

Development of Numerical Targets For Delisting the Muskegon Lake Area of Concern

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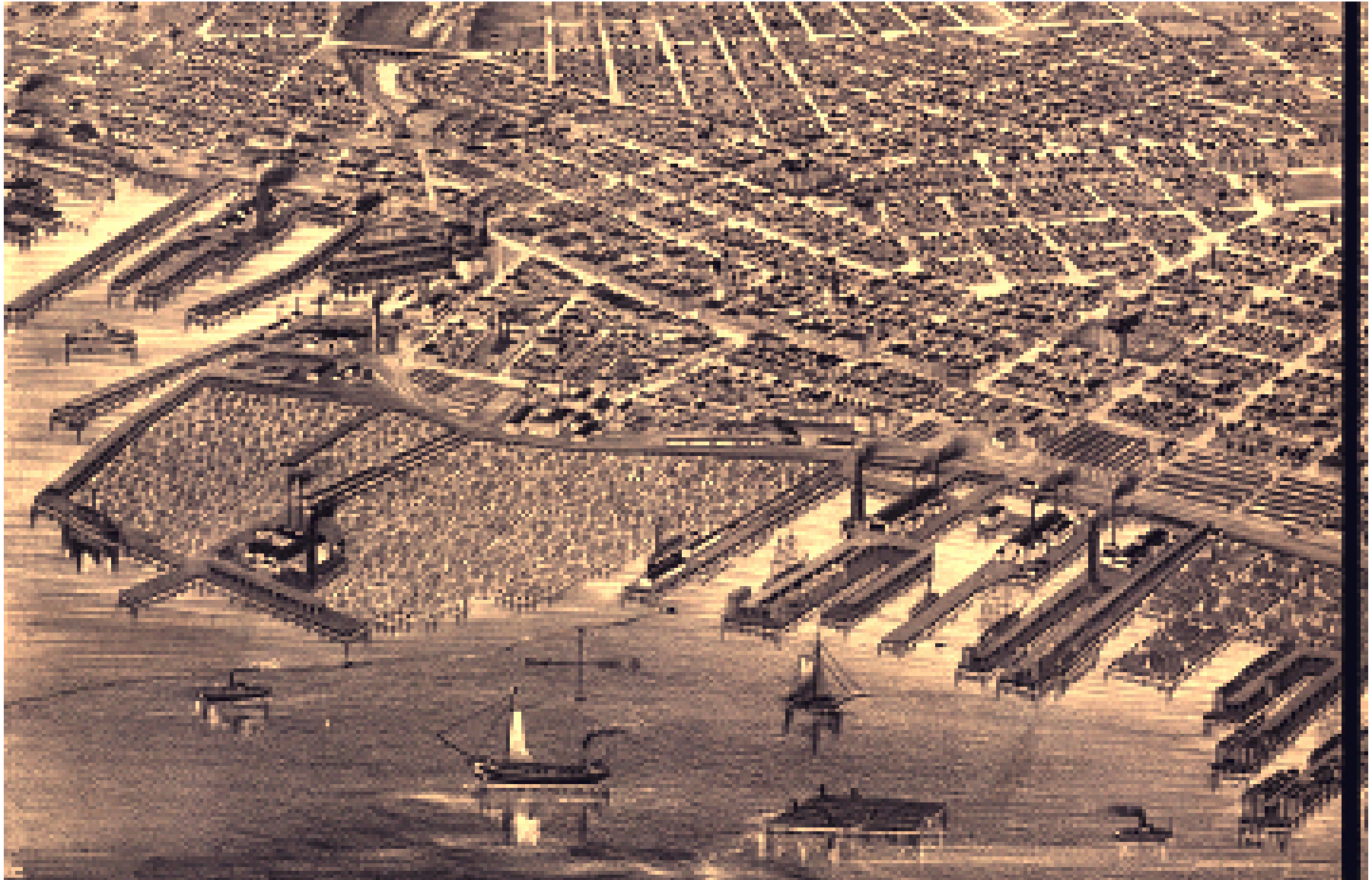
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Historical Problems in Muskegon Lake

- **Habitat destruction from logging (1800s)**
- **Direct discharge of wastewater: paper mill, metal finishing and casting, petrochemical, specialty chemical, and municipal sewage. 1940s-1970s**
- **Fish kills and tainting**
- **Oil slicks, floating scum, algal blooms, foul odors**
- **Contaminated sediments**
- **Anoxic and hypereutrophic conditions from excessive nutrient loading**
- **Designated an Area of Concern in 1985 (one of 43 of the worst sites of contamination in the Great Lakes)**
- **9 Beneficial Use Impairments (BUIs) identified from environmental pollution and ecosystem degradation**

Muskegon 1889



1900-1960 – Industrial development with littoral zone filling with foundry sand and scrap metal.



How Do We Get Off the AOC List?

