7.0 NEARSHORE FRAMEWORK

The 2012 protocol amending the GLWQA contains a commitment to develop an integrated nearshore framework for the Great Lakes (hereafter referred to as the Nearshore Framework or Framework) which will provide an overall assessment of the state of the nearshore waters of the Great Lakes (Canada and the United States, 2012). The GLWQA directed that the Framework be developed within three years of entry into force of the GLWQA (i.e., by end of February 2016) and be implemented collaboratively through the lakewide management process for each Great Lake. Once the Framework is complete, it will be incorporated into the Lake Superior Partnership and reported in the next LAMP (produced in 2020).

The nearshore regions of the Great Lakes are the geographic and ecological link between our watersheds, rivers, wetlands, and groundwater to the open deep waters of the lakes. The shallow warm water at the land-water interface provides habitat critical to maintaining our native biodiversity in the Great Lakes basin. It is also the region where human use of lake resources is most intense, from reliance on clean water for recreational uses, such as swimming and fishing, to supporting our residential populations and economic pursuits and supplying our communities with clean sources of drinking water. For the purposes of the Framework, the nearshore is defined as where the water meets the land, "*the littoral area of the Great Lakes and connecting rivers where waters are subject to direct influences from shorelands and watersheds.*" Thus, the nearshore area will not be rigidly defined by depth or distance from shore, but by zone of impact where these influences are observed.

The Nearshore Framework's assessment will identify nearshore areas that are or may become subject to high stress due to individual or cumulative impacts on the chemical, physical, or biological integrity of those areas. Since the last version of the GLWQA in 1987, the focus on areas of high stress has centered on the 43 designated Great Lakes AOCs. Lessons learned from the AOC experience will provide valuable guidance for the identification of criteria that could be used to determine areas of high stress within the nearshore. The Nearshore Framework will provide a comprehensive assessment of nearshore waters; share information from the assessment; identify areas requiring protection, restoration or prevention activities; and identify stressors at a broad scale. Agencies can then factor these findings into their priority setting and engage and empower communities to create collaborative approaches to addressing the identified issues and take action.

Manitou Island off the northeastern tip of the Keweenaw Peninsula. Credit: P. Nankervis.

8.0 SCIENCE AND MONITORING PRIORITIES

As described in Section 5.1, the CSMI is an intensive, binational collaborative research and monitoring program that follows a five-year cycle. As part of that cycle, science and monitoring priorities for Lake Superior were determined through multi-stakeholder discussions, taking into account the results of previous studies and recommendations, long-term trends and emerging issues.

Lake Sturgeon. Credit: H. Quinlan, U.S. Fish and Wildlife Service.

The Lake Superior Partnership has grouped science and monitoring priorities into three themes: chemicals and nutrients, aquatic communities, and habitat and wildlife. Table 6 lists current Lake Superior science and monitoring priorities. These priorities support Lake Superior lakewide objectives, and results will inform future assessments, including the 2020 LAMP, of the state of the lake as well as threats to the ecosystem that need to be addressed. A CSMI Task Team will provide three levels of reporting that include details of completed projects (approximately 6 months after the field year), a CSMI workshop overview (2 years after the field year), and scientific journal articles published in ensuing years.

Table 6. Lake Superior Science and Monitoring Priorities, 2016

Science and Monitoring Priority	Context	Link to Action Areas and Lakewide Objectives
Aquatic Communities		
Monitoring of the lower-trophic food-web / energy transfer.	Lake Superior has a largely native and self-sustaining food-web, despite ongoing and new and cumulative stressors. Significant management actions have been taking place to restore and maintain conditions.	Action area on native species. Lakewide objective to maintain good ecological condition of the nearshore and offshore waters.
Lake Sturgeon Index Survey	Lake Sturgeon is not only a species of conservation concern, requiring intervention, but ongoing rehabilitation efforts also have positive impacts on the quality of tributary habitats, currently assessed to be “fair” condition.	Action areas on native species and dams and barriers. Lakewide objectives to maintain good ecological condition in tributaries and watersheds.
Aquatic invasive species early detection monitoring	Aquatic invasive species are a threat to biodiversity conservation and management of a self-sustaining commercial and recreational fishery.	Action areas on aquatic invasive species, and native species. Lakewide objectives to maintain good ecological condition of tributaries, inshore, nearshore and offshore waters.

Science and Monitoring Priority	Context	Link to Action Areas and Lakewide Objectives
Support to fish rehabilitation plans	Brook Trout and Walleye are species of conservation concern, and among the species with rehabilitation plans. Understanding status and trends of fish populations help prioritize management actions.	Action areas on high quality habitat and native species. Lakewide objectives to maintain good ecological condition of tributaries, coastal wetlands, inshore, nearshore and offshore waters.
Habitat and Wildlife		
Identify and rank vulnerability of cold-water tributaries to Lake Superior to various stressors, including climate change	Lake Superior has a unique network of cold-water streams. Cold-water habitats are threatened by climate change, but current and predicted distribution, extent, and risk are not known.	Action areas on climate change, high quality habitat and native species. Lakewide objective to maintain good ecological condition of tributaries and watersheds.
Baseline water quality monitoring areas of potential future land use change.	There remain gaps in knowledge regarding the impact of past and present mining activity conducted in the watershed on nearshore environments.	Action area on other existing and emerging threats. Lakewide objective to maintain good ecological condition in the tributaries and watersheds, and protect the Lake Superior basin from contamination resulting from additional substances of concern.
Identify species of conservation concern	Recent assessments in support of *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015) identified the need to better identify the presence of species of conservation concern, their habitats, habitat range limits, sensitivity to climate change, and other concerns such as habitat connectivity.	Action areas on climate change, native species, and high-quality habitats. Lakewide objectives to maintain good ecological condition on the islands, coastal wetlands, coastal zones and tributaries and watersheds.
Land use / Land cover	The extent and rate of land use change (e.g., forested, developed, agriculture) is not fully understood, nor is the impacts of these changes to Lake Superior. Opportunity to help better inform future land use planning with regard to lakewide objectives.	Action areas on dams and barriers, climate change and high-quality habitats. Lakewide objectives to maintain good ecological condition of tributaries and watersheds, coastal zones, coastal wetlands, embayment and nearshore waters.
Explore use of lakewide macroinvertebrate monitoring to assess state of the lake, threats, stress impacts, and success of restoration and protection investments	Various macroinvertebrate monitoring efforts are taking place to track local conditions and inform local decision-making. Assess the similarities and differences, and applicability for potential lakewide standardization for lakewide reporting and decision-making.	Action areas on dams and barriers, climate change and high-quality habitats. Lakewide objectives to maintain good ecological condition of tributaries and watersheds, coastal zones, coastal wetlands, embayment and nearshore waters.

Science and Monitoring Priority	Context	Link to Action Areas and Lakewide Objectives
Chemicals and Nutrients		
Concentrations and cycling of Zero Discharge Demonstration Program chemicals in the Lake Superior basin.	While demonstrating the extent that the emissions of these chemicals can be reduced within the basin, it is also important to understand and communicate the actual concentrations and trends of these contaminants in the environment.	Action area on chemical contaminants. Lakewide objective to achieve zero release of nine persistent bioaccumulative toxic substances.
Chemicals of emerging concern - toxicity, persistence and bioaccumulative properties. Preference to all candidate "chemicals of mutual concern" under the GLWQA that are not already captured above.	While Lake Superior is the "cleanest" of the Great Lakes, there are existing chemicals of emerging concern and new substances being detected in the waters. Even if meeting acceptable concentrations, it is important to communicate that evidence, and continue to ensure Lake Superior is benefitting from pollution prevention actions.	Action area on additional substances of concern. Lakewide objective to protect the Lake Superior basin from contamination resulting from additional substances of concern.
Mercury trends in Lake Superior fish	Lake Superior data is demonstrating a vacillation (i.e., decrease/increase/decrease) in mercury. Is this a management concern? Mercury is a cause of some fish consumption advisories.	Action area on chemical contaminants. Lakewide objective to achieve zero release of nine persistent bioaccumulative toxic substances, which includes mercury.
Identify nearshore areas most susceptible to eutrophication based on loadings, climate changes, lake currents and hydrodynamics	Occasional algal blooms do occur in some localized areas. In 2012, an extreme rain event and high temperatures was associated with a rare, small blue-green bloom in the southwest of the lake.	Lakewide objectives to maintain good ecological condition of coastal wetlands, embayments and the nearshore waters.
Follow-up studies on effects of stamp sands	Stamp sands (legacy mining waste piles) that contain elevated levels of contaminants and are eroding into Lake Superior (e.g., near Gay, Michigan) can threaten water quality, habitat and species. Is this a management concern?	Action areas on additional substances of concern, high quality habitats, and native species. Lakewide objectives to protect the Lake Superior basin from contamination resulting from additional substances of concern, and to maintain good ecological condition of embayments and the nearshore waters.

9.0 ACTIONS, PROJECTS, AND IMPLEMENTATION

The following section presents actions that may be taken to restore and protect Lake Superior. It is important to emphasize that all stakeholders play a role, i.e., federal, state and provincial governments, tribal governments, First Nations, Metis, municipal governments, watershed management agencies, other local public agencies, and the public. To successfully implement these actions, coordination, science-based management, public engagement, adaptive management and a prevention approach are all essential. These concepts are discussed below, with sections organized as follows:

Section 9.1 includes: 1) **Actions** to address threats to water quality and to achieve lakewide objectives. This information can be used to help identify, support or coordinate ongoing or new projects; 2) Lake Superior Partnership **Projects** that can help focus cooperative implementation and reporting under the Lake Superior LAMP over the next five years; and, 3) **Activities that everyone can take** to help protect Lake Superior.

Section 9.2 emphasizes the importance of restoring Lake Superior's degraded **Areas of Concern** (AOCs). AOCs are designated geographic areas that have their own specific "Remedial Action Plans" (RAPs) to guide remediation and restoration actions. Restoring AOCs will help improve conditions in the lake, thereby contributing to achievement of lakewide ecosystem objectives. RAPs can be considered a complementary effort to the LAMP.

Section 9.3 emphasizes the **commitment to implement LAMP actions and be accountable** for results.


Left: Falls River culvert on Golf Course Road, Baraga County, Michigan, before removal. *Right:* Falls River Golf Course Road after culvert removal. Credit: E. Johnston, Keweenaw Bay Indian Community.

9.1 Lakewide Management Actions and Projects

Lakewide management **actions** and **projects** are organized under the different threats identified in Section 4:

- Aquatic invasive species;
- Climate change;
- Dams and barriers;
- Chemical contaminants;
- Additional substances of concern; and
- Other threats (e.g., mining impacts and energy sector activities).

Two additional categories are included, to fully capture actions identified in *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015):

- High-quality habitats; and
- Native species.

Actions

Actions needed to address threats to water quality and achieve lakewide objectives have been identified by the Lake Superior Partnership in consultation with Lake Superior stakeholders and the public. The primary sources of the identified actions are: A Biodiversity Conservation Strategy for Lake Superior (LSBP, 2015), Lake Superior Climate Change Impacts and Adaptation Report (Huff and Thomas, 2014), the Lake Superior Aquatic Invasive Species Complete Prevention Plan (LSBP, 2014), the Zero Discharge Demonstration Program (ongoing) and 1990-2010 Critical Chemical Reduction Milestones report (LSBP, 2012).

The actions are fairly broad in their scope and can be used to help identify, support or coordinate ongoing or new projects for Lake Superior. For example, the actions were used to help identify Lake Superior Partnership projects over the years 2015-2019, as described below.

Lake Superior Partnership Projects

Projects were identified by Lake Superior management experts who comprise the Lake Superior Partnership. To be identified and confirmed as a project, several factors were considered: relevancy to the broader actions needed to address a threat (referred to above), current work underway, current state of the issue, potential for a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years.

A total of 29 projects were identified. These projects can help focus cooperative implementation efforts and reporting under the Lake Superior LAMP.

Aquatic Invasive Species: Reduce the Impact of Existing Aquatic Invasive Species and Prevent the Introduction of New Ones

Context

As described in Section 4, the threat of aquatic invasive species (AIS) is ranked high, as evaluated in *A Lake Superior Biodiversity Conservation Assessment* (LSBP, 2015). This assessment examined scope, severity, and irreversibility of threats to Lake Superior. Some factors in the assessment included:

- Existing invasive species continue to impact the ecosystem (e.g., Sea Lamprey);
- Existing invasive species (found in limited areas of Lake Superior) have the potential to spread (e.g., Phragmites);
- Lake Superior waters are warming, thereby reducing the natural barrier of very cold waters that are inhospitable to many species found in the lower lakes;
- Establishment of even a single invasive species can have a greater negative consequence to Lake Superior because of the lake's relatively simple food-web, as compared to the other Great Lakes;
- Lake Superior is at one end of the Great Lakes – St. Lawrence Seaway, making it susceptible to invasive species that hitchhike via ballast water, live bait dumping, aquarium releases, water garden escapes, or as parasites or disease from introduced fish; and
- Constant vigilance is required to prevent and/or manage the risk of new invasive species becoming established in Lake Superior.

Actions

The following list of actions was developed by the Lake Superior Partnership though stakeholder comment processes and engagement (e.g., development of the *Lake Superior Aquatic Invasive Species Complete Prevention Plan* (LSBP, 2014) and *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015)). Results of these actions will contribute to achieving several lakewide objectives for Lake Superior (objectives 1-4 and 7, found in Section 3). These actions also support the GLWQA General Objective that calls for the Great Lakes to be free from the introduction and spread of aquatic invasive species.

- ➢ Establish first-response control protocols, where not already in place, in anticipation of newly-discovered aquatic invasive species;
- ➢ Implement control and/or eradication plans, where feasible, at appropriate geographic scales for priority aquatic invasive species;

- Undertake actions that reduce the risk of AIS being transferred between Lake Superior and the lower Great Lakes, the Mississippi River Basin, or other inland waters;
- Maintain Sea Lamprey at population levels that do not cause significant mortality for adult Lake Trout;
- Undertake best management practices to prevent AIS introductions during dredging operations, lock operations, construction, and other maintenance activities;
- Continue screening processes to classify species proposed for trade into three lists: prohibited, permitted, and conditionally prohibited/permitted;
- Identify AIS introduction issues and establish best management practices and restrictions for shore-land work;
- Implement compatible, federal regulatory regimes for ballast water discharge that are protective of the U.S. and Canadian Great Lakes;
- Use regulations, policies and best management practices to reduce the risk of introduction of AIS through all possible pathways, including boaters, guides, equipment and live bait dealers, hatchery operators, pet stores, home garden centers, sea plane pilots, scuba divers, and water recreationists;
- Protect exposed or seasonally-exposed wetland environments from off-road vehicular use that may be a vector for invasive plants (e.g., European Common Reed [*Phragmites australis subsp. australis*]);
- Undertake outreach, education, enforcement and research on preventing and managing AIS;
- Monitor AIS movement and establishment in the Lake Superior basin;
- Maintain a list of the AIS that are most likely to reach the Lake Superior basin, and monitor appropriately;
- Support development, testing and implementation of effective ballast treatment systems; and
- Identify ecosystems that may be more vulnerable to new AIS under changing environmental conditions.

Addressing the Issue

To address this issue across the Great Lakes, a number of binational efforts are being taken under the GLWQA 2012 (i.e., Annex 5 Discharges from Vessels, and Annex 6 Aquatic Invasive Species). These efforts include programs and measures to protect the Great Lakes from the discharge of aquatic invasive species from ships' ballast water and sediment; aquatic invasive species risk assessments; and an early detection and rapid response initiative.

Several organizations work collaboratively to tackle aquatic invasive species issues in the Great Lakes. For example, the Great Lakes Fishery Commission is working across borders to lead and implement a comprehensive Sea Lamprey control program. Since 1991, the Great Lakes Commission has supported the Great Lakes Panel on Aquatic Nuisance Species, a binational body comprised of representatives from government (state, provincial, federal, and tribal), business and industry, universities, citizen environmental groups and the larger community.

The Panel provides guidance on aquatic invasive species research initiatives, policy development and information/education programs. In 2009, the U.S. Saint Lawrence Seaway Development Corporation, in conjunction with the International Joint Commission, initiated the formation of the Great Lakes Ballast Water Collaborative, which shares information in an effort to facilitate communication and collaboration among key stakeholders and complement existing efforts to reduce the risk of introduction and spread of invasive species through ballast water.

In addition, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are found in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health*, and the U.S. Great Lakes Restoration Initiative Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 7). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone internal and public review.

The projects identified will help further focus coordination, tracking and reporting on specific work from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 7. Lake Superior Partnership Projects to Address Aquatic Invasive Species

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Add additional locations to the lakewide aquatic invasive species early detection/rapid response surveillance projects.	1854 Treaty Authority, CORA, DFO, Fond du Lac, KBIC, MDEQ, MNRF, NOAA, NPS, Parks Canada, USEPA, USFS, USFWS, WDNR
2	Undertake additional aquatic invasive species prevention outreach and education, including discussions with recreational boaters, and installation of lake access site signage.	1854 Treaty Authority, Bad River, BMIC, Fond du Lac, GLIFWC, Grand Portage, KBIC, MDEQ, Minnesota Sea Grant, MNRF, NPS, Parks Canada, Red Cliff, USFS, WDNR

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
3	Maintain and improve effectiveness of Sea Lamprey control, prevent introduction of new species, and limit expansion of previously-established aquatic invasive species.	1854 Treaty Authority, Bad River, BMIC, CORA, DFO, GLIFWC, NPS, Parks Canada, Red Cliff, USFWS, USGS
4	Contribute to the elimination of European Common Reed (i.e., *Phragmites australis, subsp. australis*) from the Lake Superior basin by undertaking or supporting lakewide distribution mapping, early detection efforts, and control efforts.	1854 Treaty Authority, Bad River, Fond du Lac, GLIFWC, MDEQ, MNDNR, MNRF, NPS, Parks Canada, Red Cliff, USEPA, USFS, WDNR

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Learn to recognize invasive species and report sightings to federal, state or provincial, tribal or Sea Grant authorities;
- Never release fish or transplant invasive plants along lakes, streams, and stormwater ponds;
- Purchase and use safe alternatives for shoreland restoration, water gardens and waterscapes, instead of potentially-invasive species; and
- Clean all aquatic plants, animals, and mud from watercraft, trailers, docks, lifts, anchors, and other recreational equipment before leaving access areas.

Located at the end of the northern breakwater, the Duluth Harbor lighthouse marks the entrance to the canal in Duluth, Minnesota. Credit: S. Bayer.

Climate Change: Respond to Climate Change

Context

As detailed in Section 4, climate change is expected to alter the Lake Superior ecosystem, and exacerbate many existing stressors. Impacts include increases in air and water temperatures, decreased extent and duration of ice cover and a possible long-term decrease in water levels. Direct effects on species and habitat will include: increased stress on cold-water fish communities as streams and rivers become warmer; a northward shift in deciduous forests and the reduction of suitable habitat for boreal species; and negative effects on fish and wildlife populations due to changing ecological conditions, which may diminish coastal wetlands. The issue of climate change was identified as a high threat to habitats and species on a lakewide scale in *A Biodiversity Conservation Assessment for Lake Superior* (LSBP, 2015).

Actions

The following list of actions was developed by the Lake Superior Partnership, through stakeholder comment processes and engagement (e.g., development of the *Lake Superior Climate Change Impacts and Adaptation* report (Huff and Thomas, 2014)). The results of these actions will contribute to achievement of several lakewide objectives for Lake Superior (objectives 2-6, found in Section 3). These actions also support the GLWQA General Objective for the Great Lakes to be free from conditions that may negatively impact its chemical, physical or biological integrity.

- Review and revise conservation, restoration and management plans, guidelines and regulations as required in response to projected climate change impacts (e.g., increased water temperatures);
- Implement adaptation actions to account for changes in variability and/or frequency in air and water temperatures, water levels, storm events and droughts, among other effects;
- Implement adaptive plant and forestry management practices that respond to climate change to minimize possible disturbances to Lake Superior;
- Create coastal development setbacks or rolling easements to allow ecosystems to migrate in response to changes in water levels;
- Prevent development near potentially newly-sensitive and/or flood risk areas;
- Increase the incorporation of climate change information into the communications, management, technical assistance, science, research and development programs of parks and protected areas;

- Undertake climate change education and outreach activities, with a focus on disseminating materials and information available from domestic climate change programs;
- Monitor the effectiveness of the Lake Superior Regulation Plan (i.e., water levels) in response to changing climate conditions with regard to protecting and preserving Lake Superior coastal ecosystems;
- Modify invasive species pathway analysis and prediction models to include climate change parameters;
- Use parks or sentinel sites as long-term integrated monitoring sites for climate change (e.g., monitoring of species, especially those at-risk or extinction-prone);
- Continue to support and enhance scientific research designed to understand resilience of ecosystems to climate change and cumulative effects;
- Make climate models, scenarios, and impact information available and accessible to those making large and small scale natural resource management decisions, growth plan decisions, and socio-economic analyses; and
- Conduct climate change vulnerability assessments for forests, fisheries, priority habitats and species, and nearshore water quality.

Addressing the Issue

To address this issue across the Great Lakes, a number of binational efforts are being taken under the GLWQA 2012 (i.e., Annex 9 Climate Change Impacts). These efforts include taking into account climate change impacts during implementation of the GLWQA, using domestic programs to address climate change impacts, and communicating binationally regarding ongoing developments of domestic climate change science, strategies and actions.

The binational Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee was established in 2015 to address the issue of water level regulation, including the potential impact of climate change. The GLAM will undertake the monitoring, modeling and assessment needed to support ongoing evaluation of the regulation of Lake Superior water levels and flows. The GLAM Committee reports to the International Lake Superior Board of Control.

In addition, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are found in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health*, and the U.S. Great Lakes Restoration Initiative (GLRI) Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 8). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership and have undergone internal and public review.

The projects identified will help further focus coordination, tracking and reporting on specific work from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 8. Lake Superior Partnership Projects to Address Climate Change

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Undertake or support outreach and education to stakeholders on the impacts of climate change in the Lake Superior ecosystem, including potential changes to habitat ranges, stormwater management, and nutrient/chemical cycling.	1854 Treaty Authority, Bad River, BMIC, CORA, ECCC, Fond du Lac, GLIFWC, Grand Portage, KBIC, MOECC, NOAA, NPS, Red Cliff, USEPA, USFS, USGS
2	Support local climate change initiatives to help communities and/or natural resource managers develop adaptation plans.	1854 Treaty Authority, Bad River, BMIC, CORA, Fond du Lac, GLIFWC, Grand Portage, KBIC, Minnesota Sea Grant, MNDNR, MOECC, NOAA, NPS, Red Cliff, USFS, USFWS, USGS

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Reduce unnecessary driving where possible; walk, bike, carpool or take mass transportation to reduce greenhouse gas emissions;
- Install rain gardens, green roofs, native landscaping and other green infrastructure measures as feasible; and
- Consider the use of passive solar energy and other forms of renewable energy.

Dams and Barriers: Reduce the Negative Impacts of Dams and Barriers by Increasing Connectivity and Natural Hydrology between the Lake and Tributaries

Context

As described in Section 4, the Lake Superior watershed contains thousands of dams and other barriers, many of which degrade water quality and disrupt habitat connectivity for aquatic organisms. Dams are a major factor in the low populations of some fish stocks, because the fish cannot access their traditional spawning areas above the dam. Some aging dams and other barriers are deteriorating, and some do not adhere to present day environmental regulatory standards. Dams and barriers were identified as a high threat to habitats and species on a lakewide scale in *A Biodiversity Conservation Assessment for Lake Superior* (LSBP, 2015).

While dams do disrupt habitat connectivity, they also have the benefit of preventing some aquatic invasive species from spreading. The question of what to do about aging dams and other barriers is an important topic in various jurisdictions and organizations all around Lake Superior.

Actions

The following list of actions was developed by the Lake Superior Partnership though stakeholder comment processes and engagement (e.g., development of *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015)). The results of these actions will contribute to lakewide objective 7, found in Section 3. These actions also support the GLWQA General Objective to support healthy and productive habitats to sustain resilient populations of native species.

- On a watershed scale, assess and prioritize habitat connectivity opportunities (e.g., culvert upgrade, road/stream crossing upgrade) with consideration of the benefits (e.g., quality or amount of habitat connected) versus the costs (e.g., community disruptions, potential spread of invasive species, financial cost);
- Protect and restore connectivity, where appropriate, by removing dams, upgrading stream/road crossing infrastructure, or by other means;
- Adopt flow standards to sustain key environmental processes, critical species habitat and ecosystem services; and
- Pursue, continue or enhance sustainable hydropower planning that adequately protects aquatic ecosystems, habitats and species.

Addressing the Issue

To address these issues across the Great Lakes, a number of binational efforts are being taken through the GLWQA (i.e., Annex 7 Habitat and Species). These efforts include assessing gaps in current binational and domestic programs to restore and maintain native species and habitat, and increasing awareness of native species and habitat and the methods to restore and maintain them.

In addition, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are found in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* and the U.S. Great Lakes Restoration Initiative Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 9). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone internal and public review.

The projects will help further focus coordination, tracking and reporting on specific projects from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 9. Lake Superior Partnership Projects to Address Dams and Barriers

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Improve access to high-resolution stream/river barrier data and species-specific benefit analyses in support of decision-making on Lake Superior habitat connectivity decisions.	Bad River, Fond du Lac, KBIC, MNRF, Red Cliff, USFS, USFWS, WDNR
2	Establish a collaborative Lake Superior streams improvement initiative in Canada to undertake stream monitoring, assessment, and data management activities, and to help identify stream protection and restoration priorities.	MNRF
3	Prepare an environmental studies report to explore the feasibility, costs and benefits associated with the options surrounding the proposed decommissioning of Ontario's Camp 43 dam, and the construction of a corresponding multi-purpose Sea Lamprey barrier at Eskwanonwatin Lake.	MNRF

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Volunteer with your local watershed group to identify those barriers in your area which need to be removed; and
- Talk to local officials to remind them about the importance of both “fish crossing the road” and “cars crossing the creek.

Lake Superior Day volunteers. Credit: C. Clements.

Chemical Contaminants: Work to Achieve Zero Releases of the Nine Persistent Bioaccumulative Chemicals by 2020, Under the Zero Discharge Demonstration Program

Context

The table below presents 9 management actions that seek to achieve the Lake Superior lakewide objective related to persistent bioaccumulative and toxic substances (objective 8). These actions also support GLWQA General Objectives that aim to maintain a source of safe, high-quality drinking water; protect Great Lakes waters from pollutants in quantities or concentrations that could be harmful to human health, wildlife, or aquatic organisms; and allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants. Chemical contaminants were identified as a medium threat to habitats and species on a lakewide scale in *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015).

The Zero Discharge Demonstration Program (ZDDP), established in 1991, targets nine critical legacy pollutants for zero discharge in the Lake Superior basin by 2020. The nine ZDDP critical contaminants are: mercury, PCBs, dioxin, hexachlorobenzene (HCB), octachlorostyrene (OCS), chlordane, DDT and metabolites, dieldrin/aldrin, and toxaphene. The *1990-2010 Critical Chemical Reduction Milestones* report documents progress toward achieving the ZDDP reduction schedules for the nine critical chemicals (LSBP, 2012).

While the program has had many successes, including significant reductions in mercury and dioxin releases, it will be challenging to achieve the program's goal of zero release of all pollutants by 2020. Despite the success of the ZDDP, contaminants continue to be present in amounts that can be a risk to human health or cause degradation to habitat. For example, although mercury discharges and emissions in the Lake Superior basin decreased by 80% from 1990 to 2010, mercury levels in some fish in some areas continue to warrant advisories for human fish consumption.

Actions

The following list of actions was developed by the Lake Superior Partnership though stakeholder comment processes and engagement (e.g., development of the *1990-2010 Critical Chemical Reduction Milestones* report (LSBP, 2012)). The results of these actions will contribute to the Lake Superior lakewide objective 8, found in Section 3. These actions also support GLWQA General Objectives to maintain a source of safe, high-quality drinking water; protect Great Lakes waters from pollutants in quantities or concentrations that could be harmful to human health, wildlife, or aquatic organisms; and allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants.

- Support efforts that increase the level of public education on mercury, PCBs and dioxin toxicity and pathways into fish, wildlife, and humans. Educate the public on reduction and/or elimination actions and projects;
- Continue to build on knowledge of existing and proposed mining projects in the basin, and possible chemical emissions, for incorporation into the Lake Superior Partnership's ZDDP chemical inventory (used to assess chemical reduction milestones) and to promote, where necessary, the use of best mining practices with regard to achievement of Lake Superior lakewide objectives;
- Promote restrictions and voluntary phase-out of non-essential mercury-containing products in households, schools, municipalities, and businesses;
- Investigate any potential further opportunities to remove mercury from wastewater, including through voluntary and regulatory means (e.g., local ordinances). Recognize many completed successful innovations and toxic reduction strategies in the basin (e.g., Western Lake Superior Sanitary District, Thunder Bay, Superior, Bayfield, Marquette, Ishpeming, and others) and look for opportunities to tech transfer their success;
- Showcase agencies and local governments that collect and track the types and amounts of pesticides disposed, to support efforts to virtually eliminate from the basin, those pesticides listed in the Zero Discharge Demonstration Program;
- Support existing pesticide collection programs, such as clean sweeps, and explore the expansion of collections to additional geographic areas;
- Track and reduce atmospheric deposition of persistent, bioaccumulative, and toxic pollutants from in-basin sources through research, voluntary actions, and enforcement of controls and regulations;
- Where possible, participate in and encourage out-of-basin actions to reduce toxic chemicals from being imported into the Lake Superior basin via atmospheric deposition;
- Support various energy efficiency and energy conservation programs (e.g., Leadership in Energy and Environmental Design) and provide resources to the public, private businesses, and municipal governments; and
- Support open burning abatement programs (e.g., burning residential garbage in backyard burn-barrels), and track the extent of open burning practice from a lakewide perspective.

Addressing the Issue

To address chemical contaminants across all the Great Lakes, a number of binational efforts are being taken under the GLWQA 2012 (i.e., Annex 3 Chemicals of Mutual Concern). These efforts include identifying chemicals of mutual concern that originate from anthropogenic (human) sources, and that are agreed to by both countries as being potentially harmful to human health or the environment; reducing anthropogenic releases of chemicals of mutual concern and products containing chemicals of mutual concern throughout their entire life cycles; and promoting the use of safer chemical substances and the use of technologies that reduce or eliminate the uses and releases of chemicals of mutual concern.

In addition, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are listed in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* and the U.S. Great Lakes Restoration Initiative Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 10). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, related work underway, current state of the issue on Lake Superior, benefits of a high degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone internal and public review.

The projects will help further focus coordination, tracking and reporting on specific work from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

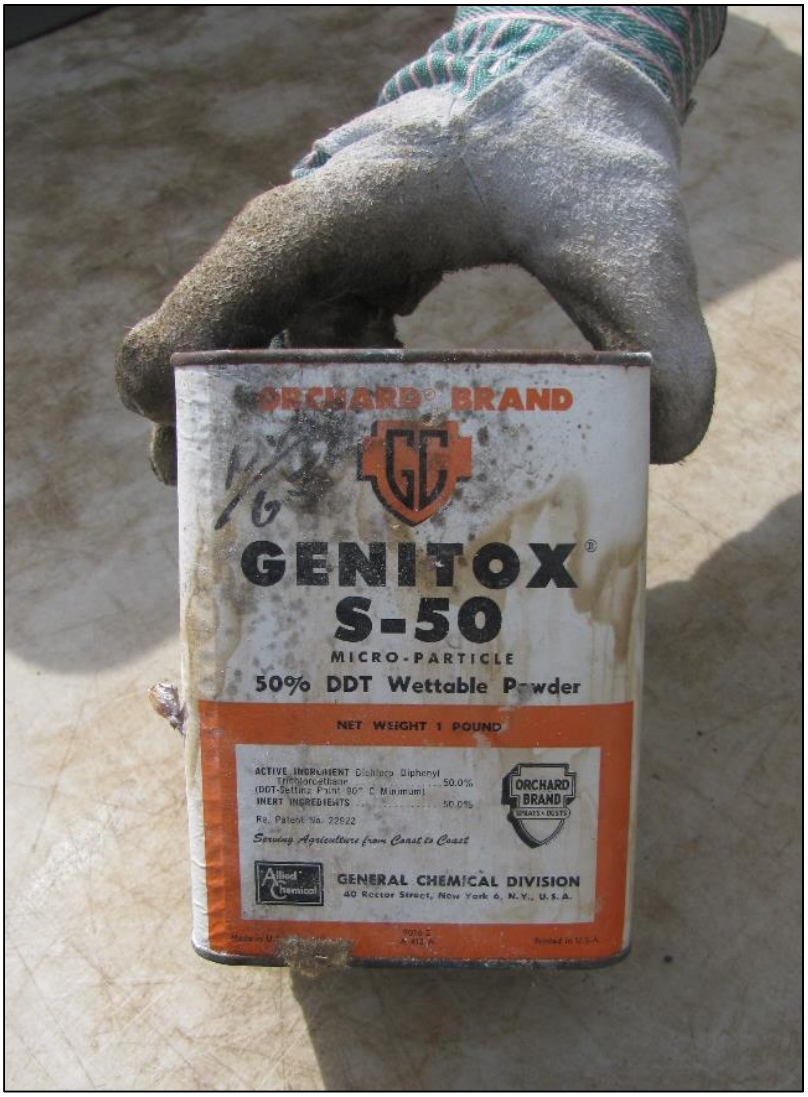
Table 10. Lake Superior Partnership Projects to Address Chemical Contaminants

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Continue outreach and education to the public on mercury toxicity; pathways into fish, wildlife and humans; and actions that can be taken to help remove mercury from the basin.	Bad River, CORA, Fond du Lac, GLIFWC, Grand Portage, KBIC, MDEQ, MOECC, NOAA, NPS, Red Cliff, USEPA, USFS, USFWS, USGS
2	Conduct a data synthesis of available mercury monitoring data for the Lake Superior basin to improve the inter-jurisdictional understanding and communication of mercury trends in the Lake Superior ecosystem.	Bad River, ECCC, Fond du Lac, MPCA, NOAA, NPS, USGS
3	Document which agencies and local governments collect and track the types and amounts of pesticides disposed, as feasible, so as to inform existing pesticide collection programs, such as clean sweeps. Information will be used to assess the potential for expanding collections to additional geographic areas.	ECCC, MDEQ, WDNR
4	Continue to support open burning abatement programs, such as "Bernie the Burn Barrel," to achieve reductions in the release of dioxins and furans into the Lake Superior basin from the practice of residential burning of garbage.	Bad River, CORA, Fond du Lac, KBIC, MOECC, MPCA, Red Cliff, WDNR, MPCA

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Reduce, reuse, repair, and recycle;
- Take household hazardous materials to hazardous waste collection depots;
- Never burn garbage;
- Use more environmentally-friendly asphalt-based sealants as an alternative to those with coal tar, which contain toxic substances; and
- Compost your garbage, and use natural pest-control methods.



DDT collected during collection event in 2013. Credit: C. Spruce.

Additional Substances of Concern: Protect the Lake Superior Basin from Future Contamination Resulting from Additional Substances of Concern

Context

In addition to the nine critical legacy pollutants that are the focus of the Zero Discharge Demonstration Program, contaminants such as pharmaceuticals and personal care products (PPCPs), microplastics, excessive nutrients, and substances identified as GLWQA Chemicals of Mutual Concern (e.g., brominated flame retardants and perfluorinated chemicals) have the potential to adversely impact the Lake Superior basin. At the same time, there is a great opportunity to maintain good water quality in Lake Superior because in most cases the concentrations of these substances are very low.

As described in Section 4, concerns about additional substances of concern include the following:

- PPCPs have been detected in nearshore waters and in bottom sediments of Lake Superior at low concentrations;
- Atmospheric concentrations of in-use flame retardants (i.e., TBB & TBPH) are increasing;
- Personal care products and contaminants such as perfluorooctane sulfonate (PFOS) and are susceptible to being transported in groundwater within the Lake Superior basin; and
- Human activities such as agriculture, urban development and forestry can increase non-point source runoff into the lake, which can include pollutants that degrade water quality and affect biological communities.

Actions

The following list of actions was developed by the Lake Superior Partnership through such processes as stakeholder review and engagement opportunities (e.g., *1990-2010 Critical Chemical Reduction Milestones* report (LSBP, 2012)). The results of these actions will contribute to the Lake Superior lakewide objective 9, found in Section 3. These actions also support GLWQA General Objectives which aim to maintain a source of safe, high-quality drinking water; protect Great Lakes waters from pollutants in quantities or concentrations that could be harmful to human health, wildlife, or aquatic organisms; and allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants.

- ➢ Implement activities identified in GLWQA Binational Strategies for future GLWQA Chemicals of Mutual Concern, as appropriate;
- ➢ Seek opportunities to support, coordinate or expand the various pharmaceutical collection initiatives taking place in the Lake Superior basin;

- Develop policies or programs that assist nursing homes and other health care facilities in proper disposal of unwanted medication;
- Consider adopting policies or resolutions restricting the use of cosmetic pesticides (i.e., pesticides used for aesthetic purposes only), using as a guide the 2009 Ontario Pesticides Act: Cosmetic Pesticide Ban Regulations; and
- Protect oligotrophic conditions (i.e., high in oxygen, low in nutrients) in nearshore and offshore waters, and restore and protect water quality in embayments and tributaries.

Addressing the Issue

To address additional substances of concern across the Great Lakes, a number of binational efforts are being taken under the GLWQA 2012 (i.e., Annex 3 Chemicals of Mutual Concern). These efforts include identifying chemicals of mutual concern that originate from anthropogenic (human) sources, and that are agreed to by both countries as being potentially harmful to human health or the environment; reducing anthropogenic releases of chemicals of mutual concern and products containing chemicals of mutual concern throughout their entire life cycles; and promoting the use of safer chemical substances and the use of technologies that reduce or eliminate the use and release of chemicals of mutual concern.

In addition, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are listed in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* and the U.S. Great Lakes Restoration Initiative Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 11). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, related work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone internal and public review.

The projects will help further focus coordination, tracking and reporting on specific projects from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 11. Projects to Address Additional Substances of Concern

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Increase efforts to educate the public on new and emerging chemicals; their potential toxicity; pathways into fish, wildlife and humans; and how the public can help remove these chemicals from the basin. Put special emphasis on the topics of microplastics and safer alternatives for personal care, household cleaning products, and pesticides/herbicides.	BMIC, ECCC, Fond du Lac, Grand Portage, KBIC, MOECC, NOAA, NPS, Red Cliff, USGS, USFWS
2	Compile information on the type and status of different pharmaceutical collection efforts in the basin and other efforts to locate and properly dispose of unwanted medication. Use this information to identify opportunities for further action.	Bad River, ECCC, KBIC, MPCA, USGS, USFWS, WDNR

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Return unused medicines, including over-the-counter drugs, to pharmacies; never flush them down the toilet or dump them down the sink;
- Choose natural fabrics, natural cleaning products, and reusable containers; and
- Read the labels of your personal care products, and use online tools to learn which chemicals to avoid.

EcoSuperior sponsored a home cleaner trade-in project in which the public was invited to trade in a typical household cleaning product for a kit to make their own cleaning products. Credit: M. McChristie.

Other Existing and Emerging Threats: Address Other Existing and Emerging Threats That May Impact Important Habitat or Native Plant and Animal Communities

Context

As described in Section 4, other threats can impact the Lake Superior ecosystem. While high threats from a lakewide perspective are addressed individually in the LAMP, there are other threats that can impact the lake or are of high importance to a particular area. Many different threats were assessed and ranked within the process to develop *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015). Other existing and emerging threats include the following:

- Fourteen mines currently operate in the Lake Superior basin, with many explorations and expansions underway. Mining activity has the potential to impair water quality and degrade habitats;
- Domestic production of crude oil has increased in both the U.S. and Canada, with an increasing amount of oil being transported through the Lake Superior basin;
- Some stretches of shoreline are becoming increasingly developed for residential, commercial or industrial land uses, which can alter natural processes and degrade habitat; and
- Adverse impacts to Lake Superior can result from unsustainable forestry practices, terrestrial invasive species, and other energy sector activities.

