# Mud Lake Futures Analysis: Ecosystem services and community values

City of Duluth Public Meeting May 30, 2019

### Introductions



This work was conducted by US EPA Office of Research and Development:

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- Joel Hoffman, EPA Office of Research and Development
- Keahna Margeson, Oak Ridge Associated Universities
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EPA Office of Research and Development is here to support decision-making, but is *not* the part of US EPA that makes decisions regarding Mud Lake.

## Presentation Objectives



- Share the methodology we used
- Report findings for ecosystem trade-offs
- Report findings for community impacts
- > Answer your questions

# Ecosystems services are the outputs of nature that make human life possible and worth living

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Predicting submerged aquatic vegetation cover and occurrence in a Lake Superior estuary

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#### ARTICLE INFO

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#### ABSTRACT

Submerged aquatic vegetation (SAV) provides the biophysical basis for multiple ecosystem services in Great Lakes estuaries. Understanding sources of variation in SAV is necessary for sustainable management of SAV habitat. From data collected using hydroacoustic survey methods, we created predictive models for SAV in the St. Louis River Estuary (SLRE) of western Lake Superior. The dominant SAV species in most areas of the estuary was American wild celery (Vollishieria mericana Michxe). Maximum depth of SAV in 2011 was approximately 2.1 m. In regression tree models, most of the variation in SAV cover was explained by an autoregression (Lg) term, depth, and a measure of exposure based on fetch. Logistic SAV occurrence models including water depth, exposure, bed slope, substrate fractal dimension, lag term, and interactions predicted the occurrence of SAV in three areas of the St. Louis River with 78–86% accuracy based on cross validation of a holdout dataset. Reduced models, sexuloing fractal dimension and the lag term. predicted SAV occurrence with 75–82% accuracy based on the state of the SAV occuracy based on the SAV occurrence with 75–82% accuracy based on the SAV occurrence with 75–84% occurrence w

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Mapping ecosystem service indicators in a Great Lakes estuarine Area of Concern



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#### ABSTRACT

Estuaries provide multiple ecosystem services from which humans benefit. Twenty-seven Great Lakes coastal systems in the United States and Canada, many of them estuarine, are currently designated as Areas of Concern (AOCs) due to a legacy of chemical contamination, degraded habitat, and non-point-source pollution. The ecosystem benefits that current and future human communities can receive from these degraded ecosystems are diminished. For an AOC to be delisted, it is generally necessary to restore aquatic habitat, among other actions. Ecosystems service mapping and assessment can inform AOC restoration and management. We describe an approach, with examples, for assessing how local-scale actions affect the extent and distribution of coastal ecosystem services, using the estuarine portion of St. Louis River AOC of western Lake Superior as a case study. We applied mapping criteria derived from locally validated predictive models, published relationships local experts,

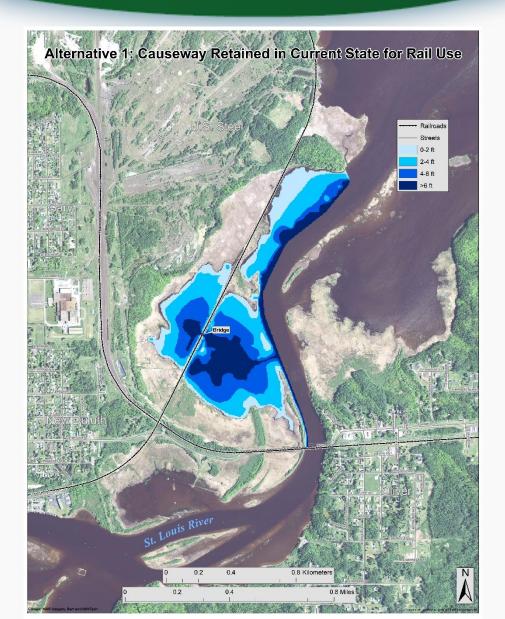
Both studies predate Mud Lake discussions by years

Table 2. Ecosystem services providing areas and extent for Mud Lake. The cells are color coded to help indicate relative change from current condition among alternatives: yellow = less than a 30% change from current conditions; blue = at least a 30% increase in area or extent from current conditions; pink = at least a 30% decrease from current conditions. For fill, a decrease in length is a positive change because it increases aquatic habitat connectivity. A decrease in protected shoreline increases connectivity but decreases shoreline habitat.

