

Muskegon Lake Area of Concern

Fish and Wildlife Habitat Restoration and Beneficial Use Impairment Removal Strategy

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Prepared for
Muskegon Lake Watershed Partnership

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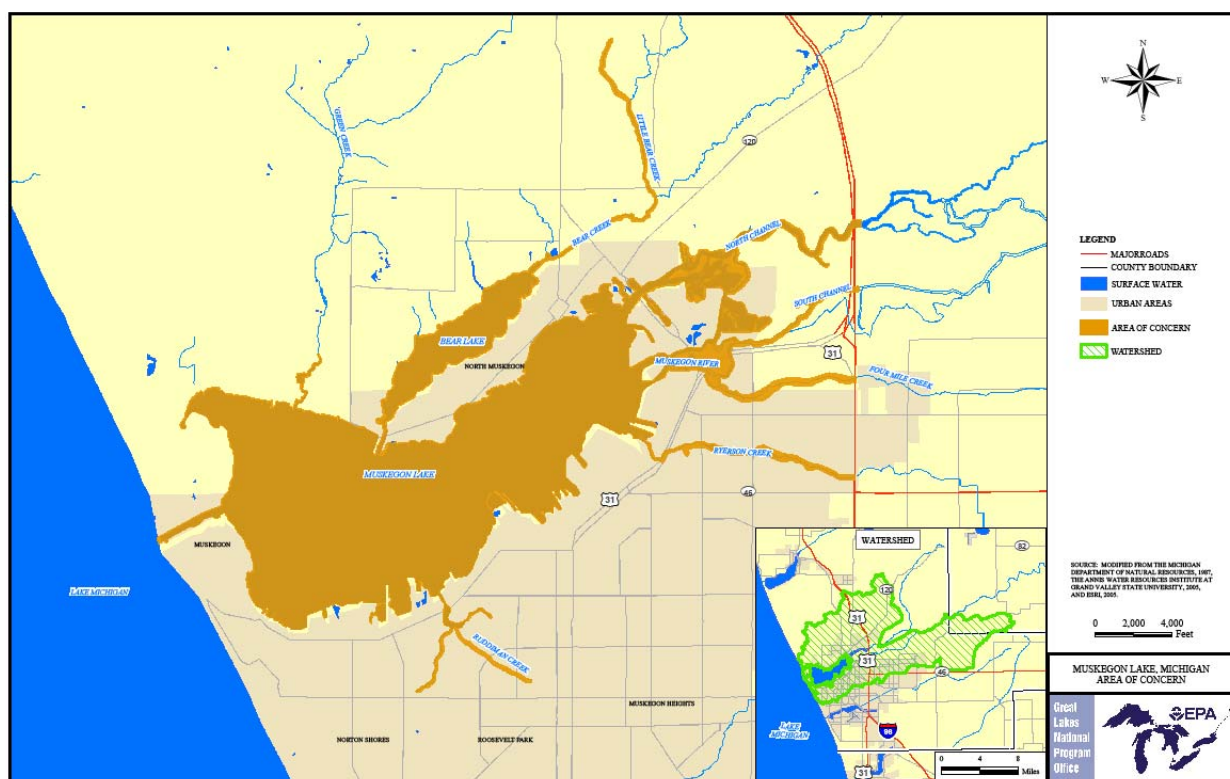
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Purpose of the Strategy

The Muskegon Lake Fish and Wildlife Restoration Strategy was developed to guide restoration of fish and wildlife habitat in the Muskegon Lake Area of Concern (AOC) and to enable the Muskegon Lake Watershed Partnership to track progress for the removal of two of the nine Beneficial Use Impairments (BUIs) identified for the AOC, the Loss of Fish and Wildlife Habitat and Degraded Fish and Wildlife Populations. The strategy was developed with guidance provided by the Michigan Department of Environmental Quality's 2007 publication, *Supporting Guidance for Local Restoration Criteria Development - Loss of Fish and Wildlife Habitat - Degradation of Fish and Wildlife Populations*, (MDEQ June 7, 2007) and the *Example Restoration Plan* (MDEQ, July 16, 2007). The Muskegon Lake Fish and Wildlife Habitat Restoration and Beneficial Use Impairment Removal Strategy is also consistent with the US Environmental Protection Agency 2005 Great Lakes National Program Office's *Pathways to Delisting* guidance document for removing fish and wildlife related BUIs in Great Lakes Areas of Concern (AOC). The fish and wildlife restoration goals illustrated in this plan were developed with support from a US EPA Great Lakes National Program Office grant in partnership with the National Fish and Wildlife Foundation. This is a dynamic strategy and it will be updated periodically to reflect the community's economic, social and environmental needs and goals.