Actions

The following list of actions was developed by the Lake Superior Partnership through stakeholder comment processes and engagement (e.g., development of *A Biodiversity Conservation Strategy for Lake Superior*). The results of these actions will contribute to the lakewide objectives for Lake Superior (found in Section 3), and the actions also support the GLWQA General Objective for the Great Lakes to be free from other substances, materials or conditions that may negatively impact the chemical, physical or biological integrity of the waters of the Great Lakes.

- ➢ Promote proactive consideration of important habitat areas and species during environmental assessment and regulatory processes for mining, supported by comprehensive binational mapping (of existing and historical mining activities and exploration) and sharing knowledge of best management practices, best available technologies and other activities, as appropriate;
- ➢ Identify and assess the risk of any newly-discovered or orphaned contaminated sites;
- ➢ Reduce non-point source pollution from urban areas, agriculture, and other sources to levels that are safe for plants, fish and wildlife;

- Integrate green infrastructure principles in coastal development projects;
- Use only sustainable forestry practices in the Lake Superior basin;
- Develop, implement, and integrate early detection and rapid response networks for terrestrial invasive species;
- Track and implement control and/or eradication plans, where feasible, for terrestrial invasive species at appropriate geographic scales; and
- Research or monitor potentially new, emerging, or cumulative threats to Lake Superior.

Addressing the Issue

Over the past several decades, there have been tremendous technological advancements, increased understanding of impacts, meaningful voluntary actions, and regulatory changes to reduce the impacts of resource extraction activities. Oversight of these activities occurs domestically by agencies with jurisdictional authority in Canada and the U.S.

To further address these threats across the Great Lakes, a number of commitments have been made in the GLWQA 2012 (i.e., Annex 2 Lakewide Management, and Article 6 Notification and Response). These commitments include identifying science priorities for the assessment of current and future threats to water quality, and for the identification of priorities to support management actions. Further, the Governments of Canada and the United States have agreed to notify each other of planned activities that could lead to a pollution incident or that could have significant cumulative impacts on the waters of the Great Lakes.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 12). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, related work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone internal and public review.

The projects will help further focus coordination, tracking and reporting on specific work from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 12. Lake Superior Partnership Projects to Address Other Existing and Emerging Threats

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Provide oil spill responders with better access to existing and new spatial data (as available) on ecologically-important and sensitive habitats.	Bad River, CORA, Fond du Lac, GLIFWC, MOECC, NOAA, NPS, Parks Canada, USFWS, USGS
2	Support efforts to increase the sustainable use of Lake Superior basin resources, with specific emphasis on projects on green stormwater infrastructure, incorporating traditional ecological knowledge into projects, and/or recognizing the monetary value of ecosystem services.	1854 Treaty Authority, Bad River, BMIC, CORA, Fond du Lac, GLIFWC, KBIC, MOECC, NOAA, NPS, Parks Canada, Red Cliff, USEPA, USFWS
3	Outreach and engage with communities and others at the local scale on the value of water and best water use practices and policies.	Bad River, CORA, Fond du Lac, GLIFWC, KBIC, MDEQ, Red Cliff, USFWS, USGS, WDNR
4	Map current and proposed mining activities in the Lake Superior basin to support understanding of the potential and cumulative impacts of mining on important habitat sites. Assess impacts due to other stressors, such as climate change.	1854 Treaty Authority, CORA, Fond du Lac, GLIFWC, MPCA, NPS, USGS

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Promote corporate social responsibility and support businesses with sustainability initiatives;
- Support green infrastructure, including low-impact development to manage stormwater;
- Report possible oil spills immediately;
- Install water-saving devices; and
- Use a rain barrel for watering the garden.

High-quality Habitats: Restore and Protect a System of Representative, High-quality Habitats

Context

As described in Section 4, Lake Superior is in the best overall condition of all the Great Lakes; many of its aquatic habitats, watersheds and coastal wetlands are in good condition. For this reason, Lake Superior provides an unparalleled opportunity for sustaining high environmental quality and providing ecosystem services for the people who live near or visit Lake Superior.

In addition to actions that target specific threats such as aquatic invasive species, site-specific considerations and management actions are needed, especially in areas of high or potentially high ecological value. While Lake Superior's habitats are in relatively good condition overall, they are not uniformly "good" all around the lake. Some areas are in excellent condition and other areas are degraded. Similarly, habitat stressors vary from location to location.

Actions

The following list of actions was developed by the Lake Superior Partnership through stakeholder comment processes and engagement (e.g., development of *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015)). The results of these actions will contribute to several lakewide objectives for Lake Superior (objectives 1, 2-4, 6, 7, found in Section 3). These actions also support the GLWQA General Objective to support healthy and productive wetlands and other habitats to sustain resilient populations of native species.

- Restore or protect wetlands, native riparian forests, and coastal habitats such as rocky shorelines, beaches and dunes;
- Achieve an overall net gain of the productive capacity of habitat supporting fish and wildlife, including coastal wetlands;
- Restore habitats that have been degraded in their ecological capacity to better support fish and wildlife communities, where feasible;
- Develop or refine ecologically-based integrated watershed management plans in priority areas;
- Use special land and water designations to protect important habitat on public property;
- Educate and engage people about restoring or protecting important habitat and related ecosystem services;
- Develop comprehensive inventories of important fish and wildlife habitats;
- Inventory and assess impacts of degraded habitats and communities, including hardened shorelines and other artificial coastal structures;

- Develop and distribute information and/or indicators on ecosystem conditions, trends, stressors and important restoration or protection sites; and
- Maintain and share data through existing and new mechanisms, as appropriate.

Addressing the Issue

To address this issue across the Great Lakes, a number of binational efforts are being taken under the GLWQA 2012 (i.e., Annex 2 Lakewide Management, and Annex 7 Habitat and Species). These efforts include: developing a nearshore framework to identify areas that are, or may become, subject to high stress, and areas that are of high ecological value; developing a baseline survey of the existing habitat against which to establish a Great Lakes Basin Ecosystem target of net habitat gain; and developing a binational framework for prioritizing habitat conservation activities.

In addition, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are listed in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* and the U.S. Great Lakes Restoration Initiative Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 13, following page). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, related work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone broader internal and public reviews.

The projects will help further focus coordination, tracking and reporting on specific projects from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 13. Lake Superior Partnership Projects to Protect and Restore High-Quality Habitats

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Investigate, evaluate, and if feasible, implement dredging solutions or other habitat restoration efforts at Buffalo Reef, Michigan.	GLIFWC, NOAA, USACE, USEPA
2	Improve the mapping and quantification of important spawning, nursery and foraging habitat for key fish species to support protection and restoration decision-making.	1854 Treaty Authority, GLIFWC, MNRF, NPS, Parks Canada, Red Cliff, USEPA, WDNR
3	Promote and support local and regional implementation of *A Biodiversity Conservation Strategy for Lake Superior, 2015* and corresponding Regional Plans.	1854 Treaty Authority, Bad River, BMIC, CORA, ECCC, Fond du Lac, GLIFWC, Grand Portage, KBIC, MDEQ, MNDNR, MNRF, NOAA, NPS, Parks Canada, Red Cliff, USFS, USFWS, WDNR
4	Formally establish the Lake Superior National Marine Conservation Area in Canada, and Federal-Provincial harmonization committee to develop and implement management priorities for the area.	MNRF, Parks Canada
5	Integrate spatial data standards, methodologies and geomatic products to help identify and prioritize sites for habitat protection and rehabilitation.	GLIFWC, MNDNR, NOAA, NPS, USEPA, USFWS, USGS
6	Protect and enhance important coastal wetland habitats on priority state and tribal lands in western Lake Superior, including Bark Bay, Frog Bay, Bad River/Kakagon Sloughs and the St. Louis River estuary.	1854 Treaty Authority, Bad River, Fond du Lac, GLIFWC, KBIC, MNDNR, NOAA, NPS, Red Cliff, USEPA, USFS, USFWS, USGS, WDNR

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Reduce, reuse, repair, and recycle;
- Stay on established trails to minimize impacts on such sensitive coastal habitat as rocky shorelines, beaches, and dunes;
- Riparian property owners are encouraged to contact federal, state or provincial, tribal, or local natural resource professionals for information, advice, and permits (where applicable) when considering restoring their shoreline;
- Support stewardship events and efforts that promote how people can protect habitats; and
- Work with community groups and local authorities to develop watershed management plans.

Diverse, Healthy and Self-sustaining Native Species Populations: Manage Plants and Animals in a Manner that Ensures Diverse, Healthy and Self-sustaining Populations

Context

Lake Superior has unique fauna, containing species and subspecies found nowhere else on the planet, such as Siscowet, a large deep water form of Lake Trout, and Kiyi, the primary prey of Siscowet. Parts of Lake Superior's coastline provide habitat for arctic-alpine plant species that began to recolonize in the region around 15,000 years ago as the last ice sheet retreated. Lake Superior is the only Great Lake with a food web still dominated by native species with largely self-sustaining populations.

In addition to addressing specific lakewide threats, management of targeted species is needed to maintain diverse, healthy and self-sustaining populations, especially species which are most vulnerable to stress, are regularly harvested, or are of special importance. Often, the results of work to improve one targeted species (e.g., Lake Sturgeon) benefits the overall ecosystem and helps to achieve lakewide objectives (e.g., maintain tributaries in good ecological condition).

Actions

The following list of actions was developed by the Lake Superior Partnership through stakeholder comment processes and engagement (e.g., development of *A Biodiversity Conservation Strategy for Lake Superior* (LSBP, 2015)). The results of these actions will contribute to several lakewide objectives for Lake Superior (objectives 1-7, found in Section 3). These actions also support the GLWQA General Objective to support healthy and productive wetlands and other habitats to sustain resilient populations of native species.

- Develop and implement plans to detect and prevent disease outbreaks;
- Use local native species, to the extent possible, in restoration projects and other natural resource management initiatives, supported by the development or maintenance of lists of native species, use standards, sources, and seed zones;
- Implement native fish and wildlife species restoration, protection or rehabilitation plans, as appropriate;
- Manage the harvest of fish, wildlife and plants, as feasible, to ensure their health, long-term sustainability and balance in the ecosystem;
- Manage over-abundant populations of species where there is strong evidence of sustained detrimental effects on habitats and/or species diversity;
- Educate citizens about the importance and appropriate use of local native plants in restoration and landscaping projects;

- Undertake comprehensive biological surveys to identify species of conservation interest and remaining natural communities;
- Catalogue Lake Superior basin's genetic diversity; and
- Develop and distribute information and/or indicators on species conditions, trends, stressors and potential rehabilitation locations.

Addressing the Issue

The Great Lakes Fishery Commission facilitates cooperative fishery management among the state, provincial, tribal, and federal management agencies, and works to achieve Fish Community Objectives in Lake Superior. These efforts are an important component of lakewide management, and are reflected in the LAMP.

In addition, to address the issue across the Great Lakes, a number of binational efforts are being taken under the GLWQA 2012 (i.e., Annex 7 Habitat and Species). These efforts include assessing gaps in current binational and domestic programs and initiatives to conserve, protect, maintain, restore and enhance native species and habitat as a first step toward the development of a binational framework for prioritizing activities; facilitating binational collaborative actions to reduce the loss of native species and habitat, recover populations of native species at risk, and restore degraded habitat; renewing and strengthening binational collaborative actions to conserve, protect, maintain, restore and enhance native species and habitat by identifying protected areas, conservation easements and other conservation mechanisms to recover populations of species at risk and to achieve the target of net habitat gain; and increasing awareness of native species and the methods to conserve them.

Furthermore, domestic efforts in both Canada and the United States are underway across the Great Lakes. Many of these commitments are listed in the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* and the U.S. Great Lakes Restoration Initiative Action Plan II.

Lake Superior Partnership Projects: 2015-2019

The Lake Superior Partnership identified a specific set of projects and agencies involved in implementing them (Table 14). The selection of these projects originated from Lake Superior management experts who comprise the various binational committees of the Lake Superior Partnership. The projects were selected in consideration of the list of actions identified above, accomplishments to date, related work underway, current state of the issue on Lake Superior, benefits of a high-degree of coordinated action, contribution to achieving lakewide objectives, and achievability over the next five years. These projects have been vetted through the larger Lake Superior Partnership, and have undergone internal and public review.

The projects will help further focus coordination, tracking and reporting on specific projects from a lakewide perspective. Implementation will take place, to the extent feasible, by agencies with mandates to undertake work in these areas. Not all of the agencies that make up the Lake Superior Partnership will be involved in implementing all of the projects. At the same time, contributions to these projects will not be limited to the agencies listed.

Table 14. Lake Superior Partnership Projects to Manage Diverse, Healthy and Self-Sustaining Native Species Populations

#	Lake Superior Partnership Projects: 2015-2019	Agencies Involved
1	Develop and update stock assessment models to improve management of self-sustaining commercial and sport fisheries for Lake Trout, Cisco, and Lake Whitefish.	Bad River, BMIC, CORA, GLIFWC, Grand Portage, MNRF, NPS, Red Cliff, USFWS, USGS, WDNR
2	Rehabilitate populations of indigenous aquatic species (e.g., Brook Trout, Lake Sturgeon, Muskellunge, Walleye, etc.).	Bad River, CORA, DFO, Grand Portage, KBIC, MNRF, NPS, Red Cliff, USFWS, WDNR
3	Update the Ecopath with Ecosim (EwE) ecological model (www.ecopath.org) with recently acquired data and knowledge in order to explore: a) how recent changes in fish abundance could be influencing the food web; b) how the ecosystem may respond to current and potential threats; and c) how components of the ecosystem may respond to potential management actions.	CORA, GLIFWC, Grand Portage, MNRF, USEPA, USFWS, USGS
4	Develop and implement improved monitoring approaches for inshore, embayment, and tributary fish populations.	1854 Treaty Authority, BMIC, CORA, Fond du Lac, GLIFWC, Grand Portage, NPS, Red Cliff, USFWS, USGS

Activities That Everyone Can Take

The general public is encouraged to help address this issue by undertaking the following actions:

- Adhere to harvest limits and guidelines;
- Use proper catch and release practices for protecting species such as Brook Trout, Lake Sturgeon, and Muskellunge; and
- Report suspicious fish die-offs immediately to federal, state or provincial, tribal or Sea Grant authorities.

9.2 Areas of Concern

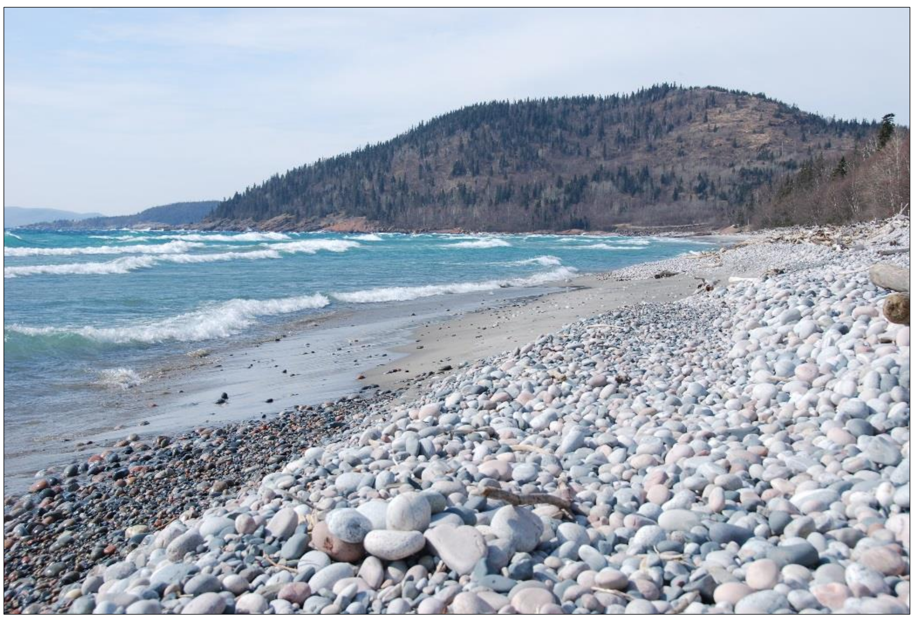
Remedial Action Plans (RAPs) are strategic plans designed to restore impaired "beneficial uses" in degraded areas, known as Areas of Concern (AOC). Refer to Section 4, to see the status of Lake Superior's AOCs.

Pursuant to the GLWQA, RAPs have been developed for each AOC, with a team of federal, state, provincial, tribal, First Nation and Métis partners, along with local stakeholders, cooperating to restore the AOC.

Maintaining a strong relationship between the LAMPs and the RAPs is essential to restoring and protecting Lake Superior. AOCs by definition can hinder the achievement of lakewide objectives. Conversely, actions completed in AOCs, such as those to remediate contaminated sediment or restore fish and wildlife habitat, greatly contribute to the achievement of lakewide objectives.

RAPs and LAMPs are similar in that they both use an ecosystem approach to assess and remediate environmental degradation. It is essential that the AOC partners and Lake Superior Partnership members continue to work collaboratively to achieve common goals, especially since much of the restoration expertise, as well as land use control and watershed planning, resides at the local level. Cooperation between the two efforts is essential to removing both lakewide and site-specific impairments.

Once an AOC is delisted, the area will come under the purview of the Lake Superior Partnership. Local watershed groups can continue to be engaged in lakewide management to build on the positive efforts completed as part of the RAP.



Peninsula Harbour AOC in Ontario. Credit: Environment and Climate Change Canada.

9.3 Implementation and Accountability

As demonstrated by the agency commitments in Section 9.1, Lake Superior Partnership organizations commit to incorporating, to the extent feasible, LAMP objectives and projects in their decisions on programs, funding, and staffing. In implementing the LAMP, Lake Superior Partnership organizations will be guided by the principles and approaches outlined in the GLWQA, including:

- Accountability – the effectiveness of actions will be evaluated by individual partner agencies, and progress will be reported through LAMP Annual Reports and the next 5-year LAMP report;
- Adaptive management – the effectiveness of actions will be assessed and future actions will be adjusted as outcomes and ecosystem processes become better understood and as new threats are identified;
- Coordination – actions will be coordinated across jurisdictions and stakeholder agencies, where possible;
- Prevention – anticipating and preventing pollution and other threats to the quality of the waters of the Great Lakes to reduce overall risks to the environment and human health;
- Public engagement – incorporating public opinion and advice, as appropriate, and providing information and opportunities for the public to participate in activities that contribute to the achievement of the objectives of the GLWQA; and
- Science-based management – implementing management decisions, policies, and programs that are based on best available science, research and knowledge, as well as traditional ecological knowledge, when available.

Implementation of projects will remain one of the highest priorities of the individual organizations that make up the Lake Superior Partnership. Organizations identified in Section 9.1 will take action, to the extent feasible, given budget constraints and domestic policy considerations.

Internal agency work planning and reporting will help track commitment progress and provide an accountability mechanism for the results of each individual organization. Internal Lake Superior Partnership committee workplans will help track implementation at a higher level to support coordination between organizations and in the engagement of others, as well as to support lakewide reporting on LAMP implementation (e.g., annual updates to the public on the LAMP).

10.0 REFERENCES

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OIL TRANSPORTATION ANALYSIS

through the Chippewa Ceded Territories

Final Report

PREPARED FOR

Great Lakes Indian Fish and Wildlife
Commission (GLIFWC)

Native Americans in the Twenty-First Century:
Nation Building II
Harvard University Native American Program
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1. INTRODUCTION

In what follows, we provide historical and empirical context to the contestation of oil pipelines (known to the regulatory community as hazardous liquid pipelines, but called oil pipelines here for brevity) in order to begin to understand the risks that oil transportation poses to the human and natural systems that of the Chippewa Ceded Territories, and, in particular, to identify how these risks may affect the environments that sustain the vital, treaty-protected resources of the Territories.

We begin by situating pipelines and oil transportation generally within the current political landscape. We then reflect some of what we have learned of the values, traditions, and knowledges held by the Ojibwe tribes that govern the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), as these will undoubtedly shape the policy and planning positions that member tribes pursue regarding oil transportation through their ancestral lands. From there, we describe the sources of our data and the methods by which it has been analyzed. These sources are both qualitative and quantitative, ranging from Congressional reports to news media accounts to hazardous liquid accident data collected by the U.S. federal government. Our data sources, detailed in an appended bibliography, are all publicly available. Those that were most integral to the writing of this report are briefly described in an additional, annotated bibliography and/or compiled as digital spreadsheets and map layers.

We then document the findings of our analyses. First, we describe the existing infrastructural networks of oil transportation, their capacities and their current volumes. Second, we touch on the current and planned expansion of these networks and the anticipated effects of such expansion of future capacities and volumes. Third, we provide an overview of the regulatory regime governing the safe siting, construction, and operation of these networks of oil transportation. Our focus here is on federal regulation, but we also touch on state-level frameworks in Michigan, Minnesota, and Wisconsin. Finally, we describe the initial findings of our analyses of spill data collected by the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (the same body whose operations are described in the preceding section on regulation). We have not undertaken more than high-level descriptive statistical analysis of these data, but recommend more rigorous analysis in order to glean further trends.

We conclude with a more holistic discussion, exploring relationships among different types of risk and different modalities of transport and considering how different interpretations of the data may yield a diverse array of policy and planning prescriptions. Although we hope to have a sense of how the values, traditions, and knowledges of GLIFWC and its member tribes might influence the responses of both tribal and professional organizations in the Ceded Territories, we do not make any recommendations of how to proceed with the data. Instead, we leave such determinations to actors on the ground who will be much better situated to make appropriate and expert decisions of how to handle the intractable issue of oil transportation in the Ceded Territories.

2. BACKGROUND

Pipelines

In the first week of June, 2015, the members of the Minnesota Public Utilities Commission voted unanimously to grant Enbridge Energy Inc. a certificate of need for the company's Sandpiper pipeline proposal, clearing a crucial regulatory hurdle for the project. A day later, an estimated 5,000 activists led by members of the Minnesota Chippewa Tribe took to the streets of St. Paul to protest the approval and the prospect of further oil infrastructural development in the region (Swayer 2015). In September of the same year, a state Court of Appeals judge overturned the Commission's approval and instructed state environmental regulators to conduct a comprehensive Environmental Impact Statement (EIS), a process involving robust ecological and engineering analyses coupled with public engagement through meetings and comment (Kraker 2016).

The EIS was never completed; as public protest and regulatory hurdles mounted, Enbridge opted to put its $7.5 billion dollar investment in Sandpiper on hold (after having spent, by the company's own estimation, some $800 million on property acquisitions for a new easement route as well as legal fees) and instead put $1.5 billion behind Energy Transfer Partners' Dakota Access pipeline (Hughlett 2016). Dakota Access would carry light crude oil from the Bakken fields of North Dakota to a refinery in rural Illinois, bypassing resistance in Minnesota altogether, from which the refined oil would be distributed to markets across the Midwest.

Sandpiper's defeat by a diverse alliance of opponents built the momentum of resistance to a booming oil economy that had been catalyzed in 2015 by then-President Obama's decision to deny TransCanada permission for its Keystone XL pipeline to cross the northern border of the United States en route to refineries in Oklahoma. Only a few months after Enbridge abandoned the Sandpiper proposal, it appeared that the company - and the oil industry in general - would be dealt another blow as the Army Corps of Engineers announced its intent to reconsider, and ultimately deny, permits allowing the Dakota Access pipeline to cross below the Missouri River (Dennis and Mufson 2016).

But everything changed when Donald Trump took office as the 45th President in January of 2017. Barely three weeks into his term, the new President reversed course on the Dakota Access pipeline, ordering the issuance of the final permit needed to complete construction on the line (Eilperin and Dennis 2017). Then, just over a month later and on the same day that the final phase of construction recommenced on Dakota Access, Trump issued an executive order reviving the Keystone XL proposal and granting TransCanada the requisite permits to carry its pipeline over the northern border of the U.S. The President did not, though, live up fully to his campaign promise in issuing the Order, waiving a stipulation he had promoted on the campaign trail that would have required the pipeline to be constructed wholly of American-made steel (Dennis and Mufson 2017).

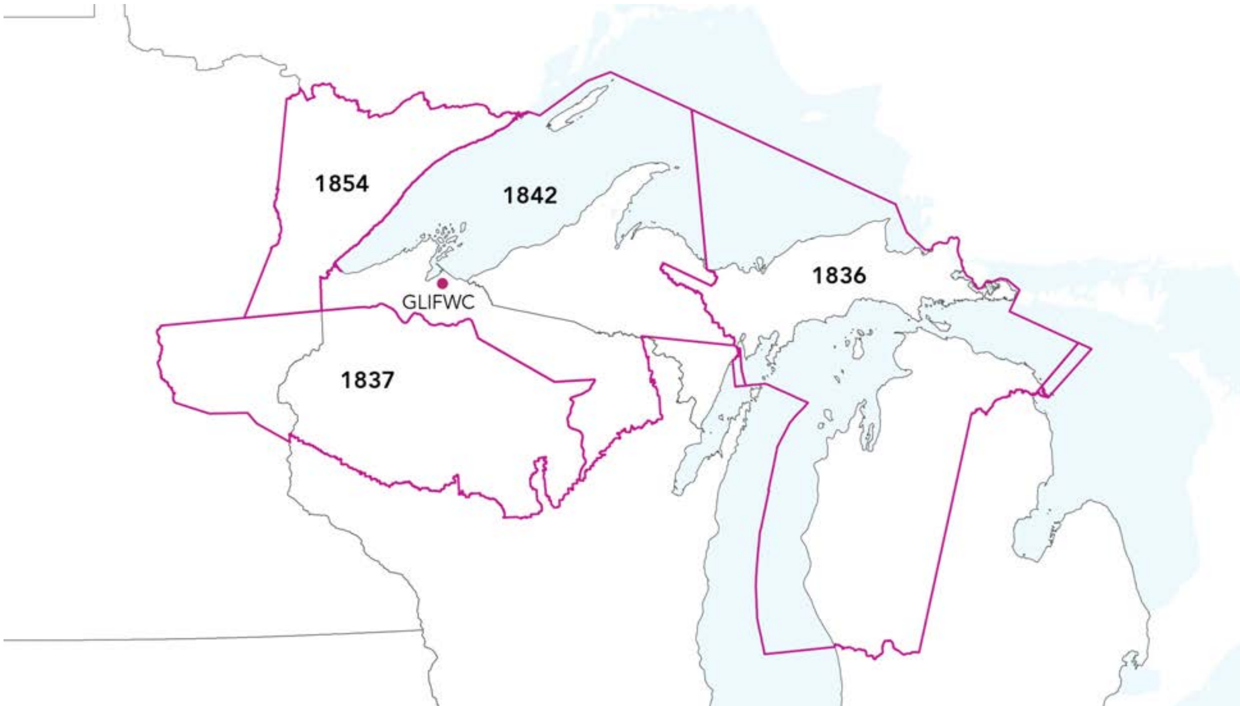
The particular sequence of events that has signaled the federal government's abrupt embrace of oil infrastructural development in the upper Midwest is something of a mixed bag for Enbridge as well as its opponents. On the one hand, Enbridge can expect a relatively quick and painless permitting process among the federal agencies with which it has to deal for its remaining pipeline projects. This most prominently includes what Enbridge calls a "replacement" of its Line 3 pipeline, but which in fact entails the abandonment-in-place of the existing line and the construction of a wholly new line along a new easement route that would deliver 760,000 barrels per day of heavy crude oil from Alberta's tar sands to temporary storage and transmission in Superior, Wisconsin.

Supporters of the oil economy in the statehouses of Minnesota, Wisconsin, and Michigan are also likely to be energized by the new atmosphere of approval coming out of Washington and may transform it into pressure on environmental agencies at the state level. On the other hand, the revival of Keystone XL is a boon for Enbridge's major competitor, TransCanada and delivery of the 830,000 barrels per day of crude to be delivered by the pipeline could dampen demand for the tar sands oil that Enbridge proposes to transport through Line 3. Moreover, as widespread general opposition to the Trump administration continues apace, longstanding opponents of pipelines in the Midwest may find an expanded base of support in their resistance to Enbridge and other oil producers and pipeline operators.

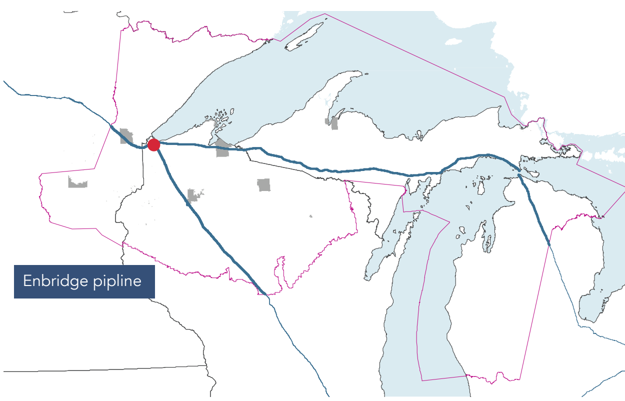
Treaty Rights

The Ojibwe people, or Anishinabe, as they call themselves, have lived in the northwestern reaches of the Great Lakes for hundreds of years. Ojibwe oral history tells of the tribes' settlement on Madeline Island, just north of Chequamegon Bay, where the Ojibwe long ago discovered the bay's wild rice beds and ended their sojourn across the North American continent. The Ojibwe had once lived along the stretch of north Atlantic coast around what is now known as the Gulf of St. Lawrence. But, in a time of sickness and turmoil countless generations ago, they were instructed by their Creator, Kitiche Manito, to travel west until they found the place where the food grows upon the water. So, the Ojibwe commenced their journey, stopping for long stretches along the St. Lawrence River and then again on the shores of Lake Huron at Sault St. Marie, before finally encountering the wild rice beds of Chequamegon Bay and coming to call Madeline Island home. From their new spiritual center on the island, the Ojibwe settled all across the basin of Lake Superior, as far as the wild rice grew, and eventually still further west (GLIFWC 2017; Warren 1855).

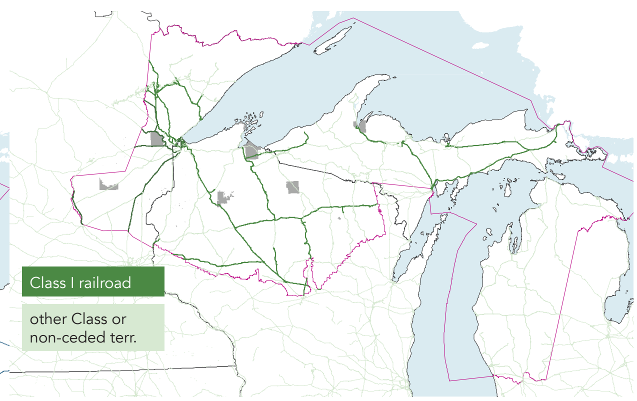
Though the cultivation of wild rice has been central to the Ojibwe lifeway for dozens of generations and many settlements have formed around the rice beds, the Ojibwe were forever a seasonally nomadic people, supplementing their rice harvests with hunting, fishing, and gathering practices in the inland areas of what are now northern Michigan, Wisconsin, and Minnesota. But it is long since the tribes of the Great Lakes have been able to engage in their lifeways without trouble or challenge. Contentious and frequently violent encounters with European traders and, eventually, settlers began in the late 17th century and continued for almost two hundred years, until the Ojibwe made their historic treaties with the federal government of the nascent United States. In a series of four treaties – signed in 1836, 1837, 1842, and 1854, respectively – the Ojibwe tribes ceded their territories in the Great Lakes to the United States in exchange for usufructory rights to the resources and practices that they had traditionally enjoyed (Ahtone 2015; GLIFWC 2017). These practices include hunting, fishing, gathering and harvesting a diverse array of flora and fauna native to the region. Since the formation of the states of Michigan, Wisconsin, and Minnesota shortly after the signing of the treaties, though, this relation of shared sovereignty over the lands of the Great Lakes –



Chippewa treaty territories by year treaty was signed
Source: GLIFWC



Pipeline infrastrucure through the Chippewa Ceded Territories.
Source: GLIFWC



Railroads through the Chippewa Ceded Territories.
Source: Department of Transportation (DOT) & GLIFWC

referred to for historical reasons as the Chippewa ceded territories – has been constantly threatened and violated.

One crucial way in which state governments and, with their permission and encouragement, private individuals and corporations have continually violated the treaties with the Ojibwe is by, first, commodifying the land and innumerable other biophysical beings, and then, second, extracting these natural resources without restraint, jeopardizing the viability of the ecosystems to which they belong. In the 19th century, such extraction principally took the form of logging and mining. According to one historian's estimate, some 170 billion board feet of timber and 150 billion tons of iron ore have been ripped from the ceded territories (Loew and Thannum 2011). Undertaken long before any conception of sustainability would be incorporated into extractive enterprise, these activities historically have amounted to the denuding of vast swaths of hardwood forest, the tearing apart of entire mountain ranges, and the pollution of many thousands of lakes, rivers, and watersheds.

More recently, in the second half of the 20th century, state government officials interested in building a tourism economy in the northern Great Lakes region began changing the laws governing commercial and sport fishing, reorienting incentives from the former to the latter. Having done so without consulting Ojibwe tribal governments, these states either unwittingly or uncaringly violated Ojibwe treaty rights, so that when members of the Ojibwe bands in the ceded territories attempted to engage in their protected practices, they were subjected to both legal and popular reprisal, the slow violence of the police state abetted by the acute violence of white racism and even outright attacks against Ojibwe fishers (Thannum and Loew 2011).

In response to such violence, numerous Ojibwe bands joined together in a series of lawsuits against the state governments of Michigan, Minnesota, and Wisconsin. Beginning with the Wisconsin State Supreme Court's affirmation of tribal treaty rights in the 1972 case *Gunroe v. Wisconsin*, the Ojibwe of the Great Lakes region won several important confirmations of their codified rights in the ceded territories. Key among these were the 7th Circuit Appeals Court's judgement in favor of the Ojibwe in *Lac Courte Oreilles Band v. Voight* (1983) and the *U.S. Supreme Court's similar judgment in Minnesota v. Mille Lacs Band of Chippewa Indians* (1999). Though the raft of judgments upholding the Ojibwe's rights to access and enjoy the environment in which they had lived for hundreds of years did not necessarily diffuse the tensions between Native and Non-native communities in the upper Midwest, much less end the violence toward the Ojibwe, it has at least given indigenous environmental advocates a usefully flexible weapon in their arsenal of resistance to environmental degradation in the ceded territories.

In the sociopolitical landscape of the ceded territories today, the Ojibwe tribes that live in northern Minnesota, Wisconsin, and Michigan are fighting to retain sovereignty over their reservation lands and maintain autonomous access to natural resources in the ceded territories--as promised in the 1800s treaties. When the 7th Circuit Appeals Court's judged in favor of the Ojibwe in Lac Courte Oreilles Band v. Voigt (1983), the decision both affirmed the tribes access to the hunting, fishing and gathering resources they reserved in the earlier treaties, and created an intertribal task force to manage the implementation of these treaty rights. In 1984, this task force was manifest in the Great Lake Indian Fish and Wildlife Commission (GLIFWC), a quasi-governmental organization governed by the eleven Ojibwe bands with historical interest in the treaties governing the ceded territories.

GLIFWC's express purpose is to "provide natural resource management expertise, conservation enforcement, legal and policy analysis, and public information services in support of the exercise of treaty rights during well-regulated, off-reservation seasons throughout the treaty ceded territories" (GLIFWC, 2017). The organization does not manage any resources on-reservation, but rather focuses on ensuring the sustainability of -- and tribal access to -- the wild rice beds, Lake Superior walleye populations, maple trees, and other resources that populate the millions of acres of ceded territory. GLIFWC is guided by an eleven member board, made up of each of the eleven tribes' tribal chairperson or their designee. The board sets the overarching direction and principles that guide the organization activities, and is guided two sub-committees of tribal members: the Voigt Intertribal Task Force (non-Lake treaty rights) and the Great Lakes Fisheries Committee (Lake Superior treaty rights).

As environmentally risky infrastructure that traverses government jurisdictions and has the potential to threaten the Ojibwe treaty resources, the Enbridge pipelines are of major concern to GLIFWC and its member tribes. The governance and ownership of the pipelines impedes on tribal sovereignty, and the infrastructure's environmental risk is a threat to the Ojibwe's lifeways and economies.

3. METHODS

All of the source material used to develop this report is publicly available and most was obtained through internet searches. Additionally, staff members of the Great Lakes Indian Fish and Wildlife Commission contributed generously both information regarding oil transportation in the Ceded Territories and knowledge pertaining to the values, traditions, and lifeways of the Ojibwe bands of the Great Lakes region. Both qualitatively and quantitatively organized data were examined and are described separately in the following section.

Literature Review

The qualitative component of our analysis entailed review of the relevant literatures. This includes information describing the material composition and engineering of pipeline networks; the chemistry of oil products and the physics of their transmission by pipeline, and the biology of their impact when spilled; the legal and historical development of the regulatory regime governing oil pipelines and their safety; and the political and economic dynamics of the financing, permitting, and operation of transmission pipelines. The sources of these data were numerous, and each source was scrutinized for the strengths and drawbacks of its orientation.

For example, much of the engineering and chemical literature is composed by researchers affiliated with oil-related industries and their representative organizations, such as the American Petroleum Institute (API). On the one hand, as the primary users - and, in many cases, inventors and/or manufacturers - of the technologies in question, these industries and their representative organizations necessarily possess expert knowledge of the technologies uses and limitations. On the other hand, though, because technologies ranging from inspection devices to diluents are generally proprietary and often effectively unregulated, information regarding their composition, use, and whatever standards may govern them are frequently not publicly available, or available only at prices unaffordable to lay and even academic researchers. Moreover, because public perception of the relative safety of oil and transmission products factors heavily into the profitability of such products, it is generally in the interest of oil producers and pipeline operators to produce information that is likely to be understood in a favorable light.

Other sources of qualitative data used to develop this report include Congressional reports, reports compiled by federal and state agencies (such as Environmental Impact Statements), academic reports and articles, and news media. Congressional reports and news media were useful in that both types of sources are intended for audiences likely to possess little or no specific, technical knowledge of the fields of oil extraction and transmission. Congressional reports are largely written by and for groups and individuals familiar with the structures and terms of American law and so tend to focus on legal and regulatory aspects of the issues. Both Congressional and news media sources are also useful in that they tend to be written in response to events or information (such as particularly harmful or highly visible accidents) that prompt concern about the safety of oil and its transportation. As such, they frequently offer a more critical perspective that works to balance the concerted optimism of industry publications. Finally, academic articles and reports authored in state and federal agencies have a different set of strengths and limitations. Both types of sources are useful in that, being written for narrower, more technically expert audiences, they tend to explore issues relating to oil transportation at a much greater level of detail and specificity and often with a greater degree of conceptual rigor than other sources. Part of the effort of achieving this rigor also generally entails that researchers and authors aim to insulate themselves from politicized perspectives in order to deliver the cleanest and clearest analysis of the issue at stake. The interest of these types of sources in impartiality can be both a strength and a weakness. It is a strength to the extent that an objective perspective can be achieved, but a weakness to the extent that such an effort will always be imperfect, though researchers and authors may not always be aware of, much less able to frankly address, biases that linger as a result of their personal or institutional positions.

Although space does not permit a discussion of specific sources here, brief commentary on certain key sources can be found in the appended annotated bibliography.

Data Analysis

The quantitative component of the analysis undertaken for this report engaged publicly available data on hazardous liquid accidents, which is provided by pipeline operators to the Pipeline and Hazardous Materials Safety Administration (PHMSA) for all accidents resulting of losses of more than five liquid gallons, as required by federal regulation. PHMSA organizes its data in several ways, some of which work in concert with the aim of this report and others that presented challenges to our analysis.

