands in this area cannot be considered for mitigation, but rather that there are likely fewer opportunities for permanent protection. Opportunities for permanent protection of large tracts of land within this buffer should be considered when wetland impacts occur in this region. In particular, preservation of land that provides wildlife habitat within this region could be considered.
4. Areas that were surrounded by federal land or within the Boundary Waters Canoe Area Wilderness were removed. These lands are known as inholdings; there is the likelihood of an existing agreement between the federal government and the current land owners that these lands will be sold/converted to public lands in the future.
5. Tracts of land smaller than 40 acres were eliminated from this watershed analysis.
6. Tracts were evaluated to select those that are closest to existing protected habitat and of the highest quality.
    - Proximity to existing protected areas including wildlife management areas, scientific and natural areas, Boundary Waters Canoe Area Wilderness, and state and national forests and parks, and proximity to perennial streams and lakes and existing wetland mitigation banking sites was quantified. A potential mitigation banking site that is currently being considered was added to the existing wetland mitigation banking sites.

- Proximity to existing wildlife movement corridors was not considered as the spatial data didn't exist to support the analysis but could be used in the future to evaluate sites[8]. The Wildlife Tool, developed in Wisconsin's Milwaukee River Basin[9] and applied in Ozaukee County and the Duck-Pensaukee Watershed[10], provides an example of one approach that might be useful.
- The *Generate Near Table* tool in ArcMap was used to calculate the shortest distance between the outside edge of a tract of land and a protected area. The percentile rank of each tract's proximity was calculated and subtracted from one so that the scores ranged from zero to one, with the highest scores indicating the tracts that are closest to existing protected habitat.
- The mean habitat quality score for each tract of land was derived from habitat quality mapping conducted as part of the Ecological Ranking Tool developed by Natural Resources Research Institute and BWSR[11]. The mean habitat quality scores ranged from 14.2 to 81.3 on a scale of 0 to 100. The percentile rank of each tract's habitat quality was calculated so that the scores ranged from zero to one, with the highest scores indicating the tracts with the highest habitat quality.
- The proximity and habitat quality scores were summed. Tracts in the lower third of scores represented the tracts that on average were farther away from protected areas and had poorer quality habitat; these tracts were removed from the analysis. Tracts in the upper two thirds of scores represented the tracts that on average were closer to protected areas and had higher habitat quality; these tracts are candidates for permanent protection of large tracts of land (Figure 2).

The areas of the candidate tracts were summed by watershed and divided by watershed area to provide the density of candidate tracts per watershed. Watersheds were ranked by the area of desirable tracts (Figure 3) and the density of desirable tracts (Figure 4).

[8] A report discovered post-analysis to support future study includes the May 15, 2006 Cumulative Effects Analysis on Wildlife Habitat Loss/Fragmentation and Wildlife Travel Corridor Obstruction/Landscape Barriers in the Mesabi Iron Range and Arrowhead Regions of Minnesota, prepared by Emmons & Olivier Resources, Inc. for the Minnesota Department of Natural Resources. QH105.M6 C86 2006.

[9] Milwaukee River Basin Wetland Assessment Project, Developing Decision Support Tools for Effective Planning. 2006. Prepared for U.S. EPA by Wisconsin Department of Natural Resources. Available at: http://dnr.wi.gov/topic/wetlands/documents/mukwonago_version_mrpwap_august_17.pdf.

[10] Miller, N., T. Bernthal, J. Wagner, M. Grimm, G. Casper, and J. Kline. 2012. The Duck-Pensaukee Watershed Approach: Mapping Wetland Services, Meeting Watershed Needs. The Nature Conservancy and Environmental Law Institute. Madison, Wisconsin. Available at: https://www.conservationgateway.org/Files/Pages/duck-pensaukee-watershed-aspx140.aspx.

[11] The Ecological Ranking Tool was developed to prioritize conservation activities (http://beaver.nrri.umn.edu/EcolRank/). The habitat quality mapping component of the Ecological Ranking Tool is based on Minnesota's Statewide Conservation and Preservation Plan.

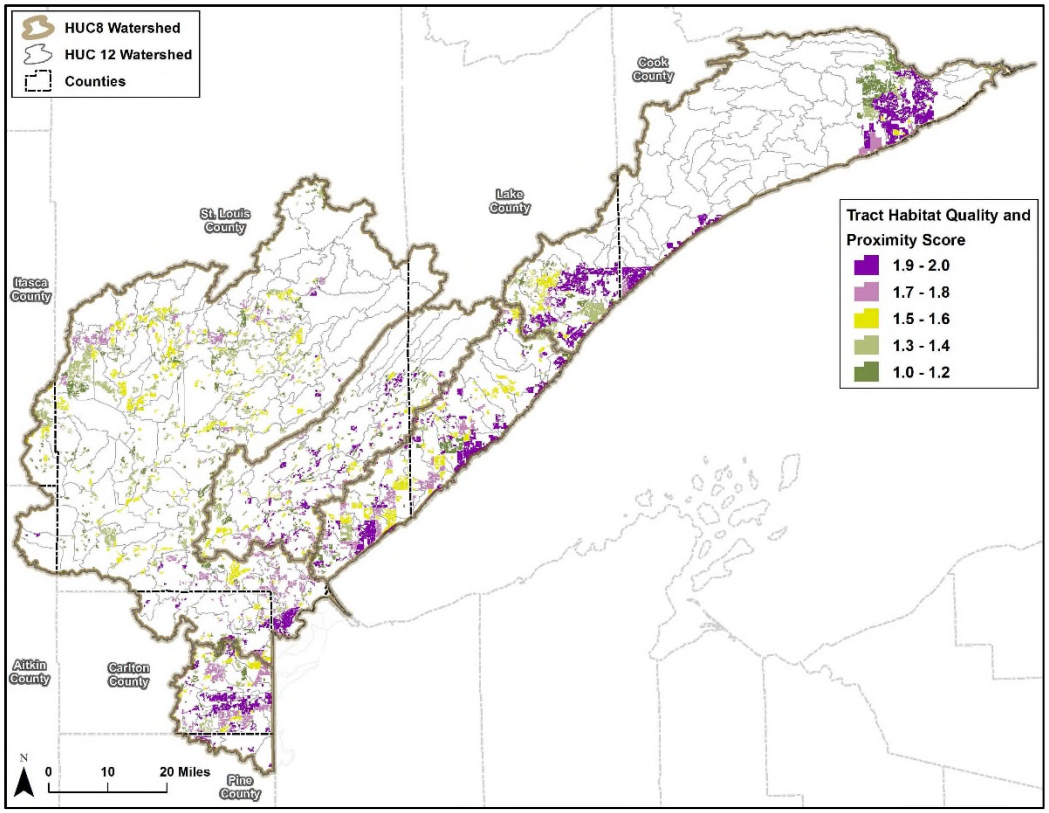


Figure 2. Inventory of candidate large tracts of land for permanent protection

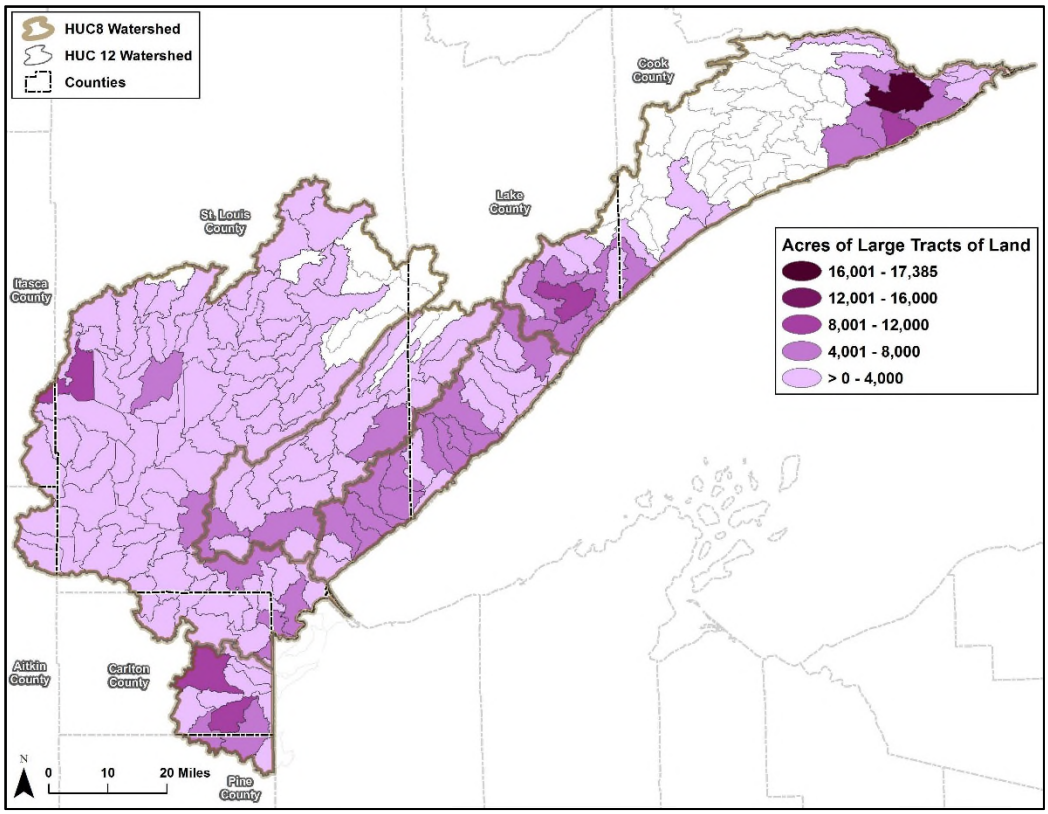


Figure 3. Watershed area – permanent protection of large tracts of land

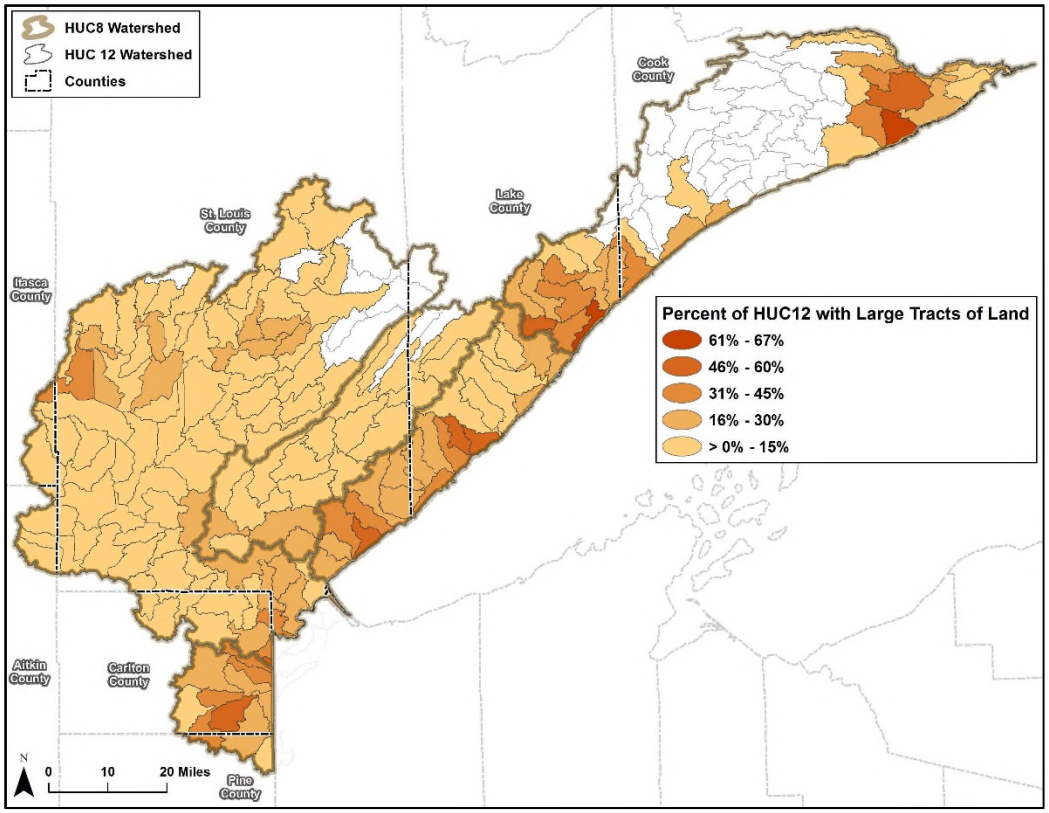


Figure 4. Watershed density – permanent protection of large tracts of land

Restoration of Riparian Buffers, Corridors, and Shoreline

Restoration of riparian buffers, corridors, and shoreline is interpreted as an alternative mitigation opportunity within the "restoration and/or protection of riparian corridors and streams" alternative mitigation option. Buffer, corridor, and shoreline areas potentially in need of enhancement or restoration were inventoried as follows:

- 100-foot buffers were delineated on all sides of streams (DNR 24K streams).
- Land cover data (NLCD 2011) was used to identify areas in need of riparian buffer enhancement or restoration, determined by the following land covers: developed, barren land, herbaceous grassland, pasture and hay, and cultivated crops. Herbaceous grassland was included to identify areas that could use enhancement to forested land covers.
- Riparian buffers that were less than 500 feet long were removed from the analysis because these small areas are unlikely to be restored as part of compensatory wetland mitigation.

The areas potentially in need of buffer enhancement or restoration (Figure 5) were summed by HUC12 watershed and divided by watershed area to estimate the density per watershed. The areas (Figure 6) and densities (Figure 7) of opportunities for buffer restoration and enhancement in each HUC12 watershed were ranked.

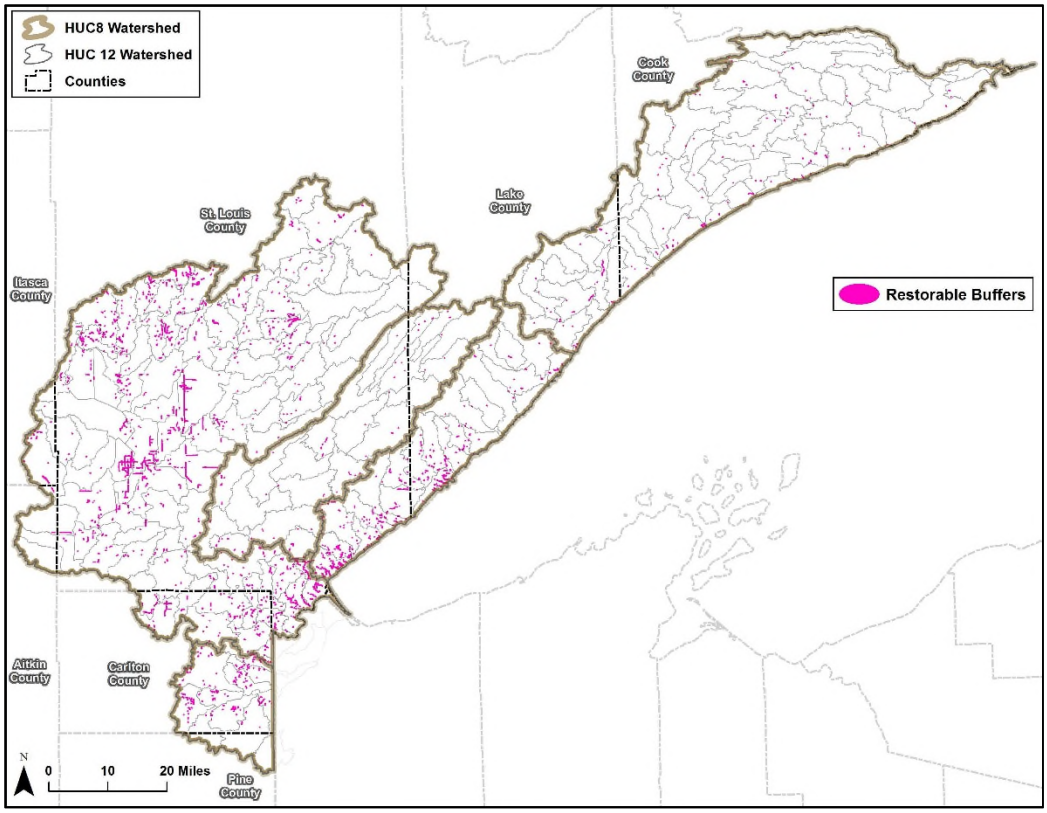


Figure 5. Inventory of restorable riparian buffers, corridors, and shoreline

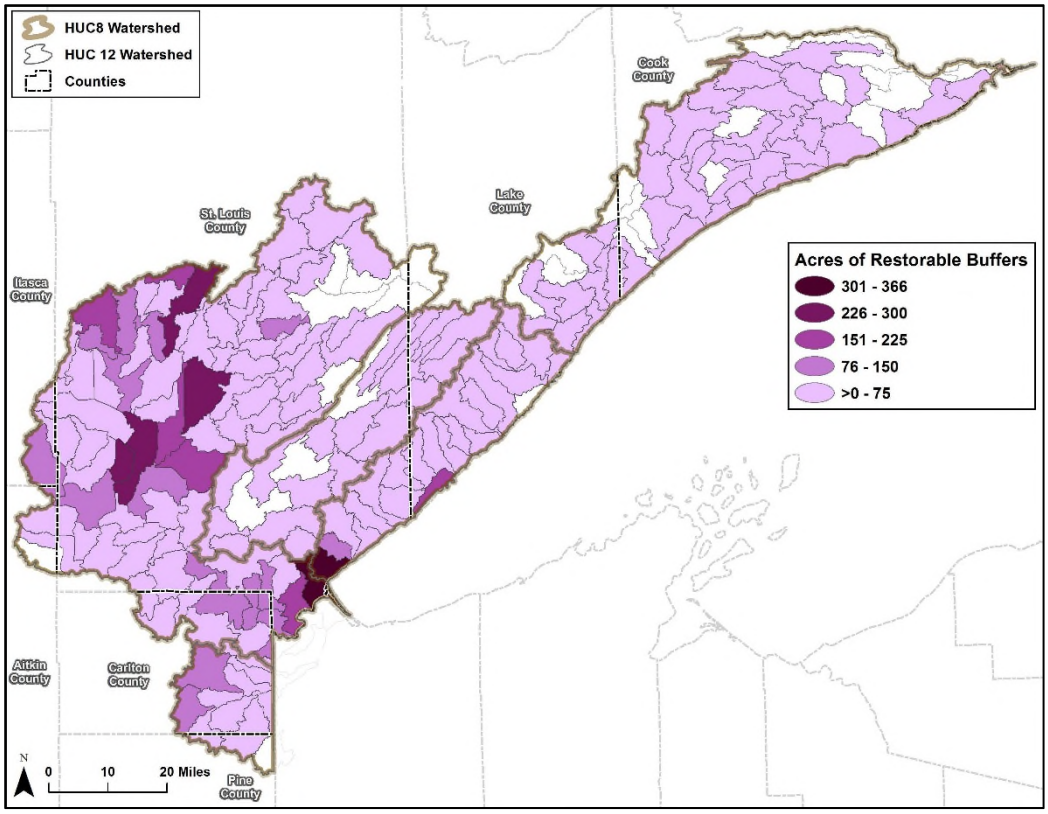


Figure 6. Watershed area – restoration of riparian buffers, corridors, and shoreline