Ecosystem Service (units)	Current Condition (Alt 1)	Retain Rail, North Opening (Alt 2)	Rail to Trail, North Opening (Alt 3)	Retain Rail, North Opening, Bay Mouth Bar (Alt 2v2)	Rail to Trail, North Opening, Bay Mouth Bar (Alt 3v2)	Remove Causeway, North Opening, Bay Mouth Bar (Alt 4)
River greater than 6 feet deep (acres)	33.2	37.1	37.1	36.5	36.5	51.1
Highly-sheltered bay (acres)	23.4	26.5	26.5	30.9	30.9	9.8
Moderately-sheltered bay (acres)	29.8	28.2	28.2	42.6	42.6	21.0
Fill in public waters (lineal feet)	4894	4782	4782	4782	4782	3067
Protected shoreline (lineal feet)	4379	4107	4107	4107	4107	1302
75-100 percent probability of SAV occurrence (acres)	75.9	84.3	84.3	79.3	79.3	73.3
25-75 percent probability of SAV occurrence (acres)	42.7	40.5	40.5	40.4	40.4	46.2
50-100 percent probability (acres) of FLV occurrence (acres)	42.2	51.2	51.2	57.9	57.9	2.9
Power boating (acres)	75.9	75.9	75.9	75.9	75.9	110.9
Human-power boating (acres)	129.7	129.7	173.4	129.7	173.4	184.0
Esocid spawning (acres)	75.7	84.0	84.0	78.9	78.9	72.9
Designated shore fishing (acres)	0.0	0.0	1.0	0.0	1.0	1.2
Boat/ice fishing (acres)	144.6	153.5	153.5	149.2	149.2	160.6
Trapping (acres)	133.6	124.7	124.7	128.2	128.2	118.7

# Mud Lake: Existing Conditions (Alternative1)





### This is the baseline

### Existing recreational access:

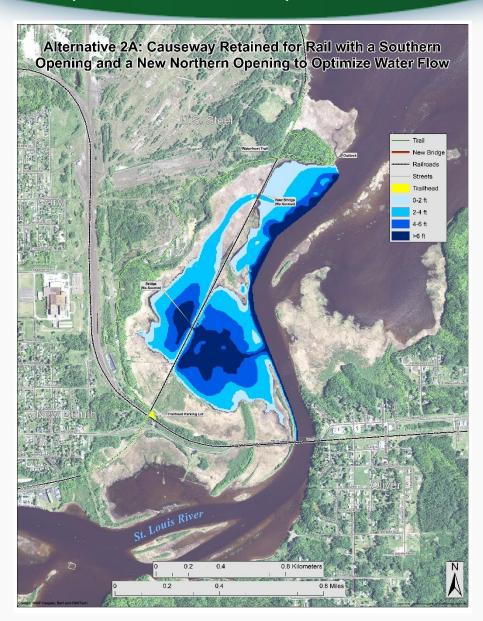
- Lake Superior and Mississippi RR
- Causeway is an informal trail
- Parking lot (informal parking on private property)

### Existing uses:

- Bird and wildlife watching
- Kayaking
- Jelly making
- Dog training
- Fishing

# Mud Lake: Retain Rail, N Open (Alternative 2)





Similar amounts of deep water habitat, sheltered bays, protected shoreline, SAV probability, human and power boating, Esocid spawning (pike, musky), shore fishing, boat and ice fishing, and trapping. V2 provides more sheltered bay habitat.