For example, PHMSA's division of accident data by the liquid's mode of transportation - namely, rail and road on the one hand and pipeline on the other - reflects a distinction of interest to groups and individuals concerned with oil transportation safety, since the various modalities entail different kinds and extents of risk to the health of humans, the environment, and the economy. As such, we have preserved this division in our analysis. At the same time, PHMSA's periodization of the data, particularly relating to pipeline accidents, reflects a necessary but challenging organization. Necessary because the types of data that PHMSA collects and the categories into which those data are sorted has changed over time in response to legislative and regulatory changes, but challenging because identifying trends in the accidents reported requires comparison of data over time. Rather than attempt such comparisons at the desired level of detail by transforming the data and risking its adulteration, we have only compared fields that are clearly commensurable across periods. This has still allowed us to compile crucial elements of the data and identify trends in the number of accidents, the amount of liquids lost, as well as the causes and costs of the accidents, and the operators of the pipelines affected. Trend identification has been limited here to simple algorithmic and descriptive statistical analysis, as our aim was more to highlight areas that may be of interest for further exploration and research than to make determinations of what trends are significant and to undertake such detailed analysis.

Moreover, we have made minor changes to data fields - often limited only to changing the field name for brevity and legibility, or changing the format of the data from text to recognized numbers - in order to make recent data with specific spatial reference information compatible with Geographic Information Systems (GIS) software. This will allow further analysis of the data without compromising any of its content. Both spatialized and spreadsheet-formatted data are appended digitally to this report, along with relevant metadata.

4. FINDINGS

Infrastructure Overview

Logging, mining, and sport fishing/hunting activities have continued to the present, controversy and all, alongside the extraction and transportation of another, profoundly dangerous commodity: oil. Since the early 1950s, the excavation, transportation, refinement, and storage of crude oil and related liquids have transformed the landscape of the ceded territories in ways both subtle and stark. In the seven decades during which oil has flowed from extraction sites across the Midwest and Plains states, as well as much of western Canada, over 11,000 miles of hazardous liquid pipelines have been laid across Michigan, Minnesota, and Wisconsin to facilitate the production cycles of the modern energy economy (PHMSA 2017). Meanwhile, in the Wisconsin border city of Superior, gargantuan storage tanks pockmark the St. Louis River and the industrial community built around it. This largely "invisible" infrastructure transports crude oil in massive quantities through the Chippewa ceded territories via pipeline, rail, and truck.

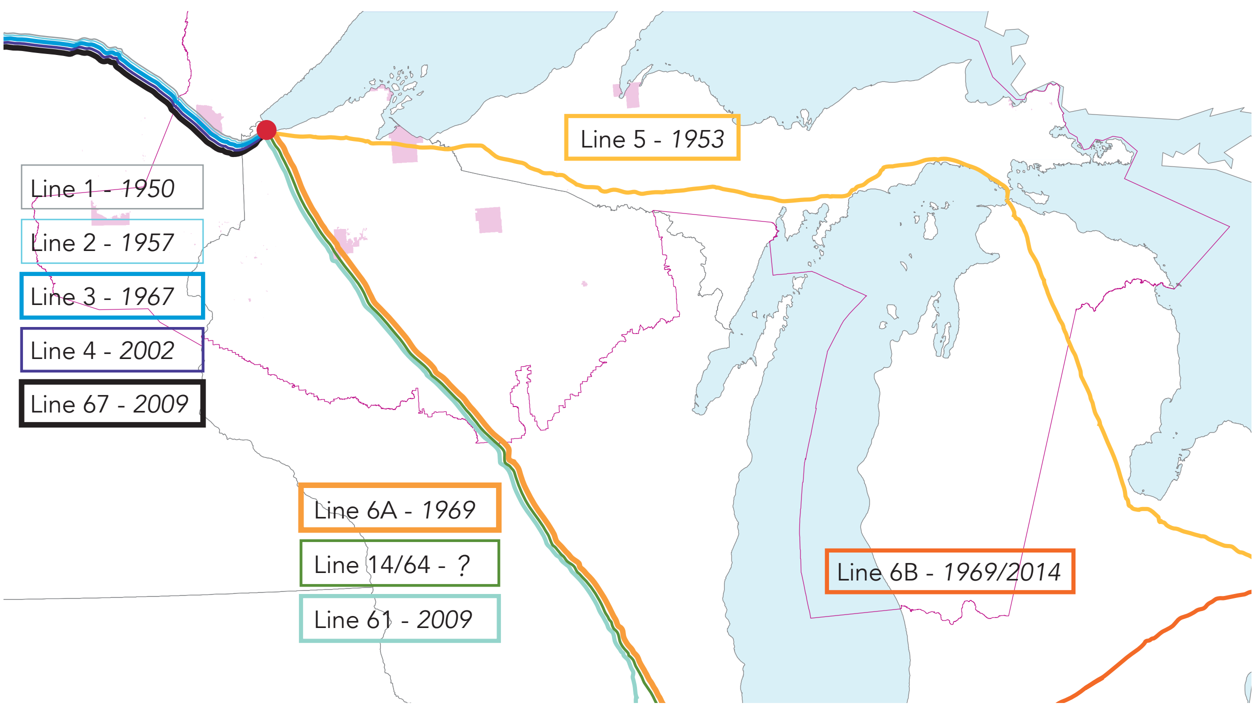
Pipeline Networks, Capacities, Volumes

There are ten different Enbridge crude oil pipelines in Wisconsin, which are of particular interest to this project. Each begins or ends at the Superior oil terminal in the northwest corner of the state. According to Enbridge's internal reports, an estimated 15% of total U.S. oil imports move through the Superior Terminal, and the site has the capacity to store approximately 10.2 million barrels of oil. The company's pipelines run through private property, tribal reservation lands, national forests, and public property under state or local governance. Enbridge has negotiated eighty-foot-wide easements with each of these property owners, most of which have been granted permanently (Enbridge). In some cases the easements are up for renewal after a specific time period (Bad River Band 2017).

The ceded territories pipelines' total around 1277 miles along three different easement routes through the area - one from Alberta, CA to Superior, WI, another running down the Wisconsin's central north-south axis to Illinois, and and a third east to Canada via Michigan and the Straits of Mackinac. The pipelines vary in capacity and diameter from twenty to forty-two inches, with twenty-one pumping stations located along the respective routes (PHMSA). The estimated maximum capacity of the Enbridge Mainline system (which connects through Superior) is over five million barrel-miles per day (bpd); however, Enbridge states the system moves approximately 2.3 million bpd through Superior Terminal. This quantity is equal to approximately thirty 120-car unit trains of crude oil tank cars moving through Superior per day.

Satellite image of Superior Terminal, *Google Earth*

US and Canada crude oil pipeline network
Source: EIA

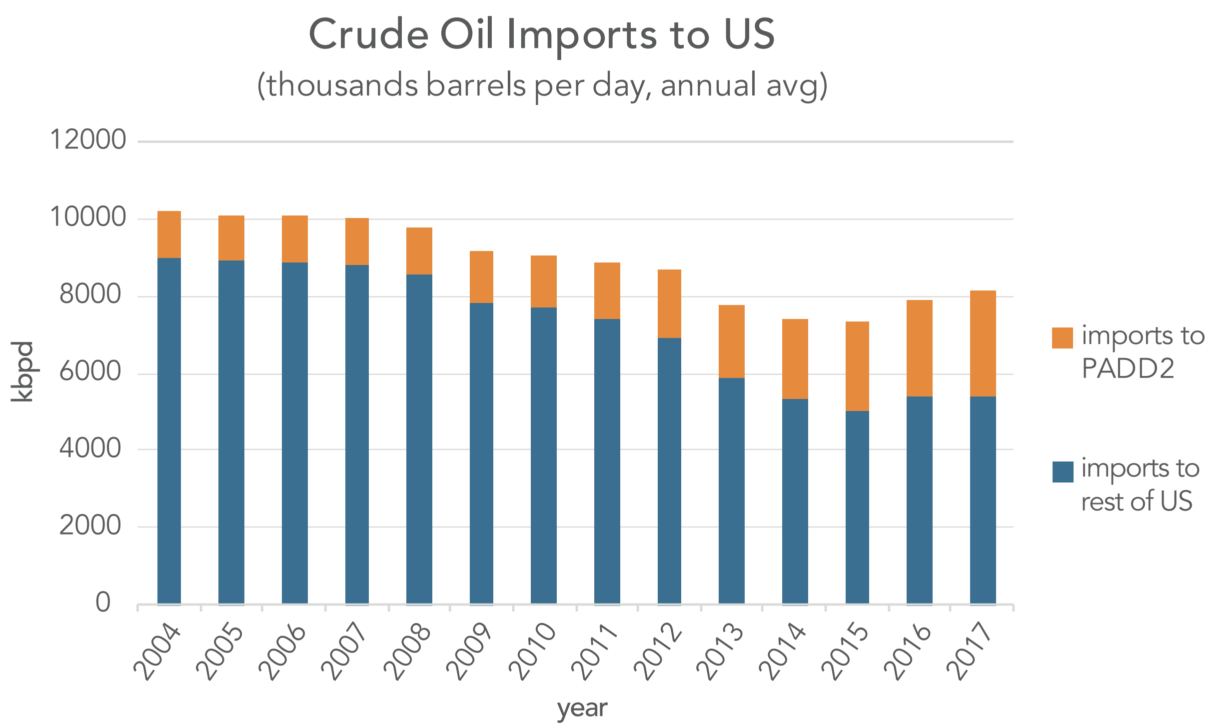


Enbridge pipeline network - line weight by relative bpd capacity
Source: Enbridge and WI DNR Environmental Impact Statement

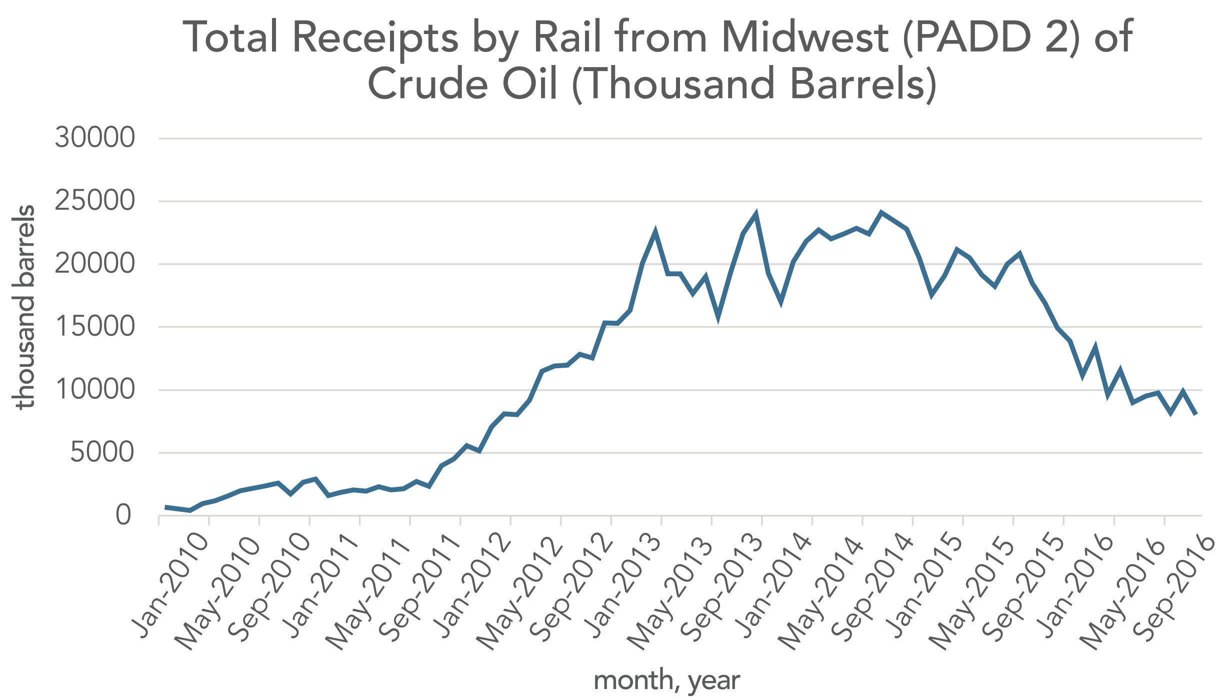
Rail Networks, Capacities, Volumes

While pipelines carry a steady volume of crude oil through the ceded territories on a daily basis, rail networks also provide a crucial piece of the oil transportation economy. Permanent, capital intensive infrastructure such as pipelines require large upfront investments, take years to permit and construct, and require complex negotiations between governments, corporations, and individual land owners. Rail networks, on the other hand, already exist and respond more elastically to immediate changes in demand for crude oil transportation. Unlike pipeline, these networks are not fixed, and they can more easily accommodate changes in crude oil extraction depending on the source (such as increased attention to the Bakken Oil fields in North Dakota) or extraction method (increased capability to extract deeply embedded bituminous crude oil).

Publicly available information on the specific railroads used to transport crude oil is limited, and most data on rail transportation of crude is aggregated spatially at a high level. As such, assessing the amount of crude oil moving through the ceded territories via rail is nearly impossible. However, inferences based on available aggregated data can begin to be made.
By looking at Petroleum Area Defense District 2 (PADD2) which includes fifteen Midwest states, certain pattern begin to emerge. Since 2010, crude oil receipts from the Midwest via rail increased dramatically until their, peak in 2014, and then tapered off. During this same period, however, crude oil imports via any means of transportation to the Midwest have nearly doubled - from an average 1376 barrels per day in 2010 to 2486 barrels per day in 2016. Thus we can infer that new pipeline capacity has likely seen the brunt of the 2014-2017 increase in crude oil transportation. Additionally, PADD 2 has seen an increase in crude oil imports relative to the rest of the PADDs around the country, indicating that Canadian exportation of crude oil has been increasing (EIA).



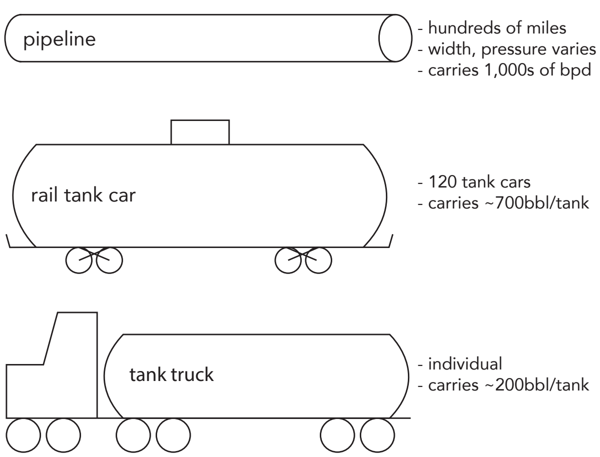
Crude oil imported to the Midwest and US by thousands of barrels.
Source: EIA



Crude oil transported by rail through the Midwest by thousands of barrels.
Source: EIA

Truck Networks, Capacities, Volumes

Most oil is carried by truck at some point in its trajectory from source to consumption. However, a truck typically only carries approximately ~200 barrels of crude oil per tank, making it a highly inefficient means of transporting large quantities of crude for long distances. It takes three trucks to carry the same amount of oil as one rail tank car (~700 barrels of crude per car), and unit trains carrying crude oil tend to be about ~120 cars long. Additionally, information on where trucks carrying crude oil are permitted was difficult to find in the ceded territories.



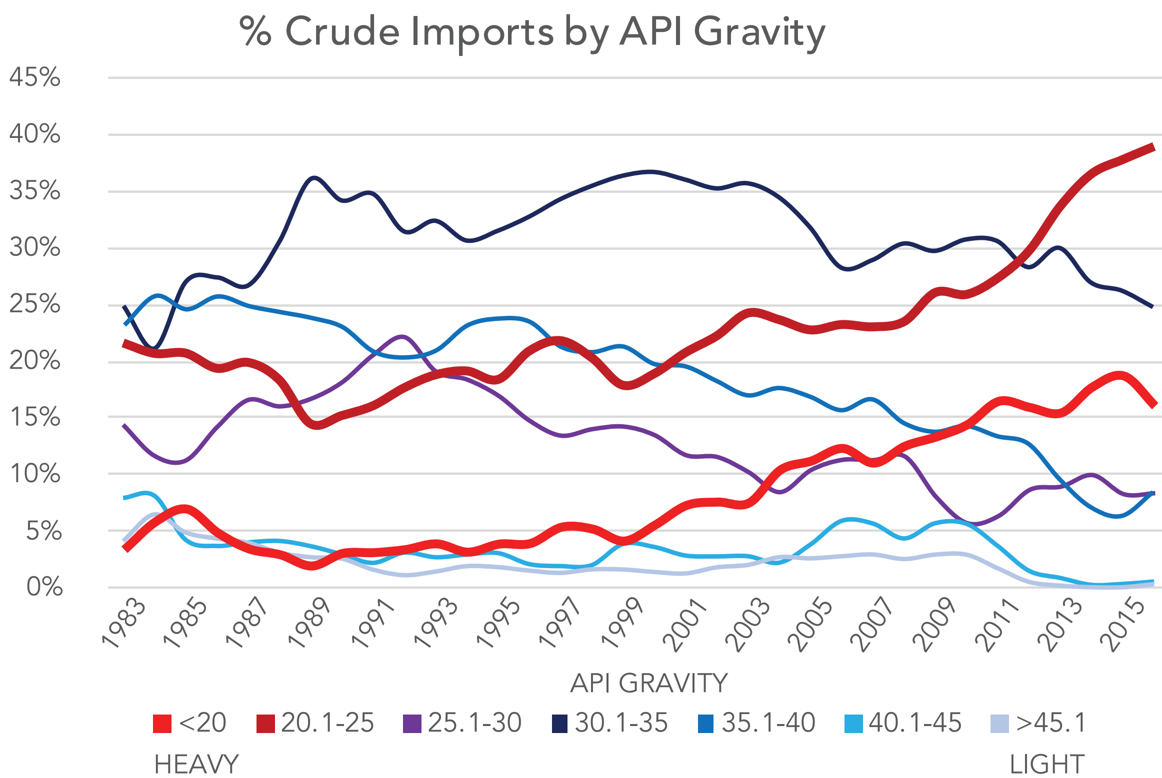
What is being transported?

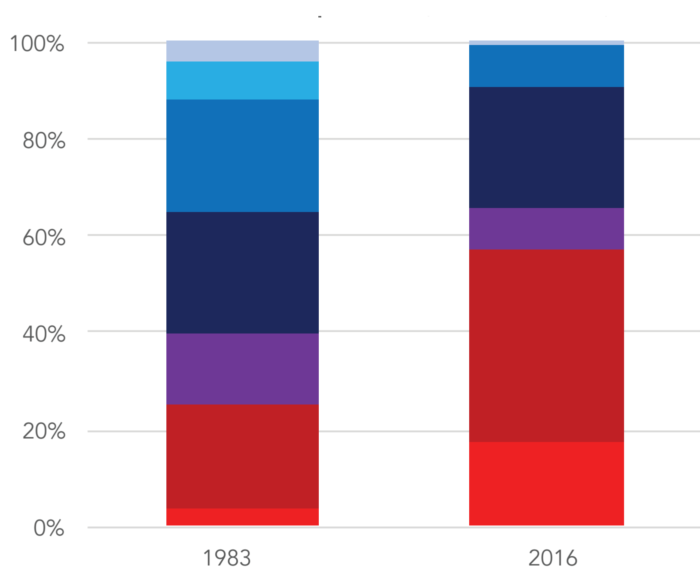
Though the Enbridge pipelines have been carrying Alberta Tar Sands crude oil since since their initial installation 1950s and 1960s, the chemical nature of the crude oil being transported has changed over time. The Tar Sands is home to a heavy, clay-like bituminous oil, which requires great energy to be extracted--usually by strip-mining or steam injection. After extraction (which is part of the 'upstream' oil industry), this thick, viscous substance is usually diluted with water and various chemical solvents in order to be transported - via pipeline, rail, or truck - to refineries around North America. The transportation of crude oil after extraction and before its refinement is referred to as the 'midstream' oil industry. After it is transported, the 'downstream' industry refines the oil and distributes the product. While the upstream and downstream sectors are known for potentially large profit margins and capital-intensive equipment, the midstream industry usually only comes into the public eye when a catastrophic spill occurs.

The most heavy Alberta Tar Sands crude, which sinks in water, requires additional diluents and pressure to move through the pipeline, and it is much more difficult to clean up in the event of a spill. According to data collected by the federal government, crude oil imports to the United States have become much heavier over the last twenty-five years, making oil transportation a riskier business (EIA). The of the crude oil varies depending on the extraction method and source location. This variation is captured by a number of metrics, including sulfuric content (the more sulfuric oil is considered "sour, while less sulfuric oil is "sweet"), the API gravity (this measure of density is named for the American Petroleum Institution and indicates whether or not the oil will sink or float in water), and vapor pressure exerted by the crude oil. Additionally, the condensates and diluents, which are mixed with the oil to assist its transportation, tend to be of a proprietary nature. Further information on the chemical composition of oils and condensates, government reporting requirements, and industry testing can be found in the annotated bibliography.

Infrastructure: Expansion & Looking Ahead

Against the grain of growing environmental consciousness, climate change concern, and





The amount of crude oil compared to other types of oil has increased in the past few decades, as measured by oil API gravity. *Source: EIA* popular protest of the oil infrastructure development in the Midwest and Plains states, Enbridge has continued to expand its pipeline operations through the region. In 2007, the construction of the "Southern Access Expansion Pipeline" along an existing Enbridge easement through Wisconsin was approved and in 2015 the company began installing additional pumps along Line 61, which will triple the pipeline's capacity from 400,000 bpd to 1.2 million bpd -almost 30% more than the Keystone XL Pipeline proposal. The company also recently replaced its Line 6B through southern Michigan, after a 2010 weld failure caused over 834,000 barrels of heavy crude oil to spill into Michigan's Kalamazoo River through a tributary crossed by the pipeline in the town of Marshall. The Kalamazoo River spill, which remains the largest onshore oil spill in American history, officially took over four years and $1.2 billion to clean up, though some local accounts contest the claim that the Alberta Tar Sands oil has been fully removed or recovered (Bergquist 2014).

Ironically, Enbridge is now leveraging the public revelation prompted by the Kalamazoo spill - namely that, as pressures increase and existing pipeline infrastructure ages, the transportation of crude oil becomes riskier - to justify the replacement of another line. In 2014, with Kalamazoo cleanup still ongoing, Enbridge filed permits in Wisconsin and Minnesota in which the company proposed to replace its aging Line 3 (installed in 1968) by constructing a wholly new line, abandoning the original pipeline in the ground. The proposed Line 3 replacement would carry 760,000 bpd over a 1,031-mile expanse of land stretching from Edmonton, Alberta, to Superior, Wisconsin at an estimated cost of $7.5 billion (Wisconsin DNR 2016; Johnson 2017). In the US, Line 3 would cross some 330 miles of Minnesotan and fourteen miles of Wisconsinite land, including land belonging to the ceded territories, at a cost of $2.5 billion.

Simultaneously, Enbridge has faced additional scrutiny of its Line 5 span under the Straits of Mackinac: a precarious four mile-wide sunken pipeline, built in 1953, which pumps crude oil from Michigan's upper peninsula to its lower peninsula. Not only is the pipeline infrastructure aging, but at times the company is in violation of state imposed safety requirements. Strong, erratic currents make this location the "worst possible place" for a pipeline in the Great Lakes (Egan 2017). Scenario studies on potential effects of a worst-case pipeline rupture in the Straits indicate that a spill there would spread quickly and widely through Lake Huron and Lake Michigan, affecting many miles of shoreline (Schwab 2016). While the report does not focus further on the risks associated with the Line 5 crossing of the Straits of Mackinaw, its heightened precarity should be noted.

Regulation Overview

As Osland (2013) helpfully observes, pipeline hazard mitigation can be thought of as a two-part management system: first, management of the lines themselves, and second, management of the environments and land uses surrounding the pipes. In the United States, this functional division mirrors a division in the scales of regulatory authority. That is, pipeline safety itself is regulated in the first and final instances entirely by the federal government – through the Federal Energy Regulatory Commission (FERC) in the case of natural gas pipelines, and through the Pipeline and Hazardous Materials Safety Administration (PHMSA) in the case of hazardous liquid lines.

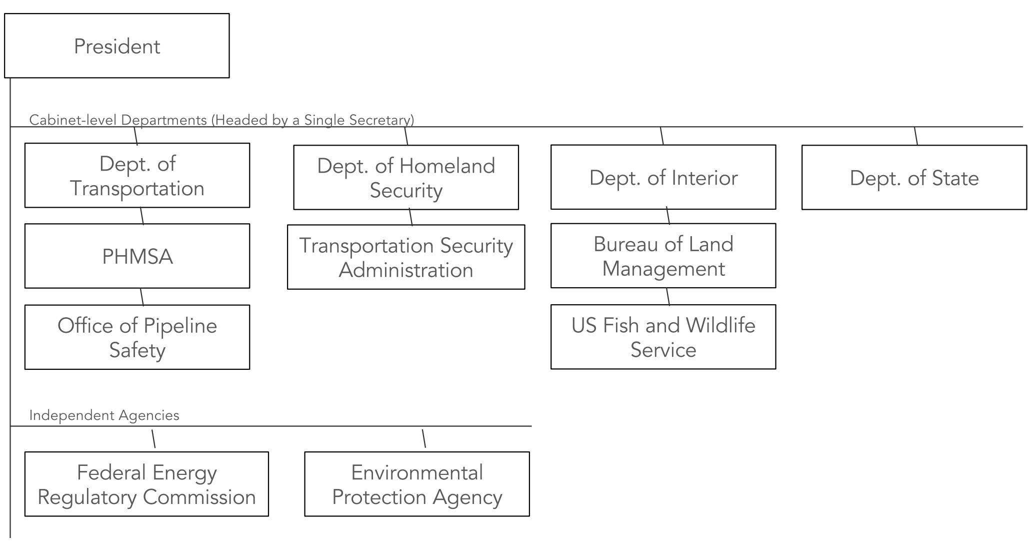
The cleanup of hazardous liquid accidents is also regulated by the Environmental Protection Agency (EPA), while the Department of Homeland Security's Transit Safety Administration (TSA) is involved in managing pipeline security. Finally, the Department of State oversees the permitting process for pipeline proposals that cross international boundaries (Pipeline Safety Trust 2015). The Bureau of Land Management (BLM) deals with the sections of pipelines crossing federal land, while the BLM's Fish and Wildlife Service is sometimes consulted on pipeline proposals that may pose risks to vital ecosystems or particular wildlife.

Because PHMSA and its antecedents are tasked with the vast majority of rulemaking and everyday enforcement regarding pipeline safety, this section focuses on the structure and operation of that administration. It does, though, also conclude with brief remarks on state and local responsibilities regarding pipeline safety and risk mitigation.

Pipeline Safety Regulatory History

Until 1968, the regulation of energy pipelines was left by the federal government to the states, of which only twenty-six had actually enacted any regulations. In that year, following a series of devastating accidents across the country, Congress passed the Natural Gas Pipeline Safety Act. The Pipeline Safety Act entrusted minimum pipeline safety regulation to the newly formed Department

FEDERAL PIPELINE REGULATORY AND PERMITTING AUTHORITIES



Pipeline permitting and regulation authority is divided among many federal departments.

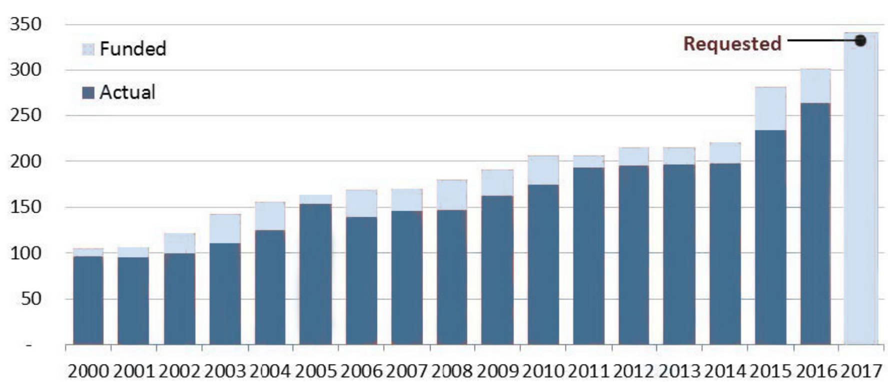
of Transportation but provided that the states could continue to regulate intrastate pipelines, provided that they certified with the DOT their authority and capacity to enact and enforce such regulations. A decade later, as accidents continued apace, Congress evinced concern that the existing certification process was inadequate and enacted the Hazardous Liquid Pipeline Safety Act of 1979. The 1979 Act further elaborated the certification standards for state partners, as well as extending regulation to cover hazardous liquid (generally meaning oil) pipelines.

The Pipeline Safety Acts have been updated repeatedly over the decades in response to revelations of persistent regulatory shortcomings made tragically clear in the wake of ongoing accidents. Such legislation has included the Pipeline Safety Reauthorization Act of 1988, which established reporting processes of operator systems to regulators and required qualifications for operator personnel; the Pipeline Safety Act of 1992, which increased maximum allowable penalties for the violation of regulations; the Accountable Pipeline Safety and Partnership Act of 1996; the Pipeline Safety Improvement Act of 2002, which was the first iteration of the Act to require operators to prioritize the regular inspection of pipelines traversing high population areas and areas of unusual environmental sensitivity (collectively referred to as High Consequence Areas, or HCAs), while also requiring PHMSA to outline a certification process for states seeking to inspect interstate as well as intrastate pipelines in their territory; the Pipeline Inspection, Protection, Enforcement and Safety Act of 2006, which extended the foregoing rules to natural gas distribution lines and authorized civil enforcement actions against violations of the "one-call" excavation safety system; and, finally, the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011, which further increased penalty maximums as previous penalties proved an ineffective deterrent to operator negligence, and also called for a number of studies and rules regarding continually problematic aspects of pipeline safety management such as leak detection and maximum allowable operating pressures (Vanzura and Linderman 2013).

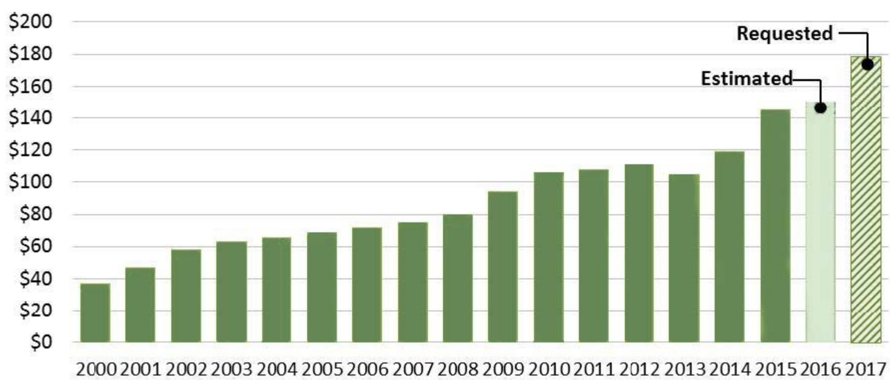
The Pipeline and Hazardous Materials Safety Administration

Throughout the years and changes to pipeline-related legislation, the basic regulation and enforcement of pipeline safety practices has remained the exclusive mandate of PHMSA, its antecedents, and its state partner agencies. PHMSA can delegate its authorities and responsibilities to state governments in a number of ways, which are discussed more below, but the most important point to make on the topic is that under no circumstances will the administration delegate its authority to enforce actions on the operators of interstate pipelines found to be in violation of federal regulation (Parfomak 2016).
In states where no delegation of authority exists, PHMSA is responsible for managing the safety of both intrastate and interstate hazardous liquid pipelines. For the most part, PHMSA's safety management strategy involves spot inspections of the management systems and records of pipeline operators. PHMSA inspectors also conduct physical inspections of pipeline transmission facilities and construction projects related to both facilities and lines. Finally, inspectors are tasked with investigating safety incidents, which, although not specifically defined in the administration's authorizing legislation, do not necessarily correspond with all hazardous liquid accidents. While PHMSA's overall annual budget is allocated by Congress, its safety program is largely funded by per-mile user fees assessed on regulated pipeline operators (Parfomak 2016).

If PHMSA inspectors encounter violations of safety regulations during their inspections and investigations, the administration may take a number of steps, depending on the nature of the violation. At a minimum, PHMSA will issue a notice of amendment to a pipeline operator,



PHMSA budget has more than doubled over the last 15 years, but remains below agency needs.
Source: PHMSA



Current staff falls below budgeted level due to shortage of qualified candidates, delays in hiring, and competition from pipeline operators.
Source: PHMSA

which points out inadequacies in the operator's safety and risk mitigation systems and outlines procedures for improving the system in question, but does not allege any violation of a specific rule or regulation. If PHMSA does find a specific violation, it will issue either a warning order, a notice of probable violation, a corrective action order, or, if the violation does not present an immediate risk to public safety, a notice of proposed safety order. Notwithstanding the numerous apparent actions PHMSA may take, all of the foregoing amount in practice to an order for a pipeline operator to take steps to enter into compliance with federal safety regulations (PHMSA nd).

If the operator in question does not comply with PHMSA's order or orders, the administration is authorized to pursue administrative, civil or criminal penalty cases. In administrative and civil cases, PHMSA can issue monetary penalties of up to $200,000 per day; in the former case, these penalties have a total dollar limit of $2,000,000, while in the latter case no such limit exists. In criminal cases, PHMSA can pursue imprisonment of individual violators for up to four years (Gosman et al 2012).

Yet despite the considerable array of actions that PHMSA may take to enforce its pipeline safety program, the administration has been criticized in recent years by both concerned members of Congress and independent pipeline safety advocacy groups for lackluster inspection and enforcement practices (Parfomak 2016; Pipeline Safety Trust 2015). Despite having its annual budget more than doubled over the last decade, PHMSA has been slow to hire the full staff for which it is authorized and, subsequently, to implement several key mandates entailed in legislative updates to PHMSA's mandate during the same period.

For example, of the forty-two studies, rules, maps, and other aspects of pipeline safety regulation imposed on PHMSA by the Pipeline Safety Act of 2011, twelve remain, by PHMSA's own count, unaddressed. These include the promulgation of crucial safety rules and standards governing automatic and remote-controlled shutoff valves, excess flow valves, integrity management expansion for pipelines in so-called High Consequence Areas (HCAs, areas of high population density or unusual environmental sensitivity – e.g., bodies of drinking water supply – that pipeline operators are required to prioritize in their risk mitigation regimes), leak detection, accident notification, and maximum allowable operating pressure verification (Parfomak 2016; PHMSA 2016).

An additional concern, for independent advocates of pipelines safety, is the relationship between PHMSA and the pipeline operators that the administration exists to regulate. For one thing, advocates have pointed out, PHMSA's inspections practices rely heavily on operators' own, self-reported safety and integrity management performances. That is, PHMSA's spot inspections for the most part entail merely checking operators' practice manuals and relevant records, rather than undertaking independent investigations of these practices or keeping independent records.

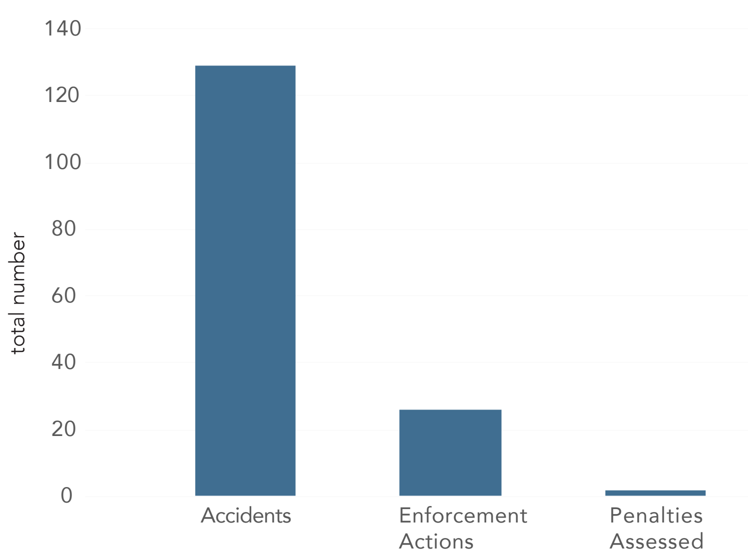
For another thing, many of the too-few standards for pipeline safety that do exist and that PHMSA has incorporated into its rules and regulations, were written by organizations representing the industries involved in hazardous liquid extraction and transportation. Besides laying the groundwork for an obvious and alarming conflict of interest, this situation prevents members of the public from undertaking independent inquiries into PHMSA's rules, regulations, and practices, since most of the standards developed by industry organizations that have been incorporated into such rules and regulations are proprietary and generally too expensive for individual members of the public to obtain (Pipeline Safety Trust 2015).

Perhaps most importantly, PHMSA's staffing shortfalls center on the administration's dearth of pipeline inspectors. In 2015, inspectors comprised some 131 of the administration's 266 full-time equivalent staff. Yet the administration's own funding requests and their requested fiscal year 2017 allocation provide for seventy-four more staff, most of whom would be inspectors. This means that PHMSA is presently only employing two-thirds of the pipeline safety inspectors that its budget allows. Even given that the metrics of what an appropriate staffing level would be is unclear in both Congressional and industry literature, it is at least clear that PHMSA is currently falling well below the staff levels that administrators believe to be necessary and fundable.

State Partnerships

Of course, even if PHMSA were to onboard the several dozen additional pipeline inspectors, its staff would comprise just over a third of the national pipeline inspection workforce, the rest of whom work through state-level agencies. In mid-2016 one PHMSA administrator (Klinger 2016, cited in Parfomak 2016) put the state-level inspection workforce at around 350 people, or an average of seven inspectors per state. States, however, vary enormously in their pipeline inspection staffing levels. One frequently-cited reason is budgetary constraints imposed both by economic conditions and by austerity-minded state political regimes. Another reason is that some states conduct their own hazardous liquid pipeline inspections through authority delegated by PHMSA, and thus retain dedicated inspections staff, while other states opt to leave inspection to the federal administration and its inspectors.

When PHMSA enters into a partnership with a state to co-manage hazardous liquid pipeline safety, the state agency responsible for taking on PHMSA's responsibilities must become certified by the administration. Certification entails an agreement that the state will adopt the minimum federal regulations – with the option to enact more stringent rules – will promote one-call compliance to minimize the risk of excavation-related accidents, and will impose administrative and monetary penalties comparable to those typically ordered by PHMSA (PHMSA nd). According to a 2013 report from the National



Minnesota pipeline accidents and enforcement.

Association of Pipeline Safety Representatives, no certified state had enacted more restrictive intrastate pipeline safety legislation than the federal minimum.

Certification allows state authorities to inspect intrastate pipelines and to enforce penalties for violation on intrastate lines. States can also certify with PHMSA to act as the administration's state agents, allowing state authorities additionally to inspect the segments of interstate hazardous liquid lines that traverse their state. Enforcement actions for interstate lines remain the sole province of PHMSA. According to PHMSA's website, as of late 2014, fourteen states were certified for intrastate pipeline safety authority, while just five acted as interstate agents (PHMSA nd).

Of the states in the upper Midwest, only Minnesota was included in either list, attaining both certification and interstate agent status. This means that, unlike Michigan's Department of Environmental Quality (DEQ) and Wisconsin's Department of Natural Resources (DNR), the Office of Pipeline Safety (OPS) in Minnesota's Department of Public Safety (DPS) is authorized to write rules and regulations governing intrastate hazardous liquid pipelines, to inspect and undertake enforcement actions of those pipelines, and to inspect interstate pipelines passing through the state. The OPS retains a dedicated inspections staff to manage these responsibilities, though the number and roles of these staff are not publicly available data. Data that are publicly available, however, suggest that state-level partners like Minnesota's OPS may be experiencing a capacity problem similar to PHMSA's, as the disparities between probable violations noted, enforcement actions undertaken, and penalties assessed point to a possible budgetary or staffing inability to engage in a robust inspection and violation enforcement program.

Local Regulatory Powers

The land around a given pipeline, meanwhile, is almost entirely regulated by the municipal governments through whose jurisdictions the pipeline runs (Fitzgerald 2013, Parfomak 2016). We say almost entirely because no specific federal rule or regulation grants such authority to municipal governments, and state governments may legislate restrictions on the kind or extent of municipal authority over pipelines. But several recent court cases have upheld the lawfulness of municipal ordinances that are not specifically preempted by state or federal law, that do not aim to regulate pipeline safety or security, and that are reasonable in scope.