- **Establish indicators and numerical targets for the restoration of each BUI**
- **Develop and implement a monitoring program to determine status and progress**
- **When monitoring data show compliance with a target for a specified length of time or a specific condition has been remediated, submit a request for delisting**

Original BUIs for Muskegon Lake Lake

Impairment	Rationale
Restrictions on Fish and Wildlife Consumption	Elevated PCBs in carp and mercury in walleye and bass
Degradation of Fish and Wildlife Populations	Fish Tainting, loss of sport fish, proliferation of rough fish, anoxia, and contaminated sediments
Degradation of Benthos	Low diversity, low numbers, dominance by worms, anoxia, and contaminated sediments
Restrictions on Dredging	Contaminated Sediments
Loss of Fish and Wildlife Habitat	Degradation due to contaminated sediments, poor water quality, and historic filling of the shoreline

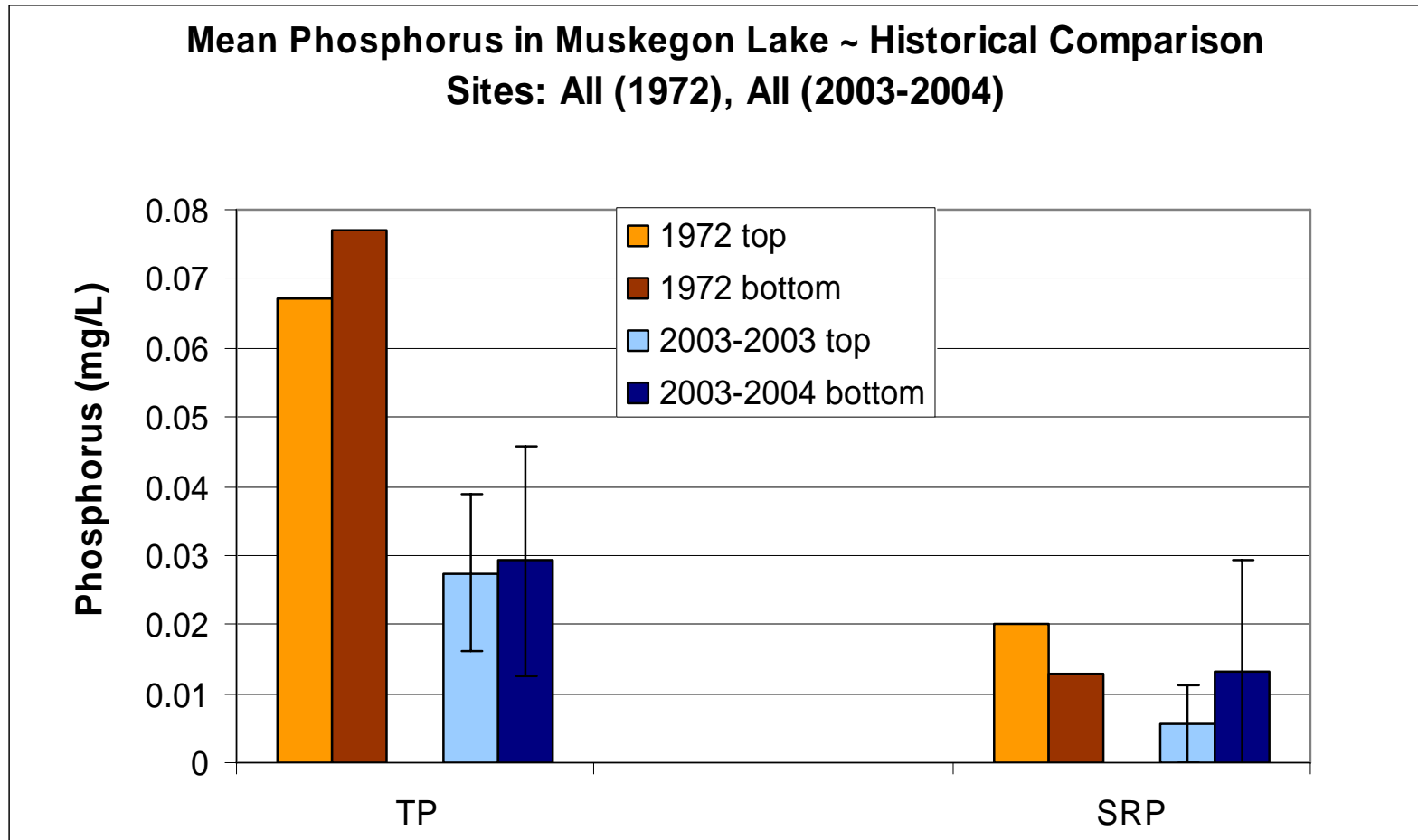
Additional BUIs for Muskegon Lake

Impairment	Rationale
Beach Closings	Frequent sewer breaks and pump failures
Groundwater Contamination	Abandon oil wells and Superfund Sites
Eutrophication and Undesirable Algae	Historic hypereutrophic conditions
Degradation of Aesthetics	Metal debris, floating scum, oil slicks