EXHIBIT 1 Map of the Muskegon Lake AOC



SOURCE: USEPA GLNPO. Data modified from the Michigan Department of Natural Resources, 1988; the Michigan Center for Geographic Information, Department of Information Technology, 2004; and ESRI, 2005

Background

Muskegon Lake is a 4,232-acre drowned river-mouth lake, connected to Lake Michigan by a navigational channel. It was designated as a Great Lakes Area of Concern (AOC) in 1985 and is one of 14 AOCs in Michigan. The physical boundary of the Muskegon Lake AOC is illustrated in the Map of the Muskegon Lake AOC (see Exhibit 1).

According to the 1987, 1994 and 2002 Muskegon Lake Remedial Action Plans (RAP), the Loss of Fish and Wildlife Habitat and the resulting Degradation of Fish and Wildlife Populations Beneficial Use Impairments (BUI) occurred along the Muskegon Lake south shoreline and within stream tributaries and the Muskegon River mouth. The BUIs were caused by the historic filling of open water, littoral zone, wetlands and the protective terrestrial critical function zone habitats. Filling occurred with post-European settlement during the lumber era of the 1800's through the post World War II industrial era into the mid 1970's. Fill material includes sawmill waste in the form of slab wood and sawdust; coal ash; commercial and municipal demolition wastes such as broken concrete, asphalt and industrial waste, including metal scrap, foundry sand, slag and associated pollutants.

Due to the altering, filling and hardening of the lake's shallow zones, wetlands and riparian corridors, aquatic fish and wildlife habitat was eliminated. This resulted in polluted stormwater runoff and degraded fish and wildlife populations. Nearshore habitat was lost and remaining habitats were fragmented and isolated. According to the 2002 Muskegon Lake Community Action Plan and the MDNR Fisheries Division, *"the greatest impact on fisheries in Muskegon Lake has been due to the loss of shallow, littoral zone fish and wildlife habitat from dredging and development. In addition to shoreline filling and dredging, significant filling of wetlands has also occurred in the primary northern pike spawning areas located above the lake."* References to filling and altering the Muskegon Lake shoreline and the resulting loss, isolation and fragmentation of aquatic habitat can be found in the 1987, 1994 and 2002 Muskegon Lake Remedial Action Plans (RAP)¹.

EXHIBIT 2

Muskegon Lake AOC Saw Mill and Industry Fill Areas



¹ References to the causes of fish and wildlife-related impairments can be found in the Muskegon Lake 1987 RAP, Michigan Department of Natural Resources: Page 31, Paragraph 4.1; Table 4.1; Page 59, Table 5-2; Muskegon Lake 1994 RAP Update, Public Sector Consultants: Page 32-38; and in the Muskegon Lake Community Action Plan (2002 RAP Update), Muskegon Conservation District: Pages 10, 14, 18, 20, 39, 40, 41.

Because of the filling and hardening, fish and wildlife habitat and populations were determined to be impaired. Although historical data is not available for specific species impacted by the significant amount of filling and shoreline hardening on Muskegon Lake, the following list includes types of fish and wildlife populations that were likely impaired by the loss of habitat:

EXHIBIT 3
Muskegon Lake AOC Fish and Wildlife Types Likely to be Degraded

Fish	Reptiles	Amphibians	Mussels	Waterfowl/Other	Marsh Birds	Mammals
White Bass	Snapping Turtle	Bull Frog	<i>Types to be added</i>	Mallard	Green Heron	Mink
Great Lakes Muskellunge	Painted Turtle	Green Frog		Canvasbacks =	Belted Kingfisher	Otter
Northern Pike	Musk Turtle	Wood Frog		Blue-winged Teal =	Spotted Sandpiper	Fox
Yellow Perch	Spotted Turtle **	Spring Peepers		Hooded Merganser	Black Tern *+	Muskrat
Lake Sturgeon **	Wood Turtle +	Northern Leopard Frog		Lesser Scaup =	American Bittern *+	Other fish-eating mammals
Brown Trout	Blanding's Turtle +	American Toad		Wood Duck	Great Blue Heron	
Rainbow Trout	Red-eared Slider	Salamanders		Canada Goose	Common Moorhen *+	
Black Crappie	Map Turtle	Skinks		Trumpeter Swan**	Marsh Wren *	
Bluegill	Spiny Soft-shell Turtle			Merlin**	Sedge Wren *+	
Walleye	Eastern Box Turtle +			Common Nighthawk	Caspian Tern* *	
Smallmouth Bass	Snakes			Peregrine Falcon ***#	Black-crowned Night Heron *+	
Largemouth Bass				Osprey**	American Coot	
Flathead Catfish				Bald Eagle**(?)		