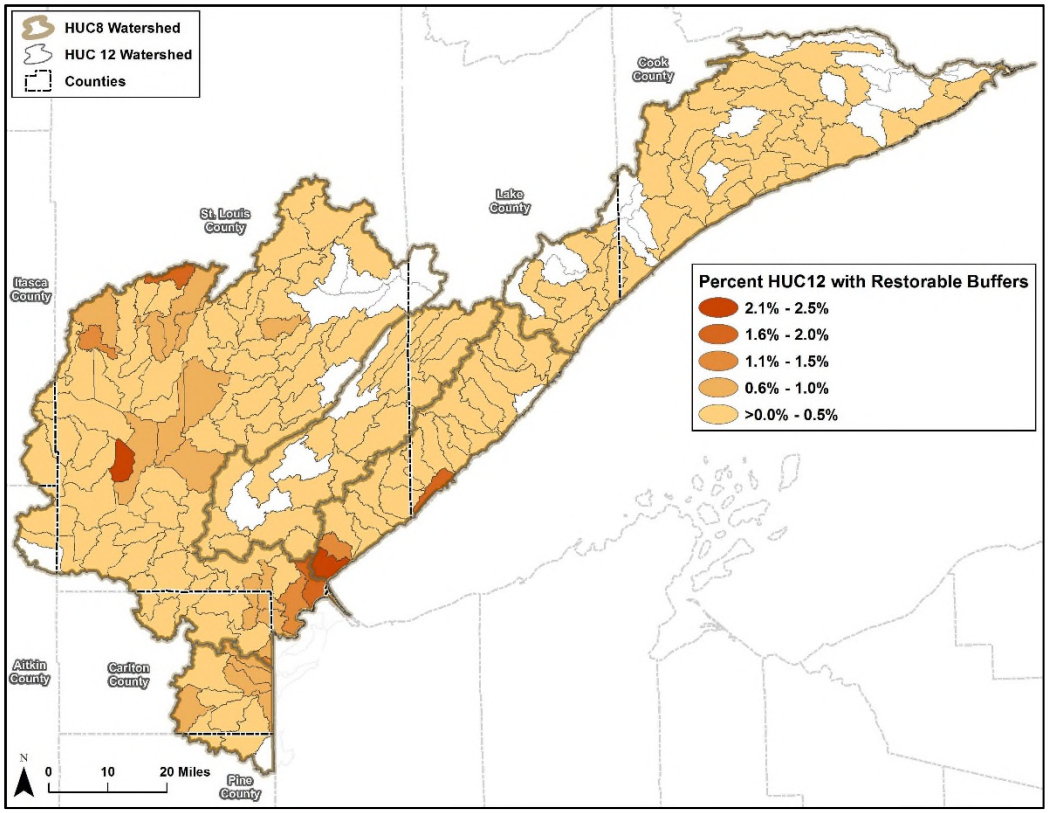


Figure 7. Watershed density – restoration of riparian buffers, corridors, and shoreline

Stream Restoration and Restoration of Natural Stream Hydrology

Stream restoration and restoration of natural stream hydrology are considered under the "restoration and/or protection of riparian corridors and streams" alternative mitigation option. The Minnesota Altered Watercourse[12] spatial dataset was used to identify streams for restoration. This dataset was developed by the MPCA and Minnesota Geospatial Information Office and is a statewide inventory of streams that have been hydrologically modified. The dataset is the result of categorizing National Hydrography Dataset (NHD) flowline waters (high resolution) into natural, altered, impounded, and no definable channel. The categorizations were performed manually based on visual interpretation of aerial photography, LiDAR derived hillshade imagery, and other spatial datasets. The process used to classify each stream reach is described in the Altered Watercourse Determination Methodology[13] and is summarized in Appendix B.

Watercourses identified as "altered" and "impounded" were considered as potential watercourses that could be restored to provide stabilization of natural hydrology (Figure 8). Stream reaches were classified by stream order based on the DNR's Stream Routes with Strahler Stream Order spatial layer. The density of altered streams was calculated by HUC12 watershed and ranked according to the level of restoration opportunity according to area (Figure 9) and density (Figure 10).

[12] http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/streams-and-rivers/minnesota-statewide-altered-watercourse-project.html

[13] Minnesota Geospatial Information Office. 2008. Altered Watercourse Determination Methodology, Final Revision (8). Prepared by Minnesota Geospatial Information Office for the Minnesota Pollution Control Agency, June, 2013. Report #wq-bsm1-02. http://www.pca.state.mn.us/index.php/view-document.html?gid=20341

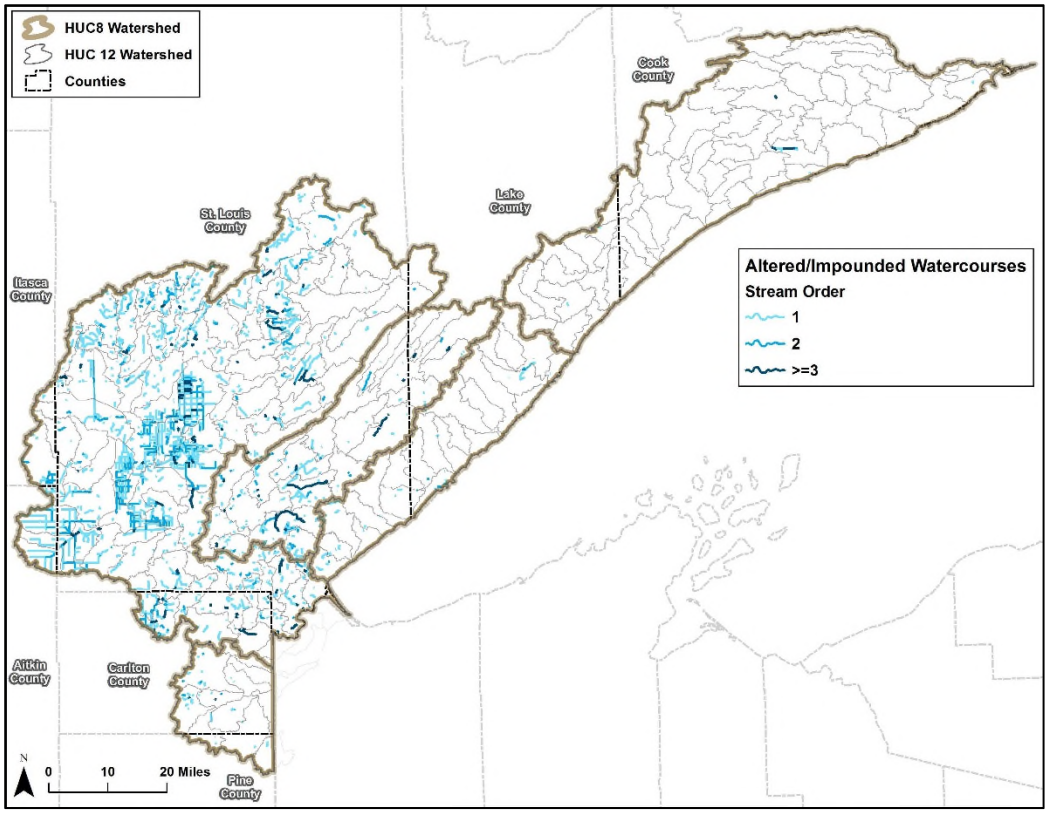


Figure 8. Inventory of altered and impounded watercourses by stream order

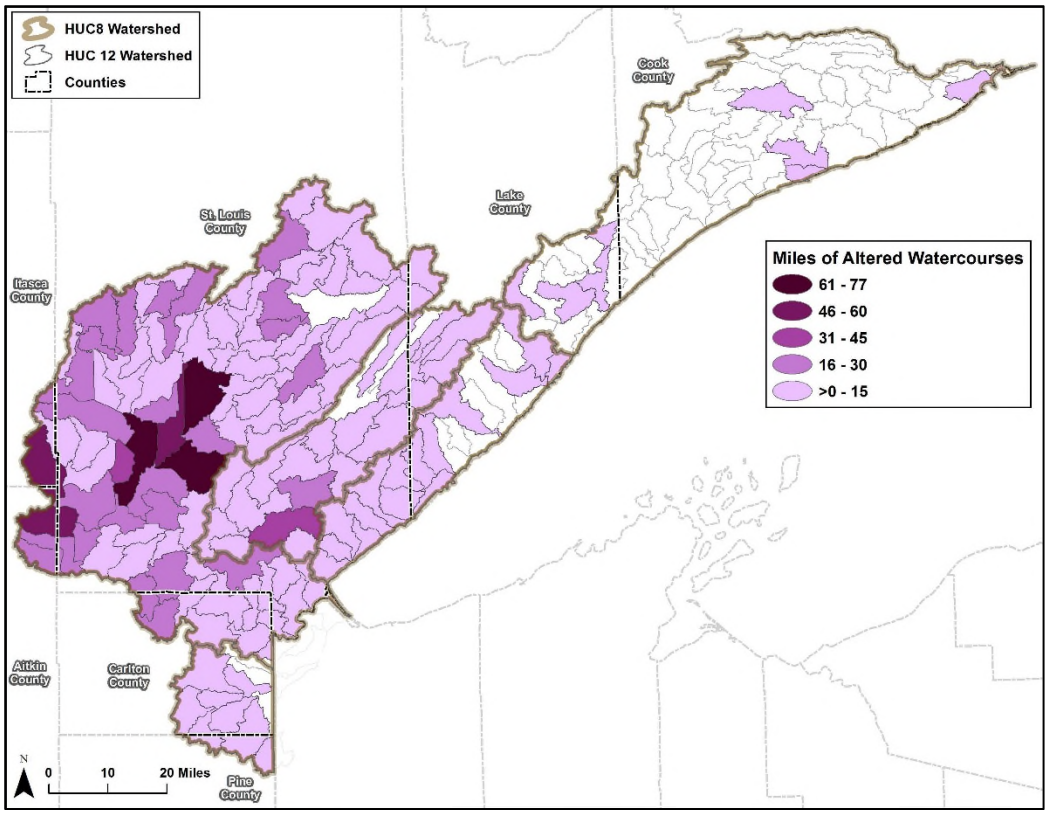


Figure 9. Watershed area – stream restoration and restoration of natural stream hydrology

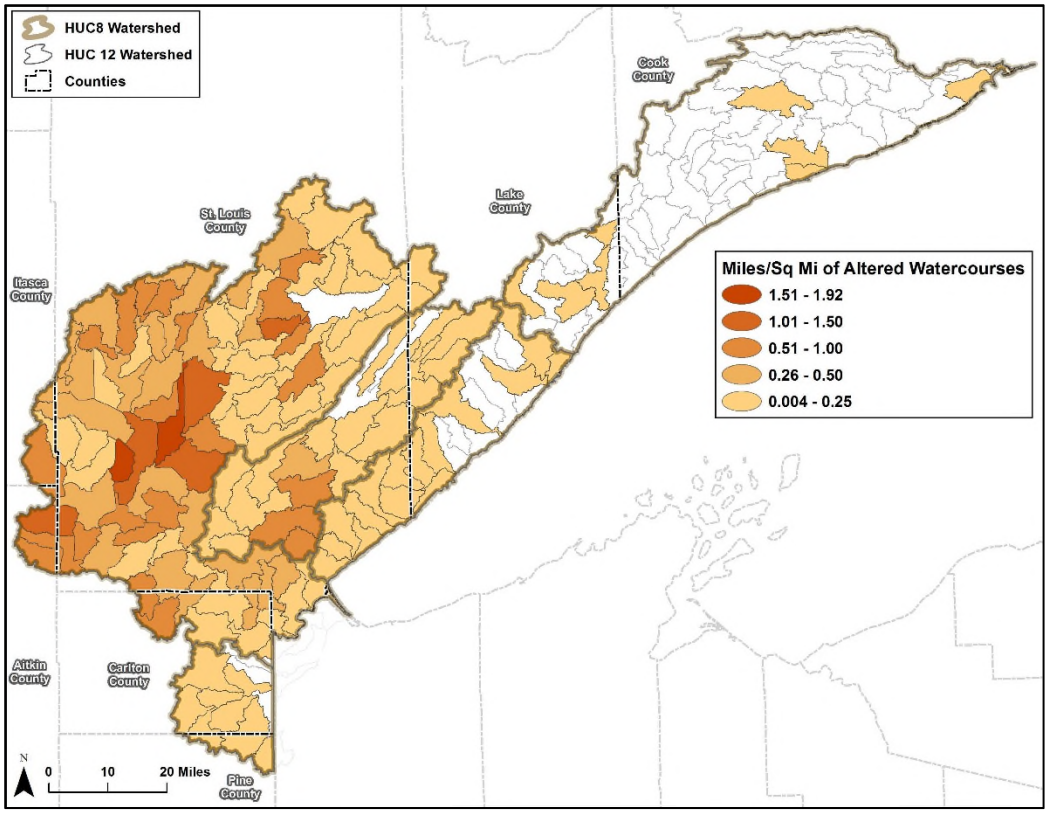


Figure 10. Watershed density – stream restoration and restoration of natural stream hydrology

Improve Natural Hydrologic Conditions and Aquatic Habitat

Projects that improve natural hydrologic conditions and aquatic habitat are considered under the "restoration and/or protection of riparian corridors and streams" alternative mitigation option. Specifically, projects that modify or remove dams or modify road crossings can lead to improved hydrologic connectivity. Existing impoundments (watercourses classified as "impounded" in the Minnesota Altered Watercourse dataset[14]) and dams (DNR's Inventory of Dams, 2/5/2015) were used to inventory potential locations where dams could be modified or removed (Figure 11). The number of impoundments and dams was summed by HUC12 watershed and ranked to provide the level of restoration opportunity (Figure 12).

[14] Impounded watercourses were also inventoried, along with altered watercourses, in the *Stream Restoration and Restoration of Natural Stream Hydrology* projects. Because the extent of impounded watercourses is a small fraction of the extent of altered watercourses, the two analyses (*Stream Restoration* and *Modify or Remove Dams*) provide distinct opportunities.