For example, in Texas Midstream Gas Services LLC v. City of Grand Prairie, 608 F.3d 200 (5th Cir. 2010), the Court struck down the part of an amended ordinance requiring a new natural gas compressor station to erect a security fence, but upheld the same amendment's requirements for setback, building materials, roofing, and noise pollution control. And in Washington Gas Light Co. v. Prince George's County Council, 711 F3d 412 (4th Cir. 2013), the Court of Appeals upheld the county's denial of the operator's request to expand their compressor station with a LNG storage tank. Specifically, the Court found that the county's recently enacted transit-oriented development overlay and zoning plan (prohibiting new industrial uses in the station area) was not preempted by federal pipeline safety regulation (FitzGerald 2013).

Again, though, the lawful enactment of such local authority depends on the relationship between local and state governments. So, in light of the last-minute additions to Wisconsin's 2015-2017 budget - one expanding the range of corporate entities eligible to wield eminent domain authority (an amendment, subsequent reporting revealed, written largely by Enbridge-affiliated lobbyists) and another specifically preempting county governments from requiring pipeline operators to carry pollution insurance above state-mandated minimums - municipal and county zoning authorities should consider drafting pipeline-related ordinances in cooperation with their state representatives.

Accidents: Road and Rail

There have 21, 608 combined hazardous liquid spills from railroad and highway transportation from 1989 to 2016 in Michigan, Minnesota, and Wisconsin. This is an average of 22 spills per year. Aggregating the number of spills via highway and railroad, however, obscures the fact that the majority of these have been spills that occur when oil is transported via highway. Of the combined spills, 20,442—95% of the total—have been via highway. Of the three states, Michigan has seen the most spills (8,314), followed by Minnesota (7,045) and Wisconsin (6,249).

As the table above shows, however, though a disproportionately large number of spills happen via highway, this is not necessarily represented in the total volume that is spilled. While railroad spills account for only 5% of the total number of spills, the volume of oil spilled when transported via rail is 46%. This means that while there are fewer spills via railroad, when they do happen, they tend to spill much more oil than when there are spills from a truck on a highway. That is, any one spill via truck will never have the potential to spill as much oil as a potential spill from a railroad accident.

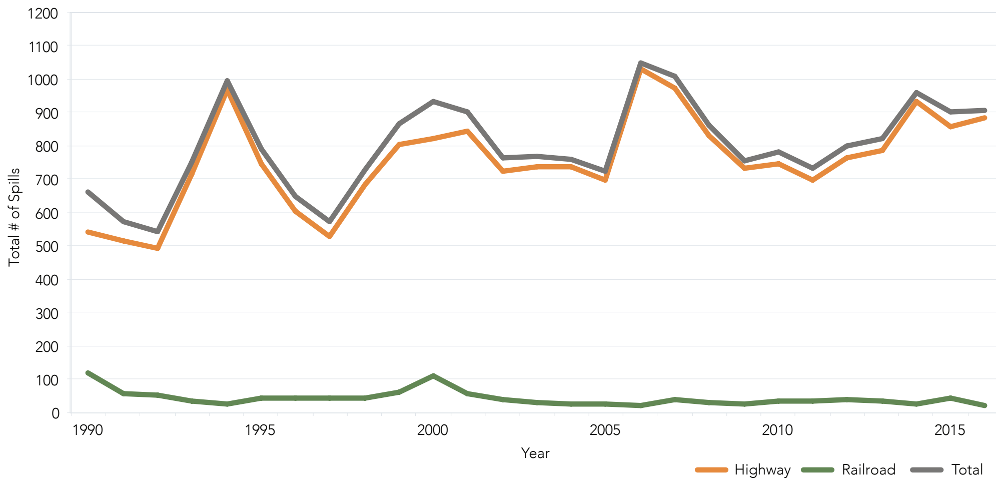
The self-reported costs of spills, which include cleanup costs, estimates of the value of equipment damaged, estimates of damage private property, and the cost of emergency response service, is much higher for highway than for railroad spills in the aggregate. However, this is largely because there are so many highway spills in any given year and the costs to deploy all the services to ensure cleanup and safety add up. When there are railroad spills, on the other hand, these costs escalate. As the graph below shows, one single railroad spill can have the potential to increase the total cost of spills in a single year, whereas the costs of highway spills tend to be more predictable and do not vary year to year. The total amount that has been spent on cleanup costs since 1990 is $16,410,833 for highway spills and $11,120,110 for railroad spills, for a combined total of $27, 530, 943.

	Highway	**Rail**	**Total**
Number of Spills	20,395	1,163	21,558
Percent of total	*95%*	*5%*	
Spill Quantity Total (LGA)	978,526	817,382	1,795,908
Percent of total	*54%*	*46%*	

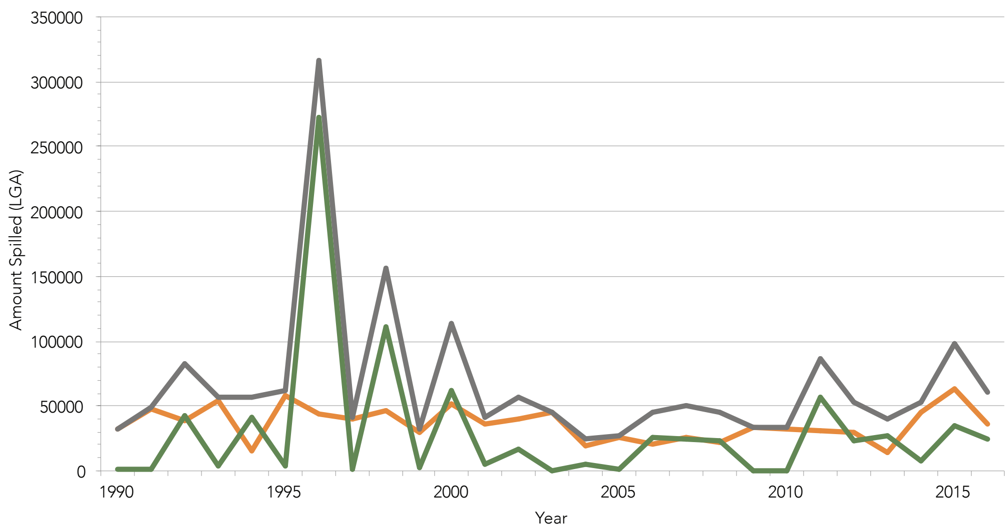
Though the number of spills by rail is only 5% of the total since 1990, it accounts for 46% of total volume spilled.

	Highway	Railroad	Total
Total Amount	$16,410,833	$11,120,110	$27,530,943
Annual Median	$539,234	$25,682	

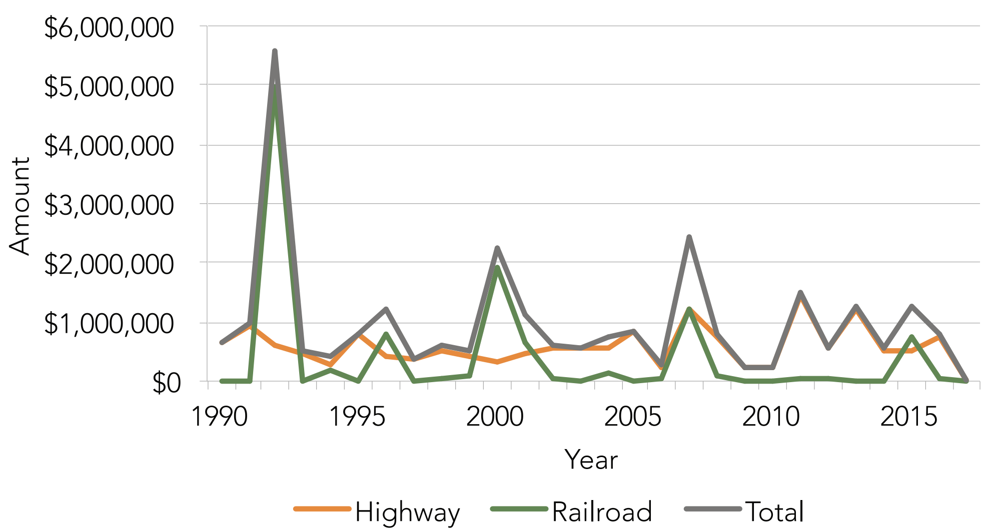
More money has been spent on cleanup costs resulting from oil transportation via highway than rail since 1990.



The annual total number of spills is higher via highway than railway.



The total yearly amount of oil spilled is higher via highway than railway, though railway accidents can potentially spill large quantities as in 1996.



There is no identifiable trend in cleanup costs for either rail or highway spills, though the price can potentially be much higher for one large rail accident.

Source: PHMSA

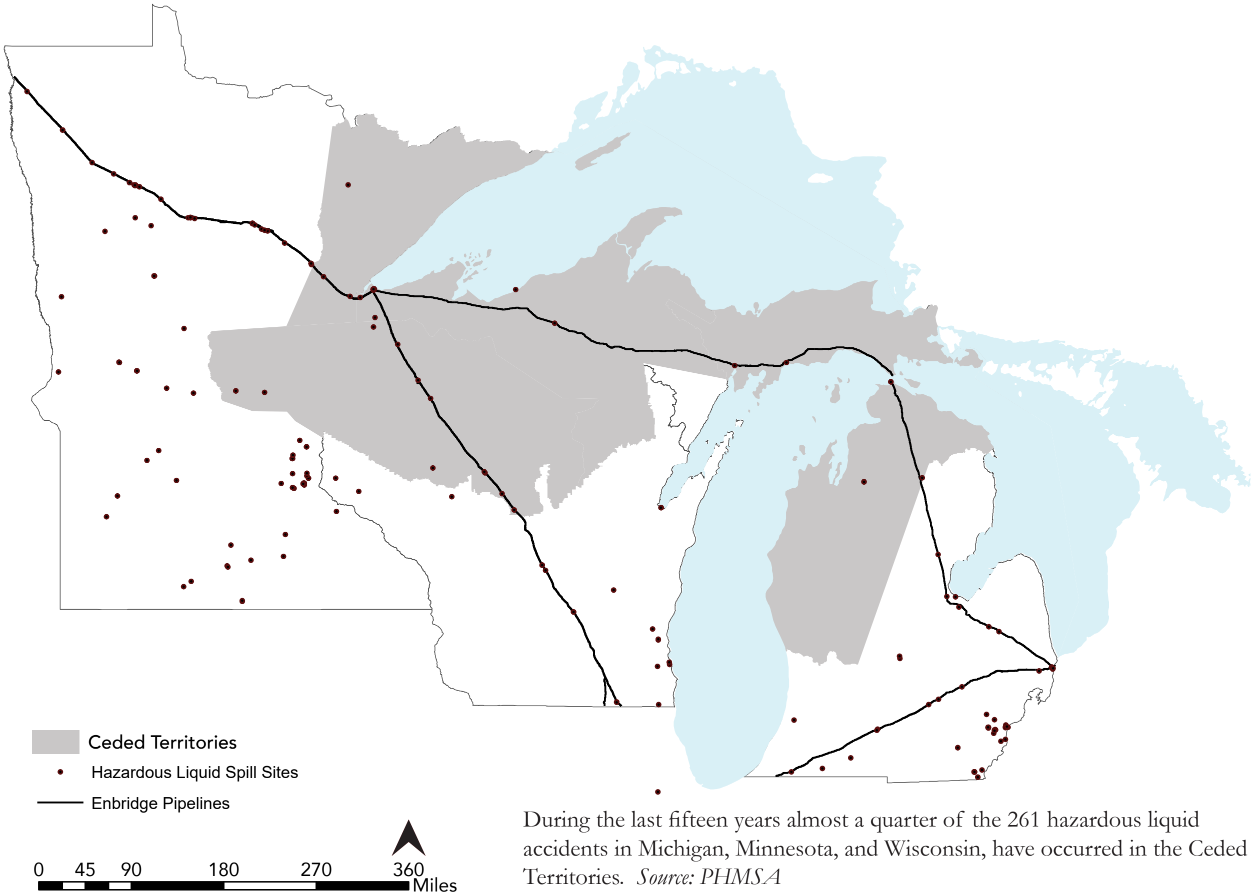
Accidents: Pipeline

Michigan, Minnesota, and Wisconsin have seen a combined 395 hazardous liquid spills over the past thirty years, averaging twelve spills per year. These accidents, though, are not evenly distributed in space or in time. Of the three states, Minnesota has seen the lion's share of accidents during the past three decades, with 190 spills. Michigan and Wisconsin have been home to 103 and 102 accidents, respectively, during the period ranging from 1986 through 2016. But while these values suggest that Minnesota may be the most spill-prone location in the western reaches of the Great Lakes, it is in fact the safest in terms of the number of spills per mile of pipeline. During the last fifteen years, for which spatial data exists, almost a quarter of the 261 hazardous liquid accidents in Michigan, Minnesota, and Wisconsin, have occurred in the Ceded Territories.

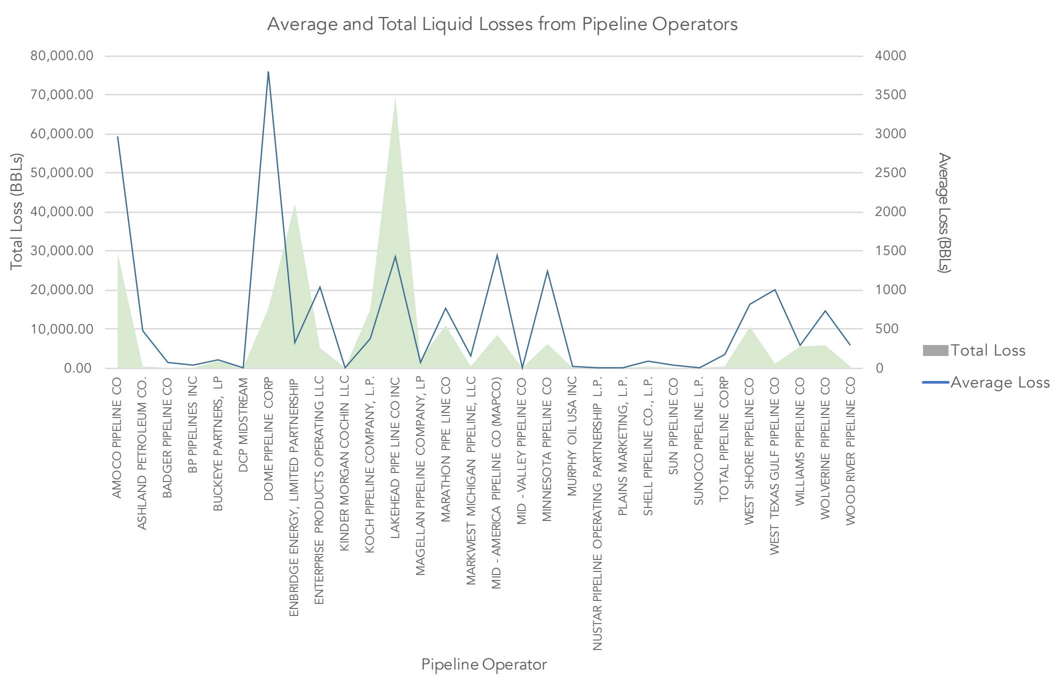
Assuming that hazardous liquids are flowing at the same velocity through all pipelines (an assumption which, as the foregoing findings on pipeline volumes shows, may or may not hold on a given day or even for a given line during the course of a day), the more line there is, the greater the spill potential. Looked at this way, the recent history of hazardous liquid accidents in these states suggests a rate of one spill per forty-eight miles of pipeline in Minnesota, compared with one spill per thirty-four miles in Michigan and one per twenty-five miles in Wisconsin. One possible explanation for this disparity is differences in oversight amongst the states.

Some of these accidents are caused by endogenous factors – defects built into the lines themselves that cause rapid corrosion, for example, or imperfect welding of the seams joining two segments of a line. Even the incorrect operation of valves and inline equipment by remote operators can have disastrous consequences. Other threats to pipeline integrity are exogenous, such as pressure from erosion, jostling caused by the invasion of tree roots, or puncture by man-made equipment or natural artifact.

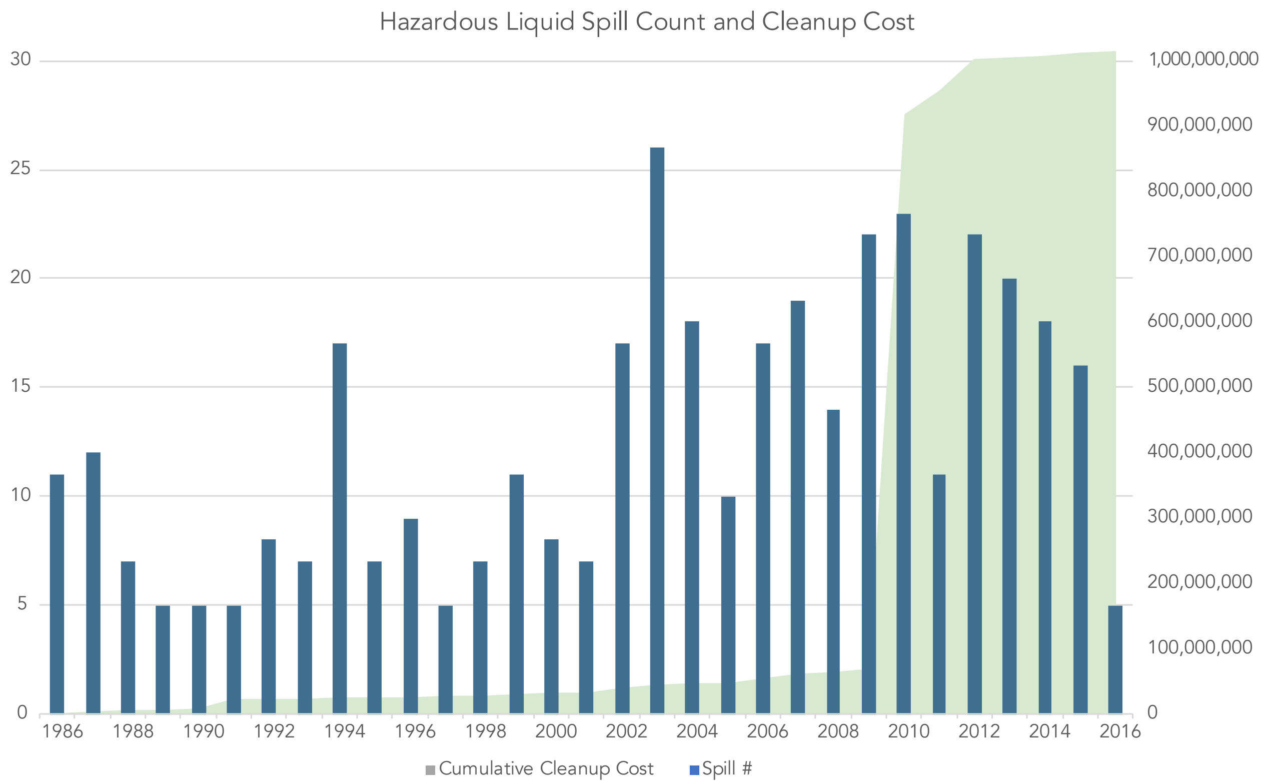
Of the 400-odd accidents that have occurred in Michigan, Minnesota, and Wisconsin during the last thirty years, almost one in three was caused by an equipment failure, while another one in six was caused by a failure in welding or the pipe itself. Excavation accidents, by contrast, caused only eight, or 2%, of the recorded spills. In the Ceded Territories specifically, equipment failures account for over 40% of accident causes, while around 20% were caused by weld failures. Still, with the exception of welding failures, infrequent excavation accidents have been the costliest form of failure on average, requiring more than $700,000 to rectify. This distribution of causes has important implications for the actions that communities living with pipelines should consider prioritizing when contemplating their risk mitigation strategies in policy and planning.
In addition to being the most common liquid to spill from pipelines in Michigan, Minnesota, and Wisconsin, crude oil is also the costliest to clean up. While HLA accidents have cost an average of roughly $130,000 to clean up and refined oil accidents have run to almost $800,000, the average crude oil spill has cost fully $4,100,000 to clean up. (Removing the Kalamazoo spill from this data lowers the average crude oil cleanup cost to roughly $445,000. It is arguable, though, whether doing so provides a more honest reflection of the true cost of an average spill, given that the federal regulation of risk management systems has been slow to evolve since the accident, rendering a similar disaster in the future totally possible.) Spills in the Ceded Territories have been somewhat less costly, averaging around $224,000. The cause of this difference is unclear.



During the last fifteen years almost a quarter of the 261 hazardous liquid accidents in Michigan, Minnesota, and Wisconsin, have occurred in the Ceded Territories. *Source: PHMSA*



Some pipeline operators have lost up to 70,000 due to spills.
Source: PHMSA



Cumulative clean up costs rose drastically with the Marsall Spill into the Kalamazoo River in 2010.
Source: PHMSA

TOTAL AND AVERAGE ACCIDENT LOSSES AND COSTS BY CAUSE

Cause	Cause Count	Total BBL Loss	Total Cleanup Cost	Total Fatality	Total Injury
CORROSION	35	8,602.62	$20,746,866.00	0	0
EQUIPMENT	111	12,398.92	$44,518,521.00	0	0
EXCAVATION DAMAGE	8	9,575.40	$5,969,388.00	0	0
FAILED PIPE	7	14,348.00	$3,645,314.00	0	0
INCORRECT OPERATION	36	11,824.01	$9,831,409.00	2	0
MATERIAL AND/OR WELD FAILURES	59	43,762.75	$892,761,087.00	2	1
NATURAL FORCES	37	3,020.66	$5,945,619.00	0	0
OTHER	65	82,139.70	$20,620,640.00	1	3
OUTSIDE FORCE DAMAGE	37	46,460.97	$11,232,227.00	1	3
(blank)					
Total	395	232,133.03	$1,015,271,071.00	6	7

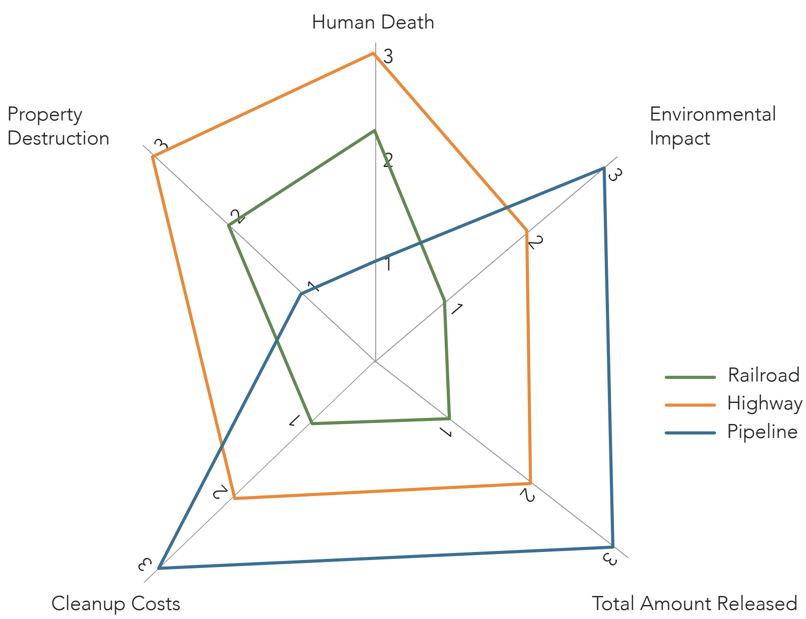
Cause	Cause Count	Avg BBL Loss	Avg Cleanup Cost	Avg Fatality	Avg Injury
CORROSION	35	245.79	$592,767.60	0.00	0.00
EQUIPMENT	111	111.70	$401,067.76	0.00	0.00
EXCAVATION DAMAGE	8	1,196.92	$746,173.50	0.00	0.00
FAILED PIPE	7	2,049.71	$520,759.14	0.00	0.00
INCORRECT OPERATION	36	328.44	$273,094.69	0.06	0.00
MATERIAL AND/OR WELD FAILURES	59	741.74	$15,131,543.85	0.03	0.02
NATURAL FORCES	37	81.64	$160,692.41	0.00	0.00
OTHER	65	1,283.43	$322,197.50	0.02	0.05
OUTSIDE FORCE DAMAGE	37	1,255.70	$303,573.70	0.03	0.08
(blank)					
Total	395	589.17	$2,576,830.13	0.02	0.02

Some of these accidents are caused by endogenous factors such as defects built into the lines themselves. Other threats to pipeline integrity are exogenous, such as pressure from erosion.

5. DISCUSSION & CONCLUSIONS

It is difficult to make a determination about which method of transporting oil is better or worse. This is because each method poses different risks and different likelihoods of each type of risks. While one may be less likely to prevent death and destruction, it is more likely to release a large amount of oil in the aggregate. While one may pose a greater risk to land area, another might be more likely to contaminate water. While one is more likely to destroy habitats, it might emit higher levels of CO2.

In reality the cost figures in the previous section over- and undervalue the nature of hazardous liquid spills. On the one hand, environmental cleanup is not the only cost incurred by pipeline operators and others responding to accidents. Rather, these figures also include estimations of the value of equipment damaged, of damage or destruction to private property not held by the pipeline operator, and of the emergency response services of the various scales of government. Still, over the last fifteen years, costs associated with environmental cleanup have comprised anywhere from 35% to 75% of total accident costs. Emergency response costs typically follow, making up around 20% of average total costs.
On the other hand, both environmental cleanup costs and, by extension, total accident costs, as reported by pipeline, rail, and truck operators, likely undervalue the extent of ecological damage caused by spills of crude oil and other hazardous liquids. For beyond the acute dangers of polluting top soils, contaminating groundwater and open water sources, and posing health threats to humans and animals, these liquids can lead to long-term ecosystem disruptions by causing the death of organic matter ranging from soil bacteria to whole populations of riverine wildlife. In some cases, these threats are also cultural, as in



This spider diagram shows how each transportation mode ranks among the others for each risk category.

the threat posed by new and existing pipelines to the wild rice lakes of Ojibwe tribes from White Earth in Minnesota to Bad River in Wisconsin and beyond. The value of these cultural assets is virtually impossible to quantify, making it difficult for pipeline operators to internalize even if they were willing to do so.

The figure above shows how each transportation method compares to the others in terms of the risks they pose to human deaths, the environment, cleanup costs, and property destruction, based on the findings presented in this report. The numbers along each line represent the ranking of risk for each transportation method; three is the highest risk and 1 is the lowest risk when compared to the other two methods. For example, pipeline comes in at 3 in the rankings for environmental risk but 1 in terms of property destruction, etc. Visualizing the rankings in this way gives a clear picture of the difficulty of assessing which transportation method is better or worse. It also provides a means of visualizing the costs and benefits for each transportation method. The visual provides a roadmap when making decisions about which method of transportation provides the best alternative, given the values, threats, and priorities of a given community. In the end, all three transportation modes can be made safer. This would require stricter regulatory controls and modern technologies. The questions, then, would be: which regulations applied to which transportation method should be tackled first, and how can the industry be made to comply with these?

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U.S. Energy Information Administration. "Crude Oil Movements of Crude Oil by Rail." 2010-2017. Webpage: http://www.eia.gov/dnav/pet/pet_move_railna_a_epc0_rail_mbbl_m.htm

U.S. Energy Information Administration. "Midwest (PADD 2) Imports & Exports." 1990-2017. Webpage: http://www.eia.gov/dnav/pet/pet_move_wkly_dc_r20-z00_mbblpd_w.htm

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7. APPENDICES

A. **Annotated Bibliography**

B. **Oil 101 Source Sheet**

3. **Source Materials (electionally appended)**

   1. Literature
   2. Shapefiles
   3. Spreadsheets

A. Annotated Bibliography

Egan, Dan."Oil and Water-A Journal Sentinel Special Report-Path of Least Resistance." Milwaukee Journal Sentinel. January 13, 2017.

This newspaper stories chronicles Enbridge's plans to build a new thousand-mile pipeline from Alberta to Superior, WI that would add another 370,000 barrels per day to its current flow, bringing the capacity for some 3 million barrels of oil to flow into Wisconsin each day. The story shows how Enbridge has implement increases in a piecemeal fashion, sometimes with permission but other times without.

Egan, Dan."Oil and Water-A Journal Sentinel Special Report-Dangerous Straits." Milwaukee Journal Sentinel. January 18, 2017.

This newspaper story provides thorough reporting about the Mackinac lines, focusing on the fact that they are in the "worst possible" place for an oil spill in the Great Lakes. It highlights how environmentalists, politicians and Michigan regulators are trying to figure out how to deal with them.

Dybdahl, David J. "An Insurance and Risk Management Report on the Proposed Enbridge Pumping Station," April 8, 2015.

Prepared for The Dane County Zoning and Land Regulation Committee, this report reviews Enbridge's liability insurance program, financial statements and government sponsored oil spill response programs to assist the committee in its review of a Conditional Use Permit (CUP) application to upgrade a pumping station on Enbridge's pipeline (Line 61) between Marshall and Waterloo, WI.

"Final Environmental Impact Statement: Enbridge Sandpiper and Line 3 Replacement Projects. Volumes I and II (Appendices)." Wisconsin Department of Natural Resources. August 2016.

Offers an apparently comprehensive analysis of the likely environmental impacts of the Enbridge Line 3 replacement. Notable for consideration of numerous alternatives to the proposed route. Additionally, describes permitting process and points to possible barriers that may be raised to stall overhasty development.

FitzGerald, Tom. "Planning, Zoning and Hazardous Liquid Pipelines." Pipeline Safety Trust Annual Conference. November 2013.

Provides a clear and concise summary of the distribution of regulatory powers among states, municipalities, and the federal government, with a focus on legal precedents establishing municipal authority over pipeline-adjacent land use planning.

Gosman, Sara, Lesley MacGregor, Gabe Tabak, and James Woolard. "After the Marshall Spill: Oil Pipelines in the Great Lakes Region." National Wildlife Federation. 2012.

This source provides the single best overview of the regulatory framework governing pipeline safety and is helpfully organized by key moments or phases in the process of constructing and operating a hazardous liquid pipeline. Also provides a focus on the application of regulation in the Great Lakes region and offers policy recommendations.

National Association of Pipeline Safety Representatives. "Compendium of State Pipeline Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations." September 2013.

This comprehensive collection of state pipeline safety regulations gives both specific information about the steps that individual states have (or have not) taken to secure regulatory authority over pipelines, organized by type of pipeline and type of action. Also provides information for comparison among states.

Parfomak, Paul W. "DOT's Federal Pipeline Safety Program: Background and Key Issues for Congress." Congressional Research Service. May 2016.

Highly readable description of the origins of the pipeline safety program and of ongoing challenges and limitations faces by PHMSA. Includes legal history, exploration of budget and staffing issues, and overview of major gaps in existing regulation.

Pipeline and Hazardous Materials Safety Administration. "Federal and State Authorities." No date.

Another take on the distribution of regulatory responsibilities and relationships. Helpful as an articulation of authorities from PHMSA itself, but neither as clear nor comprehensive as other versions of the same material, some of which are discussed above.

Pipeline and Hazardous Materials Safety Administration. "Pipeline Safety Inspections." No date.

One of the few documents that actually describes the substance of the inspections process in any detail, and here in PHMSA's own words.

Pipeline and Hazardous Materials Safety Administration. Webpage: https://primis.phmsa.dot.gov/ Last accessed 8 May 2017.

Primary source of data regarding pipeline safety program. Includes vital information on pipeline accidents by type of product (gas vs. hazardous liquids), by mode of transport (raid/road vs. pipeline) and by time period. Also includes glossary of state-level partnerships and related information (e.g. status of partnership, name and website of state partner agency, pipeline mileages and facilities under state jurisdiction). Further contains information (but seemingly no data) on operator and inspector qualifications. Finally, includes historical data on enforcement actions, although it appears that the only way to access or download the data is on a sheet-by-sheet basis, rather than in a compiled or archived format, limiting its usability. Additionally, website is poorly organized and exists in two versions (some links lead back to the previous website interface rather than to a parallel page on the more recently updated interface).

Pipelines and Informed Planning Alliance. "Hazard Mitigation Planning: Practices for Land Use Planning and Development Near Pipelines." Sponsored by the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) and the U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA). 2015.

Provides an overview of pipelines from a systems perspective, with attention to technological elements of the energy transmission process. Also useful as one of the few documents produced with PHMSA's cooperation that proactively addresses the risks associated with gas and hazardous liquid transmission and adopts an evidence-based, hazard mitigation approach to physical planning policy around such risks.

Pipelines and Informed Planning Alliance. "Partnering to Further Enhance Pipeline Safety In Communities through Risk-Informed Land Use Planning: Final Report of Recommended Practices." November 2010.

An earlier version of "Hazard Mitigation Planning," which discusses the relationship between pipelines, the risks that they carry, and the responses that municipal actors can undertake to mitigate risk. Emphasis is on new physical development around existing pipelines, which may limit usability, and hazard mitigation approach is not yet adopted.

B. Oil 101 Source Sheet

Rather than recreate the field, see sources below for an introduction to the oil industry and specific crude oil resources.

Know Your Oil - Carnegie Foundation

http://carnegieendowment.org/2015/03/11/know-your-oil-creating-global-oil-climate-index-pub-59285

Report on changing oil types, emissions, and climate change (downloadable)

Schlumberger Oilfield Glossary - industry source

http://glossary.oilfield.slb.com/

Glossary of oil-related terminology

Crude Oil Monitor - Canadian industry source

http://www.crudemonitor.ca/home.php

Reports on chemical composition of different crude streams in CA

Pipeline Safety Glossary - PHMSA - US Govt

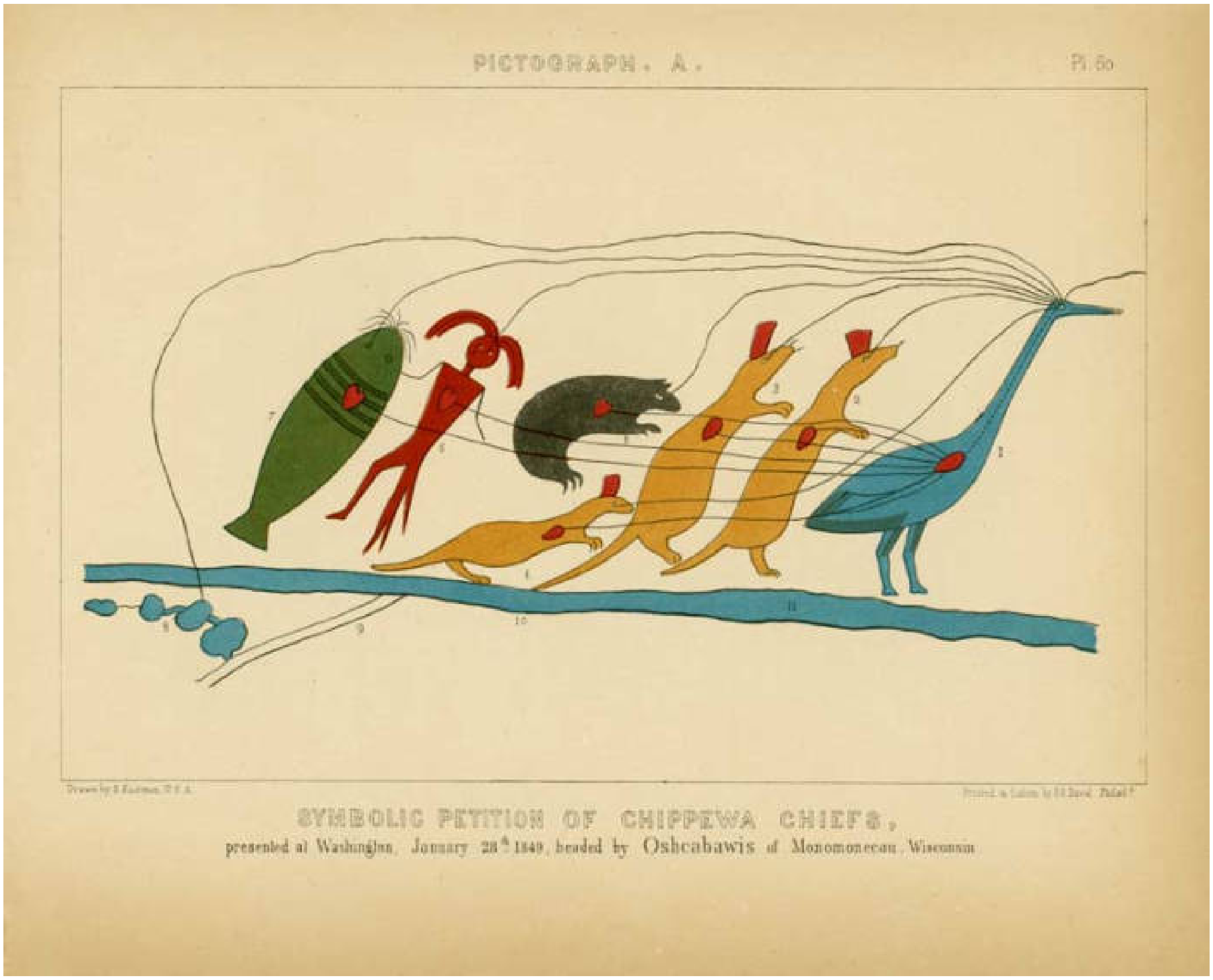
https://primis.phmsa.dot.gov/comm/glossary/index.htm?nocache=5217#ASTMInternational

Glossary of pipeline-related terminology

Energy Explained - EIA - US Govt

https://www.eia.gov/energyexplained/index.cfm?page=oil_home

Introduction to crude and refined oils, a little rudimentary but the rest of the EIA website has news, etc.



Tribal Cooperating Agencies Cumulative Effects Analysis

NorthMet Mining Project and Land Exchange

Prepared by staff from the Bois Forte Band of Chippewa, the Fond du Lac Band of Lake Superior Chippewa, the Grand Portage Band of Lake Superior Chippewa, the Great Lakes Indian Fish and Wildlife Commission, and the 1854 Treaty Authority

September 2013

Tribal Cooperating Agencies Cumulative Effects Analysis

NorthMet Mining Project and Land Exchange

In Chapter 6 of the *Preliminary Supplemental Draft Environmental Impact Statement (PSDEIS) for the NorthMet Mining Project and Land Exchange*, the co-lead agencies present a resource-specific cumulative effects analysis (CEA) for the NorthMet Project Proposed Action and Land Exchange Proposed Action that may result when combined with effects from other activities. It acknowledges that in addition to additive effects, cumulative effects may be further magnified by synergisms or cross-interactions in the environment. The analysis was developed by the co-lead agencies and their third-party contractor with consideration of the 1997 CEQ guidance *Considering Cumulative Effects under the National Environmental Policy Act* and EPA's 1999 NEPA review guidance *Consideration of Cumulative Impact in EPA Review of NEPA Documents.* However, despite specific and repeated requests from tribal cooperating agencies, the co-lead agencies did not elect to utilize a tool developed in 2011 by the EPA in cooperation with tribes, *Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands*, in order to discern potential cumulative effects to resources important to the tribes who retain usufructuary rights within the 1854 Ceded Territory. The NorthMet Project Proposed Action and Land Exchange Proposed Action are both located entirely within the boundaries of the 1854 Ceded Territory (Figure 1).