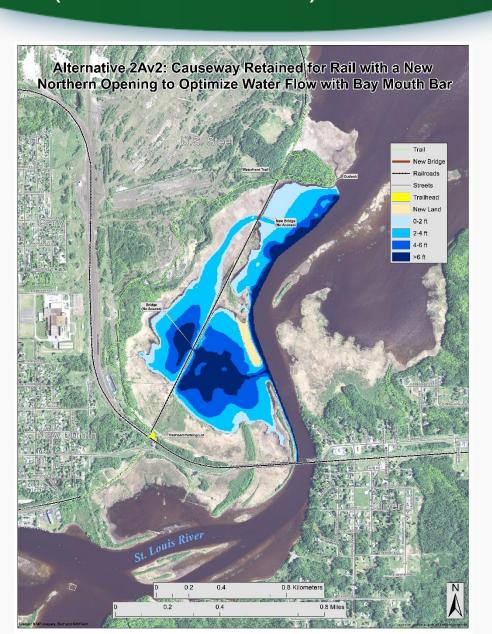
#### Potential recreational access:

- Lake Superior and Mississippi RR
- Trail on land
- Parking lot
- Designated outlook
- New bridge

- Bird and wildlife watching
- Limited kayak access
- Fishing

## Mud Lake: Retail Trail, N Open, Levee (Alternative 2v2)





Similar amounts of deep water habitat, protected shoreline, SAV probability, human and power boating, Esocid (pike, musky) spawning, boat and ice fishing, and trapping

 Better for highly-sheltered and moderately sheltered-bay habitat, and floating leaf vegetation

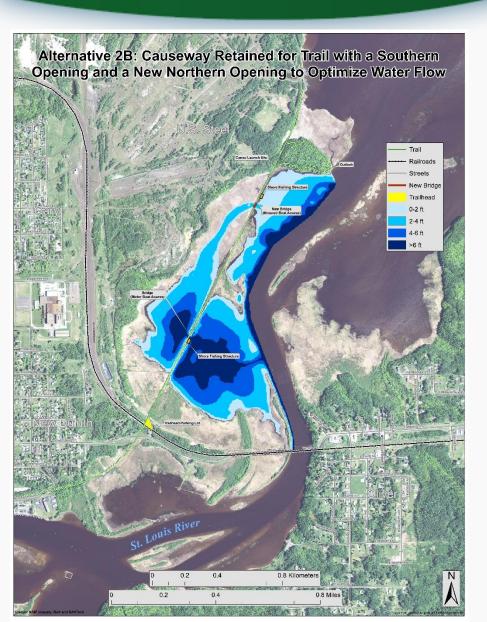
### Potential recreational access:

- Lake Superior and Mississippi RR
- Trail on land
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- New bridge

- Bird and wildlife watching
- Limited kayak access
- Fishing

# Mud Lake: Rail to Trail, N Open (Alternative 3)





Similar amounts of deep water habitat, sheltered bays, protected shoreline, SAV probability, human boating, Esocid (pike, musky) spawning, boat and ice fishing, and trapping.

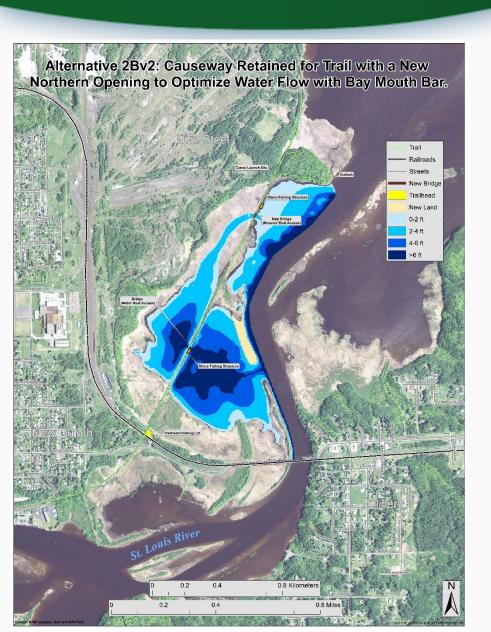
#### Potential recreational access:

- Trail on causeway
- Parking lot
- Designated outlook
- New bridges
- Two new shore fishing structures