Michigan: * Special concern, ** Threatened, ***Endangered species

US Fish and Wildlife Service Region 3 Fish and Wildlife Resource Conservation Priorities, January 2002

(Region 3 includes the Great lakes): + rare/declining

Federal Trust Species, Endangered: #

Continental Concern (a federal designation): =

²References to the Fish and Wildlife Types / Populations Likely to be Degraded (listed on page 28)

As a result of 1994 RAP recommendations, the 1995 Muskegon Lake Aquatic Plant Assessment (Mark Luttenton) and the 1995 Muskegon Lake Habitat Assessment (Day & Associates) were completed. In addition, GVSU AWRI completed a 2004 inventory of hardened shoreline. These studies provided a baseline assessment of the condition of the lake's littoral zone macrophytes and shoreline habitat, including wetlands and related land uses and land coverage. Between 1995 and 2007, several native plant stormwater vegetative buffers were installed along the shoreline to protect water quality and to protect priority habitat restoration sites. Other implementation projects were aimed at building public support for restoration and at improving aesthetics, soil erosion and sedimentation and the quality of degraded, fragmented and isolated habitat along the shoreline and at the mouths of tributaries.

Overview of Restoration Targets for Delisting

The Focus Area Approach

For purposes of setting the fish and wildlife-related BUI targets contained in this strategy, the AOC was divided into four distinct Focus Areas. This approach allowed the development of restoration targets to be set based on the unique aquatic habitat characteristics and differences in the feasibility of restoration based on past, present and future land uses and zoning within each Focus Area. The Muskegon Lake Area of Concern (AOC) Fish and Wildlife Habitat and Populations Beneficial Use Impairments (BUI) will be restored when restoration work listed for each of the four (4) habitat Focus Areas meets targeted goals for BUI removal. The Muskegon Lake Fish and Wildlife Habitat Restoration Plan identifies: 1) Quantifiable habitat restoration targets for each Focus Area 2) Potential landowner restoration partners 3) Restoration Sites within each Focus Area 4) Feasible restoration practices to restore sites within each Focus Area 5) Timetables 6) Estimated funding needs.

Implementation of the strategy will restore fish and wildlife habitat and guide the removal of two fish and wildlife-related BUIs, to ultimately delist Muskegon Lake as an AOC. Restoration Sites are aggregated within each Focus Area to culminate in meeting measurable BUI restoration and removal targets.

EXHIBIT 4
Muskegon Lake AOC Focus Areas



SOURCE: GVSU Annis Water Resources Institute.
Data modified from Michigan Center for Geographic Information, 2005 Aerial

EXHIBIT 5
Muskegon Lake AOC Focus Area / Whole Lake Targets

Muskegon Lake AOC Focus Areas	Hardened Shoreline Edge		Emergent and Upland Wetland		Open Water Wetlands		Unnatural Lake Fill	
	<i>Current Condition</i>	<i>BUI Target</i>	<i>Current Condition</i>	<i>BUI Target</i>	<i>Current Condition</i>	<i>BUI Target</i>	<i>Current Condition</i>	<i>BUI Target</i>
Focus Area 1 – Southwest Muskegon Lake Shoreline	80.3%	48% (soften 11,850 linear feet)	4.11 acres	9.11 acres	14.58 acres	19.58 acres	128.42 acres	103.42 (remove and/or improve 25 acres)
Focus Area 2 – Ruddiman Creek and Nearby Shoreline	76.6%	50% (soften 6,194 linear feet)	18.22 acres	36.5 acres	39.71 acres	39.71 acres	89.98 acres	47.98 acres (remove and/or improve 42 acres)
Focus Area 3 – Downtown Shoreline and Ryerson Creek	87.4%	76% (soften 2,775 linear feet)	11.36 acres	14.69 acres	1.45 acres	6.45 acres	144.71 acres	137.71 acres (remove and/or improve 7 acres)
Focus Area 4 – Muskegon Lake East and River Mouth	47.7%	34.6% (soften 3,267 linear feet)	134.5 acres	181 acres	33.35 acres	42.35 acres	426.52 acres	376.92 acres (remove and/or improve 47 acres)
Totals	73%	52.15%	168.19 acres	241.3 acres	89.09 acres	108.09 acres	789.63 acres	666.03 acres

* Shoreline softening and fill removal/improvements are intended to result in wetland restoration at as many restoration sites as feasible

SOURCE: Adapted from “A Guide to the Restoration of Muskegon Lake Fish and Wildlife Habitat”, 2007: Muskegon Lake Watershed Partnership and Muskegon River Watershed Assembly, with funding by a US EPA GLNPO and National Fish and Wildlife Foundation grant to Timberland RC&D Area Council

Within the four Focus Areas, a total of 36 landowner sites were identified as suitable for fish and wildlife habitat restoration. However, reaching measurable BUI removal targets is not dependent on restoration being completed at every identified site. In addition, restoration within the Focus Areas is not limited to the identified sites for purposes of BUI removal. Other suitable sites within the Focus Areas may be restored in order to achieve targets. It is expected that a flexible approach involving existing and new landowners will be necessary to achieve restoration targets. To achieve sustainability, restoration designs must be acceptable to landowners and take into account the community’s recreational, economic and social needs along with the ecological restoration goals for Muskegon Lake.