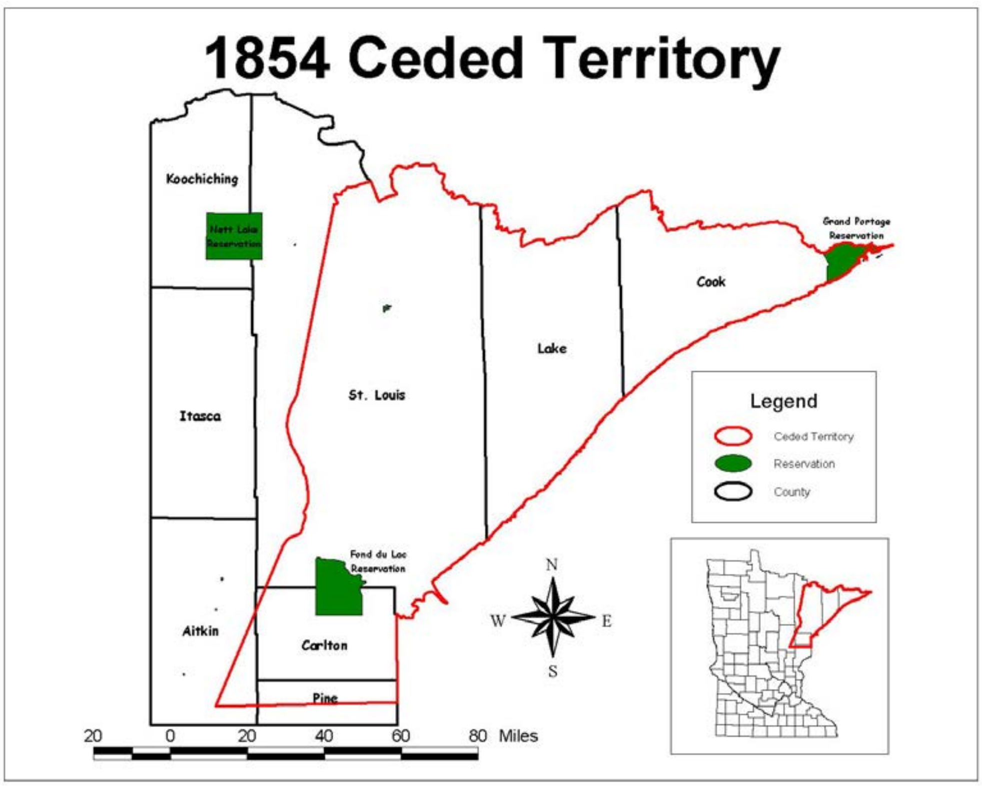


Figure 1.1854 Ceded Territory.

The Fond du Lac, Bois Forte, and Grand Portage Bands, as well as the 1854 Treaty Authority (1854) and the Great Lakes Indian Fish & Wildlife Commission (GLIFWC), have consistently advocated for a more robust, comprehensive CEA for the PolyMet NorthMet project and other mining projects. We have observed that current, historic, and 'reasonably foreseeable' mining activities have profoundly and, in many cases permanently, degraded vast areas of forests, wetlands, air and water resources, wildlife habitat, cultural sites and other critical treaty-protected resources within the 1854 Ceded Territory. As we have engaged with the lead federal and state agencies for the environmental review process under NEPA and the tribal consultation process under §106 of the National Historic Preservation Act (NHPA), we have clearly expressed our concerns for the incompleteness and inadequacy of their CEA.

In the 2008 CPDEIS section 2.2, Issues Identified During the EIS Scoping Process, it is stated that "The MnDNR and USACE determined that the following topics are not expected to present significant impacts, but would be addressed in the EIS using limited information beyond that provided in the Scoping EAW commensurate with the anticipated impacts: Cover Types; Vehicle Related Air Emissions; Air Emissions; Noise; Archeology; Visibility; Compatibility with Plans and Land Use Regulations; Infrastructure; Asbestiform Fibers; and 1854 Ceded Territory". Yet none of these resource categories or issues was fully evaluated from the standpoint of describing cumulative effects at spatial or temporal scales that the tribes find relevant, either in the earlier environmental impacts analysis or the current SDEIS process. The tribal cooperating agencies' perspectives on the resource-specific temporal and spatial boundaries for the CEA are significantly different from the co-lead agencies. Additionally, many of the tribal cooperating agencies' assumptions regarding predicted effects of the proposed actions (both the project and the land exchange) and the predicted success of proposed mitigations are significantly different from the co-lead agencies. Therefore, the tribal cooperating agencies have undertaken an alternative cumulative effects analysis, considering impacts to multiple resource categories to the extent we were able to do in the brief time within which we have been able review the draft PSDEIS, provide comments, and identify major differences of opinion.

In this CEA, we will be presenting major differences of opinion regarding cumulative effects to the 1854 Ceded Territory, Tribal Historic District (Figure 2) and the St. Louis River watershed. In addition, our analysis of the No-Action Alternative assumes current legal and regulatory requirements to remediate pollution from previous mining activities will, if implemented and enforced, lead to resource conditions that are substantially improved from their current degraded condition.

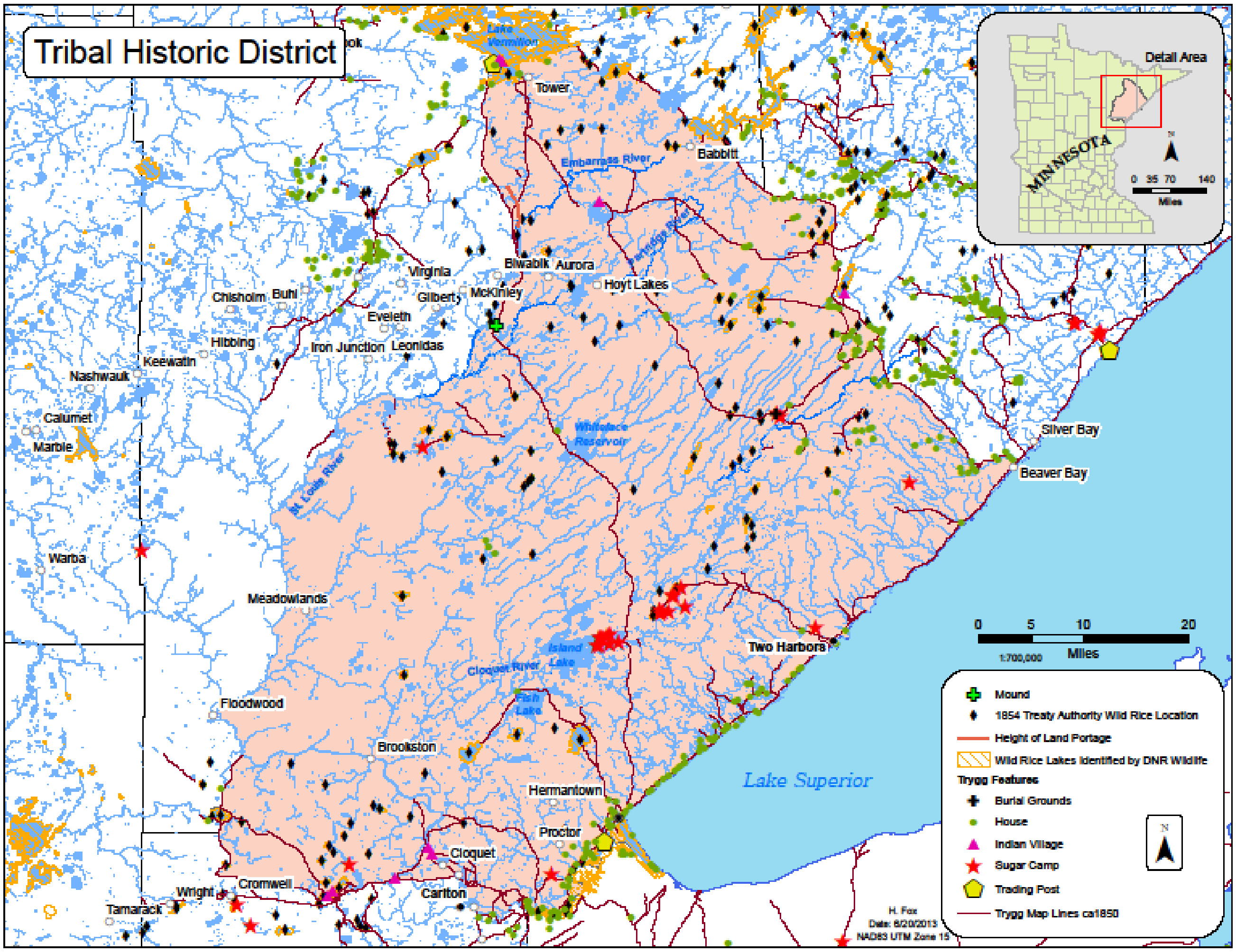


Figure 2. Tribal Historic District.

The tribal cooperating agencies use a resource-specific GIS-based approach as defined in the 2011 guidance to generate an alternative CEA that more accurately accounts for cumulative impacts to resources of tribal significance. From: *Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands:*

> The National Environmental Policy Act (NEPA) requires Federal agencies to evaluate the environmental impacts of their major projects. The scope of a federal Environmental Impact Statement (EIS) is spelled out in the NEPA legislation, in guidance documents published by the Council on Environmental Quality (CEQ) and EPA, and in various federal agencies' promulgated rules for implementing NEPA. An EIS evaluates the project's impacts to natural resources, the human environment, historical properties, and cultural properties. EIS documents are submitted for public review. Under Section 309 of the Clean Air Act, EPA is required to review and publicly comment on the environmental impacts of major federal actions including actions which are the subject of EISs.
>
> The assessment of cumulative impacts in NEPA documents is required by CEQ regulations. A cumulative impact is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (Title 40 Code of Federal Regulations (CFR) Section 1508.7, CEQ Regulations for Implementing NEPA, 1987). Only resources that are directly impacted or indirectly affected by an action are subject to a cumulative impacts analysis….
>
> In 1984, EPA issued its Indian Policy stressing two related themes: EPA will (1) pursue the principle of Indian self-government and (2) work directly with tribal governments on a government-to-government basis. Consistent with this Indian Policy and other EPA's statutory and regulatory authorities, EPA will identify and consider potential effects to reservation environments and take these potential effects into account as the Agency fulfills its regulatory duties. As a regulatory agency, EPA does not manage tribal trust resources or treaty resources in ceded territory. The U.S. Department of Interior, Bureau of Indian Affairs, does manage tribal trust resources. However, the Agency acknowledges its general trust responsibility to tribal governments which derives from the historical relationship between the Federal government and Indian tribes as expressed in certain treaties and Federal Indian laws, and understands that its regulatory activities can affect tribes.
>
> Tribal lands are fixed; that is the reservations, Indian lands, and ceded territories are specific places, defined by treaty, and tribes may hold certain rights within these areas. In addition, tribal cultural identity may be tied to specific areas, cultural properties, natural resources found within these areas or properties, and traditions and uses involving these places and resources. For this reason, tribes are not considered mobile. For these

reasons, many tribes have expressed interest and concern about cumulative impacts of actions relative to the areas they govern and/or use….

Tribal concerns about impacts to natural and cultural resources and properties and to their particular uses may include, but are not limited to the following:

- Water with naturally high quality and impacts involving -
    - Changes in concentrations of unregulated substances
    - Synergistic effects of multiple individually unregulated or regulated substances
    - Changes to water that make it unsuitable for cultural uses
- Lakes, rivers, wetlands, and other water bodies where plants of significance to tribes grow (e.g., wild rice)
- Water quality and quantity and soil quality that enable wild rice to grow
- Water quality necessary to support fish populations
- Plants and wildlife (e.g., moose, grouse, deer) of significance to tribes
- Sufficient wildlife populations and habitat to support traditional hunting, fishing, and gathering
- Fish and wildlife without contaminants that preclude their frequent consumption
- Archeological locations or areas
- Traditional or historic properties, locations or areas (e.g., traditional locations for hunting, fishing, and gathering; springs and ceremonial sites; other places where historic events occurred)
- Sacred locations or areas (e.g., gravesites, spiritual sites) without visual or noise impacts that would make them unsuitable for traditional activities
- Habitats that host culturally important resources (e.g., pipestone, sage, other culturally important plants)
- Access to areas where tribes have hunting, fishing, or gathering rights and to lands where off-reservation harvest under treaty rights occurs, including trails or passageways that link tribal use areas.
- Cultural items as defined by the Native American Graves Protection and Repatriation Act, 25 United States Code (USC) 3001, including funerary objects, sacred objects, and cultural patrimony
- Social bonds associated with traditional activities
- Tribal jurisdiction and control over reservation lands, thus improving or maintaining quality of life for residents of the reservations

An EIS that addresses cumulative impacts with respect to tribal uses and practices related to natural and cultural resources and properties should consider an analysis approach that uses:

1. A geographic area that is relevant to the tribe, for which information is collected and evaluated,

2. Information that reflects and describes tribal uses and tribal rights, and

3. A timeframe that is relevant to tribal uses.

In short, considering cumulative impacts to tribes may require a wider focus area and a discussion of direct and indirect impacts of all projects in an area, relative to tribal traditions, values, and concerns that involve using the resources affected by the project.

Regarding the geographic scope for a tribally relevant cumulative effects analysis:

- Scale is a central issue in the ecosystem approach.
- The appropriate boundary is one that ensures adequate consideration of all resources that are potentially subject to non-trivial impacts.
- For some resources, that boundary can be very large. For example, the long-range atmospheric transport of nutrients and contaminants into water bodies such as the Great Lakes and Chesapeake Bay transcends even the boundaries of their vast watersheds.
- At the other end of the spectrum, significant contributions to biodiversity protection can be made by identifying and avoiding small sensitive areas, such as rare plant communities.
- Determining relevant boundaries for assessment is guided by informed judgment, based on the resources potentially affected by an action and its predicted impacts.

The 1997 CEQ document notes that, for a project-specific analysis, it is often sufficient to analyze impacts within the immediate area of the proposed action. When analyzing the proposed action’s contribution to cumulative impacts, however, the geographic boundaries of the area should almost always be expanded. Project-specific analyses are usually conducted on the scale of forest management units, or facility footprints, or mixing zone in a waterbody pursuant to a discharge permit. Cumulative impacts analysis should be conducted in the scale of human communities, landscapes, watersheds, or airsheds.

Finally, EPA's 1999 document notes that the EPA reviewer can determine an appropriate spatial scope of the cumulative impact analysis by identifying a geographic area that includes resources potentially affected by the proposed project and extending that area, when necessary, to include the same and other resources affected by the combined impacts of the project and other actions. Furthermore:

- Geographical boundaries should not be extended to the point that the analysis becomes unwieldy and useless for decision-making.

- The analysis should use an ecological region boundary that focuses on the natural units that constitute the resources of concern.

- For non-ecological resources, other geographic areas, such as historic districts (for cultural resources) or metropolitan areas (for economics), should be used.

Cultural Resources

During the EIS scoping process for the NorthMet Project (see Section 2.1 of the Final Scoping Decision Document), no cumulative impact issues associated with cultural resources were identified. Tribes were not invited to participate in scoping. However, Tribal comments on the June 2008 PDEIS, the 2009 CPDEIS and the 2009 DEIS noted this cumulative impact and the need for analysis. The tribal cooperating agencies have repeatedly stated and commented in writing that there likely will be substantial impacts to cultural resources, and impacts to cultural resources need to be fully integrated into evaluation of potential impacts to cultural sites and cultural resources. However, there appears to be a concerted effort to diminish any and all comments on this subject and simply revert back to decisions made during the scoping phase.

The Traditional Use Survey conducted in 2011 (Latady and Isham 2011) focused on identifying and evaluating significance of places of importance to the Bands within the area to be affected by the proposed mine. Identification and evaluation is the first step before assessing adverse effects and integral to the development of a cultural resource management plan to facilitate preservation and management of cultural resources including traditional use areas. Beyond identification, the intent of the survey highlighted the potential to bridge the past and future in terms of native culture, history and natural resources.

Tribal cooperating agencies consider a 216,300 acre area bounded by the St Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail to be a Tribal Historic District, and the pertinent area for consideration of cumulative effects to cultural resources. In addition to the St Louis River, the area supports three major drainage systems, the Cloquet, Embarrass and Pike Rivers. Trygg maps (1966), historic documents (Brownell 1967, Carey 1936, Chester 1902, Lancaster 2009, Trygg 1969, Van Brunt 1922, Jenks 1901, Moyle 1941) and information contained in site files located at the Bois Forte Tribal Historic Preservation Office were used to determine the extent of the district. Additional information on Historic places and properties are available at SHPO, Superior National Forest Headquarters and Duluth Archaeology Center. Included within the proposed historic district are the headwaters of the St. Louis River, the site of ongoing mineral exploration.

Ancestors of present day Band members resided in this area for centuries and many Band members followed traditional practices extensively until about a generation ago when the effects of mining devastated the rice beds in the Embarrass and St. Louis River watersheds and closed access to large tracts of public (USFS) land where traditional harvest and collection areas occur. This proposed Tribal Historic District encompasses complex trail systems, Indian villages, trading posts, encampments for fishing, hunting, wild rice harvest and processing, sugar bush, and other traditional subsistence practices. It includes what was essentially a ‘water highway’ used by the Ojibwe at the time of European contact, and subsequently by Voyaguers during the era of heavy fur trading. In addition, numerous medicinal plant gathering sites, Midewewin lodges, vision quest locales and other sacred places occur.

Land Use

The co-lead agencies define the CEAA for land use to include effects associated with the NorthMet Project Proposed Action combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County”. Tribal cooperating agencies believe the CEA for land use should encompass the 1854 Ceded Territory, as the signatory Bands have lost access to substantial portions of the 1854 CT and the resources within (Figure 3). The 1854 Ceded Territory encompasses 6,283,836 acres in North Eastern Minnesota. Of that, 4,095,146 acres are public land ranging from Federal to CRP lands. The remaining 2,188,578 is private to private industrial land[1]. Band members generally do not exercise usufructuary rights on private lands without landowner permission, although the treaty does not hold that restriction. Lands within the 1854 Ceded Territory that have experienced urban and/or industrial development are permanently ‘lost’ as a source of treaty resources.

[1] http://deli.dnr.state.mn.us/data_catalog.html using GAP Stewardship 2008 – all Ownership Types shape file and database

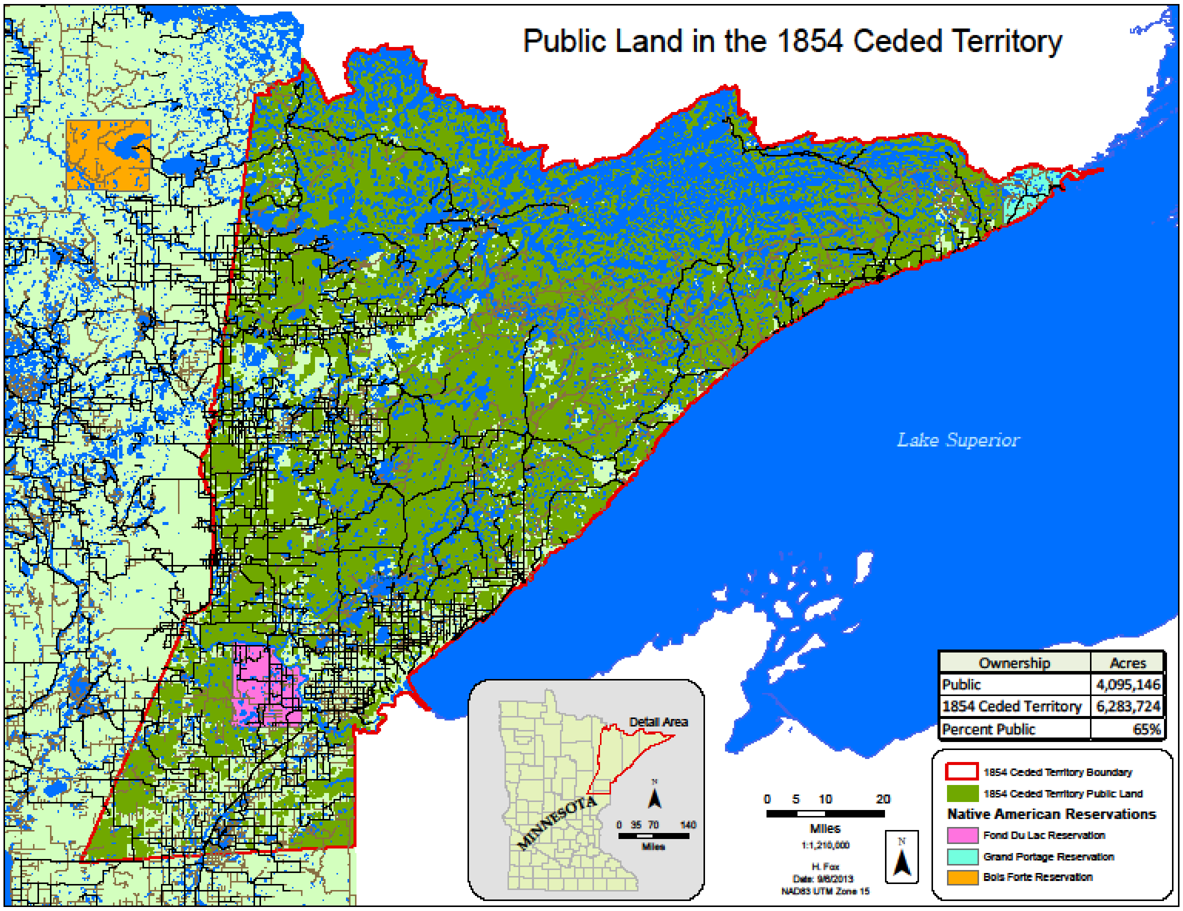


Figure 3. Public Lands within the 1854 Ceded Territory

Water Resources

The co-lead agencies evaluated cumulative impacts to surface water within the Partridge and Embarrass River watersheds only. From the preliminary SDEIS: "The St. Louis River was considered for inclusion in the cumulative effects assessment. The NorthMet Project Proposed Action is predicted to meet all water quality evaluation criteria or not make concentrations worse. Further, concentrations of sulfate and mercury, two key constituents of concern, are predicted to decrease as a result of the NorthMet Project Proposed Action. The NorthMet Project Proposed Action would also result in only minor changes in hydrology within the Partridge River and Embarrass River. Therefore, the NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River. As a result, the CEAA for surface water is defined by the Partridge River and Embarrass River watersheds as shown on Figure 6.2.3-1."

The tribal cooperating agencies believe the relevant spatial scale for water quality and hydrologic cumulative effects analysis is the entire St. Louis River watershed. This watershed has experienced substantial historic, current and proposed expanded mining activities, as well as other industrial, agricultural and urban development. In addition to the direct surface water and wetland impacts (loss and/or degradation) from these activities, nearly half of the watershed has experienced hydrologic alteration from extensive ditching. It is reasonably foreseeable that an additional 3000 acres of wetlands within the watershed will be directly impacted by proposed new mining projects and expansions that are in active permitting and/or environmental review: the PolyMet NorthMet project, Mesabi Nugget Phase II, US Steel Minntac expansion, US Steel Keetac expansion, United Taconite Tailings Basin 3 construction. To date, virtually all required wetland mitigation for mining impacts has been implemented out of the basin, representing a permanent loss of high quality ecological resources and functions.

Modeling

The tribal cooperating agencies' review of the water modeling data packages for the NorthMet Project Proposed Action led to our conclusion that Goldsim did not accurately predict existing conditions, and cannot be relied upon to accurately predict future project conditions. While we feel that modeling of the existing conditions is an inadequate substitute for a realistic No-Action Alternative model and does not follow CEQ guidelines, it appears that Goldsim does not even accurately model existing conditions. As noted in spreadsheet comments submitted June 25, 2013, for many parameters at several waterbodies the No-Action P50 model of annual average value is substantially different than the observed average existing conditions. Because of the inaccuracy of the Goldsim predictions of current conditions it is not clear that use of the Goldsim estimates of project impacts are adequate to ensure protection of water resources. For example:

- PSDEIS Table 4.2.2-18 reports Colby Lake as currently having an observed mean Arsenic of 0.78 to 1.4 ug/L (depending on the data set), whereas Figure 5.2.2-35, the No-Action (continuation of current conditions) P50 model for Colby Lake Arsenic shows annual maximum values of 0.5 ug/L

- PSDEIS Table 4.2.2-34 reports PM-10 (seep at the basin north toe) as having an observed mean Mn value of 100,192 ug/L, whereas Figure F-01-18.1 (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) shows the No-Action (continuation of existing conditions) P50 as an annual maximum Mn of 390 ug/L. at the north toe.
- PSDEIS Table 4.2.2-34 reports PM-10 as having an observed mean Aluminum of 39.6 ug/L yet Figure F-01-02.1 (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) shows an annual maximum for No-Action (continuation of existing conditions) at the north toe as 11 ug/L.
- PSDEIS Table 4.2.2-14 shows that observed average SO4 at SW-005 (9.11 mg/L) is nearly identical to the Goldsim P50 predicted current annual maximum for that site (PSDEIS Fig. 5.2.2-27, 9 mg/L). This suggests that Goldsim is under-predicting SO4 at SW-005. (The authors of the text on page 5.2.2-125 of the PSDEIS seem to misinterpret the P50 of the figure as a predicted annual average. This is not the case. The P50 of that figure is the "best" estimate of the annual maximum. The Goldsim model estimate of the annual average at SW-005 is shown as the P50 in Mine Site Data Package Attachment K Figure K-06-24.2, i.e. 6 mg/L) Again, this suggests that Goldsim is underpredicting SO4 at SW-005.
- PSDEIS Table 4.2.2-29 shows that observed average Al at PM-13 is 221 ug/L. This observed average is much higher than the modeled No-Action (continuation of existing conditions) P50 annual maximum (PSDEIS Table 5.2.2-47, 159-166 ug/L). The modeled No-Action P50 annual average for Al at PM-13 of 75 ug/L (attached Fig.I-05-02.2, Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) is only 1/3 of the observed average.

Tables 1-3 below compare the observed existing conditions values found in various PSDEIS tables to the P50 existing conditions predicted by Goldsim. While a very few of these model predictions are presented in the PSDEIS, many are not and therefor, the tables below refer back to the underlying data packages from which the PSDEIS was written.

Parameter (ug/L)	Average existing water quality (PSDEIS Table 4.2.2-14)	Annual average P50 existing conditions predicted by Goldsim (Mine Site Data Package Attach.K)
Mn	SW-002 = 142	SW002 = 80 (Fig.K-01-18.2)
Tl	SW-002 = 0.6	SW002 = 0.11 (Fig.K-01-25.2)
Mn	SW-003 = 147	SW003 = 85 (Fig.K-02-18.2)
B	SW-004a = 126.5	SW004a = 30 (Fig.K-04-05.2)
K	SW-004a = 2,700	SW004a = 1,600 (Fig.K-04-16.2)
SO4	SW-004a = 15,900	SW004a = 8,000 (Fig.K-04-24.2)
Pb	SW-005 = 1.3	SW005 = 0.26 (Fig.K-06-21.2)
SO4	SW-005 = 9,110	SW005 = 6,000 (Fig.K-06-24.2)
Tl	SW-005 = 0.4	SW005 = 0.05 (Fig.K-06-25.2)

Table 1. Observed existing conditions in the Partridge River vs. annual average existing conditions predicted by Goldsim.

Parameter (ug/L)	Colby Lake mean existing water quality (PSDEIS Table 4.2.2-18, Barr data)	Colby Lake Annual average P50 existing conditions predicted by Goldsim (Mine Site Data Package Attach.K)
Al	108	75 (Fig.K-08-02.2)
As	0.78	0.4 (Fig.K-08-04.2)
Cu	2.4	0.7 (Fig.K-08-13.2)
Ni	2.5	1.1 (Fig.K-08-20.2)
SO4	33,800	~10,000 (Fig.K-08-24.2)
Tl	0.1	0.025 (Fig.K-08-25.2)

Table 2. Observed mean existing conditions in Colby Lake vs. annual average existing conditions predicted by Goldsim.

Parameter (ug/L)	Mean seep measured value at Basin Toe (Table 4.2.2-34)	Annual maximum P50 existing condition predicted by Goldsim (Plant Site Data Package Attach.F)
Al	PM-8 = 25.7	West toe = 14 (Fig.F-04-02.1)
AL	PM-9 = 29.9	NW toe = 13 (Fig.F-02-02.1)
AL	PM-10 = 39.6	North toe = 11 (Fig.F-01-02.1)
Mn	PM-8 = 3,039	West toe = 1,250 (Fig.F-04-18.1)
Mn	PM-10 = 100,192	North toe = 380 (Fig.F-01-18.1)
F	PM-8 = 2,900	West toe = 1,100 (Fig.F-04-14.1)
As	PM-8 = 3	West toe = 2 (Fig.F-04-04.1)
B	PM-10 = 379	North toe = 330 (Fig.F-01-05.1)
Pb	PM-10 = 1.3	North toe = 1 (Fig.F-01-21.1)

Table 3. Observed mean existing conditions at the tailings basin toe vs. annual maximum existing conditions predicted by Goldsim. (Goldsim predicted mean concentrations are not provided in Modeling Data Package Vol 2-Plant Site v9 MAR2013).

The above examples are not an exhaustive list of discrepancies between observed existing water quality data and the Goldsim P50 prediction of the No-Action alternative (continuation of existing conditions) but highlight some of the most notable discrepancies. What the discrepancies demonstrate is that the Goldsim model is a relatively poor predictor of current conditions. If a model is unable to accurately predict current conditions it is even less likely to accurately predict future Project conditions. The Goldsim models need to be better calibrated to existing conditions (the calibration effort reported in "Calibration of the Existing Natural Watershed at the Plant Site v4 MAR2012" only compared model output to upstream site PM-12 and apparently did a poor job of preparing the models to predict either the lower reaches of the Embarrass or the Partridge River.) and model results recalculated.

Surface water quality

Evaluation Criteria that are used by the Project Proponent to evaluate the impacts of pollutants that are currently exceeding WQS do not comply with the Clean Water Act. 40 CFR § 122.44 (d) requires that all effluents be characterized to determine the need for a

Water Quality Based Effluent Limit (WQBEL). If a projected concentration of a specific pollutant exceeds the applicable numeric WQS, there is a reasonable potential that the discharge may cause or contribute to an excursion above WQS. Where existing data demonstrates an excursion from WQS, a WQBEL may be imposed without facility-specific effluent monitoring. In order to calculate a WQBEL, a Waste Load Allocation (WLA) for each permitted discharge must be established. The WLA is the portion of a Total Maximum Daily Load that is allowed for each point source to ensure compliance with WQS. However, it is very difficult to determine based on the information that has been provided by PolyMet if the additional contribution of each pollutant that currently exceeds WQS will exceed the load limit that would be required by a WLA to ensure compliance with WQS. And, the additional loading of pollutants that already exceed WQS demonstrates cumulative water quality impacts from the Project. Therefore, the Area of Potential Effect for water quality extends from the Embarrass and Partridge rivers to the mouth of the St. Louis River.

The Embarrass River, Partridge River and Colby Lake already have several constituents including sulfate, manganese, and mercury in concentrations that already exceed Minnesota Water Quality Standards ("WQS"). The existing large number of water-quality exceedances and the suite of constituents, particularly trace metals, exceeding WQS indicate the site has not been remediated from previous mining activities, and that the required reclamation was not adequate to ensure compliance with WQS. Concentrations of sulfate, specific conductance, manganese, mercury and arsenic that exceed MN WQS have been measured for NPDES permit Data Monitoring Reports and by the PolyMet project proponent demonstrate both water quality contamination issues and cumulative water quality impacts.

Specific conductance

Tribal staff have noted that elevated specific conductance is a water chemistry ‘signature’ for mining discharges. Specific conductance is the ability of a material to conduct an electric current measured in microSiemens per centimeter (µS/cm) standardized to 25°C. Specific conductance reflects concentrations of dissolved solids, including metal and other contaminants from mining, other industrial activities, and agriculture.

Tribal staff conducted analysis of specific conductance downstream of mine discharges using agency monitoring data (1990-2013). Analysis of specific conductance downstream of mine discharge sites indicated that specific conductance was highest nearest to mine discharge sites, and tended to only gradually decrease downstream of mine discharge sites. Linear regressions demonstrated that specific conductance was significantly negatively related to distance across all sample sites ($P < 0.01$, $R^2 = 0.15$; $n = 123$ sites; Fig. 4) and within the St. Louis River and Swan River systems ($P < 0.05$, $R^2 = 0.18$ and 0.52, respectively; Fig. 5). This analysis included stream and river monitoring only (not lakes). The regression suggests that specific conductance could drop to 150 µS/cm only 203 km (126 mi) downstream of the nearest upstream mine discharge site.

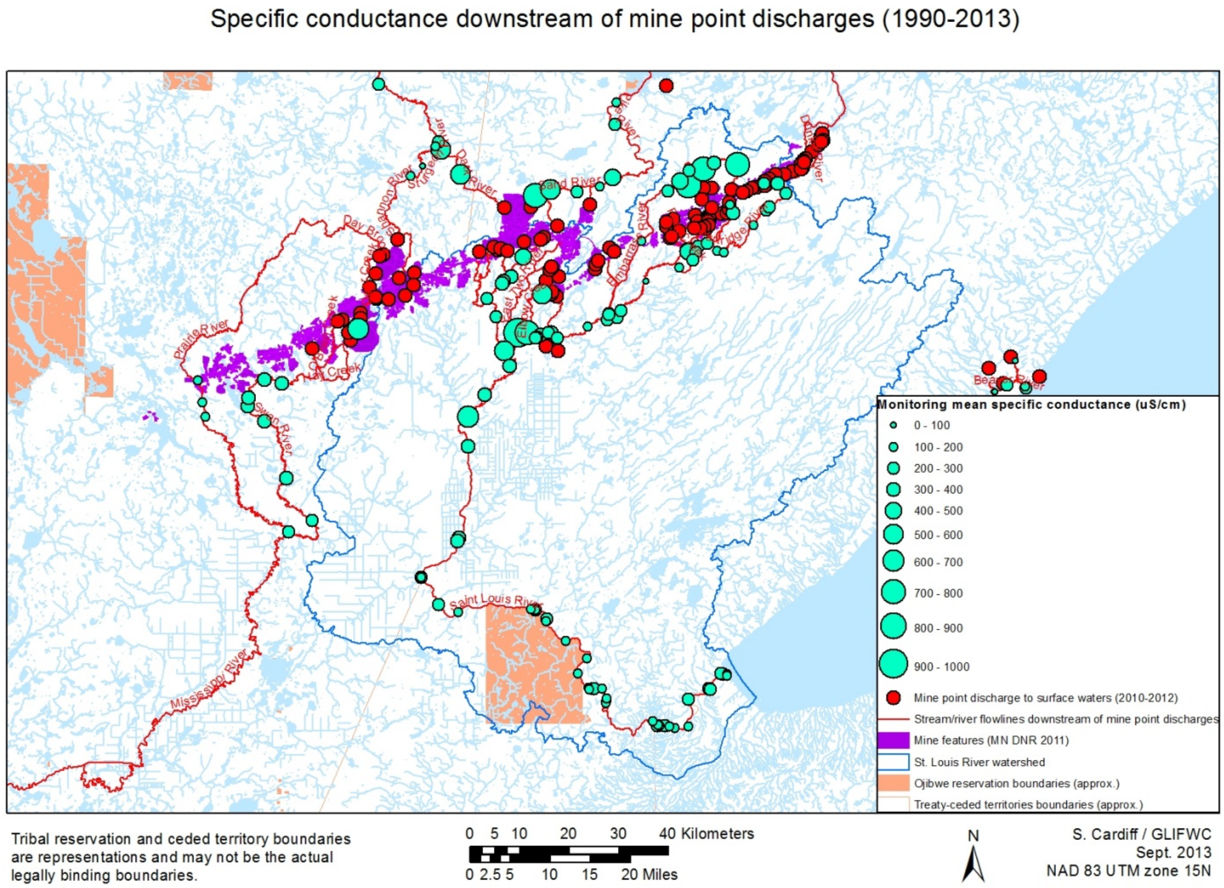


Figure 4. Mean specific conductance measurements at monitoring stations downstream of mine point discharges were inversely related to distance downstream from mine point discharge sites.

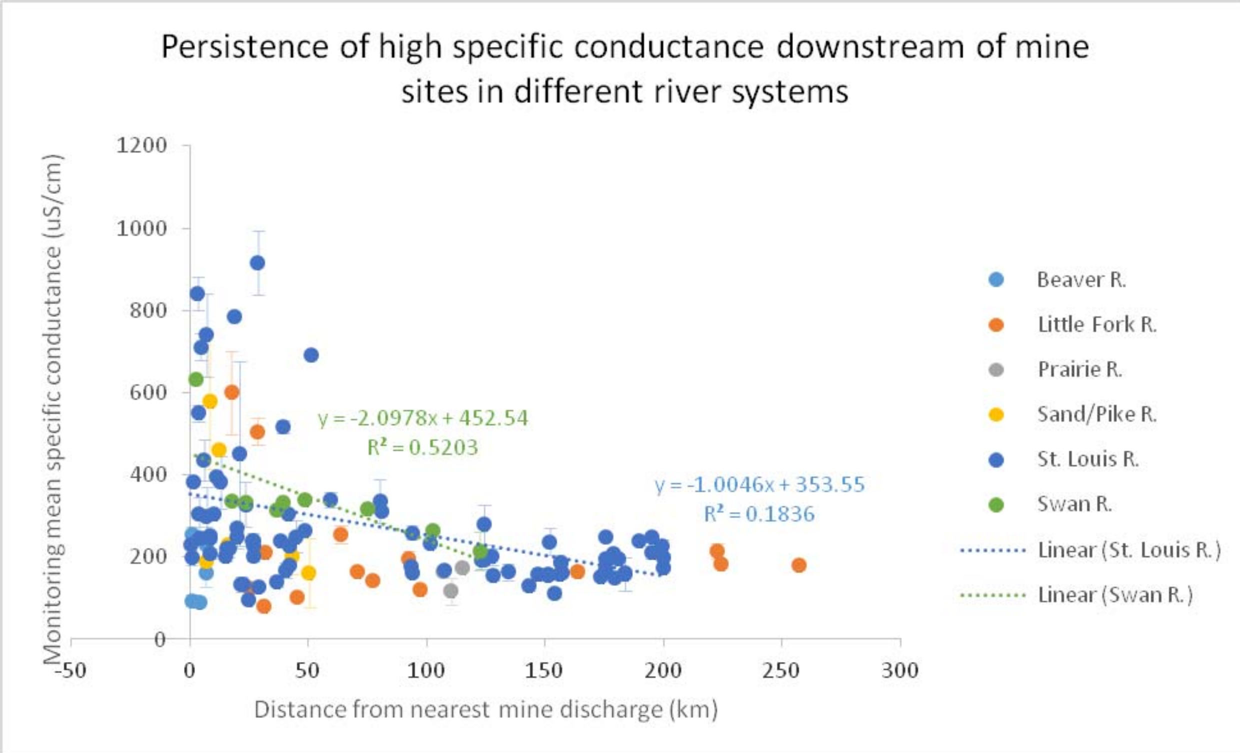


Figure 5. Linear regression indicated that mean specific conductance (±1 SE) was significantly negatively related to distance of the monitoring location downstream of the nearest mine discharge in two of the main downstream river systems, with highest specific conductance nearest to mine discharges and decreasing relatively gradually downstream (St. Louis River system $P < 0.01$, $R^2 = 0.18$, $n = 85$; and the Swan River system ($P < 0.05$, $R^2 = 0.52$, $n = 9$).

These analyses demonstrate that existing mining discharges result in elevated concentrations of pollutants that persist far downstream in the St. Louis River, which is consistent with the findings of the USEPA in their assessment report on the effects of mountaintop removal and valley fill mining[2].

Manganese

The Health Risk Limit (HRL) for manganese is 100 micrograms per liter (µg/l) because it is a potent neurotoxin known to cause brain damage when formula fed infants are exposed to high concentrations, and can cause Parkinsons-like symptoms in adults exposed to high concentrations. The average measured concentration of manganese in Wyman Creek between April 2005 and December 2012 was 1383 µg/l. Water discharging from Area Pit 5 to Spring Mine Creek, a tributary to the upper Embarrass River, between July 2010 and

[2] U.S. EPA (Environmental Protection Agency). 2011. The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/R-09/138F.

October 2011, had an average measured concentration of 804 µg/l. Test results from sixteen private drinking water wells located between the proposed project and the Embarrass River in 2008 revealed concentrations of manganese that exceeded the HRL in eight wells. The range of manganese concentrations from all of the wells was 0.66 – 4710 µg/l. The PolyMet project will contribute additional manganese to the groundwater from tailings basin water that is not captured and treated, and the water that seeps through fractures in the mine pit walls once the pit has filled with water.

In the Partridge river watershed, measured concentrations of manganese increase dramatically from the most upstream measurements to the furthest downstream measurements (Figure 6).