- Bird and wildlife watching
- Kayaking with canoe launch
- Fishing

## Mud Lake: Rail to Trail, N Open, Levee (Alternative 3v2)





Similar amounts of deep water habitat, sheltered bays, protected shoreline, SAV probability, human-powered boating, Esocid (pike, musky) spawning, ice fishing, and trapping

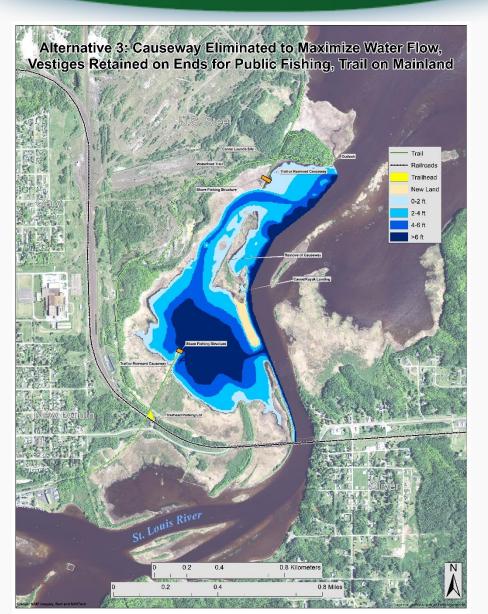
> Better for highly-sheltered and moderately sheltered-bay habitat, and floating leaf vegetation

#### Potential recreational access:

- Trail on causeway
- Parking lot
- Designated outlook
- New bridges with human-powered boat access
- Two new shore fishing structures

- Bird and wildlife watching
- Kayaking with canoe launch
- Fishing

## Mud Lake: Remove Causeway, N Open, Levee (Alternative 4)



### Most dramatic change

- More deep water habitat, most ecologically connected
- Less sheltered bay habitat, protected shoreline, floating leaf vegetation
- Most aquatic recreational use power boating, human-powered boating, boat and ice fishing, shoreline fishing

#### Potential recreational access:

- Trail on land
- Parking lot
- Designated outlook
- Fishing on causeway remnants and new fishing pier
- Canoe launch and kayak landing

- Bird and wildlife watching
- Canoeing and kayaking
- Fishing

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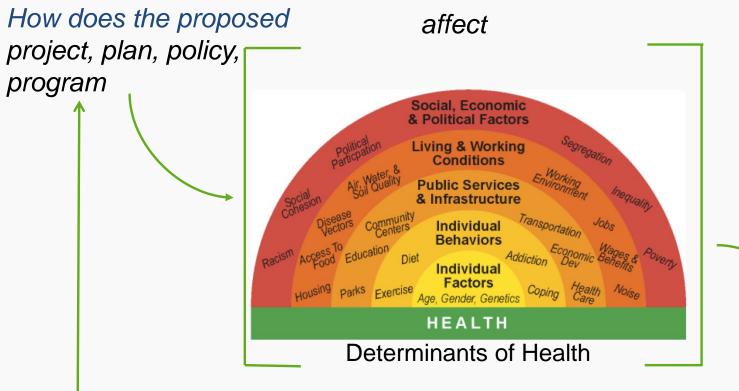
### Caveats



- We assume that the site will be similarly remediated and restored under all future alternatives
- A hydrodynamic model of current velocities and wetland water residence time was not available
  - Aquatic vegetation models assumed that current velocity will be like conditions in other sheltered bays in the river, such that establishment is possible.
  - Low current velocity could promote aggradation of wetlands, whereas high water velocity could scour existing wetland habitat.
- All models were based on a water elevation of 601.1 ft, and therefore habitat values do not reflect high water conditions (ca. 603 ft) or low water conditions (ca. 599 ft)