Monitoring & Maintenance Overview

The Focus Area BUI Removal Tables list the appropriate Monitoring Approach for each delisting parameter (e.g., acres of fill improved; linear feet of shoreline softened; acres of wetland restored). They will be used to measure overall progress in meeting BUI removal targets for the AOC. In addition, site-specific monitoring and maintenance plans will be included in habitat restoration site designs so that it can be demonstrated whether or not a positive trajectory of restoration is underway at individual habitat restoration sites. Landowners will also be encouraged to use permanent conservation easements to ensure that restoration is sustainable.

Public Involvement Overview

The MLWP and the Habitat Committee will involve technical experts and the public in a three-year review of the feasibility of the fish and wildlife targets, based on restoration progress completed and underway. Based on public input and Habitat Committee recommendations, the MLWP will identify any needed adjustments to targets and make appropriate recommendations to MDEQ. In addition, volunteers, students, local government officials and landowners will be encouraged to be involved with site restoration designs, hands-on restoration and monitoring, as appropriate.



Focus Area 1: South West Muskegon Lake Shoreline

Description of Impairment and Location

The loss of fish and wildlife habitat and the resulting degradation of populations occurred in Focus Area 1, located along the Muskegon Lake south shoreline, due to the historic filling of open lake, littoral zone, emergent wetland and the protective riparian buffer and terrestrial critical function zone habitats. The shoreline habitats were filled with sawmill slab wood, sawdust and foundry waste, including sand, slag and broken concrete. The removal of Pigeon Hill, a massive coastal, freshwater sand dune was mined and its habitats lost, degraded, isolated and fragmented. A relatively undisturbed littoral zone between the paper mill and condominiums needs preservation. If connected with property that could be enhanced at the west end of the paper mill, it could also serve to restore reptile and amphibian habitat. A portion of the Grand Trunk property is owned by the MDNR and has potential for fill removal, shoreline softening and restoration of open water wetland habitat.

Impairments:

Loss of Fish and Wildlife Habitat and Degraded Fish and Wildlife Populations

Although historical data is not available for specific species impacted by the significant amount of fill and shoreline hardening on Muskegon Lake, Table 2 (page 5) presents a list of fish and wildlife that were likely impacted.

Current Physical Habitat Conditions in Focus Area 1:

- 80.3% of the shoreline is hardened/armored
- 128.42 acres of lake, littoral zone and wetland are impacted by unnatural fill
- 4.11 acres of wetland are present, based on 2005 aerial vegetation
- 14.58 acres of macrophytes are present.

²References – Muskegon County Museum Archives and GVSU-AWRI Information Services

EXHIBIT 6

Muskegon Lake AOC Focus Area 1 Restoration Sites and Unnatural Fill Map



Potential Habitat Restoration Sites:

1. Sweetwater (northern-most portion of Grand Trunk peninsula)
2. Grand Trunk (Volunteer Restoration Partnership with MDNR (landowner) and City of Muskegon)
3. SAPPI Fine Paper (east and west ends and any riparian edge)
4. Muskegon Country Club (littoral zone and wetland)
5. Torresen Marine, Muskegon Yacht Club (riparian edge plantings/greenway)
6. Edgewater Residential Landowners (riparian edge plantings/greenway)
7. Harbor Towne Condominiums, Marina, Yacht Club, Dockers Restaurant (Former Pigeon Hill dune restoration)
8. Muskegon City Beach / Lake Michigan Channel area (Former Pigeon Hill dune restoration)

Restoration Work for Focus Area 1, South West Muskegon Lake Shoreline

- A total of 11,850 linear feet of hardened shoreline will be softened by the removal of armoring and the installation of Best Management Practices (BMPs). BMPs may include a combination of native, vegetative shoreline/wildlife travel corridors, native plant stormwater buffers and rain gardens; removal of hardened shoreline debris and replacement with shoreline geo-web BMPs where erosion protection is needed for restoration.
- A total of 25 acres of unnatural fill is targeted for improvement. Removal of 25 acres of unnatural fill would likely not be feasible in this focus area due to existing development conditions. Therefore, the MLWP will work towards reaching this target by removing unnatural fill and restoring open water wetland where possible, and also by improving the unnatural fill by restoring more natural soil horizons and installing native plantings in landscapes, rain gardens and wetland enhancement projects.
- The restoration of 5 acres of open water wetlands is desired as one outcome of habitat restoration work within this focus area. However, if it is determined by the MLWP and the Habitat Committee that wetland restoration is not feasible in this focus area, this target can be met within another focus area in the AOC watershed boundary. If it is determined that the restoration of 5 acres of emergent and upland wetland restoration is not feasible, another priority area within the AOC boundary will be selected for emergent and upland wetland restoration.
- Eight (8) potential habitat restoration sites and landowners have been identified as potential habitat restoration partners, although restoration activities are not limited to the 8 sites. It is expected that a flexible approach of involving multiple variations of new and existing landowners will be necessary to reach restoration targets.