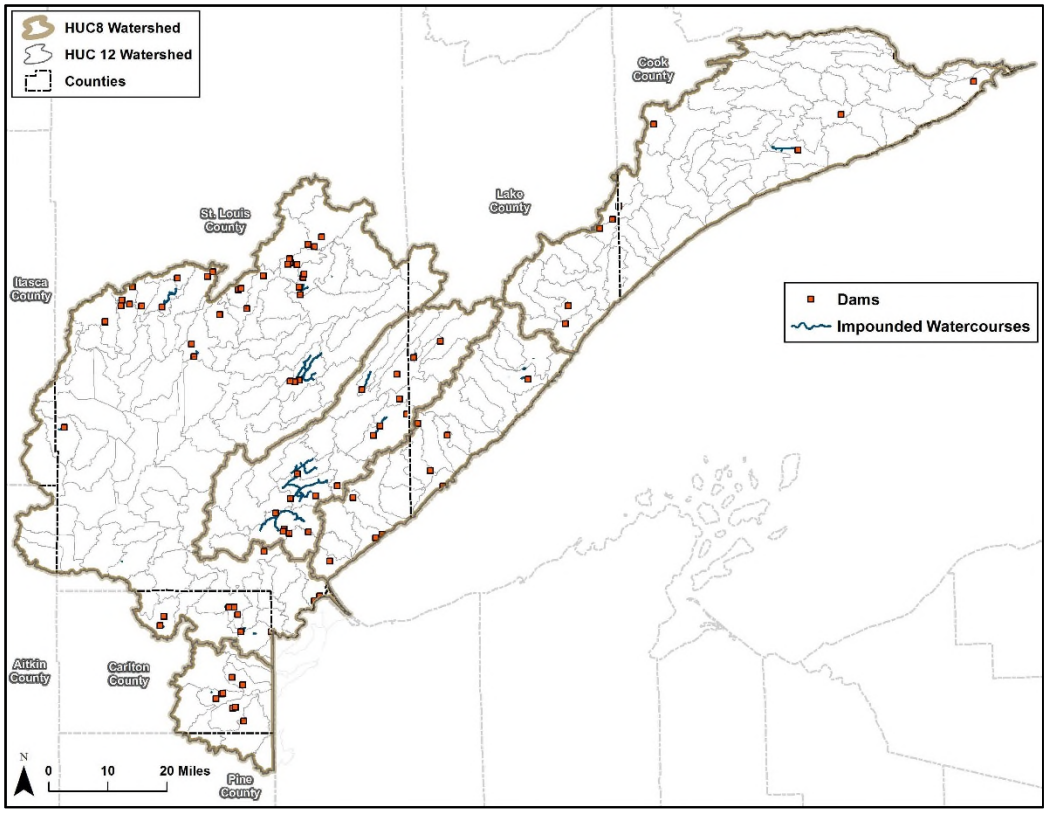


Figure 11. Inventory of dams and impounded watercourses

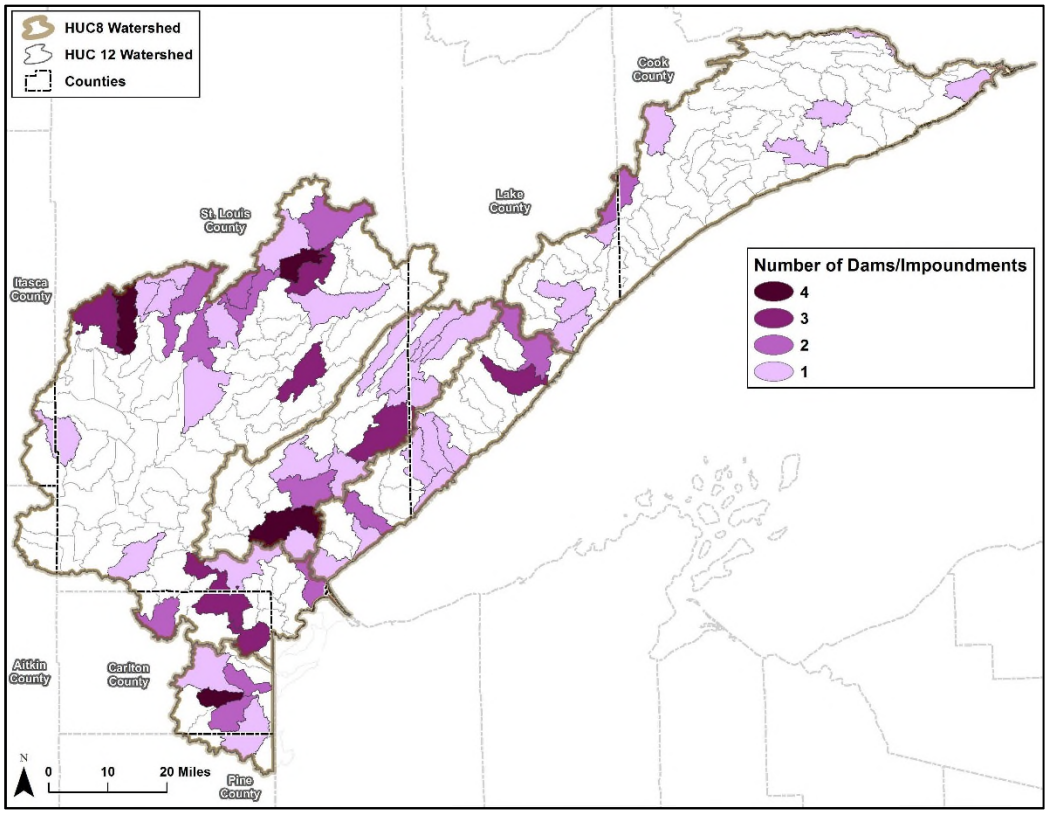


Figure 12. Watershed count – dam/impoundment modification or removal

Culverts, if undersized, can create barriers to fish passage through road crossings. Culvert enhancements can improve fish passage in addition to reducing erosion. Culvert locations and assessments have been or are being mapped in areas within BSA1. Carleton County recently finished the Nemadji River Watershed Culvert Inventory for Fish Passage [15], which included a fish passage inventory on 92 culverts in the Nemadji River watershed in Carleton County (Figure 23). Cook County has a preliminary culvert inventory[16], and Lake County is completing a culvert inventory that includes fish passage assessments. The United States Forest Service has an inventory of existing road crossings in the Superior National Forest and is considering enhancements to that inventory.

To address portions of BSA1 that are not covered by a culvert inventory, locations where roads cross perennial streams were used to identify potential fish passage restrictions. This is a first step to identify candidate locations for culvert enhancements, and the existing site-specific culvert inventories discussed in the previous paragraph should supersede the spatial analysis presented here. Roads (Minnesota Department of Transportation) and perennial streams (DNR 24K) were intersected in GIS to identify stream crossings (Figure 13). The number of road crossings was summed by HUC12 watershed and divided by watershed area to estimate the density of opportunity for road crossing modification, and then ranked by number of crossings (Figure 14) and by density (Figure 15).

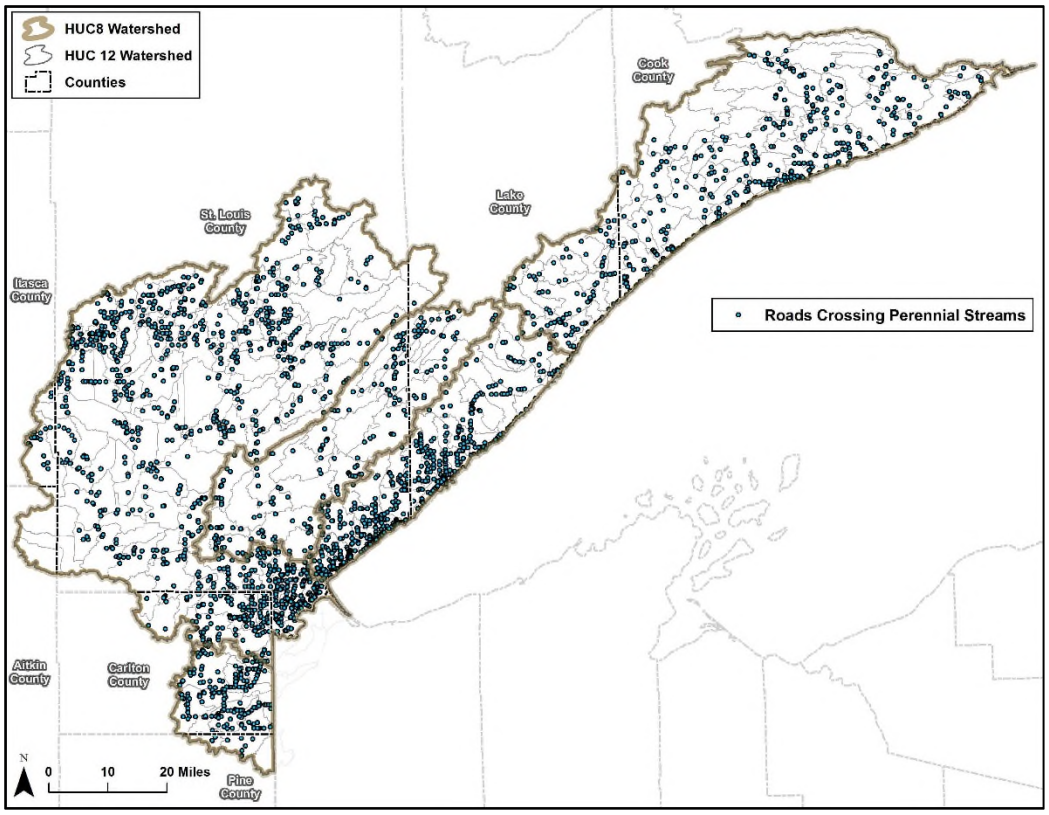


Figure 13. Inventory of road-stream crossings

[15] Carleton County Soil & Water Conservation District. 2015. Nemadji River Watershed Culvert Inventory for Fish Passage: 2011-2014 US Fish and Wildlife Service Fish Passage Project Report. Contract F11AC01319.
[16] Beaster, Tristan and K. Anderson. 2009. Inventory and Assessment of Coastal Zone Stream Crossings on County Roads in Cook County, Minnesota. Prepared by Cook County SWCD and SWCD Technical Service Area #3.

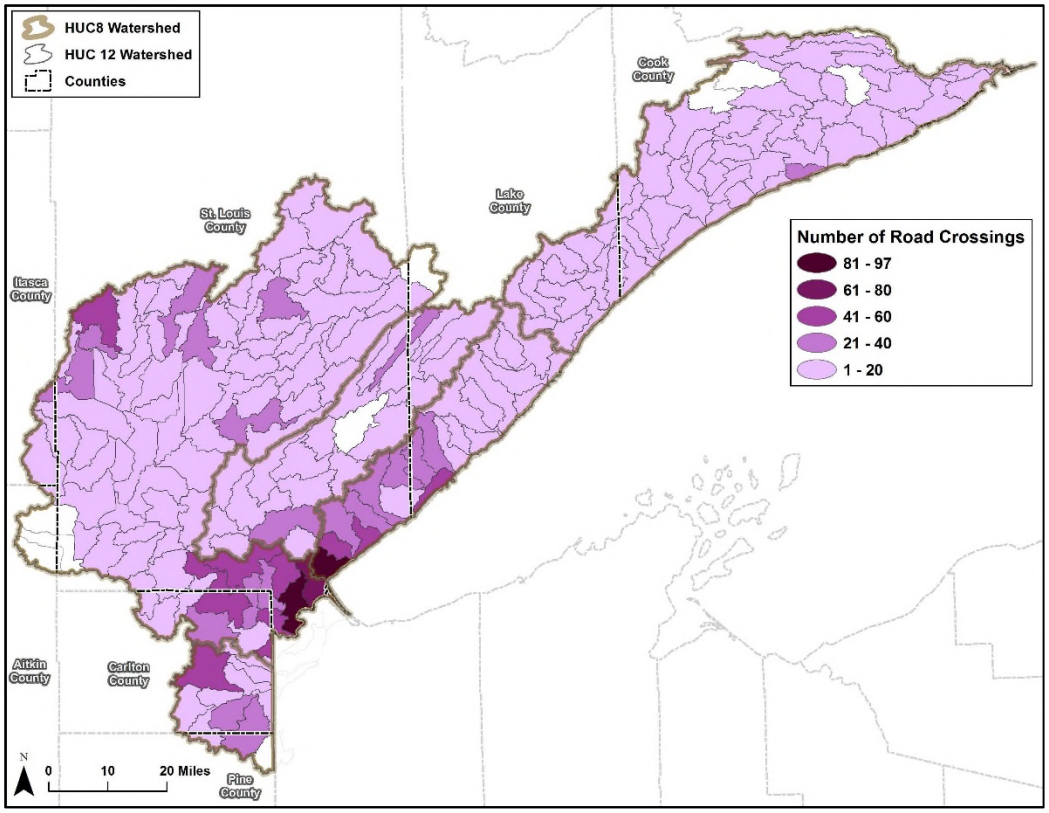


Figure 14. Watershed count – modify road crossings

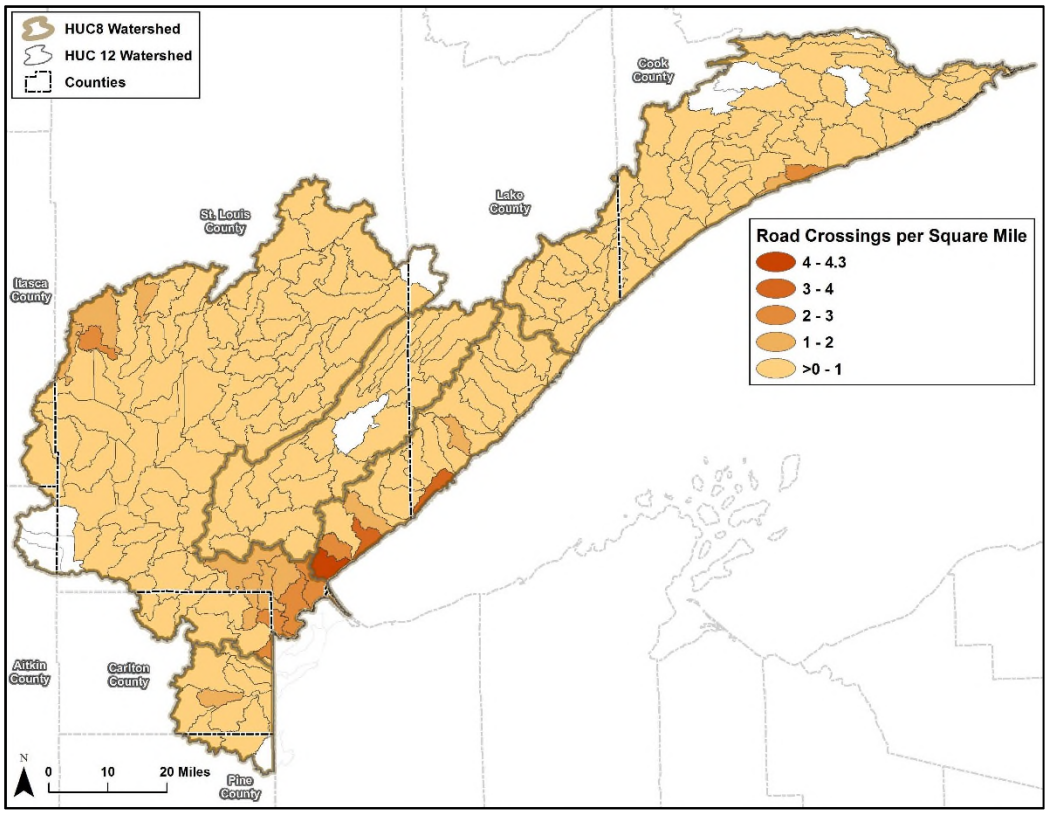


Figure 15. Watershed density – modify road crossings

Peatland Hydrology Restoration

Restoration of peatland hydrology using ditch blocks or similar activities can be applicable under the "peatland hydrology restoration" alternative mitigation option. While there is no existing spatial dataset that specially identifies peatlands, there are several methods that could be used to approximate the location of peatlands such as using modifiers available in the National Wetland Inventory. In this analysis, the location of peatlands was approximated using the following landform types from the Minnesota Department of Agriculture's AgroEcoregions GIS layer: peatlands, poorly-drained lake, somewhat poorly drained lake, poorly drained lake sediments, and red lake loams. A 500-foot buffer was created around all NWI wetlands within the identified peatlands area and overlain with the reaches indicated as altered in the Minnesota Altered Watercourse spatial dataset. Drained and otherwise altered peatlands were approximated as the buffered wetlands that intersect with an altered watercourse (Figure 16). Wetland buffer widths of 200, 500, and 1,000 feet were examined, and the resulting drained wetlands identified with the 500-foot buffer appeared to be the most reasonable. The area of drained peatland was summed by HUC12 watershed and divided by watershed area to estimate the density of opportunity for peatland hydrology restoration, and then ranked by area (Figure 17) and by density (Figure 18).