In the Embarrass River watershed, high concentrations of manganese are associated with mining features. SD033 is the discharge from Area Pit 5, and the former LTV tailings basin appears to be the source of pollution for monitoring locations MLC-2, PM-19, and PM-11 (Figure 7).

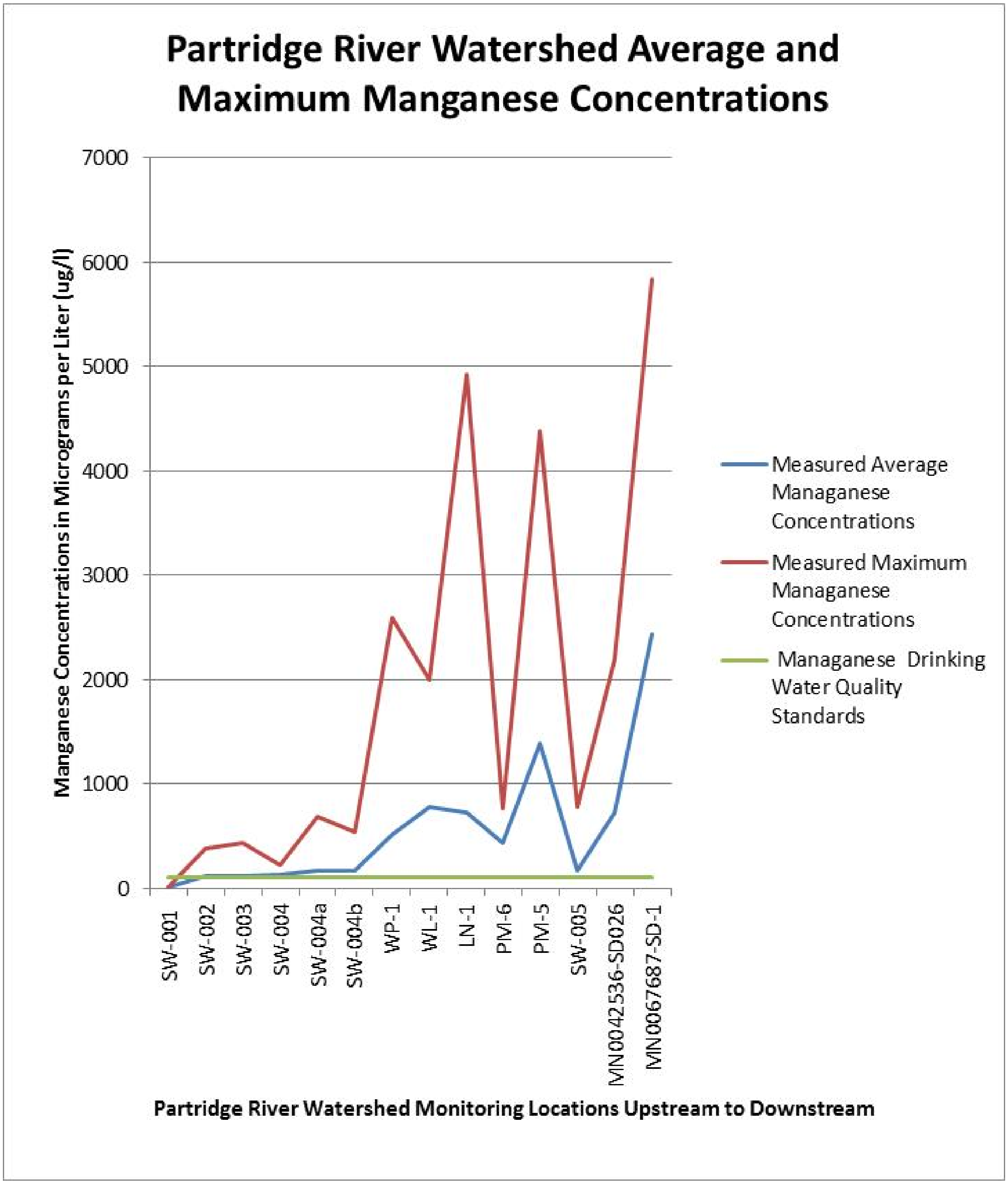


Figure 6. Partridge River Watershed Manganese Concentrations.

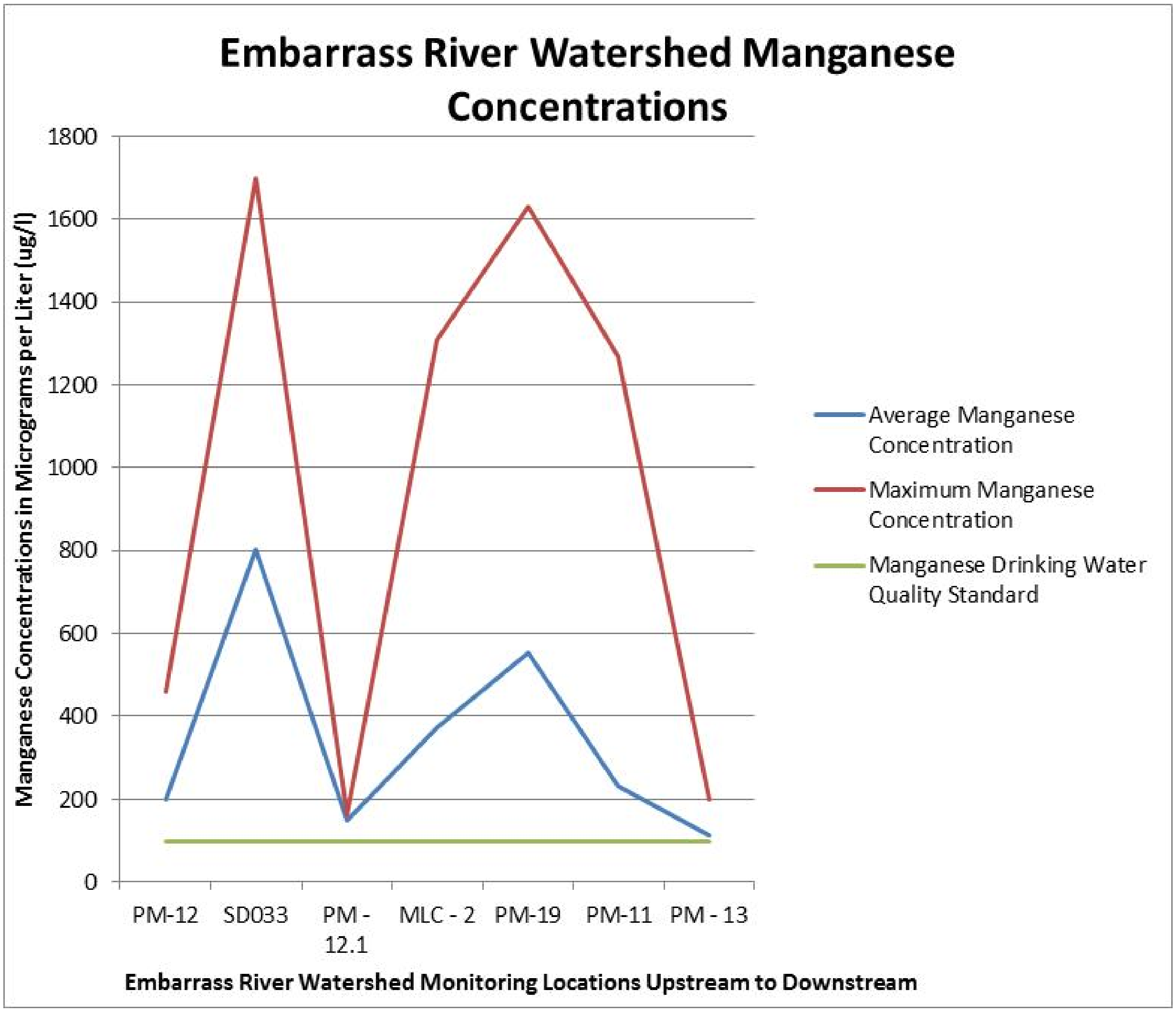


Figure 7. Embarrass River Watershed Manganese Concentrations.

Arsenic

Arsenic is a known carcinogen. The drinking water standard for arsenic is 10 µg/l, based on both human health and the economics of treating drinking water to meet the standard. Based on human health alone, the standard for arsenic is less than 2 µg/l[3]. Arsenic concentrations measured in sixteen private drinking water wells between the proposed project and the Embarrass River in 2008 ranged from less than the detection limit of 2 to 7.5 µg/l. Arsenic concentrations are projected to increase as a result of the PolyMet project[4].

In the Partridge River watershed, measured maximum arsenic concentrations exceed Class 2A and 2Bd water quality standards at all but three locations (Figure 8). The locations where the maximum measured concentration of arsenic does not exceed the Class 2A and 2Bd water quality standards are in the upper portion of the watershed.

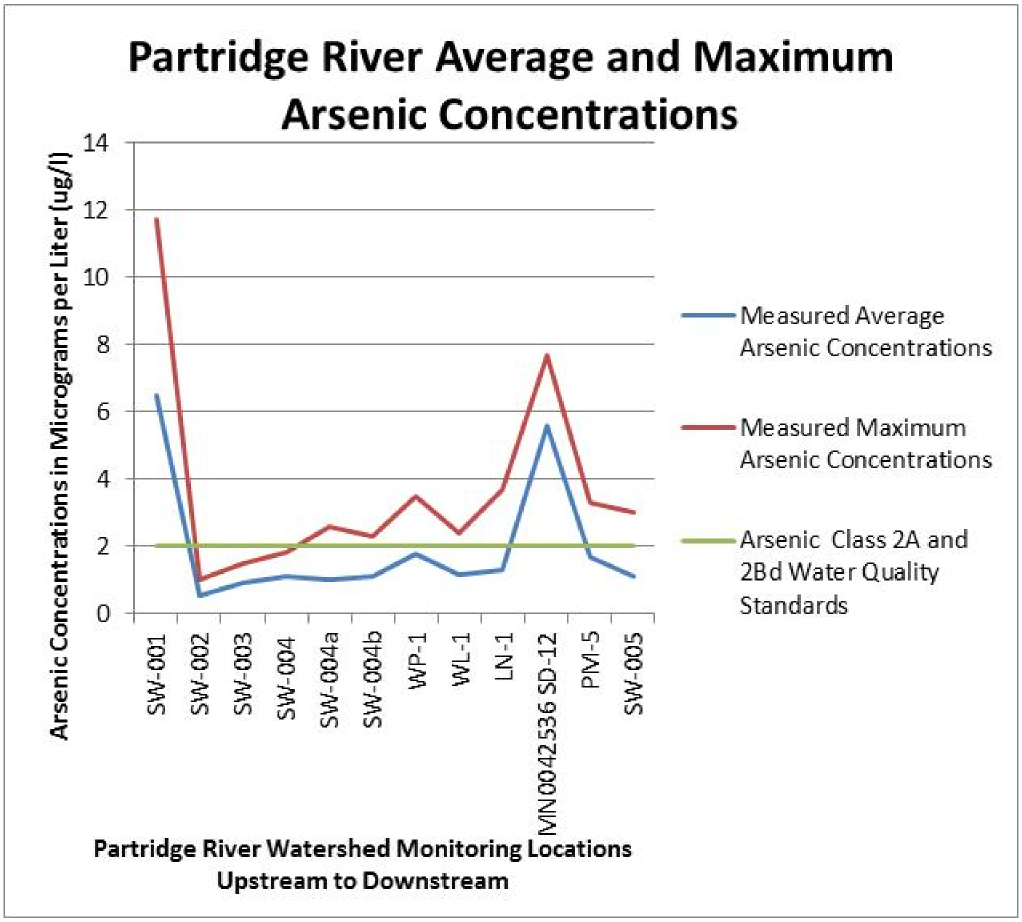


Figure 8. Partridge River Arsenic Concentrations.

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[3] 40 CFR 131.36

[4] PolyMet Water Modeling Data Package

In Colby Lake, which is the City of Hoyt Lakes drinking water source, the increase in arsenic from the PolyMet project would be 38.5% (5.2.2-127 Table 5.2.2-33 Maximum Modeled Monthly P90 Surface Water Concentrations for the Colby Lake). This is significant because the US EPA's Priority Toxic Pollutants rule suggests that this level of arsenic would be more than an order of magnitude higher than what would prevent cancer in humans. The increased arsenic in the Partridge River — up to 55% at SW-004b are even more striking (p. 5.2.2-113, Table 5.2.2-29 Maximum Modeled Monthly P90 Surface Water Concentrations for the Mine Site), which may affect humans through fish consumption, even if the water isn't used for drinking.

Aluminum

The Class 2A chronic standard for total aluminum, applicable to Wyman Creek, is 87µg/l. The quality of Class 2Bd surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. The Class 2Bd standard for aluminum is 125µg/l, applicable to the Embarrass River, Partridge River and St. Louis River. As Figure 9 below demonstrates, at every site where data is available the maximum aluminum concentrations exceed WQS, except at SW-001. The average aluminum concentration exceeds WQS at one quarter of the sites where monitoring data is available for aluminum.

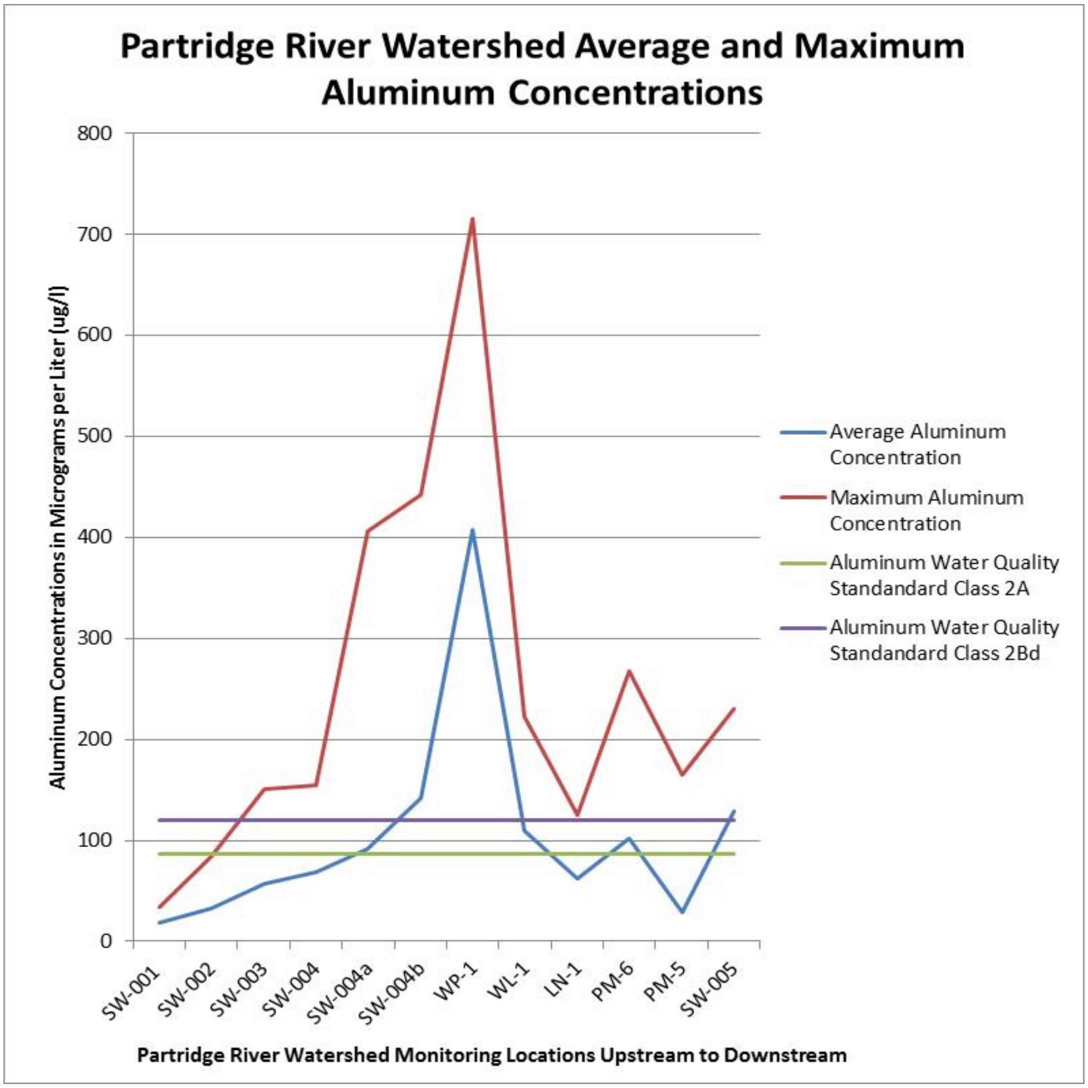

Figure 9. Partridge River Watershed Aluminum Concentrations.

Aquatic Species

Within the CEA area defined by the co-leads for impacts to aquatic species (the Partridge and Embarrass Rivers from their headwaters to a point approximately 15.5 miles downstream of the NorthMet Project Proposed Action activities, where the rivers form the St. Louis River), the MPCA has assessed and identified waterbodies that are impaired for fish and/or benthic macroinvertebrate communities, based upon recent monitoring data (since 2009). The draft 2012 §303(d) list prepared by the MPCA includes more headwaters streams and rivers in the St. Louis River watershed that are also impaired for aquatic communities (Figure 10). It is likely that the state-led stressor identification process underway will identify historic and existing mining operations as major causal factors for these impairments. The tribal cooperating agencies believe that the appropriate spatial scale for considering cumulative impacts to aquatic species is the St. Louis River watershed.

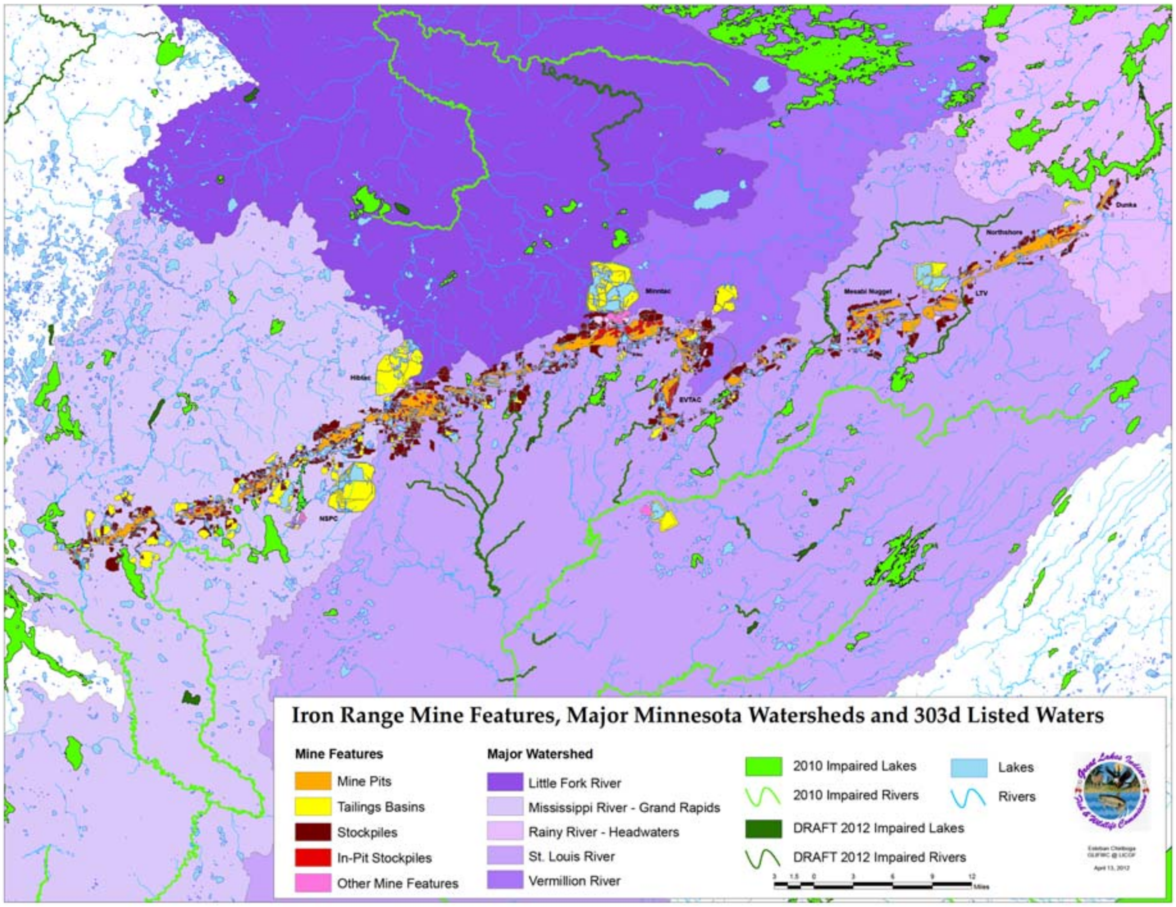

Figure 10. Impaired Waters (§303(d) Listed) within the St. Louis River and other mining-impacted watersheds.

The co-lead agencies conclude that, since the NorthMet Project Proposed Action is not predicted to result in any short- or long-term exceedances of surface water chronic standards in the Partridge River, Colby Lake, or the Embarrass River, even under extreme low-flow conditions during operations, no cumulative effects on aquatic resources are predicted within the CEAA. The co-lead agencies also conclude that there will be no effects on current baseline habitat conditions (as defined by hydrologic changes) from the NorthMet Project Proposed Action; therefore, no cumulative effects are anticipated. Both of these assumptions are major differences of opinion between the co-lead agencies and the tribal cooperating agencies. Clearly there are already adverse effects of mining operations and other development within these subwatersheds.

Mercury

From the PSDEIS: "The NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loadings to the Partridge River from 24.2 grams per year to 23.0 grams per year. This would primarily be a result of a decrease in natural runoff (with a total mercury concentration of 3.6 ng/L) and a proportional increase in water discharged from the West Pit via the WWTF (with a total mercury concentration of 1.3 ng/L)."

The understanding of mercury dynamics in the St. Louis River watershed is very limited and is insufficient to lead to the conclusion reached in the PSDEIS that "the NorthMet Project Proposed Action would not exceed applicable environmental evaluation criteria." This lack of scientific information is explicitly stated throughout the PSDEIS and is what led the Minnesota Pollution Control Agency (MPCA) early this year to delay the establishment of a St. Louis River TMDL until further mercury cycling data could be collected.

The PSDEIS also states that the current fish tissue concentration in the five local lakes results in Hazard Quotients (HQs) that exceed 1 (page 6-58), but gives no further information. The *Cumulative Impacts Analysis, Local Mercury Deposition and Bioaccumulation in Fish (July 2012)* (Barr report) showed modeled contributions from both the Mesabi Nugget LDSP and PolyMet; this information should be included in the SDEIS for public review. The Barr report provides the actual HQs, rather than just saying "they exceed 1". The SDEIS should state clearly that in one case, the existing HQ equals 46.2, which is 46 times as high as the number where action is recommended.

The Barr report also states that "the existing health risk under Scenario 1 and 2 to subsistence/tribal and subsistence anglers eating three pounds or more per week of fish from these lakes would be significantly higher – up to fifteen times the EPA assumed safe risk intake level for a pregnant mother or child under the age of 15". While the incremental risk from the project may be small, the existing risk is large and has not yet been addressed through a total maximum daily load (TMDL) or other reduction program. Table 5 and Figure 9 from the Barr report should be included to give the public a clear idea of the existing condition of the local waters and why the tribes believe that no additional mercury should be added at this time. The SDEIS does not provide any rationale for more mercury to be added to a system that is already so high in mercury, but rather only suggests that the TMDL should take care of this.

Mercury is potent neurotoxin, with the primary human and wildlife route of exposure through consumption of fish. The Embarrass River, Wyman Creek, Whiteface Reservoir, Stony Creek, West Two River, numerous lakes, and the entire St. Louis River all have fish consumption advisories in place for recreational fishing. These advisories do not consider subsistence fishing. Mercury concentrations in fish from these impaired waters will require additional load reductions beyond the emissions reductions required by the statewide mercury TMDL.

Mercury levels in Lake Superior lake trout remain higher than the other Great Lakes, despite significant reductions in the amount of mercury being released from sources around the lake. The largest source of mercury from within the Lake Superior basin is the mining sector, at 63% of total emissions.[5] There has not been significant "ground-truthing" of mercury deposition rates that were used in the modeling assessment. Tribal cooperating agencies note that no studies have been conducted within this region of active mining to determine why fish tissue mercury concentrations are so high if the local sources mainly emit 'non-locally polluting' forms of mercury.

[5] Lake Superior Lakewide Management Plan Annual Report 2012, Catalogue No.: En161-9/2012E-PDF

A 2011 Minnesota Department of Health study[6] of infants in the Lake Superior basin found that 1 in 10 infants are born with unsafe mercury levels in blood. Blood spot mercury concentrations in infants from Minnesota were significantly higher than infants born in the Lake Superior basin in Wisconsin and Michigan.

Increased sulfate concentrations increase bioaccumulation of mercury. Additionally, mercury loadings to surface waters from the project is expected to increase from removing peat and storing peat in the overburden storage layout area without a cover or liner. Stormwater run-off containing concentrations of mercury that exceed MN WQS have been well documented (Aitkin AgriPeat). The Laskin Energy Center NPDES permit MN000990-SD-2 has a permit limit of 19.1 ng/l[7], even though the aquatic life WQS for the Lake Superior basin is 1.3 ng/l. Other existing permitted facilities contribute mercury loadings to the Partridge and Embarrass Rivers, in addition to the local atmospheric deposition (Figures 11, 12).

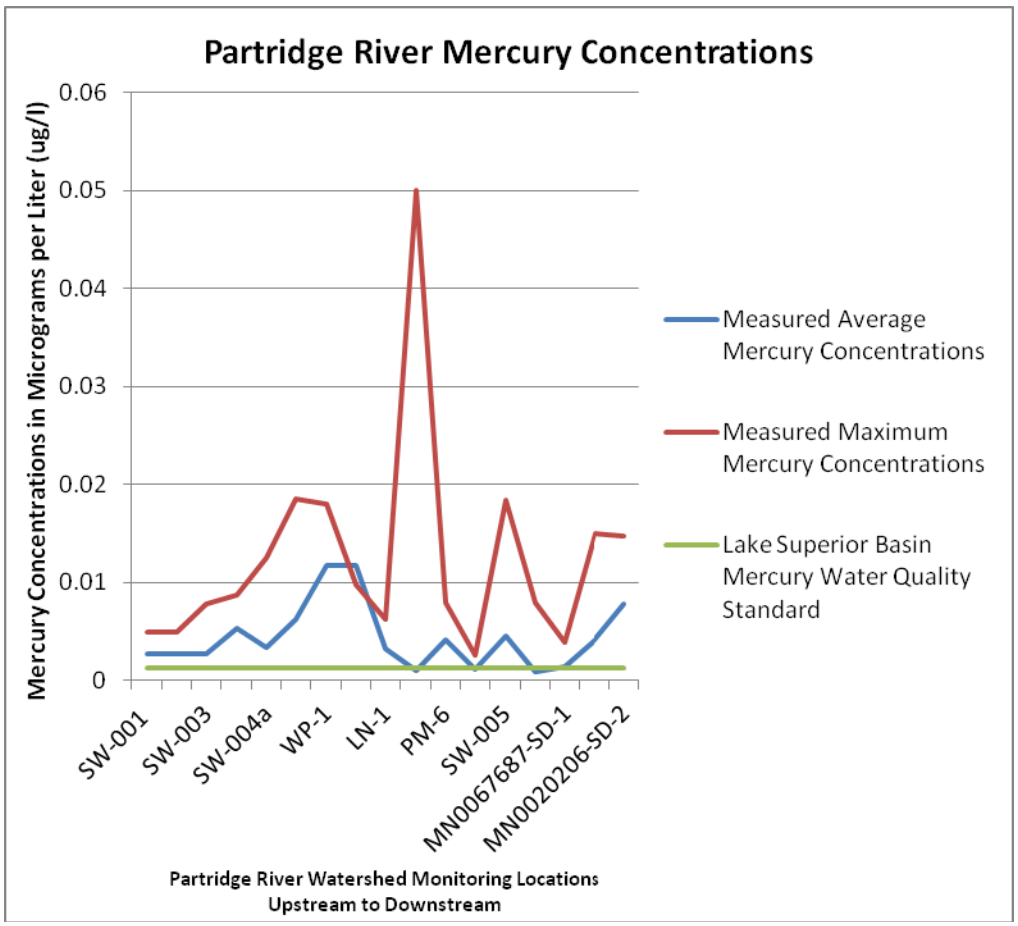

Figure 11. Partridge River Mercury Concentrations

[6] McCann, P. (2011). *Mercury Levels in Blood from Newborns in the Lake Superior Basin* (Minnesota Department of Health: Environmental Health, pp. 181)

[7] MPCA DMR data for NPDES permit MN0000990-SD-2 2000-2013.

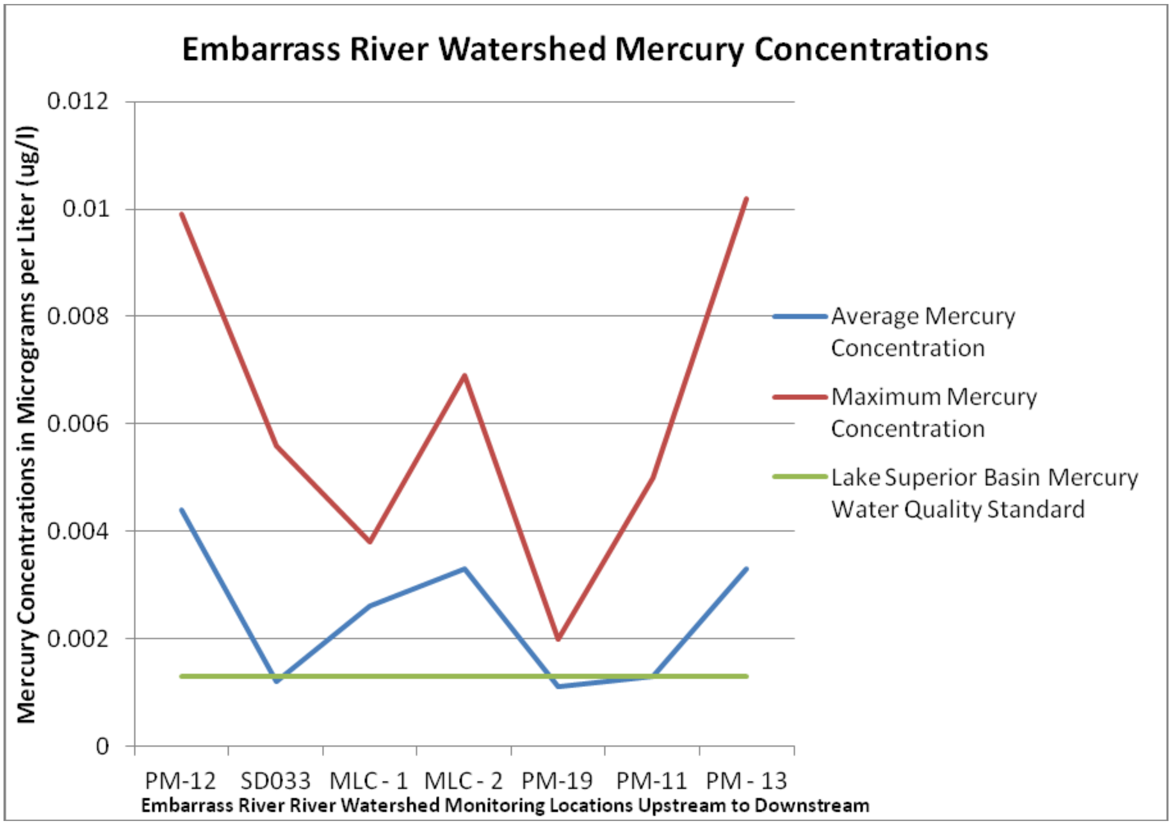

Figure 12. Embarrass River Mercury Concentrations.

Cumulative effects associated with mercury deposition and increased mercury methylation (mediated by increased sulfate loading and hydrologic alteration of peatlands) therefore extend from the plant site down the Embarrass River to the St. Louis River estuary. Additional analyses of predicted mercury impacts from the NorthMet Project Proposed Action have been provided by GLIFWC[8].

Sulfate

From the preliminary SDEIS: "Sulfate concentrations increase to an average of approximately 150 mg/L downstream of the confluence with Second Creek at the County Road 110 bridge (Mesabi Nugget monitoring location MNSW12). The wild rice surveys found sulfate concentrations as high as 289 mg/L below Second Creek during a relatively dry period. The baseline sulfate concentrations found in the Partridge River reflect the effects of discharges from existing activities within the watershed. The NorthMet sulfate load to the Partridge River would total an average of about 41 kg/d, which represents a 0.1 percent

[8] Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury on the "Northmet Mining Project and Land Exchange: Preliminary Supplemental Draft Environmental Impact Statement"

increase over existing loads. Therefore, the NorthMet Project Proposed Action should not adversely affect downstream waters that support the production of wild rice."

Sulfate concentrations in Trimble Creek, the Embarrass River, and the Partridge River currently exceed the wild rice standard of 10 mg/l. The drinking water standard and the cold water fisheries standard for sulfate is 250 mg/l. Discharge from Area Pit 5 near the proposed PolyMet tailings basin has measured sulfate concentrations that range from 170 to 2520 mg/l, averaging 1,083 mg/l between 2001 and 2013[9]. Sulfate concentrations measured in the discharge from the Peter Mitchell Pit to the upper Partridge River for NPDES permit MN0046981-SD-9 ranged from 14-37 mg/l. Sulfate concentrations measured in the discharge from the LTV Tailings basin to Second Creek for NPDES permit MN0042536-SD026 ranged from 118-360 mg/l in the period between 2008 - 2013[10]. Sulfate impaired wild rice waters, for the first time ever, will be included in the MPCA impaired waters list in 2014. The Bands believe that the Embarrass River, Second Creek, the Partridge River, Dunka River, and Bobs Bay of Birch Lake should be included on that list. In addition, the Swan River, Swan Lake, Sand River and the Twin Lakes (Sandy and Little Sandy Lakes, adjacent to the US Steel Minntac tailings basin) are all impaired wild rice waters due to concentrations of sulfate that exceed the MN wild rice sulfate standard.

The wild rice sulfate WQS is exceeded at almost every point where data is available in the Embarrass River watershed (Figure 12), and the drinking water standard is exceeded at half of the monitoring locations. In the Partridge River watershed, the wild rice sulfate WQS is exceeded at fourteen of seventeen locations (Figure 13). And, the sulfate drinking water standard is exceeded at two locations in the Partridge river watershed. The NorthMet Project Proposed Action will contribute additional sulfate to the groundwater from tailings basin water that is not captured and treated, water that seeps through fractures in the mine pit walls once the pit has filled with water, and stockpile infiltration and run-off.

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[9] MPCA DMR data for NPDES permit MN0042536-SD033 2001 -2013.
[10] MPCA DMR data for NPDES permit MN0042536-SD026 2008 -2013.

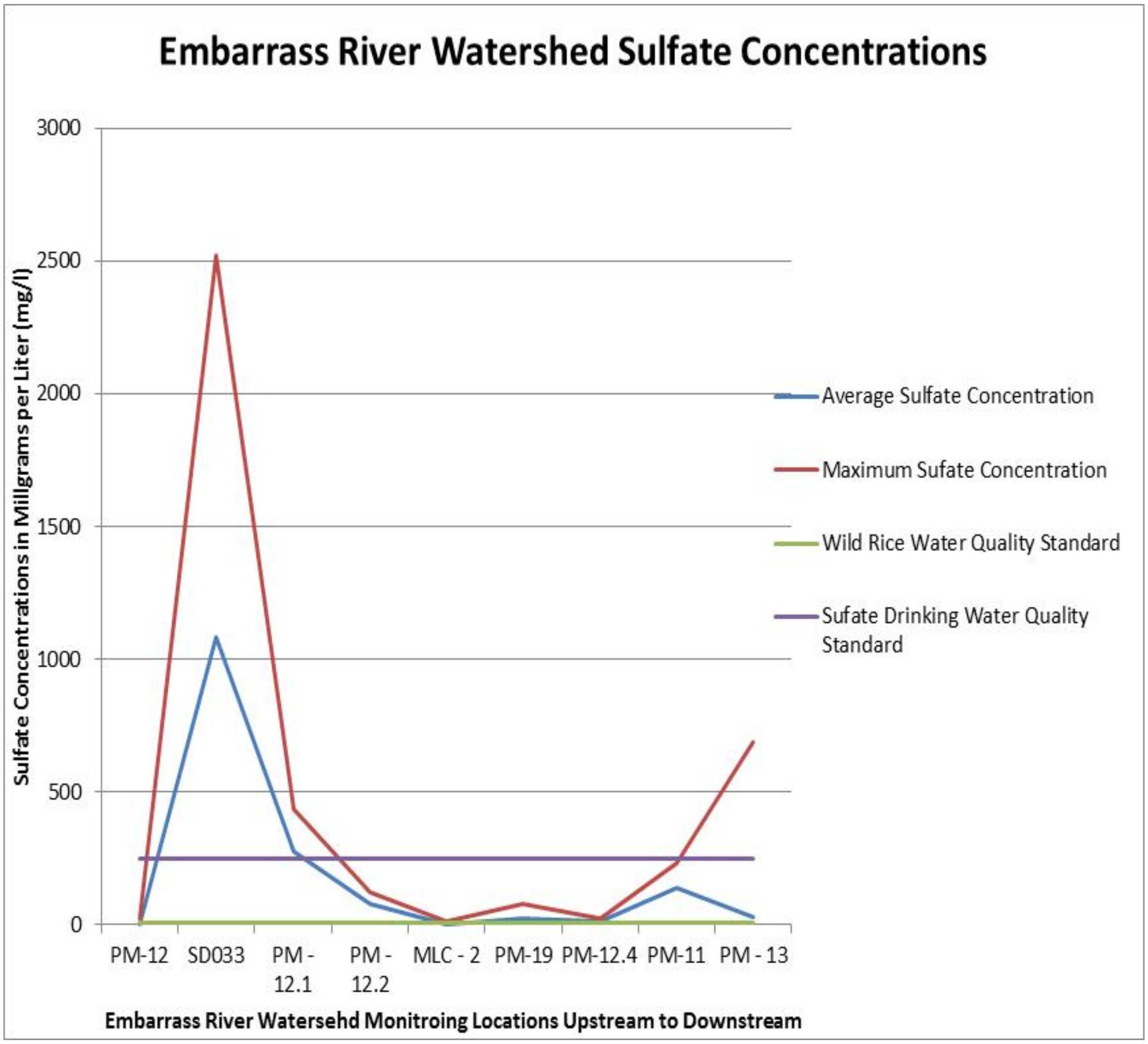

Figure 12. Embarrass River Watershed Sulfate Concentrations.