Table 1: Focus Area 1 BUI Removal Targets – Muskegon Lake AOC

BUI Removal and AOC Delisting Parameter	Current Condition	Restoration Target	Restoration Needed	*Monitoring Approach
Hardened Edge	80.3% (29,461 linear feet)	32.3% softened (11,850 linear feet or 3,950 yards)	48% (17,611 linear feet)	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC
Emergent and Upland Wetland	4.1 acres	+5 acres	9.1 acres	Great Lakes Marsh Monitoring Program; Bird Studies Canada and W. MI Volunteer Coordinators
**Open Water Wetlands	14.6 acres	+5 acres	19.6 acres	Fisheries IBI; GVSU-AWRI
Fill	128.4 acres	25 acres removed or improved	103.4 remaining or 128.4 acres with 25 acres improved	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC
Benthos	Lakewide baseline	Meet Degraded Benthos Target	Remove Degradation of Benthos BUI	Refer to Degradation of Benthos BUI criteria
Aesthetics	Five Sites	Meet Degradation of Aesthetics Target	Remove Degradation of Aesthetics BUI	MDEQ statewide monitoring program and locally developed site restoration plans

* A combination of population-based indicators and spatial, habitat-based measurements will be used to demonstrate a positive trajectory for restoration at specific sites. See Appendix for Monitoring Approach Protocols and/or Procedures

** Open Water Wetlands acreage is based on the 1995 Muskegon Lake Aquatic Plant Assessment, Dr. Mark Luttenton

Related Ongoing Planning Processes

Grand Trunk:

- The Muskegon Lake Watershed Partnership works with the Grand Trunk Restoration Partners (community volunteers from SAPPI Fine Paper and United Steel Workers Local 1015, Lakeside Neighborhood Association, businesses, City of Muskegon and Muskegon Public School students) to improve habitat at Grand Trunk annually. Activities include removal of foundry fill, slag, broken concrete and softening the shoreline with plantings of Michigan native trees, shrubs, flowers, grasses and emergent vegetation.
- Invasive species management for honeysuckle and black locust is also performed on sites impacted by unnatural fill. This site's habitat was also improved with a MDEQ Clean Michigan Initiative/Muskegon Conservation District NPS grant that installed two swales and native vegetative stormwater runoff filters. It is the site of wild rice seeding by the Muskegon River Watershed Assembly (MRWA).
- The US Fish and Wildlife Service's Coastal Program is providing grant funds for additional shoreline softening and native plant restoration activities through 2008/2009 in partnership with MRWA and West Michigan Shoreline Regional Development Commission (WMSRDC).
- WMSRDC has proposed restoration for the Grand Trunk site as part of a pending NOAA Great Lakes Habitat Restoration Program and MRWA has proposed it for matching Natural Resource Damages Assessment (NRDA) funding.

SAPPI Fine Paper:

- MLWP Habitat Committee members have discussed potential restoration and preservation ideas with SAPPI Fine Paper representatives for the east end (adjacent to Grand Trunk marsh) and for the fenced-off west end (former wood yard) along the shoreline and adjacent to the Muskegon Country Club's wetland and littoral zone. Immediately to the west is the City of Muskegon's JayCee's Boat Launch Ramp. Restoration in this area has the opportunity to create suitable habitat for breeding amphibians, waterfowl habitat and species that require space that includes a contiguous complex and/or diversity of habitats.

Edgewater:

- A demonstration habitat improvement project was completed with Edgewater residents in 2007 with funding from a US EPA GLNPO grant to demonstrate techniques that improved fill, eliminated lawn, removed large broken concrete and softened the shoreline with habitat-friendly limestone erosion protection and a native plant buffer.

Scope of Work for Focus Area 1

1. Timetable: approximately 3-8 years
2. Funding: approximately \$1.5 million Responsible Entities: The Muskegon Lake Watershed Partnership's Habitat Committee with support from the West Michigan Shoreline Regional Development Commission will be the responsible parties who will ensure that the restoration plans are developed and actions are complete. MLWP and WMSRDC will work with restoration partners, subcontractors and landowners, including Grand Trunk Restoration Partnership, Muskegon River Watershed Assembly, Muskegon Conservation District, City of Muskegon, GVSU Annis Water Resources Institute, Muskegon Community College and Bird Studies Canada to ensure that monitoring and evaluation is complete in conjunction with habitat plans and projects carried out in Focus Area 1.
3. Indicator and Monitoring: Monitoring restoration in this area will require confirmation of the removal and enhancement of fill for improved aquatic habitat and a spatial increase of riparian habitat and visual observations to ensure survival rate of native plant species is suitable to establish a trajectory for recovery of riparian habitat. The Great Lakes Marsh Monitoring Program will be used to monitor marsh birds and/or amphibians as indicators of restoration progress in a representative habitat within the focus area and the Fisheries IBI will be used to indicate the presence of suitable aquatic vegetation that meets the MDNR Fisheries Division goals for healthy fisheries. Site-specific monitoring plans to ensure the success of restoration and maintenance plans will be identified during the project restoration design phase, as appropriate for each site.