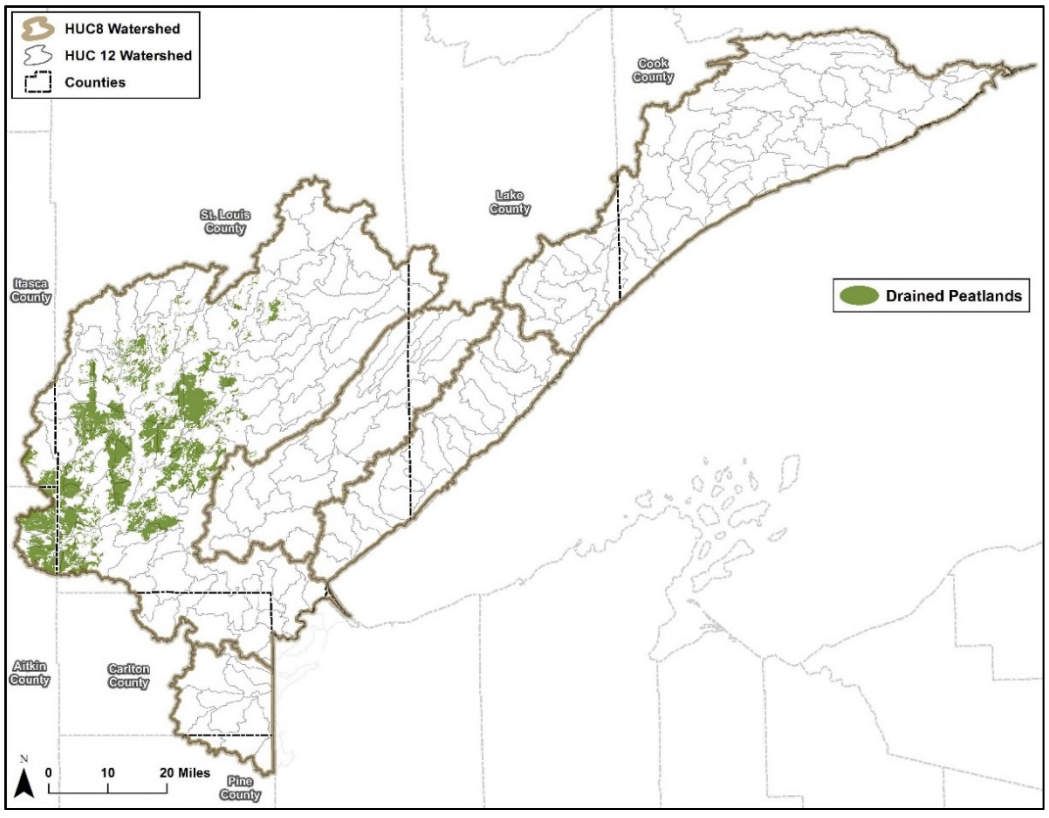


Figure 16. Inventory of potentially drained peatlands

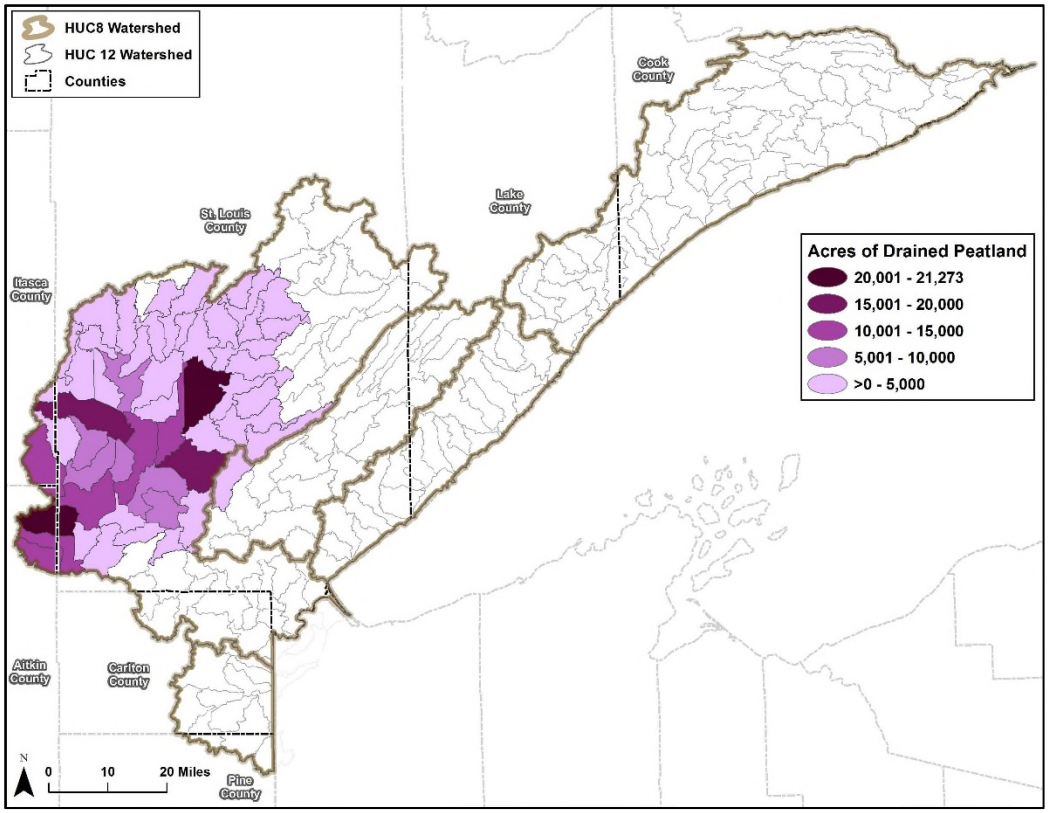


Figure 17. Watershed area – peatland hydrology restoration

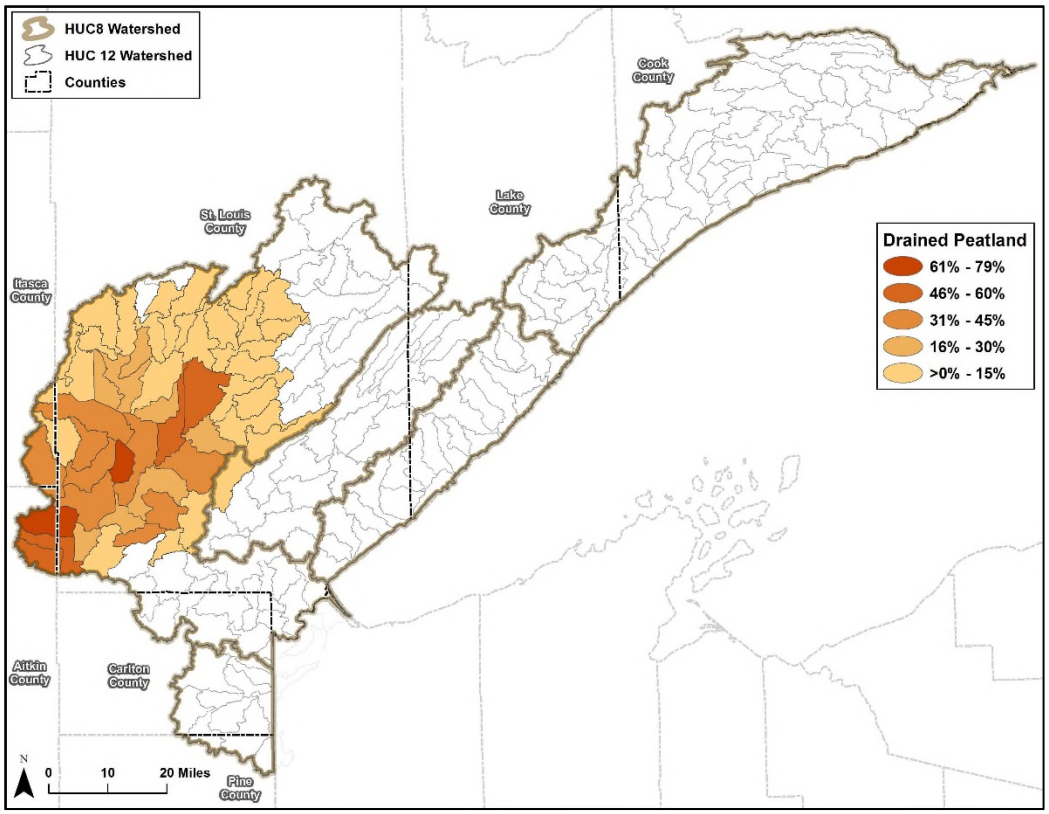


Figure 18. Watershed density – peatland hydrology restoration

2.2. Preservation and Restoration Watersheds

HUC12 watersheds were ranked according to their need for preservation or restoration; this ranking is independent of the inventory of potential mitigation projects (Section 2.1.2). The term "needs" for preservation indicates that the watershed has an abundance or specified level of high quality resources (e.g., scientific and natural areas) and there is greater potential for anthropogenic stressors to impact these high quality resources. The term "needs" for restoration indicates that the watershed has an abundance or specified level of degraded resources (e.g., impaired waters). As such, it is assumed for this analysis that such resources may benefit from the implementation of applicable alternative mitigation opportunities. Watersheds were ranked using the data sets presented in Figure 19.

2.2.1 Preservation Watersheds

Watersheds with preservation needs are defined by the presence of high quality resources that have a greater potential to be affected by anthropogenic stressors. High quality resources include:

- Minnesota County Biological Survey sites of biodiversity significance
- Designated trout streams and trout lakes
- Wild rice lakes
- Scientific and natural areas
- Boundary Waters Canoe Area Wilderness

The area of high quality resources in each HUC12 watershed was used to designate watersheds as having high, moderate, or low quality resources using thresholds at the 33rd and 66th percentiles. These percentiles were used to create three groups with equal numbers of watersheds to approximate low, moderate, and high levels of high quality resources.

The potential for anthropogenic stressors to impact high quality resources was approximated by road density and proximity to mining. Other measures of stress were investigated, such as imperviousness and change in imperviousness, but these measures resulted in similar HUC12 watershed rankings as the road density indicator. Average imperviousness and change in imperviousness in the majority of the HUC12s was less than three percent and below 0.1 percent, respectively. These small percentages raise issues regarding the accuracy of the spatial dataset (2011 NLCD) relative to the scale of the analysis. Other potential indicators of anthropogenic stress to high quality resources could include timber harvest and cumulative loss of aquatic resources; information to address these indicators was not available within the timeframe of this project.

Road density and proximity to mining were used as surrogates for anthropogenic impacts; this analysis assumes that impacts to high quality resources are more likely to occur where there is access to the resources provided by existing roads and in areas close to existing mining. Thresholds at the 33rd and 66th percentiles were used to create three equal road density groupings. For mining, any HUC12 watershed that intersects a 6-mile buffer of the iron ore formation was considered to have a high likelihood of anthropogenic stressors due to proximity to mining; the remaining HUC12 watersheds were considered to have a low likelihood. The following was followed to combine the road density and the proximity to mining indicators into one anthropogenic stressor ranking: if a HUC12 watershed scored high in either indicator, it was given a high anthropogenic stressor score; if any of the remaining HUC12 watersheds scored moderate, it was given a moderate score; and the remaining HUC12 watersheds were given a low score.

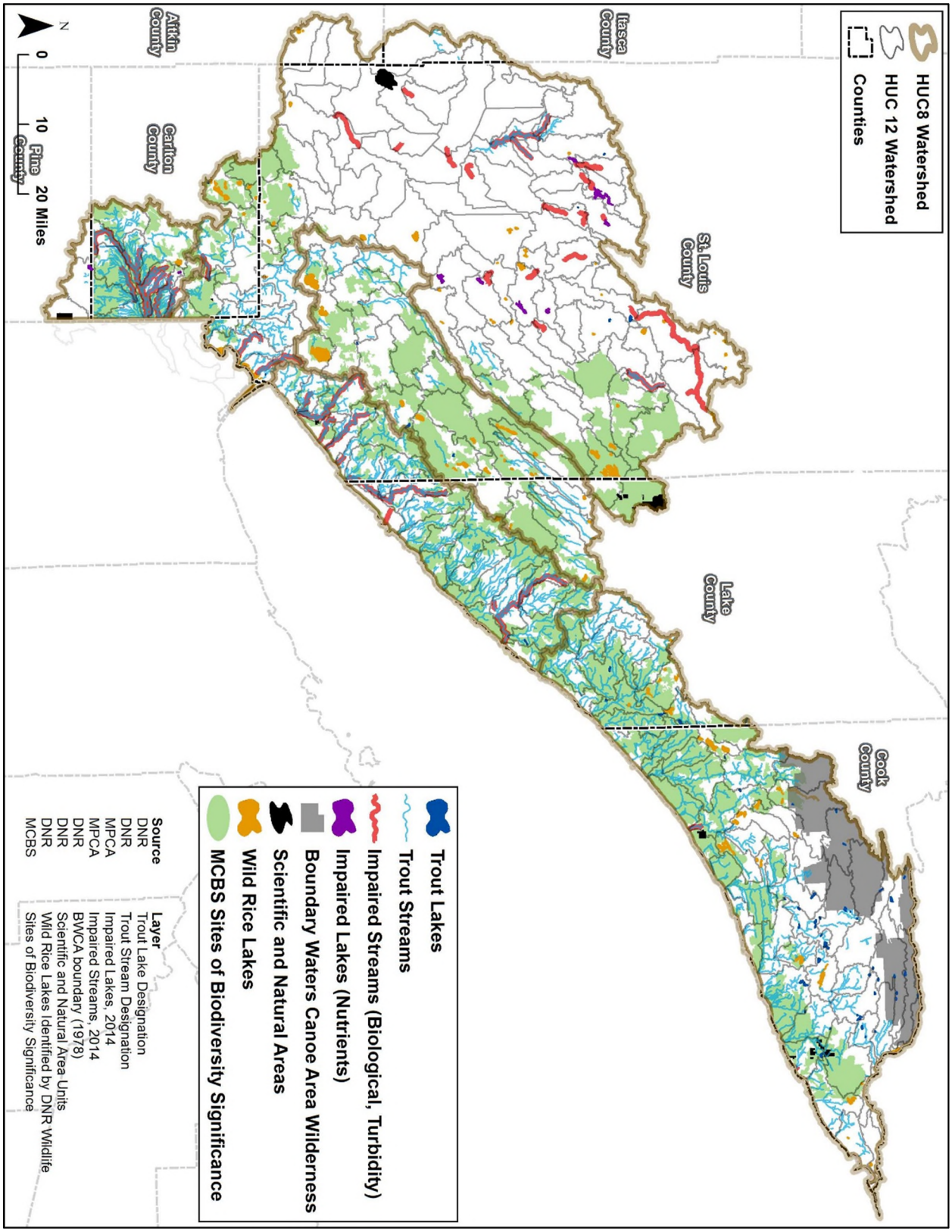


Figure 19. Data sets used in ranking preservation and restoration watersheds

The watershed rankings for high quality resources and anthropogenic stressors were integrated according to the schematic in Figure 20 to determine preservation needs (Figure 21). The low, moderate, and high preservation needs groups are combined with the opportunities analysis results for permanent protection of large tracts of land in the results section to produce five final groups for the suitability analysis of permanent protection of large tracts of land.

The preservation watersheds (Figure 21) highlight the large amounts of high quality resources along the north shore of Lake Superior. There are fewer high quality resources in the mining region, but because these areas have a high potential for anthropogenic stressors, they scored moderate for preservation needs.