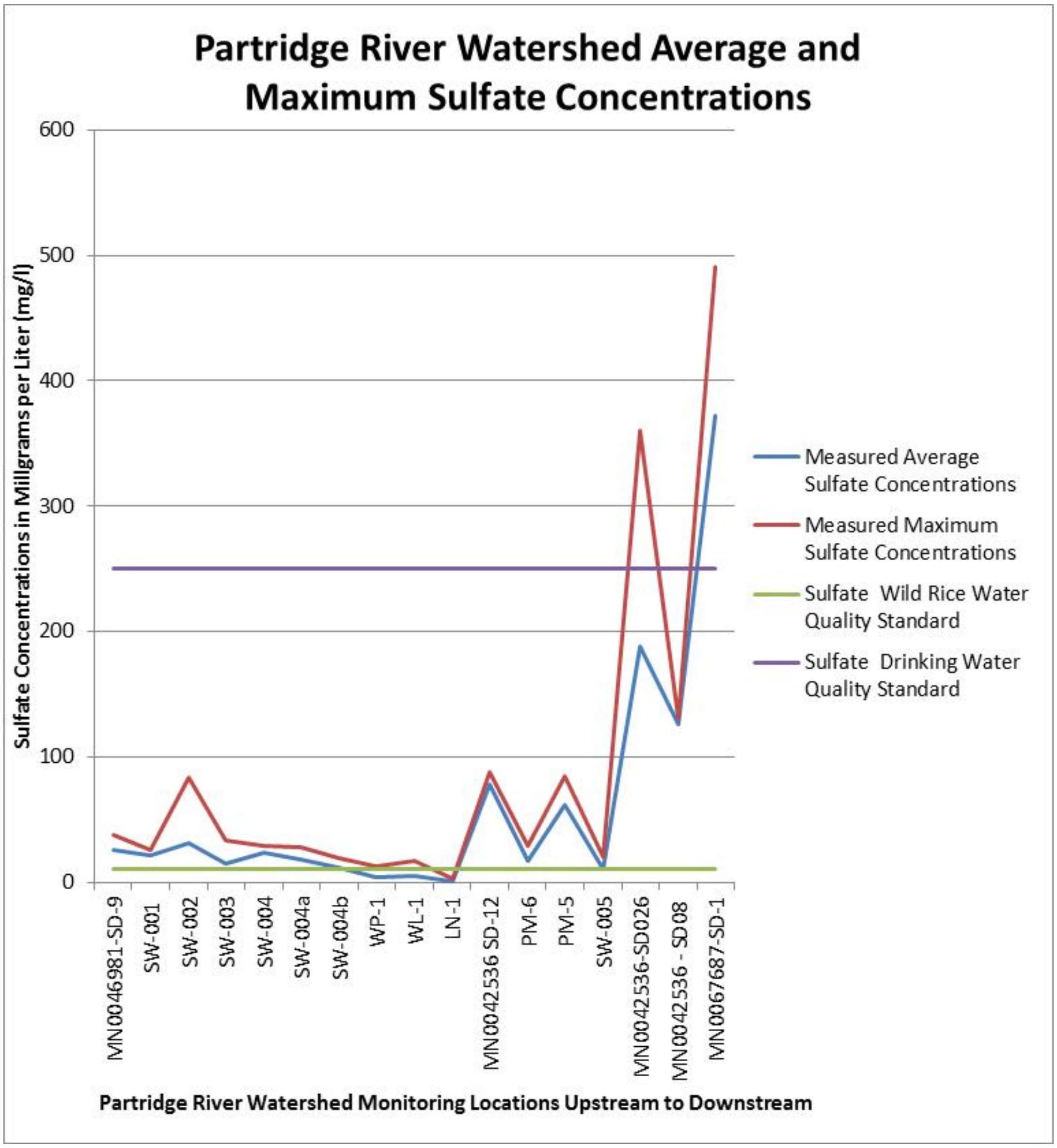

Figure 13. Partridge River Watershed Sulfate Concentrations.

Tribal staff did additional analysis of sulfate concentrations throughout the St. Louis River watershed. Analysis of sulfate concentrations downstream of mine discharge sites indicated that sulfate concentrations were highest nearest to mine discharge sites, and tended to only gradually decrease downstream of mine discharge sites. Linear regressions demonstrated that mean sulfate was significantly negatively related to distance across all sample sites ($P < 0.01$, $R^2 = 0.14$, $n = 92$) and within the Saint Louis River system ($P < 0.01$, $R^2 = 0.17$, $n = 73$; Figure 14). This analysis included stream and river monitoring only (not lakes).

The regression suggests that sulfate concentrations could drop to less than 10 mg/L only 170 km (105 mi) downstream of the nearest upstream mine discharge site (Figure 15).

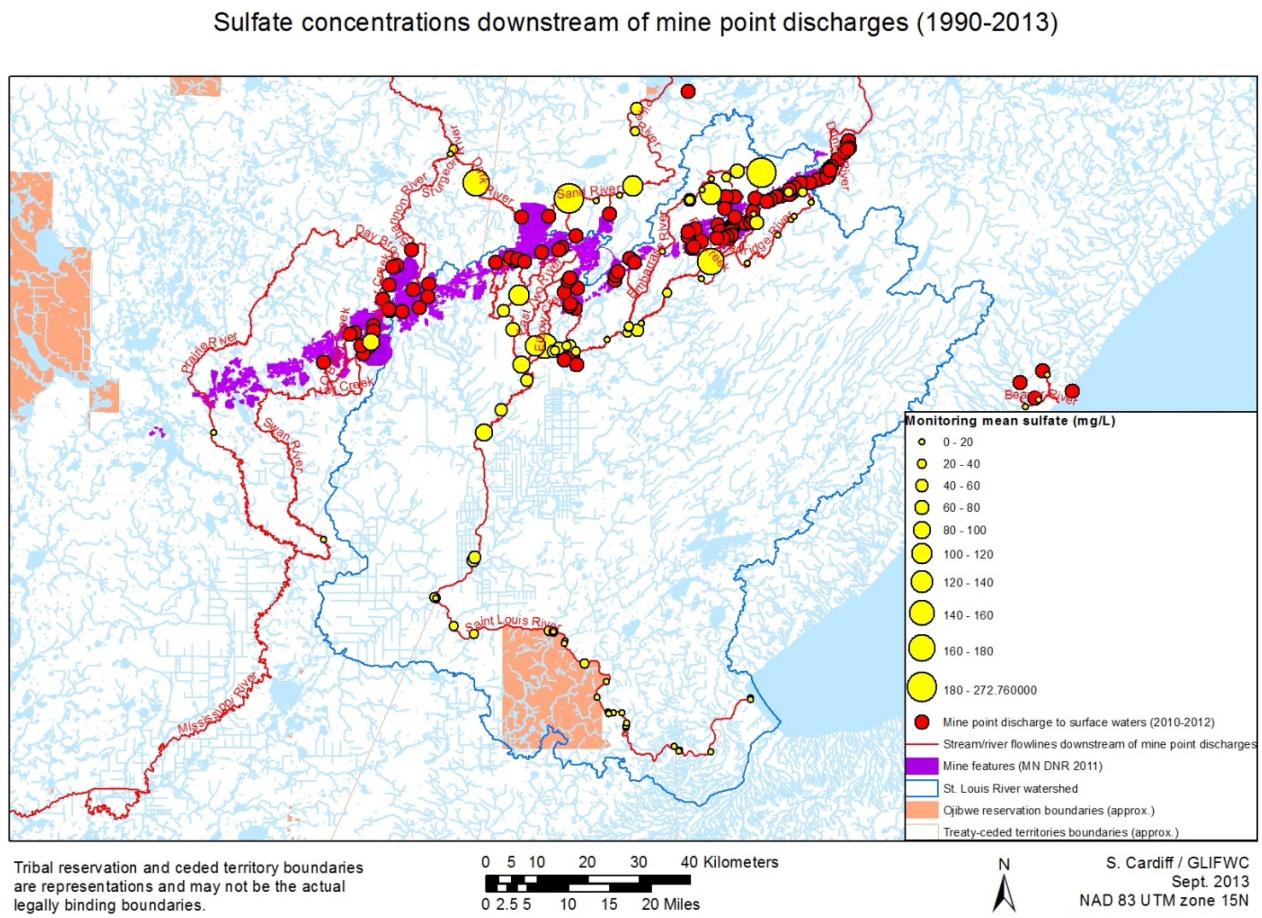

Figure 14. Mean sulfate concentrations at monitoring stations downstream of mine point discharges was inversely related to distance downstream from the discharge sites.

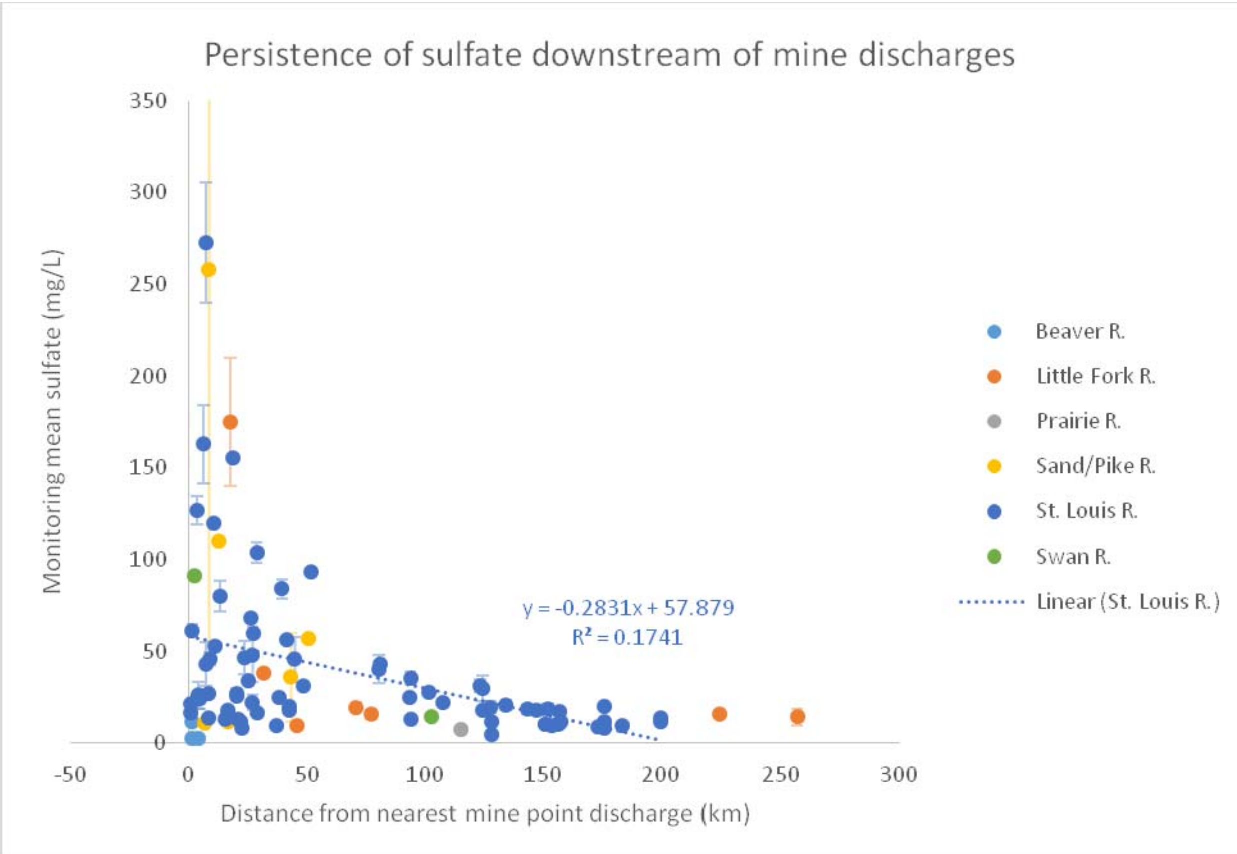

Figure 15. Linear regression indicated that mean sulfate (±1 SE) was significantly related to distance of the monitoring location downstream of the nearest mine discharge in the St. Louis River with highest sulfate concentrations nearest to mine discharges and decreasing relatively gradually downstream ($P < 0.01$, $R^2 = 0.17$, $n = 73$).

Ground water quality

From the PSDEIS: "Neither the Scoping Decision Document nor the SDEIS identified potential cumulative effects on groundwater. Although the NorthMet Project Proposed Action would affect groundwater levels, this effect would be very limited geographically and temporally (e.g., groundwater levels would be restored once pit dewatering ceases) and not subject to any off-site cumulative effects. The effects of mine dewatering are considered in terms of effects on surface water flows."

The cumulative effect of blasting ore, or vibration, has not been mentioned in the SDEIS, or even considered. It is evident that effect of blasting ore will increase fractures in the Virginia Formation and the Duluth Complex in the vicinity of the Project[11]. And, that

[11] ISEE Presentation Wesley L. Bender, Understanding Blast Vibration and Airblast, their Causes, and their Damage Potential (updated 2009), available at http://www.iseegoldenwest.org/Blast%20Effects.pdf (last visited 9/5/13)

fractures have already hydrologically connected the Biwabik Iron Formation with the Virginia Formation and Duluth Complex, as a result of blasting in the Peter Mitchell Pit. The increase in fractures from blasting has likely hydrologically connected some of the known and inferred faults in the vicinity of the Peter Mitchell Pit, too. And, there will be a cumulative impact on water quality and water quantity resulting from blasting ore in the proposed PolyMet mine pit because the fractures from blasting in the Peter Mitchell Pit will overlap fracturing resulting from blasting in the PolyMet Pit. The area where most of the new fractures are likely to be created lie within the Virginia formation between the two pits. The Virginia Formation is known to have the highest sulfur content of the three bedrock formations found within the area between the proposed PolyMet mine pit and the Peter Mitchell mine pit, and the second highest transmissivity rate.

The PolyMet SDEIS section on vibration (Chapter 5.2.8) does not discuss impacts of blasting in creation of fractures. However, fractures created by blasting and shoveling ore would extend far beyond the pit walls. Section 5.2.8-9 **Vibration** of the preliminary SDEIS states: "permanent ground displacement occurs close to the blast. For heavily confined rocks, ground vibrations of 25.4 mm/sec will occur as far away as 1,581 meters. For free face average rock, ground vibrations of 25.4 mm/sec will occur as far away as 627 meters." "Permanent ground displacement" is a discreet way to refer to the creation of new fractures without having to discuss the resulting increase in groundwater flow and connectivity to surface waters. In fact, all of the PolyMet predictions regarding discharge from the mine pits and waste rock piles, including the more reactive waste rock piles and the ore surge pile as well as the unlined permanent Category 1 waste rock pile, are made without considering the effects of fractures on discharge to groundwater and surface water.

Excerpts from three reports produced for the PolyMet project regarding groundwater/surface water interactions include the following:

"Groundwater samples were collected from three of the deep borings at the site. Two of the samples were collected from 6-in diameter exploratory boreholes. The remaining sample was collected from the water supply well (Unique Well Number 717972). This well is open to both the Duluth Complex (20-150 feet below ground surface) and the Virginia Formation (150-200 feet below ground surface)….The water sample from well MW-05-02 exceeded criteria for ammonia (240 ug/l), pH (10),aluminum (322 ug/l), and copper (11.2 ug/l). The sample from MW-05-08 exceeded criteria for aluminum (1,040 ug/l), copper (10 ug/l), and mercury (0.0053 ug/L). The sample from MW-05-09 exceeded criteria for aluminum (4,640 ug/L), chromium (28.6 ug/l), cobalt (5.4 ug/l), copper (72.2 ug/l), lead (5.6 ug/l), and mercury (0.0181 ug/l)…. The presence of ammonia in the deep boreholes may indicate that the water in the borehole came from the shallow surficial deposits. Ammonia is not typically found in deep bedrock systems but is common in wetland environments."[12]

[12] Hydrogeologic Investigation- PolyMet NorthMet Mine Site report RS-02. Barr Engineering. 2006

"The water samples from wells P-2 and P-4 exceeded the nitrogen (ammonia as N) criteria (270 ug/L and 110 ug/L respectively). The presence of ammonia nitrogen in the samples likely indicates that there is a hydraulic connection between the bedrock aquifer and the surficial aquifer; however, the nature of this connection cannot be determined at this time."[13]

"The samples from pumping well P-2 all contained measurable tritium, indicating that at least a portion of the source water is post-1952 water."[14]

The Peter Mitchell Pit lies approximately one mile north of the proposed PolyMet mine pit. Taconite production began in 1955 at the Peter Mitchell Pit. Based on the review of the Peter Mitchell NPDES permit MN0046981 at various discharge locations, unionized ammonia nitrogen has exceeded permit limits on numerous occasions[15]. Unionized ammonia nitrogen is used to blast rock. Though PolyMet did not determine what the source unionized ammonia or tritium found in the deep boreholes was, it seems likely that because of the Peter Mitchell Pit's close proximity to the proposed PolyMet mine site, the Peter Mitchell Pit is the source of contamination. The approximate fifty- year travel time of the pollutants found in the P-2 bore hole from the Peter Mitchell Pit were not used to estimate travel time for pollutants leaving the PolyMet mine pit and reaching the Partridge River, or even to calibrate the model.

In fact, bedrock groundwater flow paths have not been determined using standard methods for hydrogeologic investigations. Instead, a model has been developed that uses extremely low baseflows in the Partridge River in order to suggest that peak concentrations of contaminants will not reach surface water features for hundreds or even thousands of years. Even though data collected for PolyMet in the three hydrologic investigations between 2006 and 2007 demonstrate a strong connection between boreholes in the bedrock aquifer and the surficial aquifer and surface water (including wetlands). This information, and the results from winter flow monitoring have not been incorporated into the PolyMet project projections for surface and groundwater quality and quantity.

Groundwater contamination from the previous mining activities is still an issue near the LTV tailings basin and mine pits more than twenty years after operations have ceased. The above evidence suggests that, whatever the degree of fractures now existing in the rock, blasting at the levels proposed by PolyMet will create damage to rock masses and rock fractures over an extensive area, including the entire mine site and extensive adjacent wetlands areas (Figure 16). This evidence requires that the impacts of fractures on propagation of pollutants from all mine sources be analyzed in detail and calls into question PolyMet's claims that discharge of sulfates and toxic metals from the mine site will not impact wetlands and exceed water quality standards. The impacts of vibrations and airblast on slope stability of waste rock piles are not discussed in the SDEIS either.

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[13] Hydrogeologic Investigation – Phase II PolyMet NorthMet Mine Site RS-10. Barr Engineering. 2006

[14] RS10A –Hydrogeological – Drill Hole Monitoring and Data Collection – Phase 3. PolyMet Mining, Inc. March 2007.

[15] MPCA DMR data for MN0046981 from website "What's in My Neighborhood" (http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood-text-search.html) (last visited 9/4/13)

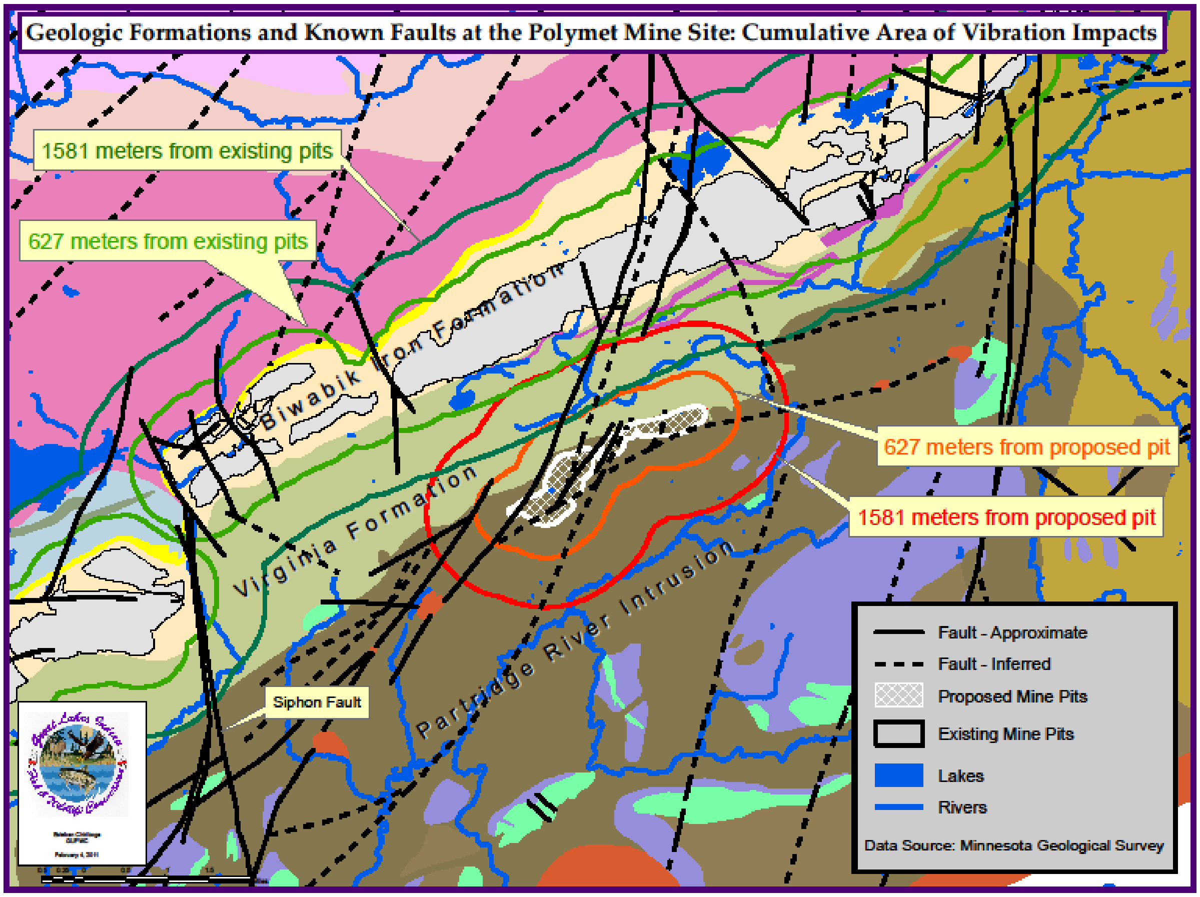

Figure 16. Cumulative Area of Vibration Impacts.

Impacts to water quality in the immediate vicinity of the project area from mining activities include:

Peter Mitchell Pit: Expansion of the Peter Mitchell Pit to the South towards the proposed PolyMet project and the in-pit disposal of Virginia Formation waste rock.

Former LTV Site (Cliffs): Dunka Pit, Area Pit 5, Tailings Basin, Area Pit 2, Area Pit 3

Mesabi Nugget: Area Pit 1, Area Pit 9, Area Pit 9S, Area Pit 6, Area Pit 2WX, Stevens Pit

Considering there are domestic wells south of the property, and pit 2WX will likely overflow to surface water features when mining has ceased, contaminant transport models for surface and groundwater need to be developed if pit 2WX or pit 6 are mined due to the presence of the Virginia Formation and the Aurora Sill.

Wetlands

The co-lead agencies confined their cumulative effects analysis for wetlands to the Partridge and Embarrass River watersheds, simply quantifying the wetland acreage change from pre-settlement conditions to the present, then projecting the estimated acres in the future based upon impacts due to the NorthMet Proposed Project. The co-lead agencies, relying upon the XP-SWMM model developed for the Partridge River, conclude that “changes in annual flow (and therefore stage) in the Partridge River would be within the naturally occurring annual variation for the Partridge River. Therefore, no potential indirect cumulative wetland effects are identified for the wetlands abutting the Partridge River.

The PSDEIS states: “The St. Louis River is located downstream of the Partridge River. Effects on flows (and, by extension, water surface elevations) generated by the NorthMet Proposed Action are anticipated to be less than those estimated for the Partridge River and within the natural variation of flow within the St. Louis River. Therefore, no potential indirect cumulative wetland effects are identified for the wetlands within the St. Louis River below the ordinary high water mark from its confluence with Embarrass River to Lake Superior.”

The tribal cooperating agencies take a different approach to quantifying cumulative wetland impacts for the NorthMet Proposed Action. Referencing the alternative indirect wetland impacts analysis provided by GLIFWC for the PolyMet mine site, tribal cooperating agencies believe that cumulative wetland impacts within the St. Louis River watershed should be the scale of the analysis, and that direct and indirect wetland impacts due to hydrologic modification (ditching) should be included (Figure 17). There are 1,387,630 acres of wetlands in the St. Louis River watershed, with 1732 individual wetlands impacted by ditching, totaling 198,989 acres. Ditching has occurred in 14.3% of the wetlands in the watershed. Approximately 50% of the subwatersheds have had some degree of impact from ditching, while some have experienced ditching in nearly 100% of their wetlands. Clearly, this has a profound impact to the connected surface waters, and impacts to specific stream reaches should be assessed.

There are direct impacts to wetlands that occurred when the ditches were constructed. Those impacts depend on the length and width of each ditch. The second, and larger, set of impacts is indirect. The ditches have converted some percentage of the wetlands to upland, and changed the functions and values of another percentage of wetlands.

St. Louis River Sub-watershed impacted by Ditching

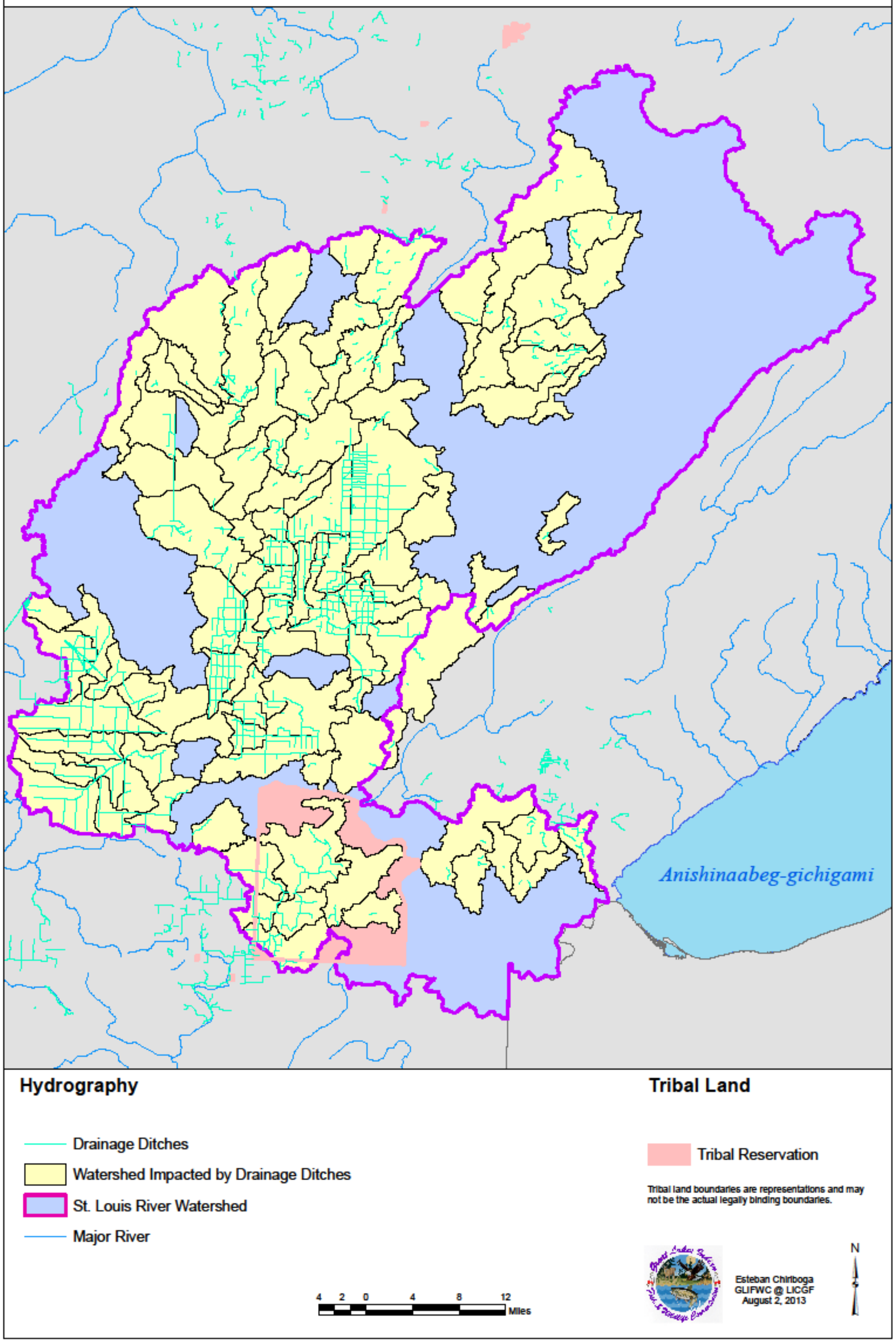

Figure 17. St. Louis River Watershed Hydrologic Impacts from Ditching

Tens of thousands of acres of high quality wetlands within the St. Louis River watershed have been entirely and permanently lost to historic and current mining operations, prior to regulatory requirements for mitigation. Since the initiation of state and federal wetland mitigation requirements for permitting wetland dredge and fill activities, most mitigation has taken place outside the St. Louis River watershed and has not replaced the wetland types and functions that have been lost. Nearly 3000 additional wetland acres will be directly impacted under several reasonably foreseeable mining projects within the watershed (Figure 18).

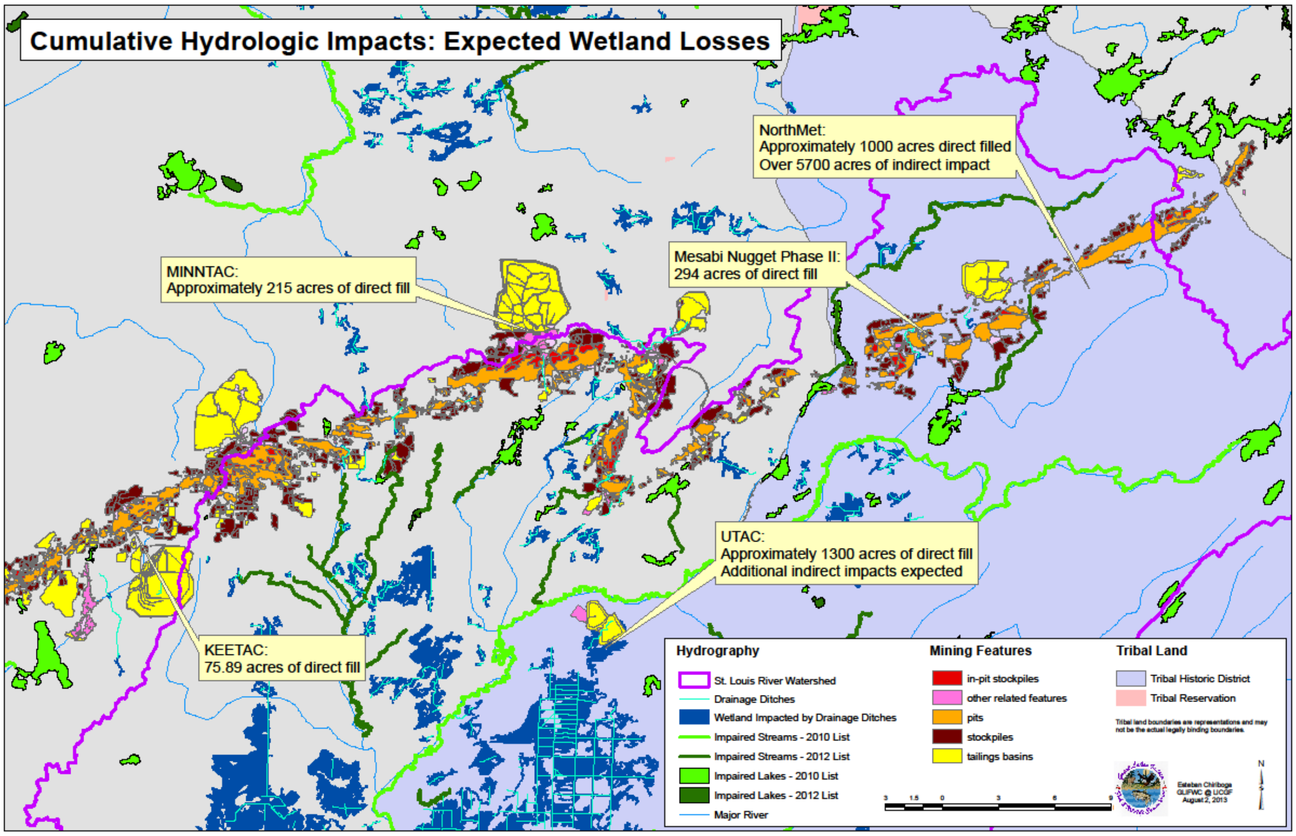

Figure 18. Cumulative Hydrologic Impacts: Expected Wetland Losses within the St. Louis River watershed

When all impacts to water quality, aquatic communities, wetlands, and hydrology are considered in a comprehensive manner, the cumulative effects on water resources are extensive (Figure 19).

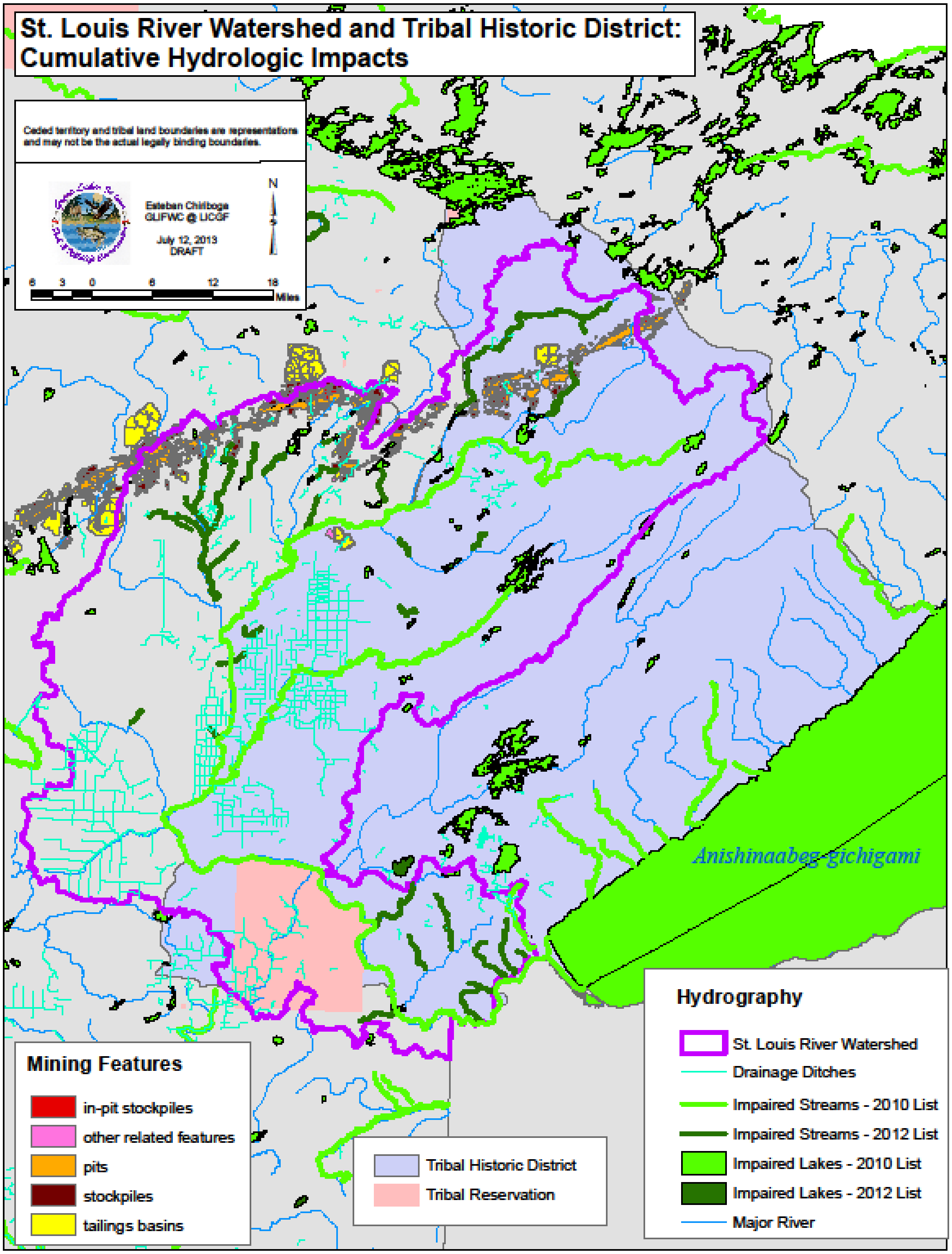

Figure 19. St. Louis River Watershed and Tribal Historic District: Cumulative Hydrologic Impacts.

Vegetation

The co-lead agencies evaluated cumulative effects on vegetation within the portion of the Mesabi Iron Range encompassed by the Nashwauk Uplands and Laurentian Uplands ecological subsections. From the preliminary SDEIS:

"Minnesota Biological Survey
The MDNR operates the MBS program, which includes spatial information from survey reports on native plant communities and rare species. Sites of Biodiversity Significance are designated and ranked by the MDNR based on the environmental conditions present, including native plant communities, rare species, and unique habitat. The MBS utilizes a four-tiered ranking system: Outstanding, High, Moderate, and Below (from highest to lowest). Sites of High Biodiversity Significance contain very good-quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes (MDNR 2008a). The entire 3014.5-acre Mine Site has been characterized by the MBS as various Sites of High Biodiversity Significance due to the presence of the One Hundred Mile Swamp site, which covers 15 percent of the Mine Site, and the Upper Partridge River site, which is 85 percent of the Mine Site (MDNR 2008a)."

The tribal cooperating agencies believe a more relevant spatial reference for cumulative effects to vegetation would include the One Hundred Mile Swamp and the Headwaters Site. Additionally, the "Contributing Past, Present and Reasonably Foreseeable Actions should include the extensive mineral exploration taking place within the headwaters of the St. Louis River. The degradation and destruction of this landscape and the vegetation that provides forage and habitat for culturally important species, as well as sustenance and medicine for band members, has been a cumulative impact to cultural and natural resources since the signing of the treaty.

From Danielson and Gilbert (2002):
"The Ojibwe gather over 350 wild plant species for food, utilitarian, medicinal, ceremonial, and commercial purposes (Meeker, Elias and Heim 1993; Densmore 1928). Examples include sweet grass (*wiingashk*), white sage (*mashkiki*), basswood (*wiigob*), yellow birch (*wiinizik*), paper birch (*wiigwaas*), wintergreen (*wiinisiibag*) red-osier dogwood (*miskoobimizh*), bearberry (*miskwaabiimag*), wild sarsaparilla (*waaboozojiibik*), white water lily (*akandamoo*), bluebead lily (*odotaagaans*), Canada mayflower (*agongosimin*), swamp milkweed (*bagizowin*), wood lily (*mashkodepin*), rue anemone (*biimaakwad*), wild ginger (*namepin*), blue cohosh (*beshigojiibik*) bloodroot (*meskwiijiibikak*), black ash (*aagimaak*), yarrow (*ajidamoowaanow*), wild rose (*oginiiminagaawanzh*), Labrador tea (*waabashkikiibag*), sweet flag (*wiikenh*), wild black current (*amikomin*), wild blackberry (*odatagaagominagaawanzh*), blueberry (*miinagaawanzh*), nannyberry (*aditemin*), and highbush cranberry (*annibiminagaawashk*). Tribal members may gather wild plants, as guaranteed by their treaty rights, on all public lands within the ceded territories.

The Ojibwe have been "managing" (e.g., respecting, observing and utilizing) the land and its resources since time immemorial. However, tribal members seldom use the term "managing." Through the sharing of stories and spiritual beliefs, elders transfer a wide spectrum of skills and information to younger generations. Some scholars refer to this information as traditional ecological knowledge and wisdom (TEKW). Berkes (1999) defines TEKW as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. TEKW does not reflect a stagnant inventory of information but rather, without disregarding past wisdom, continues to transform through time.

TEKW and contemporary ecosystem management, though not identical, share common characteristics. A report published by the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management states: "Ecosystem management is management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research base on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function. In additions, "ecosystem management assumes intergenerational sustainability as a preconditions for management rather than an afterthought" (Christensen et al. 1996). Clearly, shared principles include adaptive management through observation and monitoring and an intergenerational sustainability, including the relationship and dependence of humans and all life on each other.

The tribes remind (these) land managers that, as necessitated by trust responsibility and treaty law, they must ensure the availability and sustainability of wild plant harvest. Irrevocably, the Ojibwe worldview teaches values based on an understanding that humans depend on all other earth beings (Johnston 1976)."