4. Public Involvement: Annual Spring and Fall Stewardship events and other special, restoration project-related events will involve the community in restoration activities and the maintenance of the native plant habitats.

South West Muskegon Lake Shoreline Focus Area 1 Public Input / Needs Identified at February 26, 2007 MLWP Public Meeting	Timeline						
	2008	2009	2010	2011	2012	2013	2014
Remove unnecessary seawall remnants & broken concrete fill northwest of Muskegon Yacht Club, along Edgewater St. Replace with engineered soft shoreline, native plant landscapes	X	X	X				
Enhance former Pigeon Hill sand dune area with native dune plants, create a safe wildlife corridor & control foot traffic in dunes		X	X				
Assess bird migration needs and develop appropriate habitat rehabilitation activities throughout target area	X	X	X				
Encourage landowners to conserve natural areas and to re-vegetate with native plants in landscapes	X	X	X	X	X	X	
Conserve and enhance Muskegon Country Club littoral zone, emergents and shrub scrub buffer, east of City's JayCees public launch ramp to connect habitat with SAPPI's west end buffer	X	X	X				
Enhance wetland & buffer near railroad track and houses near Grand Trunk wetland/MDNR property for reptiles & amphibians	X	X	X				
Enhance shallow water / littoral zone between SAPPI and Grand Trunk shorelines for waterfowl and other wildlife		X	X	X			
Benthos sampling offshore of SAPPI	X	X	X				
Determine on site environmental conditions that may affect future habitat rehabilitation at SAPPI		X	X				
Improve access and enhance SAPPI shoreline buffer at west end to connect with Muskegon Country Club littoral zone for reptiles and amphibian critical function zone habitat		X	X	X			

Project Reporting

All progress on associated targets will be reported to MDEQ via the MLWP support staff or MLWP chair. Progress reports will be made on an annual basis in written format and discussed with the Muskegon Lake AOC coordinator from MDEQ. Specific MLWP roles for restoration, monitoring and reporting tasks will be further defined during project planning by the MLWP Habitat Committee with staff support from WMSRDC (as grant project and staff support funding allows). The MLWP Muskegon Lake AOC BUI Removal Strategy will also be used to track progress, adding an additional layer of assurance that the restoration plan is being carried out effectively.

Focus Area 2: Ruddiman Creek and Nearby Shoreline

Description of Impairment and Location

The loss of fish and wildlife habitat and the resulting degradation of populations occurred in Focus Area 2, located along the Muskegon Lake south shoreline, due to the historic filling of open lake, littoral zone, emergent wetland and the protective riparian buffer and terrestrial critical function zone habitats. The shoreline habitats were filled with sawmill waste, slab wood and foundry waste, including sand and slag. As a result, most of the shoreline was rip rapped with large chunks of broken concrete to prevent erosion. The banks of Ruddiman Creek were also lined with broken concrete and fill in the mouth includes slabs of broken concrete and tires. A former oil tank farm, located immediately east of the Ruddiman Creek mouth, filled and polluted groundwater, surface water, soils, and degraded wetland habitat. A current groundwater cleanup at the filled wetland site is preventing the plume from migrating to surface waters. A large concrete wall continues to isolate the wetland from the lakeshore and the creek, restricting fish and wildlife movement and access to critical habitats. To the east of the former tank farm, a linear littoral zone and shoreline wetland fringe was degraded by historic slab wood fill and railroad operations. The wetland fringe needs to be enhanced and preserved in order to connect fragmented habitat along Lakeshore Trail (bike path) between the former tank farm and Lakeshore Yacht Club/Coles Marina. At the west side of the mouth of Ruddiman Creek, an existing wetland is in need of preservation. West of Ruddiman Creek is the Lake Express ferry terminal, a marina and aggregate storage area. Industrial fill has hardened the shoreline and extensive slab wood and sawdust fill has degraded open water, wetland and benthic habitats.

Impairments:

The impairment in Focus Area 2 is the Loss of Wildlife Habitat and Degraded Wildlife Populations. Although historical data is not available for specific species impacted by the significant amount fill and shoreline hardening on Muskegon Lake, the table on page 5 lists species that were likely impacted.

Current Physical Habitat Conditions in Focus Area 2:

- 76% of the shoreline is hardened/armored
- 89.98 acres of lake, littoral zone and wetland are impacted by unnatural fill
- 18.22 acres of wetland are present, based on 2005 aerial vegetation
- 39.71 acres of macrophytes are present

³References – Muskegon County Museum Archives and GVSU-AWRI Information Services

EXHIBIT 7

Muskegon Lake AOC Focus Area 2 Restoration Sites and Unnatural Fill Map



Potential Habitat Restoration Sites:

1. Great Lakes Marina, Great Lakes Dock & Lake Express
2. Mouth of Ruddiman Creek, west & wetland - R.C. Productions
3. Ruddiman Creek mouth, main branch and pond - City of Muskegon
4. Ruddiman Creek main branch, west branch and north branch - riparian landowners
5. Former Amoco Tank Farm - City of Muskegon & BP
6. Lakeshore Trail (bike path below residential Lakeshore Drive) – City of Muskegon & residents
7. Coles Bakery & Marina & Lakeshore Yacht Club
8. Michigan Steel Bay and Foundry Peninsulas

Restoration Work for Focus Area 2, Ruddiman Creek & Nearby Shoreline

- A total of 6,194 linear feet of hardened shoreline will be softened by the removal of armoring and the installation of best management practices (BMPs) including native, vegetative shoreline buffers, rain gardens, shoreline geo-web native plantings and other BMP techniques.
- A total of 42.25 acres of unnatural fill is targeted for improvement, preferably with 19.75 acres removed and restored and an additional 25 acres improved by installing native plantings, rain gardens, wetland enhancements and related BMP techniques.
- The restoration of 18.28 acres of emergent and upland wetland and no net loss of open water wetland is desired as one outcome of habitat restoration work within this focus area.
- Eight (8) potential habitat restoration sites and landowners have been identified as potential habitat restoration partners, although restoration activities are not limited to the 8 sites. It is expected that a flexible approach of involving multiple variations of new and existing landowners will be necessary to reach restoration targets.

Table 2: Focus Area 2 BUI Removal Targets – Muskegon Lake AOC

BUI Removal and AOC Delisting Parameter	Current Condition	Restoration Target	Restoration Needed	*Monitoring Approach
Hardened Edge	76.6% (17,837 linear feet)	50% (11,643 linear feet)	26.6% softened (6,194 linear feet or 2,064 yards)	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC.
Emergent and Upland Wetlands	18.22 acres	36.5acres	+18.28 acres	Great Lakes Marsh Monitoring Program; Bird Studies Canada and W. MI Volunteer Coordinators
**Open Water Wetlands	39.71 acres	39.71acres	+ 0 acres	Fisheries IBI; GVSU-AWRI
Fill	89.98 acres	70.23 remaining	19.75 acres <i>removed</i>	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC
Fill	89.98 acres	67.48 remaining	22.5 acres <i>improved</i>	“ “
Fill	89.98 acres	47.7 remaining	42.25 acres <i>combined</i>	“ “
Benthos	Post remediation	(see target)	Monitoring	GVSU-AWRI
Aesthetics	Ruddiman Creek Mouth Michigan Steel Bay	See Degradation of Aesthetics Target	Remove Degradation of Aesthetics BUI	MDEQ statewide monitoring program and locally developed site restoration plans

* A combination of population-based indicators and spatial, habitat-based measurements will be used to demonstrate a positive trajectory for restoration at specific sties. See Appendix for Monitoring Approach Protocols and/or Procedures

** Open Water Wetlands acreage is based on the 1995 Muskegon Lake Aquatic Plant Assessment, Dr. Mark Luttenton
Other Habitat Committee Notes: Remove contaminated fill at former Amoco site and return to wetland habitat; No net loss of open water wetlands due to dredging or filling.

Related Ongoing Planning Processes

Ruddiman Creek and Nearby Muskegon Lake Shoreline:

- The US EPA contracted with Biohabitats to produce the Muskegon Lake / Ruddiman Creek Ecological Restoration Master Plan, completed in March, 2008. The MLWP is using the master plan to develop proposals for restoration projects within Focus Area 2.
- The US FWS Coastal Program is partnering with MLWP, MRWA, WMSRDC and MCD on an aquatic habitat restoration project, including softening of hardened shoreline, removal of Phragmites and other opportunistic non-native invasive plants, with the restoration of a fragmented shoreline corridor with native, aquatic emergent and riparian plant species. The YES (Youth, Environment Summit) program and Great Lakes Stewardship Initiative with the Muskegon Area Intermediate School District is providing teacher training, curriculum and plant materials for hands-on restoration activities.

Mouth of Ruddiman Creek:

- A Ruddiman Creek 319 Watershed Planning Project proposal was submitted to MDEQ in 2008. If funded, the proposal will provide necessary hydrologic information to assist with the appropriate design of water quality and aquatic habitat restoration projects, as recommended in the EPA/Biohabitats ecological restoration master plan.

Former Amoco Tank Farm Peninsula:

- NOAA's Fisheries Habitat Restoration Center is partnering with WMSRDC, GLC and the MLWP Habitat Committee to develop restoration designs for aquatic fish and wildlife habitat at AOC sites, including the former Amoco Tank Farm, a priority identified in the Biohabitats ecological restoration master plan.