Figure 20. Approach to scoring HUC12 watershed preservation needs

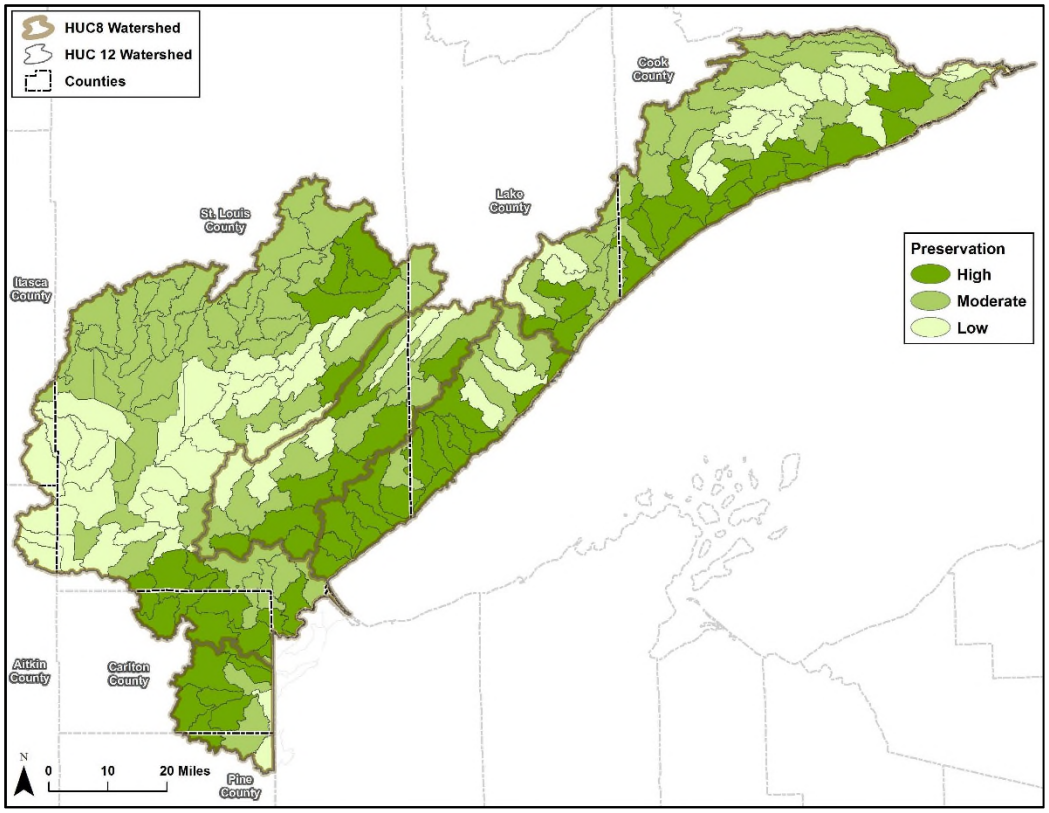


Figure 21. Watershed preservation ranking

2.2.2 Restoration Watersheds

Watersheds with restoration needs are defined by water quality impairments and altered streams. Waters listed as impaired for biota, turbidity, and eutrophication on Minnesota's Draft 2014 303(d) list have a high need for restoration. In addition, watersheds with a high density of natural system alteration (Minnesota Altered Watercourse dataset, altered reaches) have a high need for restoration. Additional measures of restoration need, such as level of development, were not used; the use of impaired waters and altered watercourses already integrates multiple levels of disturbance. The following summarizes the combinations of impaired waters and density of altered watercourses used to assign watershed rankings for restoration (Figure 22).

- High: presence of impaired water or high density (highest third) of altered watercourse
- Moderate: absence of impaired water or moderate density (middle third) of altered watercourse
- Low: absence of impaired water or low density (lowest third, including zero) of altered watercourse

Similar to the three groupings used to designate preservation needs, three groups were created here to later be combined with the opportunities analysis results. The majority of the watersheds with a high restoration rank are in the St. Louis River watershed and near Duluth, where the hydrology is altered and there are many impaired water bodies.

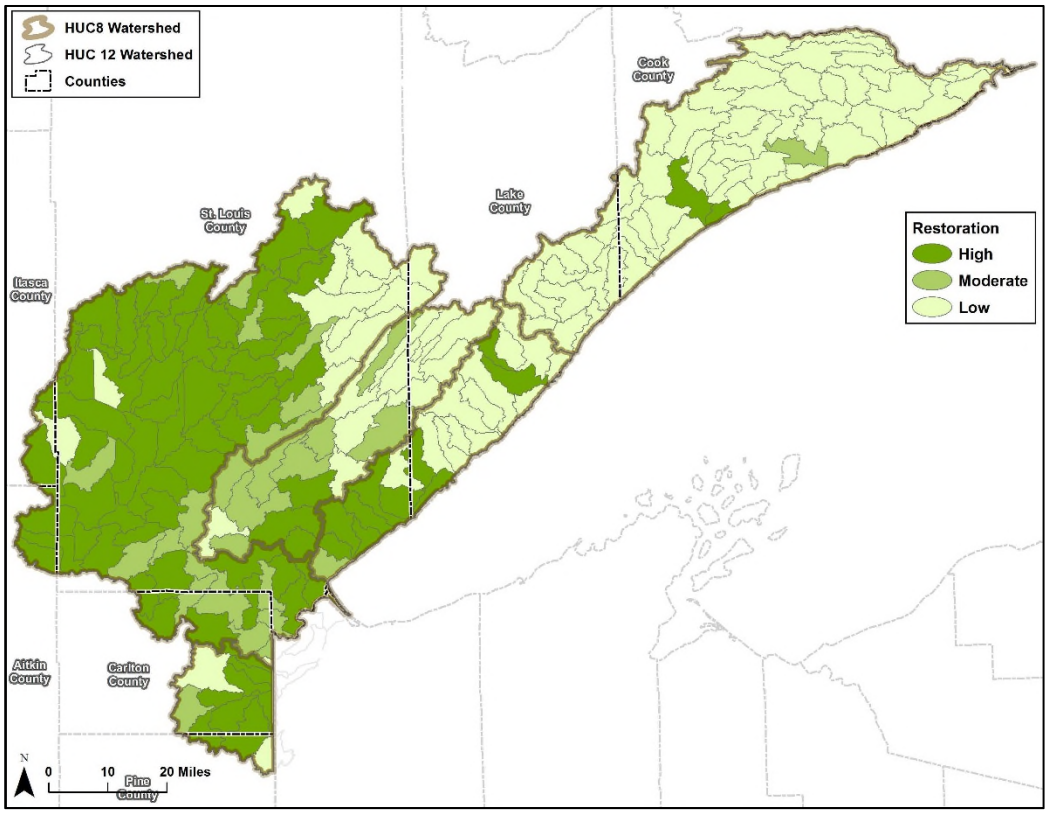


Figure 22. Watershed restoration ranking

3. Results

3.1. Site-Specific Implementation Opportunities

Potential implementation activities were spatially located (Figure 23) and summarized (Table 3) according to the methods outlined in Section 2. These projects have not been pre-approved as alternative mitigation projects, but represent project examples that may be considered by permittees as the Team further develops an approach to wetland mitigation alternatives in northeastern Minnesota. These actions will not be considered eligible to provide compensatory mitigation until deemed appropriate by the permitting agencies.

Criteria that could be useful when evaluating specific projects identified in this report (Table 3) and as projects are proposed by potential applicants are provided below. These criteria, in combination with the watershed scale ranking analysis, can help to select site-specific projects. Some criteria apply to all of the potential project types while other criteria are more specific to a certain project type. For example, accessibility is especially important for restoration or enhancement projects in stream corridors. Projects that will result in significant disturbance of natural areas in order to access a project site could be considered infeasible or not creditable. Projects that are very small in scale may also not be deemed

creditable. These additional criteria can be used to evaluate the potential for a project to be considered for alternative mitigation credit:

- Ranking of watersheds for preservation and restoration
  - Located in a watershed with high preservation or restoration needs.
- Type and level of wetland functions replaced
  - The anticipated type(s) of wetland functional gain is included for the site-specific projects identified in Table 3; the level of wetland functional gain is unknown at this time.
- Size of potential project area
- Proximity or connectivity to public, protected lands
- Accessibility for projects that require construction activities
- Land ownership (public versus private)

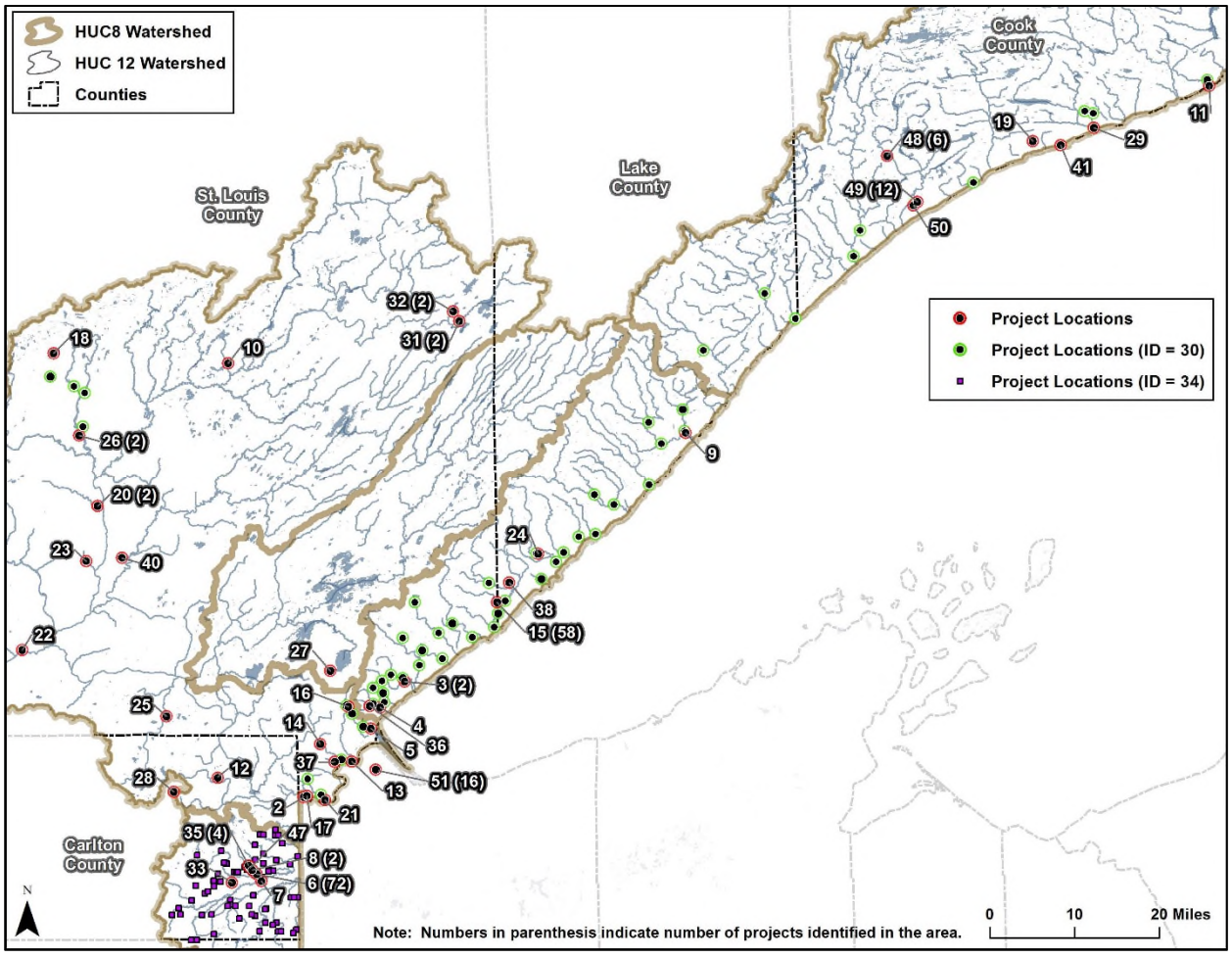


Figure 23. Site-specific project locations

See Table 3 for a detailed listing of activities at each location ID number. Red markers are all actions from Table 3 except for those with location ID 30 or 34. The numbers associated with the red markers are the location ID and, in parentheses, the number of potential projects in that location if greater than one. Location ID 30 and 34 are identified with different markers because of the high number of projects in these locations.

Table 3. Alternative mitigation options, potential implementation actions, and applicable wetland functions.
The "potential implementation actions" include project types in bold and site-specific projects in bulleted format.

Alternative mitigation option	Potential Implementation Actions	Applicable Wetland Functions (MnRAM v 3.4)							Figure 23 Location ID
		Vegetative diversity/integrity	Hydrologic regime	Flood/stormwater attenuation	Downstream water quality	Wetland water quality	Shoreline protection	Habitat	
Expanded use of preservation	**Permanent protection of large tracts of land focused on sensitive species habitats, aquatic buffers, shoreline habitat (lake and river fringe wetlands), upland high priority areas, and areas with significant natural heritage value such as wild rice lakes**	x						x	NA
Restoration and/or protection of riparian corridors and streams	**Restoration of riparian buffers, corridors, and shoreline**	x			x		x	x	NA
	• Remove sheet piling along St. Louis River and restore shoreline in Chambers Grove Park [i]	x			x		x		02
	Stream restoration and restoration of natural stream hydrology		x		x		x	x	NA
	• Amity Creek restoration to provide bank stabilization, habitat creation, and channel restoration to reduce sediment loading and stream turbidity in trout stream (currently impaired)				x		x	x	03
	• Chester Creek restoration to a properly sized stream channel with enhanced fish habitat to address erosion and restore fish habitat in trout stream with an *E. coli* impairment		x		x			x	04
	• Coffee Creek restoration to a shaded, free-flowing natural channel to reduce erosion and slumping of trout stream		x		x		x		05
	• Deer Creek stabilization of slumping streambanks to reduce sediment loading and turbidity and support aquatic life in trout stream [d]				x		x		06
	• Deer Creek culvert replacement at State Highway 23 to stabilize bank slump, reduce sediment loading and turbidity, and support aquatic life in trout stream [d]				x		x		07
	• Deer Creek stabilization of migrating knickpoints with constructed rock riffles to reduce sediment loading and turbidity and support aquatic life in trout stream [d]				x		x		08

Alternative mitigation option	Potential Implementation Actions	Applicable Wetland Functions (MnRAM v 3.4)							Figure 23 Location ID
		Vegetative diversity/integrity	Hydrologic regime	Flood/stormwater attenuation	Downstream water quality	Wetland water quality	Shoreline protection	Habitat	
Restoration and/or protection of riparian corridors and streams (continued)	• East Beaver River restoration to restore channelized trout stream in golf course to provide habitat and stream condition needed to support aquatic life (currently impaired).		x		x				09
	• Ely Creek restoration of incised stream channel to restore aquatic life (currently impaired)		x		x				10
	• Flute Reed River restoration of impaired trout stream to reduce sediment loading and turbidity				x				11
	• Jolicour Creek restoration to remove constricting culverts and draw down their associated pools		x						12
	• Keene Creek stream relocation and habitat restoration of trout stream with an *E. coli* impairment; acquire conservation easement [j]				x			x	13
	• Kingsbury Creek restoration of channelized reaches of trout stream including stabilization of slumping bluff to reduce sediment loading and support aquatic life (currently impaired) [j]		x		x		x		14
	• Knife River streambank and bluff restoration, including grade control (e.g., toe of bank stabilization, cross vein designs, channel adjustment), bank full benches, and tree planting to reduce sediment loading and turbidity in impaired trout stream [e]				x		x		15
	• Miller Creek restoration to reconnect floodplain and restore stream plan and profile that will lead to improvements in habitat for cold water assemblages (currently impaired) in trout stream		x	x	x			x	16
	• Mission Creek restoration to address severe streambank slumping and habitat degradation in trout stream as a result of altered hydrology		x		x		x	x	17
	• Penobscot Creek restoration of channelized stream reaches to restore natural function. The creek is highly channelized (>50%) and primarily serves as a mine drainage and stormwater conveyance ditch		x	x	x				18
	• Rosebush Creek restoration to address streambank instabilities from 2008 and 2012 floods in intermittent stream				x		x		19

Alternative mitigation option	Potential Implementation Actions	Applicable Wetland Functions (MnRAM v 3.4)							Figure 23 Location ID
		Vegetative diversity/integrity	Hydrologic regime	Flood/stormwater attenuation	Downstream water quality	Wetland water quality	Shoreline protection	Habitat	
Restoration and/or protection of riparian corridors and streams (continued)	• Sand Creek and unnamed tributary restoration of incised stream channel to restore aquatic life (currently impaired)		x		x				20
	• Sargent Creek stream improvements to reduce sediment loading and turbidity in trout stream with an *E. coli* impairment				x				21
	• Savannah River remeander to restore original stream channel				x				22
	• Skunk Creek restoration of channelized reaches of trout stream to reduce sediment loading and support aquatic life (currently impaired)		x		x				23
	• Skunk Creek (Nemadji River watershed) restoration to recover natural stream channel, stabilize road embankment, and remove fish barrier		x		x			x	33
	• Stewart River restoration to restore 150 feet to a natural stream channel, stabilize eroding stream banks, and eliminate a fish barrier to reduce sediment loading and turbidity in trout stream		x		x		x	x	24
	• Stoney Brook remeander to restore original stream channel to trout stream		x		x				25
	• Swan River watershed (Dempsey Creek, Barber Creek, East Swan River, and West Swan River) restoration of incised stream channels in impaired watershed to reduce sediment loading and turbidity in impaired trout streams		x		x				26
	• Ugstad Creek restoration of channelized trout stream to remeander the channel and reestablish connection with floodplain		x	x	x				27
	• Wild Rice Lake water level stabilization (source of Moosehorn River) through downstream culvert modifications		x						28
	• Woods Creek restoration to address erosion and altered hydrology in trout stream		x		x		x		29
	• Additional restoration sites identified by various agency staff								30