### What is Health Impact Assessment?



lead to health outcomes

Alternative	Recreational Access	Uses		
Alternative 1: No Change	<ul> <li>LSMR passenger train</li> <li>Causeway is an informal trail</li> <li>Parking lot (on private land)</li> </ul>	<ul> <li>Bird and wildlife watching</li> <li>Kayaking</li> <li>Jelly making (berry picking)</li> <li>Dog training</li> <li>Fishing</li> <li>Trapping</li> </ul>		
Alternative 2 and Alternative 2 v2: Retain Rail	<ul> <li>LSMR passenger train</li> <li>Trail on land</li> <li>Parking lot</li> <li>Designated outlook</li> <li>New bridge</li> </ul>	<ul> <li>Bird and wildlife watching</li> <li>Kayaking<sup>3</sup></li> <li>Fishing</li> <li>Trapping</li> <li>Hiking and biking</li> </ul>		
Alternative 3 and Alternative 3 v2: Rail to Trail	<ul> <li>Trail on causeway</li> <li>Parking lot</li> <li>Designated outlook</li> <li>New bridges with kayak and canoe access</li> <li>Two new shore fishing structures</li> </ul>	<ul> <li>Bird and wildlife watching</li> <li>Kayaking with canoe launch</li> <li>Fishing</li> <li>Trapping</li> <li>Hiking and biking</li> </ul>		
Alternative 4: Remove Causeway	<ul> <li>Trail on land</li> <li>Parking lot</li> <li>Designated outlook</li> <li>Fishing on causeway remnants and new fishing pier</li> <li>Canoe launch and kayak landing</li> </ul>	<ul> <li>Bird and wildlife watching</li> <li>Canoeing and kayaking</li> <li>Fishing</li> <li>Trapping</li> <li>Hiking and biking</li> <li>Power boating</li> </ul>		

Alternative	Description of Impacts	Impacts on health
Alternative 1: No Change	<ul> <li>Baseline alternative</li> <li>No change to the health determinants</li> <li>Current users will continue current uses. (e.g. railroad, informal trail, bird and wildlife watching, kayaking, fishing, etc.)</li> <li>Least protective for water quality, negative impact on indigenous communities' rights</li> <li>By definition, informal trails are NOT sanctioned</li> </ul>	<ul> <li>Access would remain <u>limited</u>.</li> <li>Positive impact on health for current users</li> <li>Potential negative impacts to indigenous communities' rights</li> </ul>
Alternative 2 and Alternative 2 v2: Retain Rail	<ul> <li>Rail continues, along with other uses (bird and wildlife watching, kayaking, fishing, etc.)</li> <li>Potential to improve habitat <ul> <li>Might positively bird and wildlife watchers, and anglers</li> </ul> </li> <li>Will positively impact hikers and bikers through the addition of a trail on land</li> </ul>	<ul> <li>Positive impact on most impacted populations</li> <li>LSMR, anglers, boaters, and trail users</li> </ul>
Alternative 3 and Alternative 3 v2 <sup>4</sup> : Rail to Trail	<ul> <li>Great loss for railroad organization (e.g., social cohesion and sense of purpose) and a loss for rail riders</li> <li>Potential to improve habitat, <ul> <li>Might positively bird and wildlife watchers, and anglers</li> </ul> </li> <li>Will positively impact hikers and bikers through the addition of a trail on land</li> <li>Tall bridge would provide improved access for kayakers and canoers to all of Mud Lake</li> </ul>	<ul> <li>Positive impact on recreational users, anglers, and boaters</li> <li>Negative impact on LSMR and the neighborhood that identifies with train</li> </ul>
Alternative 4: Remove Causeway	<ul> <li>Great loss for railroad organization (e.g., social cohesion and sense of purpose) and a loss for rail riders.</li> <li>Most potential to improve habitat         <ul> <li>Creation of a high-quality coastal wetland, which will likely positively impact indigenous communities (especially for wild rice harvesting), bird and wildlife watchers, and anglers</li> </ul> </li> <li>Positively impact hikers and bikers through the addition of the trail</li> </ul>	<ul> <li>Positive impact on recreational users, indigenous communities' rights, anglers, and boaters</li> <li>Negative impact on LSMR and the neighborhood that identifies with train, and bird watchers</li> </ul>

### Thank you for your time



Questions?

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