Further documentation of the high quality and ecological function of this landscape is found in *An Evaluation of the Ecological Significance of the Headwaters Site, Northern Superior Uplands Ecological Land Classification System Section; Laurentian Uplands Subsection Lake and St. Louis Counties, Minnesota*, March 2007):

"The Headwaters Site straddles the continental divide, with water from the Site flowing both east through the Great Lakes to the Atlantic Ocean and north to the Arctic Ocean. Paradoxically, the divide runs through a peatland. Although the peatland appears flat, water flows out of it from all sides, forming the ultimate source of rivers that eventually reach two different oceans. The Site is the headwaters of four rivers: Stony River, Dunka River, South Branch Partridge River, and the St. Louis River, which is the second largest tributary to Lake Superior…

The Headwaters Site encompasses vast peatlands on its eastern side, unfragmented upland forests in the west, and broad transition zones between them. Within the Site are two distinct areas, referred to in the document as the "Extensive Peatlands" and the "Big Lake Area," which are linked hydrologically as part of the Upper St. Louis River watershed. The Extensive Peatlands area is a mosaic of open and forested wetland communities and includes forested upland islands and peninsulas. The Big Lake Area, in the southwestern quarter of the Site, includes Big Lake and surrounding unfragmented upland forest interspersed with small wetlands.

The Headwaters Site is unique in northeastern Minnesota in several ways. The size and complexity of the peatlands in the Extensive Peatlands are unmatched in the Northern Superior Uplands Ecological Land Classification System (ECS) Section. The Sand Lake Peatland Scientific and Natural Area (SNA), established by the Wetlands Conservation Act of 1991, protects one of the 15 most significant peatlands in the state, and it is by far the largest SNA in the Section (MNDNR 1984).

The Nature Conservancy's (TNC) Superior Mixed Forest (SMF) Ecoregion Plan identifies the Sand Lake/Seven Beavers (SL7B) conservation area, including the entire Headwaters Site, as one of 51 conservation areas in the Ecoregion that best represent the ecosystems and species of the Ecoregion, and serve as a blueprint for conservation action…According to the SMF Ecoregion Plan, these conservation areas are the best opportunities for conserving the full diversity of terrestrial and aquatic ecosystems and globally rare or declining species. The SMF Ecoregion Plan identifies these areas as critical places for conserving biodiversity…and outlines the threats to conservation and conservation targets for these areas…recognizing that more detailed site planning is needed to address how to implement conservation efforts…

The Minnesota Pollution Control Agency has ranked the Upper St. Louis River watershed in the second highest category in the Lake Superior Basin for watershed integrity (Minnesota Pollution Control Agency 2003). The Headwaters Site is among the highest quality areas within the watershed. The upland forest surrounding Big Lake is among the largest, if not the largest, unfragmented, predominantly upland forest in the North Shore Highlands, Toimi Uplands, and Laurentian Uplands (NTL) ECS Subsections. The upland forest area covers 7,920 acres (including 788-acre Big Lake). This high-quality, fire-dependent forest has not been logged in recent decades, except for two stands totaling 140 acres, along the northern edge of the Site.

Covering an area roughly 11 to 12 miles (from northeast to southwest) by 7 to 8 miles (from northwest to southeast), the Headwaters Site is a mosaic of high-quality native plant communities that have functioned under relatively undisturbed conditions since the nineteenth and early twentieth century, when parts of the Site were logged and then burned by wildfires. A corridor containing a railroad grade and power line crosses this vast area, representing the only major permanent conversion of the natural landscape. Minnesota County Biological Survey (MCBS) sites bordering about two-thirds of the Site's boundary have been assigned High or Moderate statewide Biodiversity Significance (Figure 4, page 85). The lack of roads, absence of recent large-scale logging, and large size of the Site allow for natural functioning of ecological processes. These processes include disturbances such as wind, fire, and flooding, as well as plant species competition, nutrient cycling, and hydrology. Natural landscape patterns, such as patch size of the various plant communities, have not been altered, in comparison with most other parts of northeastern Minnesota (White and Host 2003). Minimal recent human disturbance also results in a landscape with very few populations of exotic or invasive species.

The predominant upland forest native plant community in the Big Lake Area is Aspen – Birch Forest [FDn43b], with inclusions of Upland White Cedar Forest [FDn43c] and White Pine – Red Pine Forest [FDn43a] (Figure 5, page 87). Isolated wetlands within the Big Lake

Area's upland forest support a variety of native plant communities, including Northern Poor Conifer Swamp [APn81], Northern Rich Spruce Swamp (Basin) [FPn62], White Cedar Swamp (FPn63a), Northern Alder Swamp [FPn73a], and Black Ash - Conifer Swamp [WFn64a]…

The Extensive Peatlands are composed of a complex of native plant communities, including Northern Cedar Swamp [FPn63]; Northern Rich Spruce Swamp (Basin) [FPn62]; Northern Alder Swamp [FPn73]; Northern Rich Tamarack Swamp (Water Track) [FPn81]; Northern Rich Fen (Water Track) [OPn91]; Northern Rich Fen (Basin) [OPn92]; Northern Shrub Shore Fen [OPn81]; Northern Spruce Bog [APn80]; Northern Poor Conifer Swamp [APn81]; Northern Open Bog [APn90]; and Northern Poor Fen [APn91]. The many upland islands in this portion of the Site provide additional native plant community diversity, supporting community types in the Northern Dry-Mesic Mixed Woodland [FDn33] and White Pine-Red Pine Forest [FDn43] classes…

The Headwaters Site supports healthy known populations of eight state-listed plant species, all of which are listed as Special Concern (SPC) in Minnesota: coastal sedge *(Carex exilis)*, Michaux's sedge *(Carex michauxiana)*, English sundew *(Drosera anglica)*, bog rush *(Juncus stygius),* small green wood orchid *(Platanthera clavellata),* Lapland buttercup *(Ranunculus lapponicus)*, sooty-colored beak rush *(Rhynchospora fusca)*, pedicelled woolgrass *(Scirpus cyperinus/S. pedicellatus)*, and Torrey's mannagrass *(Puccinellia pallida)*...The unfragmented complex of high-quality native plant communities within and across the Site's landforms provide excellent habitat for a wide variety of animal species distinctive of the landscape, including moose, gray wolf, sandhill cranes, American bitterns, boreal and great gray owls, and numerous amphibians, butterflies, and small mammals.

In 2005 and 2006 the Minnesota County Biological Survey of the MN DNR conducted rare plant and native plant community fieldwork, mapped the native plant communities and completed this Ecological Evaluation of the Headwaters Site. Based on the natural features and conditions revealed through this recent work and that of others since the 1980s, MCBS recommends the primary management objective for the Headwaters Site be to protect, enhance, or restore ecological processes and native plant community composition and structure. In accordance with this objective, the site or portions of the site may be identified by landowners or land management agencies for conservation activities such as special vegetation management, including ecologically based silviculture and forest development activities, or for designation as a park (city, county, state, or private), research natural area, non-motorized recreation area, scientific and natural area, or other reserve. This Ecological Evaluation has been written to characterize the ecological significance of the MCBS Site as a whole and to serve as a guide for conservation action by the various landowners.

MANAGEMENT RECOMMENDATIONS
Overview
The Headwaters Site is a large, natural area with features of widely recognized statewide ecological and biological significance. These include:

- one of the 15 most significant peatlands in the state (MN DNR 1984, Wright et al. 1992);
- the largest SNA in the Northern Superior Uplands Section;

- one of the largest, unfragmented, predominantly upland forest patches in the Laurentian Uplands,
- Toimi Uplands, and North Shore Highlands subsections;
- an ecologically functional mosaic of high quality native plant and animal communities;
- a concentration of excellent occurrences of rare species populations;
- support of species with large home ranges;
- six state-designated old-growth stands;
- remote, undeveloped lakes.

The documented condition and quality of the aquatic and vegetation resources within this headwaters region of the St. Louis River watershed meet the resource-based threshold of an Aquatic Resource of National Importance, under the Memorandum of Agreement reached by the EPA and the US Army Corps of Engineers in 1992[16].

Wildlife

The word "moose" does not appear at all in the SDEIS cumulative effects analysis, despite consistent concerns raised by tribal cooperating agency staff to co-lead agency staff during the environmental review process. As of August 19, 2013, moose are now proposed to be listed as a MNDR species of concern.

The tribal profile for the Grand Portage Band, states the unique importance of this species:

"Moose are the primary subsistence species for the Grand Portage Band and define the subsistence culture."
http://www4.nau.edu/tribalclimatechange/tribes/greatlakes_lschippewa.asp

From the Fond du Lac Wildlife Biologist: "In my experience at FDL, moose have always had a loyal core of hunters who pursue moose every year. Primarily for meat, but some for hide, bone and antler related crafts. I think also for the camaraderie, family traditions, etc – same as the rest of us for deer or duck camp. For the last couple of years at least, FDL has been supplying other bands with moose hides for drums.

Until very recently, the demand for moose hunting opportunities at FDL has always been greater than the supply. It's unique among locally hunted or trapped wildlife species that way. As the moose population has rapidly dwindled in the last couple of years, I believe more and more potential moose hunters are deciding it's not worth the effort.

Of all wildlife species, moose has required the most back and forth discussions between staff, legal counsel and the DNR regarding co-management of resources within the 1854 Ceded Territory. This again is a supply and demand issue, and reflects the relatively low density at which moose populate the landscape – even when times were good. -My program invests more effort and money in annual population surveys of moose than any other wildlife species."

[16] Clean Water Act Section 404(q) Memorandum of Agreement, Part IV (August 11, 1992)

The rationale for a comprehensive cumulative impacts analysis for moose can be found in the MDNR SONAR proposing listing of moose as a species of special concern:
(p. 21) "Between 1990 and 2000, the northwestern Minnesota Moose population underwent a substantial decline, and a 2007 Minnesota DNR aerial survey determined that as of that date, fewer than 100 Moose comprised the northwestern population. Aerial surveys currently estimate the northeastern Minnesota population at roughly 4,230 individuals. The northwestern Minnesota Moose population decline occurred in less than a decade. Recent surveys document a slow decline in the northeastern Minnesota Moose population.

"Increased temperatures are likely to increase heat stress and lead to increased mortality within the state's remaining Moose populations. Changes in land ownership and changes in forest management practices within the state's Moose range may be having a significant adverse effect on the quantity and quality of the species' habitat within the state, and particularly on thermal refuges in warmer weather. The state's northeastern Moose population has not shown as rapid a decline, but is very likely to be dramatically impacted by rising temperatures resulting from climate change. This will likely lead to a marked decline in this population within the foreseeable future."

From the *Report to the Minnesota Department of Natural Resources(DNR) by the Moose Advisory Committee (18 August 2009)*:
"In MN, moose habitat can be characterized as young forest stands, older forest stands with gaps of regenerating forest, wetlands, muskeg, marsh, riparian areas and brushlands with abundant deciduous browse within reach of moose and adequate winter and summer thermal cover. Functionally, habitat provides forage and cover. Moose forage has a primarily deciduous browse component and a seasonal aquatic component. Cover has several potential components for moose: protection from heat, protection from deep snow, moderation of cold temperatures, predator avoidance and presence of calving locations. In addition to the functional aspects of habitat, spatial distribution of habitat must also be considered at a variety of scales (from subhome range to the landscape level).

"As moose are increasingly challenged by warmer temperatures and changing precipitation patterns due to climate change, changes in land ownership and changes in forest management practices that occur within MN moose range have the potential to significantly affect the quantity, quality, and distribution of moose habitat. Examples include but are not limited to: habitat fragmentation due to expected and occurring ownership changes and shifting landowner objectives, changes in the extent of forest management due to national and state economic effects on the primary wood- using industry in Minnesota, and increased harvesting of smaller diameter trees and brush used by moose for browse as the demand for woody biomass increases. Focused management to provide high quality habitat (forage and cover) may be necessary to slow population declines and maintain or recover moose in appreciable numbers in Minnesota."

A cumulative impacts analysis must be done for this species of concern that it is of particular cultural importance to the Bands.

Air

Fugitive dust:

The tribal cooperating agencies believe that wind-blown dust particles containing sulfate compounds that are emitted from mining and beneficiation activities could contaminate wetlands, lakes, and streams near the project site and could cause harm to the Species of Special Concern that have been found in this area and to the animals that depend on these plants for food. While the PSDEIS attempts to address this issue, this is the first time details of this analysis have been available for review, and the tribes have identified some areas that require more work. The tribes do not agree with the assumption that only those areas showing model-estimated deposition rates greater than 100% of background deposition will be impacted. The choice of the "100% of background" level of deposition appears to be arbitrary and is not supported by any documentation. Further, the modeled deposition rates do not include the effects of contamination to wetlands and water bodies that may occur through other mechanisms, such as pit leaks and seepage, nor how additional sulfate will impact waters that are already experiencing elevated sulfate levels, with regard to the growth of wild rice. The work that has been done so far in this section does not meet the definition of a cumulative review.

The text describing this analysis is also unclear in places, as described below. In addition, tribal cooperating agency air staff members were not consulted regarding the impact of fugitive dust on historic properties and the definition of intra-property APE, especially with regard to mercury or acid dust (See page 4.2.9-9 of the PSDEIS).

All figures and page numbers cited below refer to the PSDEIS.

Misleading Description

- While areas of fugitive dust deposition may not exceed the ambient air quality standard beyond the property boundary, as stated in the PSDEIS, this information is irrelevant with regard to the tribes' concerns regarding sulfide dust, because there is no ambient air quality standard that is applicable to sulfide dust. Therefore, statements of this nature should be removed.

Acid and Metallic Dust

- Figure 5.2.3-23 (PSDEIS) shows that there are indeed potential indirect impacts to wetlands outside of the ambient air boundary due to deposition of dust. Figure 4.2.9-3 corroborates this claim by showing that the Fugitive Dust Area of Potential Effects extends well beyond the plant site.

- Page 5.2.3-6 lists the fugitive sources that were modeled for deposition. Rail cars and tailings basins were not included. Section 5.2.3.2.2 (page 5.2.3-58) states that the air IAP group determined that emissions from railcars would be coarse in nature and would not be dispersed to any great extent; therefore these emissions were not modeled. The section also states that “Based on this conclusion, air modeling of potential release of dust from railcars will not be performed because the potential wetlands effects would not be significant”. The analysis also assumes “that all spillage of the coarse material would occur in a 2-meter-wide strip on both sides of the center line of the railway over the entire haul distance.” While the dust may settle near the tracks, there is no evidence that it will not subsequently disperse and cause impacts. The dust can easily be spread through run-off.

- Tailings basin emissions were not modeled. Pages 5.2.3-50 and 5.2.3-51 and page 5.2.3-74 discuss fugitive dust somewhat, but do not make it clear whether “dust” is meant to address the acidic composition of the dust, or some other component. There are also contradictory statements on page 5.2.3-51: “All of the receptor nodes with the highest model-estimated deposition rates were located within the ambient air boundary” versus “Of the 234 acres of wetlands, 228 acres (97%) would be located within the Mine Site ambient air boundary”. “97%” does not equal “all”; apparently 6 acres of wetlands with the highest model-estimated deposition rates are outside of the ambient air boundary.

- Figure 5.2.3-17 indicates that the Partridge River could be impacted by fugitive dust, however this is not stated or addressed in the text.

- From page 5.2.3-51 “The potential release of dust from railcars transporting ore from the Mine Site to the Plant Site was addressed in an Air Quality IAP Workgroup that concluded potential wetland effects would not be significant and, therefore, air modeling was not performed (PolyMet 2013b). The tribal cooperating agencies have not been provided with any report that was generated by that workgroup, nor do they have any information about how that conclusion was reached. Also, “Of the 19,914 acres of wetlands identified within the Mine Site receptor grid, deposition modeling results indicated that 234 acres of wetlands could be potentially indirectly affected (modeled metal deposition rates greater than 100% of the background”. It is unclear whether modeling was performed for both metals and sulfide dust, and whether the results discussed on page 5.2.3-74 are for metals or sulfide dust. While Figures 5.2.3-16, 5.2.3-17, 5.2.3-22, and 5.2.3-23 differentiate between metals or dust modeling results, the discussion needs to be clearer.

- There are a number of unclear or incorrect statements under the heading *Fugitive Dust/Metals and Sulfide Dust Emissions* on page 5.2.3-74. Initially, the section states that "all receptors have model-estimated dust deposition of 50% or less of the effects-level background of 365 $g/m^2/yr$" but the next sentence states that "at the Plant Site, there would be two locations showing model-estimated deposition rates greater than 100% of background deposition". These two statements are contradictory.

- It is not clear which metals were modeled and whether the background concentrations mentioned (365 $g/m^2/yr$) was for metals or sulfide dust. There is no explanation for the origin of this background concentration and how the metals concentrations in dust were obtained. There is also no explanation of why 100% of background deposition was chosen as an indicator of whether potential effects could occur. To our knowledge, no discussion of this modeling or the assumptions contained within it was conducted with tribes or the co-leads before the PSDEIS was released.

- This section also indicates that the "southern and western two-thirds of the basin" shows model-estimated deposition rates greater than 100% of background deposition (exactly what constituent is being discussed is not clear). However, this same paragraph goes on to state that only 193.9 acres of wetland out of 25,846 could be potentially indirectly affected. These two statements appear to contradict one another. Without knowing what constituent is being discussed, it is hard to know which figure (5.2.3-16, 5.2.3-17, 5.2.3-22 or 5.2.3-23) corresponds to the text. Also, the yellow highlighted area on Figure 5.2.3-23, which indicates the "extent of the highest estimated deposition receptors with deposition of 100% of background", appear to cover a much larger area than 193.9 acres out of 25,846 total acres.

- The paragraph also states that "approximately 90% of the receptor nodes with the highest model estimated deposition rates are located within the ambient air boundary". It is impossible to verify this statement, because a map showing the location of the receptor nodes does not seem to have been included. If this statement is true, it overlooks that fact that 90% of the ***area*** predicted to be impacted does not lie within the ambient air boundary - only about 60% does, judging from Figure 5.2.3-23.

- The tribal cooperating agencies do not agree with the statement that "no potential indirect wetland effects from fugitive dust to Second Creek would occur" (page 5.2.3-74). A portion of Second Creek appears within the area predicted to experience deposition of 100% of background.

- Chapter 5's discussion of fugitive sulfide dust calls for future wetlands monitoring where predicted deposition will exceed 100% of the background value (first full paragraph on page 5.2.3-51). This monitoring should look at water chemistry, hydrology, soil color, texture, and composition and should take place annually for the first three years of operation and then every five years afterward. Baseline numbers should be obtained before construction starts.

- Page 5.2.4-4, *Indirect Effects* calls for water spraying areas of fugitive dust release during dry periods. Page 5.2.7-8 also calls for watering haul roads and other unpaved roads. In the case of dust that may have high acidic content, this would be a poor option, as the addition of water to the dust could simply create problems with run-off. The fugitive dust control plan also lists several monitoring options that "could" be done. These are left as vague ideas, but are not required. These options should be made more concrete.

Fibers

The tribes believe that the cumulative impacts of mineral fibers are not adequately addressed in the PSDEIS. In fact, no cumulative impact analysis of mineral fibers was performed because the PSDEIS asserts that mineral fibers will not be contacted in this project. This is a reckless assumption to make, with little evidence provided for justification, and it leaves a potentially harmful situation completely unaddressed. For example, the distance of the PolyMet project to known deposits of mineral fibers should be given in the PSDEIS. Rates of mesothelioma on the Iron Range are already alarmingly high, making it irresponsible for potential cumulative impacts to remain unaddressed. Although preliminary results from the University of Minnesota indicate that exposure to dust from today's taconite operations is "generally within safe exposure limits", it is possible that exposure to additional dust could lead to more cases of mesothelioma 30-40 years in the future, after the mine has closed. This is an issue that should unquestionably have received a cumulative impacts analysis. While the mine is expected to close in 20 years, this is not a timeframe that is relevant to either tribal concerns or to the development of mesothelioma. Tribal members live and recreate in areas close enough to the mine for this to be a source of concern. The proximity of fish, game, and culturally significant plants to the project site cause this issue to be an item of concern.

Only one year of mineral fiber monitoring in Hoyt Lakes is proposed in the PSDEIS, which the tribes believe is insufficient for detecting the potential release of fibers from portions of the formation that will be encountered during later years of operation. It is also not clear why Hoyt Lakes was chosen as a monitoring site, or if this where air dispersion modeling predicts maximum impacts. The tribes would expect to see monitoring performed for the entire life of the mine, at the site of maximum predicted impact. Since no "safe" mineral fiber concentration level has yet been specified, the tribal cooperating agencies urge the State of Minnesota to move forward to set this limit as soon as possible.

Noise

The co-lead agencies simply state that there are no other past, present, or reasonably foreseeable actions that would interact in such a way as to have a cumulative effect on the receptors identified in Sections 4 and 5 and no further evaluation of cumulative noise effects has been conducted. The tribal cooperating agencies believe it is indefensible to conclude that, amidst a “mining district” with multiple active mine facilities operating in close proximity, that there is no cumulative effect of 24 hour/day, seven days/week of heavy industrial and blasting noise on sensitive wildlife and on traditional cultural practices.

Cumulative Impacts of Noise, Vibration and Airblast Overpressure

Tribal cooperating agencies note that the noise information presented in the PSDEIS will be replaced with new data in the SDEIS. We have not been afforded the opportunity to review this information and must withhold detailed comment on the noise analysis for a later date.

With respect to cumulative impact analysis, tribal cooperating agencies do not believe that an adequate analysis has been done. Meeting ambient noise standards is a different question than assessing impacts. Impacts should be fully characterized in this document and contour maps showing overlapping noise pollution from different projects provided. Without this information, it is not possible for the public to review the cumulative impacts of noise. In addition, the cumulative impacts of mine related vibration have not been assessed. As shown in Figure 20, the cumulative effects of vibration are spatially extensive.

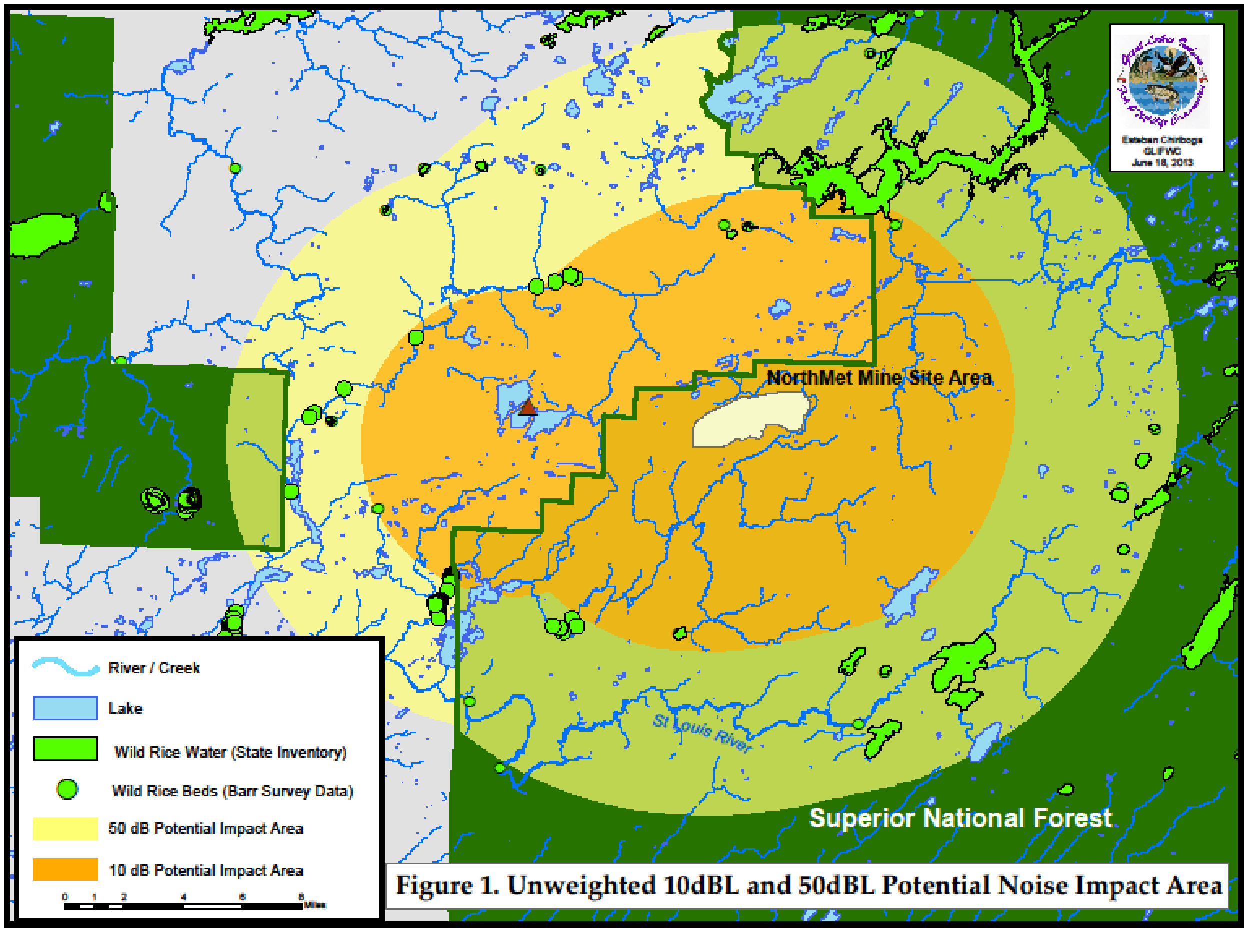

Figure 20. Unweighted 10 dBL and 50 dBL Potential Noise Impact Area

Tribal cooperating agencies also note that the noise, vibration, and airblast overpressure analysis confuses baseline noise levels with existing conditions and assumes they are the same thing. Baseline noise levels in the SDEIS should be natural noise levels that do not include existing mine operations such as Northshore. In other words, baseline is the pre-mining condition. Existing conditions are the noise levels currently recorded at the site of the proposed mine which include any contributions from the Northshore mine, the Dunka road, etc. The analysis would then use both of these pieces of information to assess the effects of the project as a single entity and in combination with other projects in the cumulative section. The lead agencies have indicated that they are using existing conditions (currently measured noise levels) as background. This is not appropriate and should be corrected.

The noise data presented in the SDEIS used A-weighted decibel data (dBA). This is appropriate when considering the effects of noise on humans because it focuses on the frequencies that the human ear can perceive. However, this weighting is not appropriate when assessing the effects on animals because they can perceive different, and often greater, ranges of frequencies than humans. The United States Department of Transportation (USDOT) has developed a document[17] describing the effects of noise on animal populations. In general the document indicates that the sensitivities of various groups of wildlife can be summarized as:

- Mammals < 10 Hz to 150 kHz ; sensitivity to -20 dB
- Birds (more uniform than mammals) 100 Hz to 8-10 kHz; sensitivity at 0-10 dB
- Reptiles (poorer than birds) 50 Hz to 2 kHz; sensitivity at 40-50 dB
- Amphibians 100 Hz to 2 kHz; sensitivity from 10-60 dB

Figure 21 indicates the noise area of impact for wildlife. The noise contours are unweighted decibel values (dB). A more complete analysis of these impacts in the SDEIS document for the NorthMet project is needed. Known locations of wild rice are included in the map because it is an important source of food for waterfowl. We also note that the entire area of impact is important habitat for Canada Lynx.

As illustrated in Figures 21 and 22, the impacts of noise, airblast and ground vibration overlap in a large area surrounding the mine site. Figure 21 (Cumulative Impacts on Wildlife) also provides the location of the remaining wildlife corridors in the area. The wildlife corridor immediately northwest of the mine site would be cumulatively affected by noise (10dBL and 50 dBL) airblast overpressure and ground vibration. These impacts when thought of in the context of its proximity to the mine site, wetland destruction and fragmentation of the 100 mile swamp lead to a conclusion of a severe and significant impact to this corridor. Figure 22 (Cumulative Impacts on Humans) indicates areas of tribal significance that are affected.

[17] *Synthesis of Noise Effects on Wildlife Populations*, USDOT Publication No. FHWA-HEP-06-016, September 2004

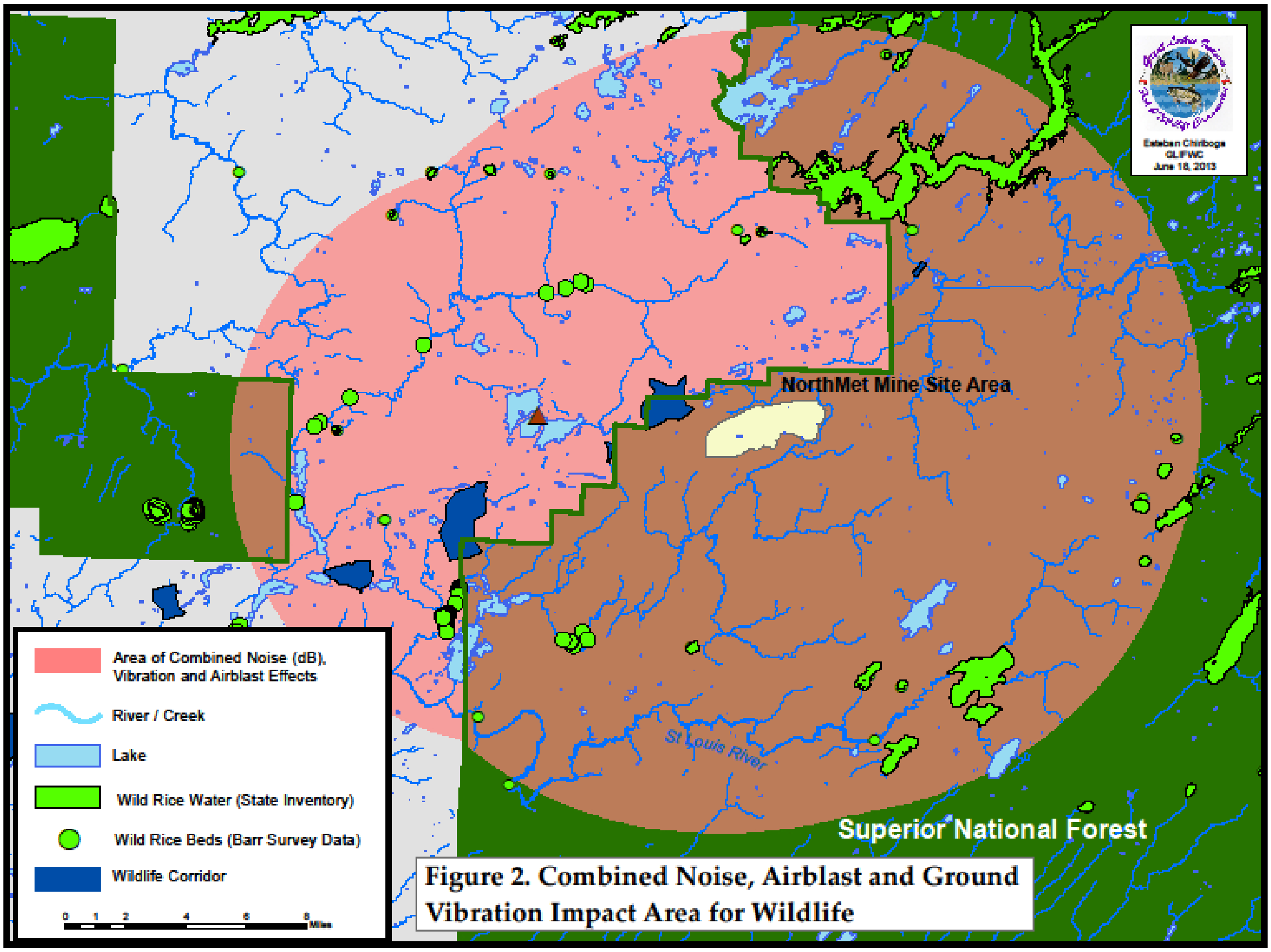

Figure 21. Combined Noise, Airblast and Ground Vibration Impact Area for Wildlife

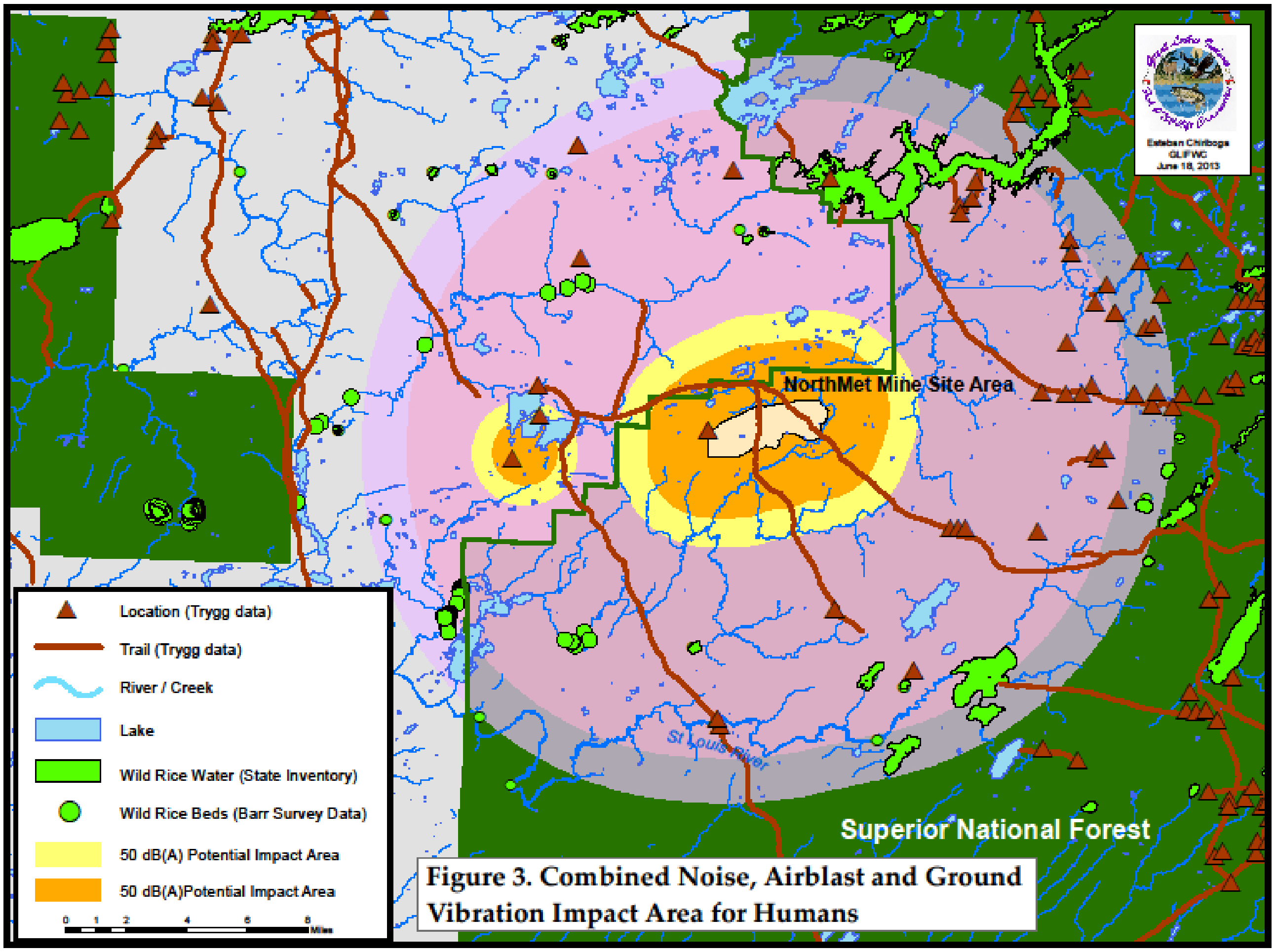

Figure 22. Combined Noise, Airblast and Ground Vibration Impact Area for Humans

No Action Alternative

A December 3, 2008 memo from NTS to the MPCA regarding the Area of Concern (AOC) Summary for the VIC Projects on the Cliffs Erie Property shows twenty-nine AOCs within the Project area. Only three AOCs have been remediated. Twenty of the remaining twenty-six sites' status is listed as "Area within property under Contract for Sale with PolyMet. No actions have been taken with regard to this site."

Some of those sites include: "Oily Waste Disposal Area, Private Landfill, Dunka WTP Sludge, Tailings Basin Reporting, Transformers, Emergency Basin, Cell 2W Salvage Area, Hornfels..." It also appears that there has not been a brownfield/superfund site investigation for the properties PolyMet intends to acquire for the Project area to assess existing contamination. Therefore, critical information to determine cumulative impacts at the site are not included in the SDEIS, and natural background water quality cannot be differentiated from existing contamination requiring remediation.

According to CEQ guidelines:

"No action" in such cases would mean the proposed activity would not take place, and the resulting environmental effects from taking no action would be compared with the effects of permitting the proposed activity or an alternative activity to go forward.

Where a choice of "no action" by the agency would result in predictable actions by others, this consequence of the "no action" alternative should be included in the analysis. For example, if denial of permission to build a railroad to a facility would lead to construction of a road and increased truck traffic, the EIS should analyze this consequence of the "no action" alternative."

Based on the above CEQ guidelines, it is clear that activities that will occur under the Cliffs Consent Decree should be included in modeling of a No Action alternative. Unfortunately not only are the consent decree activities not included, but the fact that it will be precipitating on the tailings basin for the foreseeable future has not been included in the No Action modeling. This is evident by the model results that show stable levels of chloride coming from the basin for the next 200 years (Figure 23) when there is no ongoing source for chloride. With no source for new chloride, rainwater will gradually dilute the residual chloride in the basin and levels will drop. The PSDEIS claims that the basin's water quality has stabilized and that the current conditions will not change over time. The claim of chemical stability is based on basin pond water sampling for only 4 years (2001 – 2004, PSDEIS Table 4.2.2-23).

Since there has been no water quality data collected in the basin pond for 9 years it is reasonable to assume that the past 9 years of precipitation has diluted the water chemistry in the basin pond, and that eventually the more dilute water will percolate through the basins and be discharged at the toe. If chemical stability is to be assumed, more recent data on basin pool water chemistry is needed. While the CEQ makes it clear that a blind "continuation of existing conditions" model is inappropriate as a No Action alternative, a "continuation of existing conditions" model that ignores simple environmental processes such as precipitation is even less appropriate.

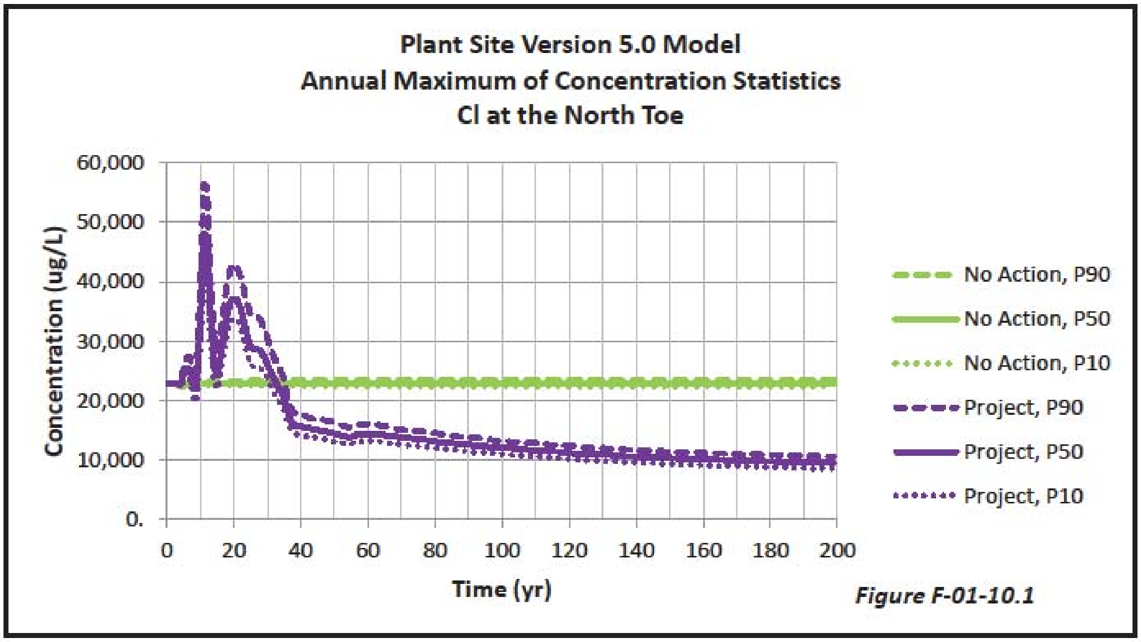

Figure 23. Annual Maximum of Concentration Statistics: Chloride at the North Toe.

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