Alternative mitigation option	Potential Implementation Actions	Applicable Wetland Functions (MnRAM v 3.4)							Figure 23 Location ID
		Vegetative diversity/integrity	Hydrologic regime	Flood/stormwater attenuation	Downstream water quality	Wetland water quality	Shoreline protection	Habitat	
Restoration and/or protection of riparian corridors and streams (continued)	**Improve natural hydrologic conditions and aquatic habitat**, including the following project types: 1) replace or remove road/stream crossings; 2) improve fish passage (e.g., replace undersized culverts that restrict fish passage); 3) replace culverts that contribute to stream instability, erosion, and bank/bluff failures); 4) reconstruct road embankments by replacing road bed with more porous medium to allow hydrologic connectivity (for example, a road along a stream where the road cuts the stream off from its floodplain, or where a road transects a wetland and cuts off hydrologic connection); 5) modify or remove dams; 6) select trail locations to maintain hydrologic connectivity		x		x		x	x	NA
	• Replacement of undersized culverts at lower Laird Creek and Pine Lake tributary to improve fish passage and reduce erosion [h]				x			x	31
	• Removal of road/stream crossing structures and restriction of vehicle and ATV access at the upper Laird Creek and Stone Creek sites to reduce erosion and restore hydrologic pathways [h]		x		x			x	32
	• Replace undersized culverts that are currently restricting fish passage at priority locations identified by Carlton SWCD in the Nemadji River watershed							x	34
	• Corrective actions for red clay dam failures in Deer Creek that will restore a more natural hydrologic regime and reduce sediment loading and stream turbidity in impaired trout stream [a, d]		x		x				35
	Miscellaneous								
	• Implement green infrastructure practices in Chester Creek (trout stream with *E. coli* impairment) watershed to reduce flooding, prevent pollutant loading, and provide for climate change adaptation [k]		x	x	x				36
	• Reduce runoff and sediment transport in Knowlton Creek Watershed and restore cold-water stream habitat to trout stream [i]		x	x	x			x	37

Alternative mitigation option	Potential Implementation Actions	Applicable Wetland Functions (MnRAM v 3.4)							Figure 23 Location ID
		Vegetative diversity/integrity	Hydrologic regime	Flood/stormwater attenuation	Downstream water quality	Wetland water quality	Shoreline protection	Habitat	
Restoration and/or protection of riparian corridors and streams (continued)	• Upland erosion control in Knife River watershed: gully stabilization, road ditch maintenance and revegetation to reduce sediment loading and turbidity in impaired trout stream [e]				x				38
Stabilization of natural hydrology	**Restoration of large-scale wetland hydrology using ditch blocks or similar, which may restore hydrology and natural fluctuations in the water table over a large area**		x	x	x	x		x	Project locations will be identified on a site-specific basis
Peatland hydrology restoration	**Restoration of peatland hydrology using ditch blocks or similar**		X	x	x	x			NA
	• Restoration of large drained areas near the town of Meadowlands • Partially drained wetland areas containing extensive peatlands have been identified (not included as site 40). In St. Louis County: 166 sites have high restoration potential (11,048 ac) [g]		*x*	*x*	*x*	*x*			40
	Restoration of peatland vegetation	x				x			Project locations will be identified on a site-specific basis

Alternative mitigation option	Potential Implementation Actions	Applicable Wetland Functions (MnRAM v 3.4)							Figure 23 Location ID
		Vegetative diversity/integrity	Hydrologic regime	Flood/stormwater attenuation	Downstream water quality	Wetland water quality	Shoreline protection	Habitat	
Other watershed plan implementation projects	Village Ditch/Nature Boy Creek: improve water quality, reduce flooding, erosion, and sedimentation deposition; replace the culverts on 7th Avenue East and 4th Avenue East to reduce sediment and erosion of Village Ditch/Nature Boy Creek [b]			x	x				41
	Remove Deer Creek impoundment of sediment from groundwater discharge points ("sediment volcanoes") to reduce sediment loading and turbidity in impaired trout stream [d]				x				47
	Poplar River watershed BMPs that address eroded road and trail conditions to reduce sediment load to impaired trout stream: Mystery Mountain Road, Moose Mountain Summit Road, Eagle North Face Road, Ullr Road, Timberwolf Road, Lutsen Resort Trails Project [f]				x				48
	Address slumps, ravines, and flowpaths in Poplar River watershed to reduce sediment loading and turbidity in impaired trout stream [f, l]				x				49
	Reduce erosion from ski slopes in Poplar River watershed to reduce the effective slope length and increase vegetation, to reduce sediment loading and turbidity in impaired trout stream [f]				x				50
	Sites identified for habitat restoration in St. Louis River Area of Concern [i, j]							x	51

a. Carlton County Comprehensive Local Water Management Plan, 2014-2020
b. Cook County Comprehensive Local Water Management Plan, 2014-2024
c. Lake County Local Water Management Plan Update, 2006-2015
d. Deer Creek Turbidity TMDL Implementation Plan, 2013
e. Knife River Turbidity TMDL Implementation Plan, 2011
f. Poplar River Water Quality Restoration: Implementation Plan for Turbidity Reduction, 2014
g. Northeast Minnesota Wetland Mitigation Inventory and Assessment, Phase 2, 2010
h. Ecosystem Analysis of the Sand Lake/Seven Beavers Project Area, in the Upper St. Louis River Watershed, MN, 2005 (The Nature Conservancy)
i. St. Louis River Area of Concern Implementation Framework: Roadmap to Delisting (Remedial Action Plan Update), 2013
j. Lower St. Louis River Habitat Plan: Strategies Implementation Planning Worksheets, 2005
k. Economic Assessment of Green Infrastructure Strategies for Climate Change Adaptation: Pilot Studies in The Great Lakes Region, 2014
l. Poplar River Sediment Source Assessment, 2010

3.2. Watershed Opportunities

HUC12 watersheds with the highest level of project opportunities (Section 2.1) and the greatest need for preservation or restoration (Section 2.2) were identified. This HUC12 watershed selection was completed for each of the project types that were selected for a watershed scale opportunity analysis. Protection needs are only applicable to the Permanent Protection of Large Tracts of Land opportunity. Restoration needs are applicable to the following opportunities:

- Restoration of riparian buffers, corridors, and shoreline
- Stream restoration and restoration of pattern, profile, and dimension of the stream system
- Modify or remove dams to improve natural hydrologic conditions and aquatic habitat
- Modify existing road crossings to improve natural hydrologic conditions and aquatic habitat
- Peatland hydrology restoration

The rankings developed in the opportunities analysis (high, high-moderate, moderate, low-moderate, low) were integrated with either the protection or restoration needs (high, moderate, low) in a suitability analysis to identify watersheds for implementation of potential alternative mitigation projects (Figure 24). Figure 25 through Figure 30 present the results; Appendix C provides detailed results by watershed. Watersheds that have an overall rank of high or moderate-high could be good candidates for an agency or permittee to further evaluate for potential alternative mitigation options.

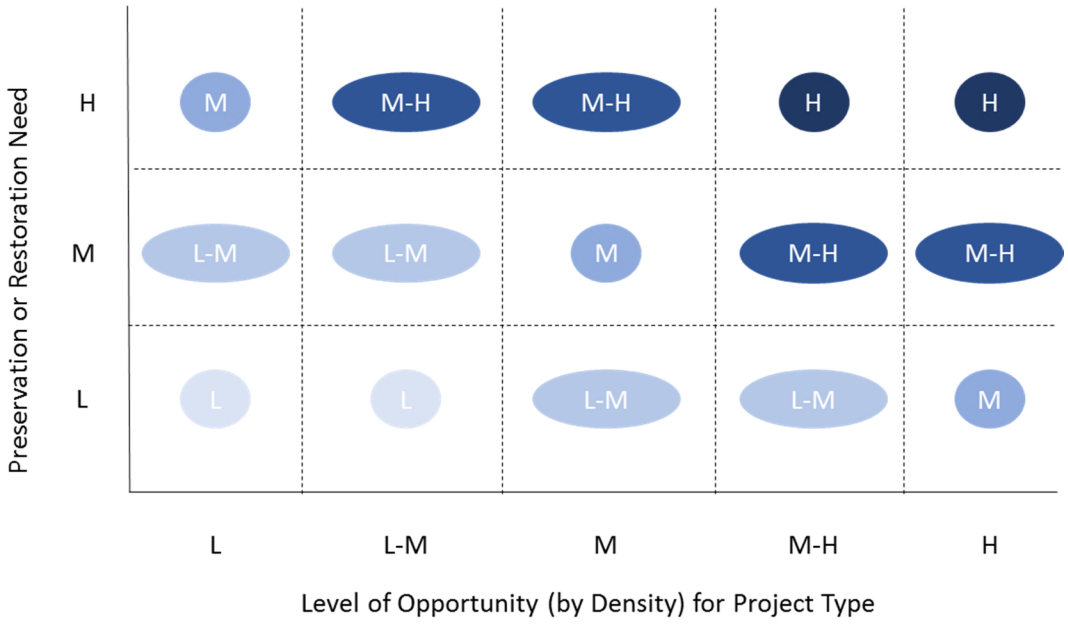


Figure 24. Watershed suitability approach

The five groupings identified in the opportunities analysis maps (Section 2.1.2) were assigned to five groups ranging from low to high (low [L], low-moderate [L-M], moderate [M], moderate-high [M-H], and high [H]) on the x-axis. The three groupings from the preservation or restoration needs analysis (L, M, and H) are represented on the y-axis.

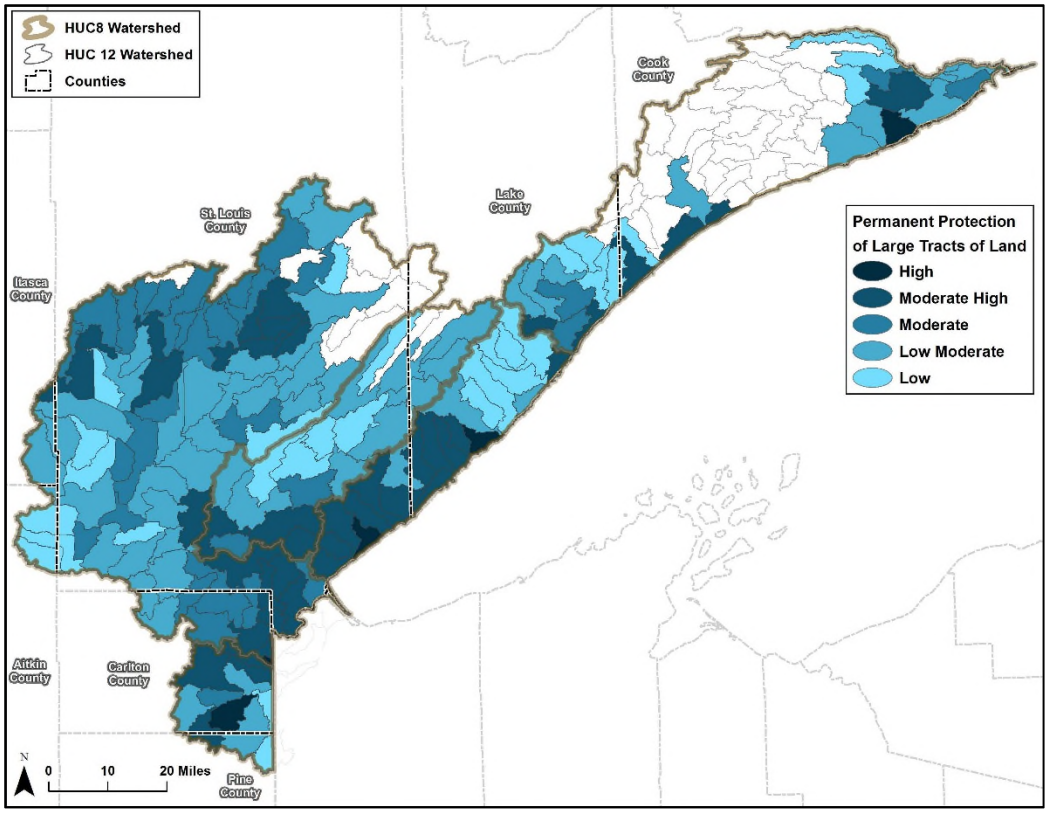


Figure 25. Watershed suitability – permanent protection of large tracts of land

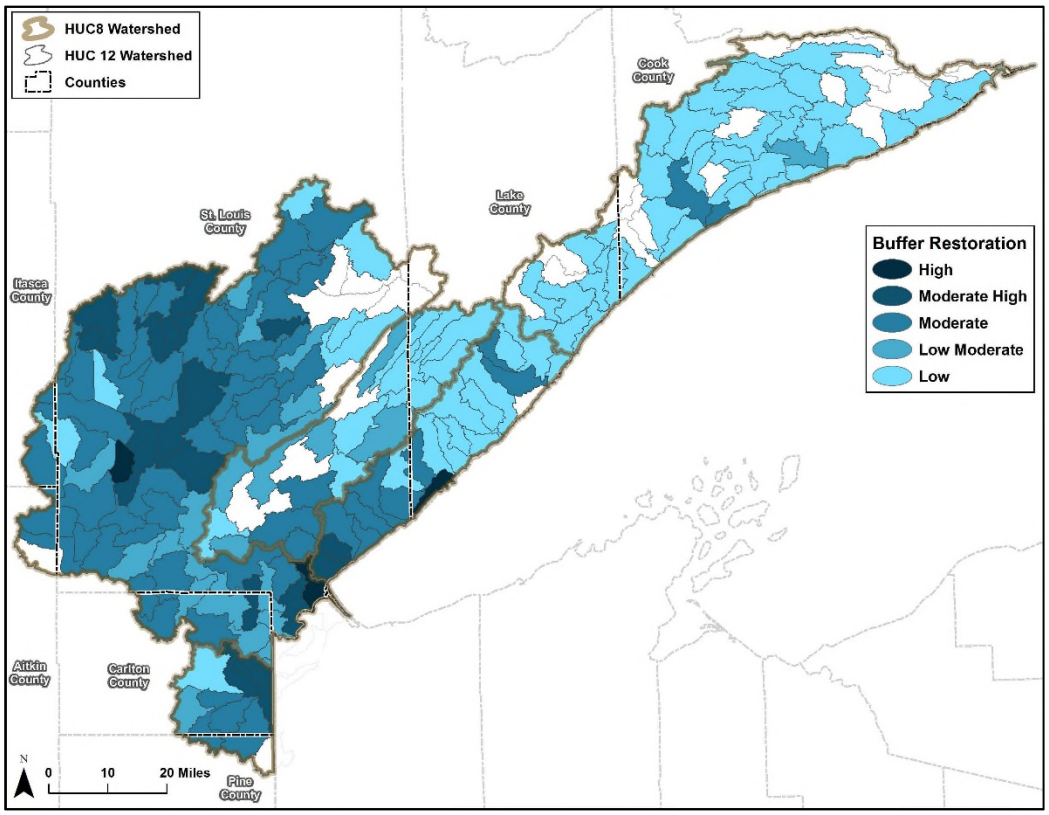


Figure 26. Watershed suitability – restoration of riparian buffers, corridors, and shoreline

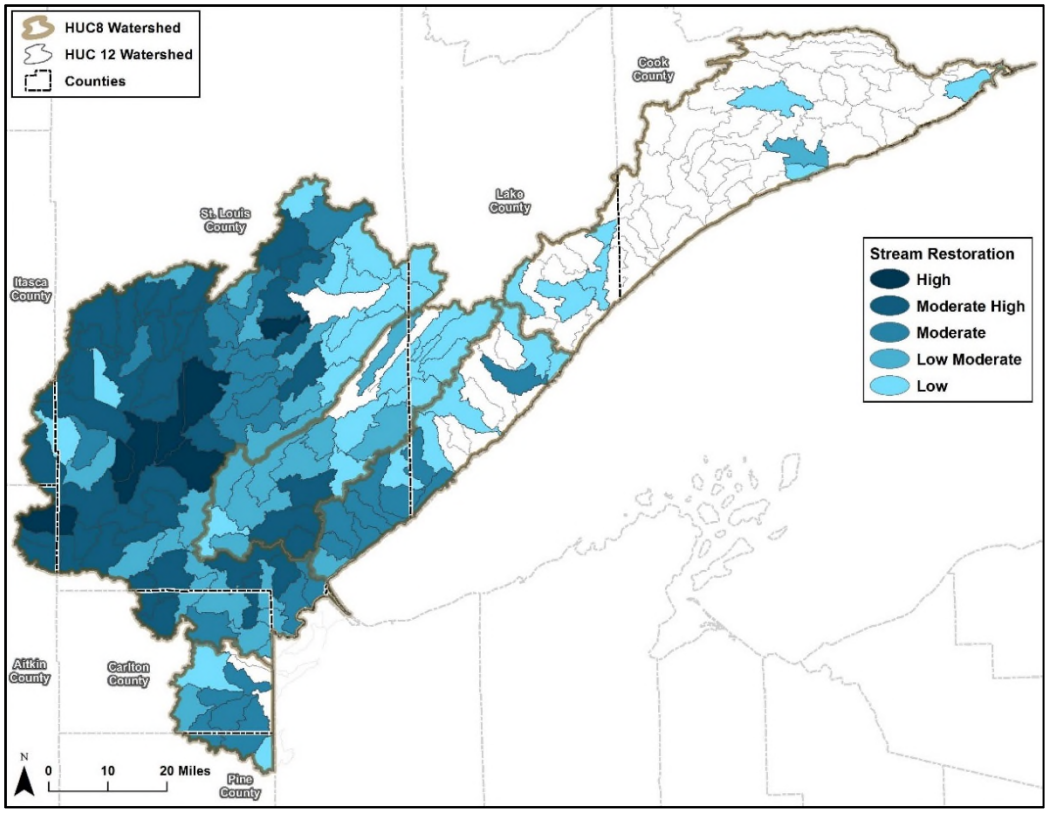


Figure 27. Watershed suitability – stream restoration and restoration of natural stream hydrology