Target Development Process

- 1. Consider historical and current sources of degradation**
- 2. Identify parameters/target levels from site specific information, regulatory guidelines, and literature references**
- 3. Monitoring program design**
- 4. Identify partners/funding sources**
- 5. Approval of the PAC and stakeholders**
- 6. Scientific peer review**

Change in Phosphorus Concentration



*Change in Muskegon Lake Benthos
1972 and 1999 Mean Values*

	1972	1999
Total Benthos (#/m ²)	2858	6452
Oligochaeta (#/m ²)	2558	4562
% Oligochaeta	89	68
Chironomidae (#/m ²)	158	677
Diversity (SW)	0.68	1.66

Restoration Progress in Muskegon Lake

- **Discharge of industrial and municipal wastewater removed from Muskegon Lake. Advanced tertiary treatment system installed (1974)**
- **Remediation of Ruddiman Creek and the Story/Ott Superfund Site.**
- **Numerous enforcement activities resulting in groundwater and soil remediation (Teledyne, Brunswick, Sealed Power, MichCon, etc.).**
- **Remediation of.**
- **Heritage Landing and Fisherman's Landing**
- **319 project and numerous conservation efforts to improve water quality in the Muskegon River Watershed.**
- **GLFT/Wege research for environmental and fisheries management.**

Why Consider Delisting and Target Development?

- **Lakes meet the MDEQ Water Quality Standard for total phosphorus (30 ug/l)**
- **Significant remediation and source control has occurred**
- **Productive fisheries (MDNR and public)**
- **Public perception of the BUIs has changed**
- **Opportunity to become active managers**
- **Data drives informed decisions and actions**
- **Great Lakes Legacy Act and funding emphasis to support delisting**

Target Setting Process

- **AWRI facilitated the establishment of indicators and numerical targets for the restoration of 5 BUIs as part of a \$22,000 grant from the Great Lakes National Program Office**
- **AWRI reviewed scientific historical and current data, literature, and MDEQ/EPA guidance.**
- **Indicators and Targets were developed with input from the PACs and stakeholders.**
- **Indicators and Targets were peer reviewed by recognized scientists.**
- **Targets were modified based on peer review and adopted by the PAC in April 2006.**

Target for Delisting the Degradation of Aesthetics BUI

Public areas in the Muskegon Lake AOC should not contain quantities of contaminants, submerged rubble, and metallic debris that impede the safe access and enjoyment of the resource. Target areas: Ruddiman Creek, Ryerson Creek, Grand Trunk, Heritage Landing, Michigan Steel Bay

Target for Delisting the Beach Closings BUI

Ruddiman Creek is not included on the Michigan 303(d) list for pathogens and the bathing beaches at Harbor Towne and Muskegon State Park (Muskegon Lake) meet the water quality standards for total body contact for two consecutive years.

Target for Delisting the Fish Consumption BUI

The BUI will be considered restored when average the following annual concentrations/values are achieved for Muskegon Lake and Bear Lake:

Indicator	Target
Surface Total Phosphorus Concentration	30 ppb
Chlorophyll <i>a</i>	10 ppb
Secchi Disk depth	~ 2.0 m
Trophic Status Index	50-55

Target for Delisting the Degradation of Benthos BUI

The BUI will be considered restored when average benthic macroinvertebrate populations Muskegon Lake and Bear Lake reflect the following conditions:

Indicator	Target
Sediment Toxicity	Amphipod Survival >60%
<i>Hexagenia</i>	Present in river mouth littoral zone
% Oligochaeta	< 75%
Chironomidae (#/m²)	> 500
Diversity (SW)	> 1.5

Target for Delisting the Fish Consumption BUI

- **Key fish species:** walleye, smallmouth bass, and carp
- **Sample design:** 10-20 fish of each species collected in July and/or August
- **Tissue analyzed:** edible portion
- **Reference systems:** pooled non AOC drowned river mouth: Mona Lake and Pentwater Lake
- **Restoration target end:** BUI will be considered restored when edible portion analyses of key fish species are not significantly different from the pooled reference site data for 2 consecutive sampling periods (5 years). If a significant difference between Muskegon Lake and the reference systems remains at the end of the monitoring period, all the data for Muskegon Lake will be evaluated for a statistically significant decreasing trend in concentration. In this situation, the BUI will be considered restored when edible portion analyses of key fish species in Muskegon Lake show a significantly different decreasing trend from 1986 to the end of the monitoring period.

Future Actions

- **Complete targets for remaining BUIs. Grant Funding obtained and targets will be completed in 2007.**
- **Develop and implement a monitoring program to determine status and progress.**
- **Conduct corrective actions as necessary.**
- **When monitoring data show compliance with a target for a specified length of time, submit a request for delisting.**

Acknowledgements

- **Great Lakes National Program Office**
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- **Muskegon Lake PAC**
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