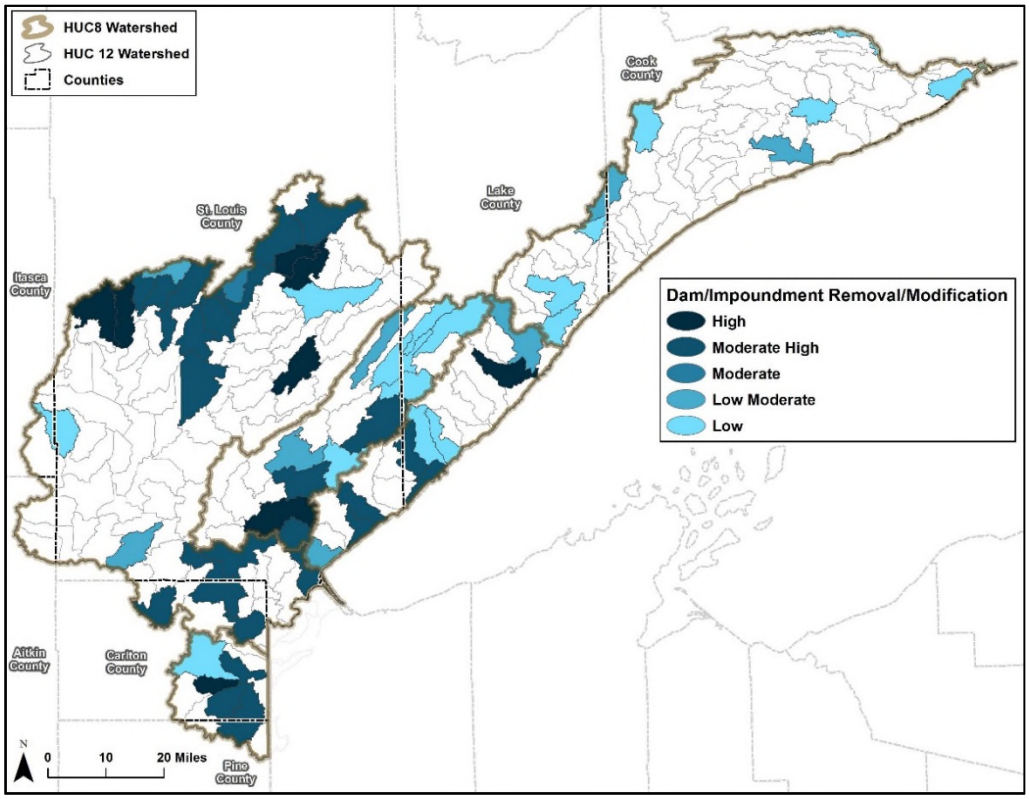


Figure 28. Watershed suitability – dam/impoundment modification or removal

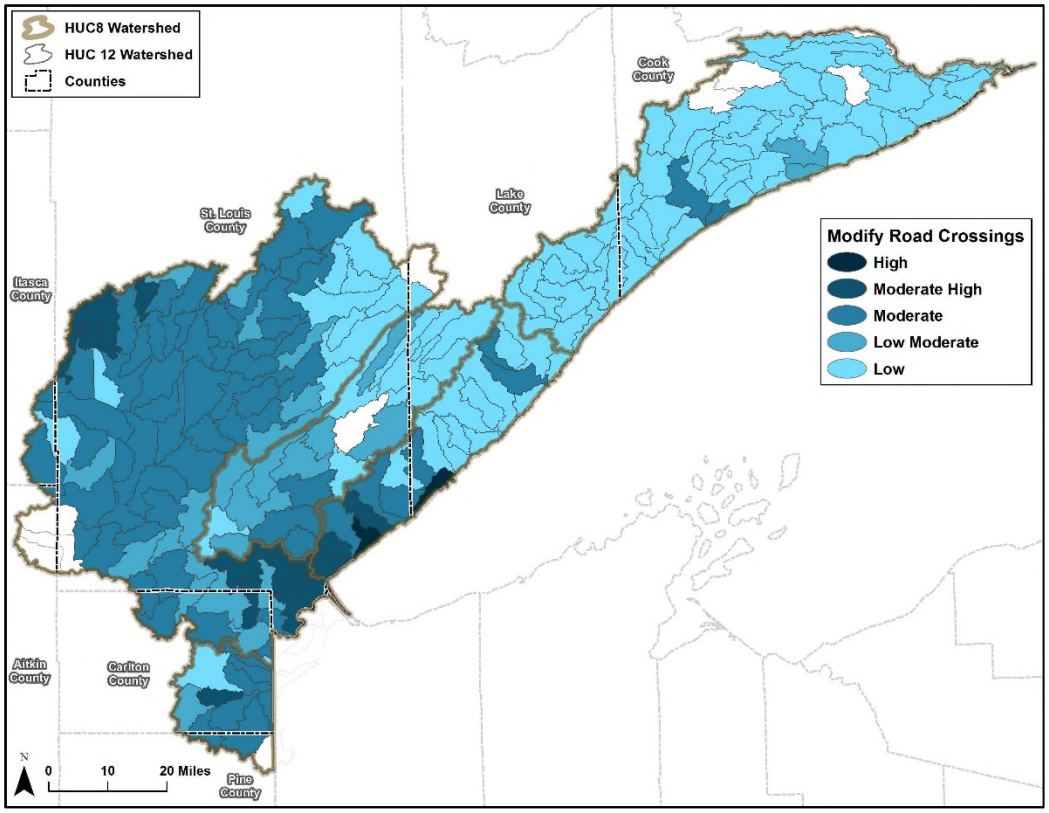


Figure 29. Watershed suitability – modification of existing road crossings

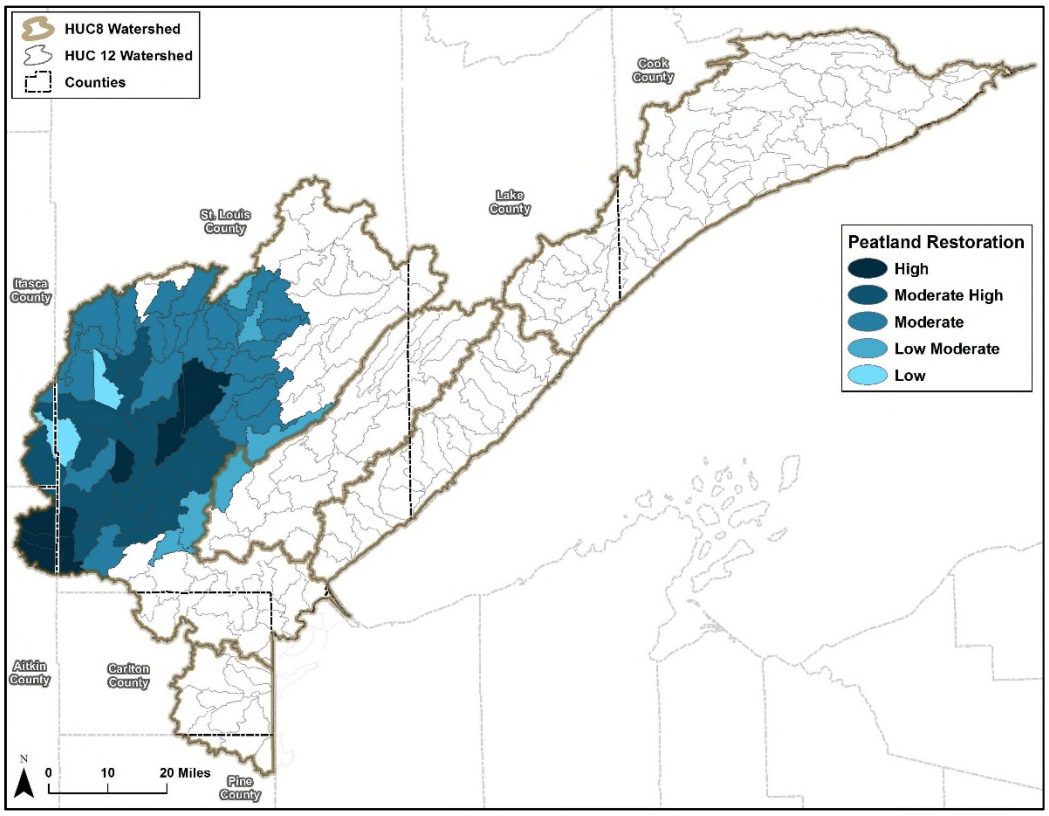


Figure 30. Watershed suitability – peatland hydrology restoration

4. Project Summary and Next Steps

This report demonstrates that a potential exists in northeast Minnesota for alternative mitigation opportunities, provides a methodology for identifying and prioritizing opportunities by watershed, and offers a methodology that can be used to further the efforts in the state. This report and the associated geodatabase, available from EPA by contacting Kerryann Weaver – EPA Region 5 Watersheds and Wetlands Branch[17] can be used to aid in decision-making and to address inquiries about opportunities for alternative mitigation options. This report and the analyses included do not replace the need to evaluate traditional wetland mitigation opportunities, specifically wetland restoration, enhancement, preservation, and creation, prior to considering alternative methods.

The watershed analysis was conducted at a HUC12 scale, and therefore should be used appropriately to evaluate differences amongst watersheds, but is not a sufficient tool to identify specific project opportunities beyond those identified in Section 3.1. The reliability and accuracy of the underlying datasets used to process the watershed-scale analysis varies, and therefore the results of this analysis should be used by trained resource professionals with an understanding of natural resource management and data sources.

While this report documents several different types of opportunities, additional analyses could be further evaluated as additional information becomes available or as further work is conducted at smaller scales:

- **Wildlife corridors and habitat.** Additional work could be done to further evaluate important wildlife corridors and habitat in BSA1 and potential stressors to these resources. For example, species of greatest conservation need that have been identified as priorities in BSA1, and their specific habitat requirements, could be included in ranking of preservation watersheds. Wildlife habitat restoration, particularly within the mining areas surrounding the Biwabak Iron Formation, could also potentially be considered as an additional project type.
- **Restoration of peatland vegetation.** The updated NWI may provide better detail on vegetation types to identify peatland vegetation. Peat mining permits could also be used to determine impacted peat areas.
- **Stabilization of natural hydrology.** An analysis that evaluates impacts of roads that cross wetlands could be used to determine where roads are having a large-scale hydrologic impact on wetlands. The analysis could take into account wetland plant community types (with particular emphasis on wetter/drier communities) that differ on either side of a road. The NWI may provide other indicators that could also be of use to determine hydrologic impacts.
- **Increase robustness of ranking watersheds for restoration and preservation.** Stronger indicators may be needed to further evaluate watersheds for reservation or preservation priorities. For example, as additional information is made available, the analysis could consider ranking watersheds based on potential functional gains or cumulative loss of aquatic resources.

[17] weaver.kerryann@epa.gov

In addition, increased coordination with watershed and wetland planning activities in nearby areas of Wisconsin could further enhance activities in Minnesota. For example, in Douglas County (Wisconsin), a diverse group of partners is developing watershed-based wetland plans founded on ecosystem service assessments. Efforts in other similar areas could be used to complement approaches being taken in Minnesota. Consideration of the use of wetland functional approaches outlined in the Region 5 Wetland Supplement to the EPA Watershed Handbook[18] could be used or modified to provide additional value.

Next steps may include a new examination of existing traditional mitigation options (i.e., inventory and assess potential mitigation sites which includes wetland restoration, enhancement, creation and preservation) in BSA1 and incorporating that into to the current effort to identify alternative mitigation options in BSA1 to begin to better address the issue of how compensatory mitigation, using both traditional and non-traditional methods, can be used to ensure the integrity of the watersheds where authorized impacts occur.

Next steps will also likely focus on evaluating potential crediting, at both a state and federal level, for the various alternative mitigation options. Research on how the alternative mitigation options could be credited is needed and could involve a survey of permitting entities throughout the country and literature review. Policy discussions and decisions will be needed to determine potential crediting options. In addition, more work is likely needed to further identify and prioritize traditional mitigation options. As referenced in the Siting Report, it is recommended that the agencies continue to collaborate on discussions on credit allocation methods and amounts for potential alternative mitigation actions.

[18] Available at: http://www.epa.gov/region5/agriculture/pdfs/wetlands-in-watershed-planning-supplement-region-5-201302.pdf.

Appendix A – Interview Background

Interviews were conducted with the Team and others to identify additional site-specific implementation activities. A preliminary list of potential implementation activities derived from review of existing watershed plans was provided. Each individual was contacted by phone to discuss the following:

- What has been your experience with the potential project(s) and is there any information available that would further inform our evaluation?
- Are there any implementation activities that we should be including in this evaluation?
- Are there any additional local or watershed plans or relevant efforts that should be reviewed and incorporated?
- Are there other people that you recommend we contact?

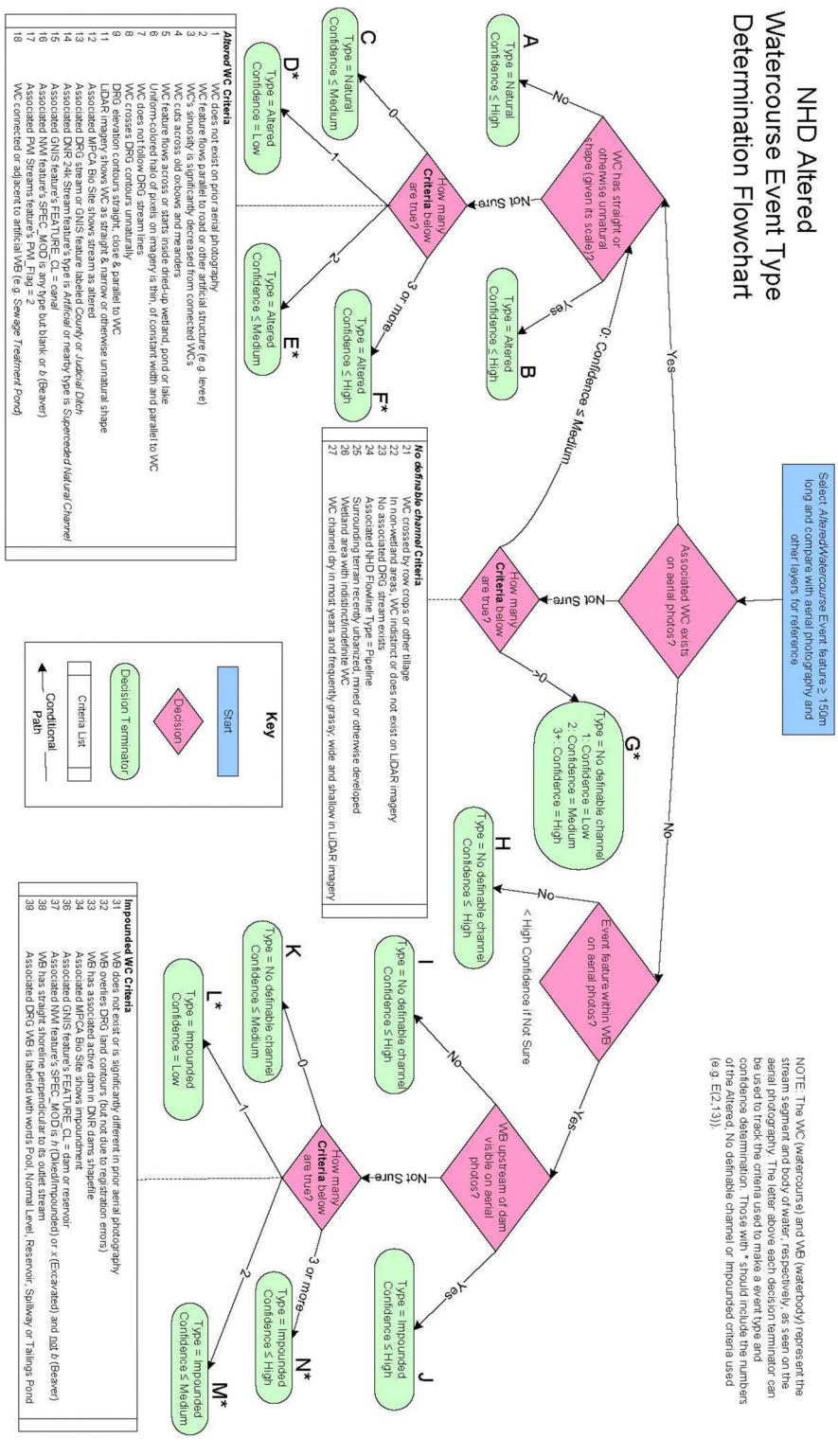
The individuals listed in the table below provided input on the identification of site-specific implementation activities through email or phone interview, or indirectly through communication with other individuals listed here.

Individuals that provided input on the identification of site-specific implementation activities

Agency/Organization	Interviewee(s)
Board of Water and Soil Resources	Les Lemm
	Ken Powell
Carlton Soil and Water Conservation District (SWCD)	Brad Matlack
	Neva Widner
Cook SWCD	Kerrie Berg
Fond du Lac Reservation	Rick Gitar
Lake SWCD	Dan Schutte
	Ann Thompson
Minnesota Department of Natural Resources	Jennifer Engstrom
	Edie Evarts
	Deserae Hendrickson
	Karl Koller
	Doug Norris
	Dean Paron
	Steve Persons
	Jeff Tillma
Minnesota Pollution Control Agency	Tom Estabrooks
	Karen Evens
	Brian Fredrickson
	Mark Gernes
	Jeff Jasperson
	Mike Kennedy
South St. Louis Soil and Water Conservation District	Tim Beaster

Agency/Organization	Interviewee(s)
St. Louis River Alliance	Kris Eilers
SWCD Technical Service Area III	Keith Anderson
United States Army Corps of Engineers	Leslie Day
	Greg Larson
	Tim Smith
United States Environmental Protection Agency Mid-Continent Ecology Division	Tom Hollenhorst
United States Fish & Wildlife Service	Andrew Horton
United States Forest Service	Jason Butcher
	Marty Rye

Appendix B – Altered Watercourse Process



Appendix C – Watershed Results

The following table lists the rankings by HUC12 watershed presented in Figure 25 through Figure 30 in Section 3.2.

Watershed opportunities rankings

HUC12 Watershed	Permanent protection of large tracts of land	Restoration of riparian buffers, corridors, and shoreline	Stream restoration and restoration of natural stream hydrology	Dam/impoundment modification or removal	Modification of existing road crossings	Peatland hydrology restoration
040101010101	No Opportunity	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010201	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010202	Low	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010203	Low	No Opportunity	No Opportunity	Low	No Opportunity	No Opportunity
040101010204	Low	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010205	Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010206	Moderate High	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010207	Low Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010208	Low Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010301	Moderate	Low	Low	Low	Low	No Opportunity
040101010302	Low Moderate	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010303	High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010401	No Opportunity	Low	No Opportunity	No Opportunity	No Opportunity	No Opportunity
040101010402	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010403	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010404	No Opportunity	Low	No Opportunity	No Opportunity	No Opportunity	No Opportunity
040101010405	No Opportunity	Low	Low	No Opportunity	Low	No Opportunity
040101010406	No Opportunity	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010407	No Opportunity	Low	No Opportunity	Low	Low	No Opportunity
040101010408	Low	Low	No Opportunity	No Opportunity	No Opportunity	No Opportunity
040101010409	Low Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010501	Low Moderate	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010502	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010503	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010504	No Opportunity	Low Moderate	Low Moderate	Low Moderate	Low Moderate	No Opportunity
040101010505	No Opportunity	Low	Low	No Opportunity	Low Moderate	No Opportunity
040101010601	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010602	No Opportunity	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010603	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010604	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010605	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010606	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010701	Moderate High	Moderate	No Opportunity	No Opportunity	Moderate	No Opportunity
040101010702	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010703	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010704	No Opportunity	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010705	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity

HUC12 Watershed	Permanent protection of large tracts of land	Restoration of riparian buffers, corridors, and shoreline	Stream restoration and restoration of natural stream hydrology	Dam/impoundment modification or removal	Modification of existing road crossings	Peatland hydrology restoration
040101010706	Low Moderate	Moderate	No Opportunity	No Opportunity	Moderate	No Opportunity
040101010707	Moderate High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010801	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010802	No Opportunity	Low	No Opportunity	Low	Low	No Opportunity
040101010803	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010804	No Opportunity	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010805	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101010901	No Opportunity	No Opportunity	No Opportunity	Low Moderate	Low	No Opportunity
040101010902	No Opportunity	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010903	No Opportunity	Low	Low	Low	Low	No Opportunity
040101010904	Low	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101010905	Moderate High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101011001	Low	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101011002	Low	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101011003	Low Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101011004	Low	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101011005	Low	Low	Low	No Opportunity	Low	No Opportunity
040101011006	Moderate High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101011101	Low Moderate	No Opportunity	Low	No Opportunity	Low	No Opportunity
040101011102	Moderate High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101011103	Low Moderate	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101011104	Moderate	Low	Low	Low	Low	No Opportunity
040101011105	Moderate	Low	No Opportunity	Low	Low	No Opportunity
040101020101	Moderate High	Low	Low	No Opportunity	Low	No Opportunity
040101020102	Low	Moderate	No Opportunity	No Opportunity	Moderate	No Opportunity
040101020103	Low	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101020104	Low	Low	Low	Low Moderate	Low	No Opportunity
040101020105	Low	Moderate	Moderate	High	Moderate	No Opportunity
040101020106	Low Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040101020201	Low	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101020202	Low	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101020203	Low Moderate	Low	Low	No Opportunity	Low	No Opportunity
040101020204	High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101020205	Moderate High	Low	No Opportunity	No Opportunity	Low	No Opportunity
040101020206	Moderate High	Low	No Opportunity	Low	Low	No Opportunity
040101020301	Moderate High	Low	Low	Low	Low	No Opportunity
040101020302	Moderate High	High	Moderate	Moderate High	High	No Opportunity
040101020303	Moderate High	Moderate	Moderate	Moderate High	Moderate	No Opportunity
040101020304	Low Moderate	Low	Low	No Opportunity	Low	No Opportunity
040101020305	Moderate High	Moderate	Moderate	No Opportunity	Moderate	No Opportunity
040101020306	Moderate High	Moderate	Moderate	No Opportunity	Moderate	No Opportunity
040101020401	Moderate High	Moderate	Moderate	Moderate High	Moderate High	No Opportunity
040101020402	High	Moderate	Moderate	Moderate High	High	No Opportunity
040101020403	Moderate High	Moderate High	Moderate	No Opportunity	Moderate High	No Opportunity

HUC12 Watershed	Permanent protection of large tracts of land	Restoration of riparian buffers, corridors, and shoreline	Stream restoration and restoration of natural stream hydrology	Dam/impoundment modification or removal	Modification of existing road crossings	Peatland hydrology restoration
040101020404	Moderate High	Moderate	Moderate	No Opportunity	Moderate	No Opportunity
040101020405	Moderate High	Moderate High	Low Moderate	Low Moderate	Moderate High	No Opportunity
040102010101	No Opportunity	Low	Low	No Opportunity	Low	No Opportunity
040102010102	No Opportunity	No Opportunity	Low	No Opportunity	Low	No Opportunity
040102010103	Low	No Opportunity	Low	No Opportunity	Low	No Opportunity
040102010104	No Opportunity	Moderate	Moderate High	High	Moderate	No Opportunity
040102010105	Moderate	Moderate	Moderate	High	Moderate	No Opportunity
040102010201	No Opportunity	No Opportunity	Low	No Opportunity	No Opportunity	No Opportunity
040102010202	No Opportunity	No Opportunity	Low	No Opportunity	Low	No Opportunity
040102010203	Low Moderate	No Opportunity	No Opportunity	Low	Low	No Opportunity
040102010204	Moderate High	Moderate	Moderate High	No Opportunity	Moderate	Moderate
040102010205	Moderate High	Moderate High	High	No Opportunity	Moderate	Moderate
040102010206	Moderate High	Low Moderate	Low Moderate	No Opportunity	Low Moderate	Low Moderate
040102010301	Low Moderate	Moderate	Moderate	Moderate High	Moderate	No Opportunity
040102010302	Low Moderate	Low	Low	No Opportunity	Low	No Opportunity
040102010303	Moderate	Moderate	Moderate High	Moderate High	Moderate	No Opportunity
040102010304	Moderate	Low Moderate	Low Moderate	Moderate	Low Moderate	Low Moderate
040102010305	Moderate	Moderate	Moderate	Moderate High	Moderate	Moderate
040102010401	Moderate High	Moderate	Moderate High	No Opportunity	Moderate	No Opportunity
040102010402	Low Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102010403	Low Moderate	Moderate	Moderate	No Opportunity	Moderate	Moderate
040102010404	Moderate High	Moderate	Moderate	No Opportunity	Moderate	Moderate
040102010501	No Opportunity	Moderate High	Low Moderate	Low Moderate	Low Moderate	No Opportunity
040102010502	Moderate	Moderate	Moderate High	Moderate High	Moderate	Moderate
040102010503	Moderate	Moderate	Moderate High	Moderate High	Moderate High	No Opportunity
040102010504	Moderate High	Moderate High	Moderate High	No Opportunity	Moderate	Moderate
040102010601	Moderate	Moderate	Moderate High	High	Moderate	Moderate
040102010602	Moderate	Moderate High	Moderate High	High	Moderate High	Moderate
040102010603	Moderate High	Moderate High	Moderate High	No Opportunity	Moderate High	Moderate
040102010604	Low Moderate	Moderate	Moderate	No Opportunity	Moderate	Moderate High
040102010605	Moderate	Moderate	Moderate High	No Opportunity	Moderate High	Moderate
040102010606	Moderate High	Moderate	Moderate High	No Opportunity	Moderate	Moderate
040102010607	Low	Low	Low	No Opportunity	Low	Low
040102010608	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102010701	Moderate	Moderate	Moderate	Moderate High	Moderate	Moderate
040102010702	Moderate	Moderate	Moderate High	Moderate High	Moderate	Moderate
040102010703	Moderate	Moderate High	Moderate High	No Opportunity	Moderate	Moderate
040102010704	Moderate	Moderate High	Moderate High	Moderate High	Moderate	Moderate
040102010705	Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102010706	Moderate High	Moderate	Moderate High	No Opportunity	Moderate	Moderate
040102010707	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102010708	Moderate	High	High	No Opportunity	Moderate	High
040102010709	Moderate	Moderate High	High	No Opportunity	Moderate	Moderate High
040102010801	No Opportunity	Low	Low	No Opportunity	Low	No Opportunity

HUC12 Watershed	Permanent protection of large tracts of land	Restoration of riparian buffers, corridors, and shoreline	Stream restoration and restoration of natural stream hydrology	Dam/impoundment modification or removal	Modification of existing road crossings	Peatland hydrology restoration
040102010802	No Opportunity	Low	Low	No Opportunity	Low	No Opportunity
040102010803	Low Moderate	No Opportunity	Low	No Opportunity	Low	No Opportunity
040102010804	Low Moderate	Moderate	Moderate High	High	Moderate	No Opportunity
040102010805	Low Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102010806	Low	Low Moderate	Low Moderate	No Opportunity	Low Moderate	Low Moderate
040102010807	Moderate	Moderate	Moderate	No Opportunity	Moderate	Moderate
040102010901	Low Moderate	Moderate	Moderate	No Opportunity	Moderate	Moderate
040102010902	Low Moderate	Moderate	Moderate	No Opportunity	Moderate	Moderate
040102010903	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102010904	Low Moderate	Moderate High	High	Moderate High	Moderate	High
040102010905	Low Moderate	Moderate High	High	No Opportunity	Moderate	High
040102010906	Low Moderate	Moderate High	High	No Opportunity	Moderate	Moderate High
040102010907	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102010908	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102011001	Low Moderate	Low	Low	Low	Low	Low
040102011002	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102011003	Low	Moderate	Moderate	No Opportunity	Moderate	Moderate High
040102011004	Low	Low Moderate	Low Moderate	No Opportunity	Low Moderate	Moderate
040102011005	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102011101	Low	No Opportunity	Moderate High	No Opportunity	No Opportunity	High
040102011102	Low	Moderate	Moderate High	No Opportunity	No Opportunity	High
040102011103	Low	Moderate	High	No Opportunity	No Opportunity	High
040102011104	Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102011201	Low Moderate	Moderate	Moderate High	Moderate High	Moderate	No Opportunity
040102011202	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	No Opportunity
040102011203	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	No Opportunity
040102011301	Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102011302	Low	Moderate	Moderate High	No Opportunity	Moderate	Moderate High
040102011303	Low Moderate	Moderate	Moderate High	No Opportunity	Moderate	Moderate
040102011304	Low Moderate	Low Moderate	Low Moderate	Low Moderate	Low Moderate	No Opportunity
040102011305	Moderate High	Low Moderate	Low Moderate	No Opportunity	Low Moderate	Low Moderate
040102011306	Low Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	Low Moderate
040102011401	Moderate High	Moderate	Moderate High	No Opportunity	Moderate High	No Opportunity
040102011402	Moderate High	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102011403	Moderate	Moderate High	Moderate High	No Opportunity	Moderate High	No Opportunity
040102011501	Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102011502	Moderate High	Moderate	Moderate High	Moderate High	Moderate High	No Opportunity
040102011503	Moderate	Low Moderate	Low Moderate	Moderate High	Low Moderate	No Opportunity
040102011504	Moderate	Moderate	Moderate	No Opportunity	Moderate	No Opportunity
040102011505	Moderate High	Low Moderate	Low Moderate	Moderate High	Low Moderate	No Opportunity
040102011601	Moderate High	Low Moderate	Low Moderate	No Opportunity	Moderate	No Opportunity
040102011602	High	Low Moderate	No Opportunity	No Opportunity	Low	No Opportunity
040102011603	Moderate High	Moderate High	Moderate	No Opportunity	Moderate High	No Opportunity
040102011604	Moderate	High	Moderate	Moderate High	Moderate High	No Opportunity

HUC12 Watershed	Permanent protection of large tracts of land	Restoration of riparian buffers, corridors, and shoreline	Stream restoration and restoration of natural stream hydrology	Dam/impoundment modification or removal	Modification of existing road crossings	Peatland hydrology restoration
040102020101	Low Moderate	Low	Low	Low	Low	No Opportunity
040102020102	Low Moderate	Low	Low	No Opportunity	Low	No Opportunity
040102020103	No Opportunity	Low	Low	Low	Low	No Opportunity
040102020104	Low Moderate	Low	Low	Low	Low	No Opportunity
040102020105	Low Moderate	Low	Low	Low	Low	No Opportunity
040102020201	Low	Low Moderate	Low Moderate	Low Moderate	Low Moderate	No Opportunity
040102020202	No Opportunity	Low	No Opportunity	No Opportunity	Low	No Opportunity
040102020203	Low Moderate	No Opportunity	No Opportunity	No Opportunity	Low	No Opportunity
040102020301	Low	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102020302	Low	No Opportunity	Low Moderate	Low Moderate	Low Moderate	No Opportunity
040102020401	Low	Low	Low	No Opportunity	No Opportunity	No Opportunity
040102020402	Low Moderate	Low Moderate	Low Moderate	Moderate High	Low Moderate	No Opportunity
040102020403	Low Moderate	Low	Low	Low	Low	No Opportunity
040102020404	Moderate	Moderate	Moderate High	Moderate High	Moderate	No Opportunity
040102020501	Moderate High	Moderate	Moderate High	Moderate High	Moderate	No Opportunity
040102020502	Moderate High	Moderate	Moderate High	High	Moderate	No Opportunity
040102020601	Low	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102020602	Low Moderate	No Opportunity	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102020603	Low Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	Low Moderate
040102020604	Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040102020605	Moderate High	Low	Low	No Opportunity	Low	No Opportunity
040103010101	High	Moderate	Moderate	Moderate High	Moderate	No Opportunity
040103010102	Low Moderate	Moderate	Moderate	Moderate High	Moderate	No Opportunity
040103010103	Low	Moderate High	No Opportunity	No Opportunity	Moderate	No Opportunity
040103010201	Moderate High	Moderate	Moderate	No Opportunity	Moderate	No Opportunity
040103010202	Low Moderate	Low Moderate	Low Moderate	No Opportunity	Low Moderate	No Opportunity
040103010203	Moderate	Moderate	Moderate	High	Moderate High	No Opportunity
040103010204	Moderate High	Low	Low	Low	Low	No Opportunity
040103010205	Low Moderate	Moderate High	Moderate	Moderate High	Moderate	No Opportunity
040103010301	Low	No Opportunity	Low	No Opportunity	No Opportunity	No Opportunity
040103010401	Moderate High	Moderate High	No Opportunity	No Opportunity	Moderate	No Opportunity
040103010403	Moderate High	Moderate High	No Opportunity	No Opportunity	Moderate	No Opportunity