Scope of Work for Focus Area 2

1. Timetable: approximately 5-8 years
2. Funding: approximately \$2.5 million
3. Responsible Entities: The Muskegon Lake Watershed Partnership's Habitat Committee with support from the West Michigan Shoreline Regional Development Commission will be the responsible parties who will ensure that the restoration plans are developed and actions are complete. MLWP and WMSRDC will work with restoration partners, subcontractors and landowners, including Muskegon River Watershed Assembly, Muskegon Conservation District, City of Muskegon, GVSU Annis Water Resources Institute, Muskegon Community College, Greater Muskegon and Muskegon Catholic Central Schools, and Bird Studies Canada to ensure that monitoring and evaluation is complete in conjunction with habitat plans and projects carried out in Focus Area 1.
4. Indicator and Monitoring: Monitoring restoration in this area will require confirmation of the removal and enhancement of fill for improved aquatic habitat and a spatial increase of riparian habitat and visual observations to ensure survival rate of native plant species is suitable to establish a trajectory for recovery of riparian habitat. The Great Lakes Marsh Monitoring Program will be used to monitor marsh birds and/or amphibians as indicators of restoration progress in a representative habitat within the focus area and the Fisheries IBI will be used to indicate the presence of suitable aquatic vegetation that meets the MDNR Fisheries Division goals for healthy fisheries.
5. Public Involvement: Annual Spring and Fall Stewardship events and other special, restoration project-related events will involve the community in restoration activities and the maintenance of the native plant habitats.

Muskegon Lake South / Ruddiman Creek Focus Area 2 Public Input / Needs Identified at February 26, 2007 MLWP Public Meeting	Timeline						
	2008	2009	2010	2011	2012	2013	2014
Work with Lakeshore Yacht Harbor and Coles to develop fish and wildlife opportunities		X	X				
Clean up shallow water/littoral zone at Michigan Steel bay		X	X				
Continue wild rice and native grasses at Michigan steel bay, peninsulas and Ruddiman Creek bay	X	X	X				
Connect bike trails with habitat/greenway	X	X	X	X	X	X	
Assess Foundry Park for appropriate habitat improvements		X	X				
Manage invasive species along bike path	X	X	X				
Continue habitat restoration of Ruddiman creek cleanup sites, mouth and adjacent Muskegon Lake shoreline	X	X	X	X			
Improve and protect former Amoco tank farm for nature and people	X	X	X				
Assess dam and culverts impact on Ruddiman Creek habitat quality		X	X				

Project Reporting

All progress on associated targets will be reported to MDEQ via the MLWP support staff or MLWP chair. Progress reports will be made on a biennial basis in written format and discussed with the Muskegon Lake AOC coordinator from MDEQ. Specific MLWP roles for restoration, monitoring and reporting tasks will be further defined during project planning by the MLWP Habitat Committee with staff support from WMSRDC (as grant project and staff support funding allows). The MLWP Muskegon Lake AOC BUI Removal Strategy will also be used to track progress, adding an additional layer of assurance that the restoration plan is being carried out effectively.

Focus Area 3: Downtown and Ryerson Creek

Description of Impairment and Location

The loss of fish and wildlife habitat and the resulting degradation of populations occurred in Focus Area 3, located along the Muskegon Lake shoreline in the downtown development area due to historic filling of open lake, littoral zone, emergent wetland and the protective riparian buffer and terrestrial critical function zone. Relative to the other focus areas, Focus Area 3, located between Michigan Steel and the former Teledyne Continental Motors was the most heavily industrialized, deep water port area along the shoreline. Beginning in the 1980's, this area began to see industry leave the shoreline and new developments include public-friendly uses, including Heritage Landing, a county-owned park and later GVSU Annis Water Resources Institute and the Michigan Alternative and Renewable Energy Center. These and other commercial and quasi-public developments took advantage of brownfield redevelopment grants, loans and other re-development tax incentive authorities to facilitate development. Due to the historic impacts of heavy industry, sediments remain contaminated with mercury, oil, grease and PAHs at the Division Street Outfall, mouth of Ryerson Creek and offshore from the Mich-Con / Lakey Foundry 201 site.

Impairments:

The impairment in Focus Area 2 is the Loss of Wildlife Habitat and Degraded Wildlife Populations. Although historical data is not available for specific species impacted by the significant amount fill and shoreline hardening on Muskegon Lake, the table on page 5 lists species that were likely impacted.

Current Physical Habitat Conditions in Focus Area 3:

- 87.4% of the shoreline is hardened/armored
 - 144.71 acres of lake, littoral zone and wetland are impacted by unnatural fill
 - 11.36 acres of wetland are present, based on 2005 aerial vegetation
 - 1.45 acres of macrophytes are present, based on 1995 aquatic plant assessment
- ³ References – Muskegon County Museum Archives and GVSU-AWRI Information Services

EXHIBIT 8

Muskegon Lake AOC Focus Area 3 - Restoration Sites and Unnatural Fill & Wetland Maps



Potential Habitat Restoration Sites:

1. Andries, VerPlank, Great Lakes Dock & Materials, Former Rag & Metal properties
2. Ryerson Creek (bay, mouth and stream), City of Muskegon & Private Landowners
3. Terrace Point / Shoreline Inn Riparian Edge
4. Former Lakey Foundry and Public Access Area
5. Mart Dock
6. GVSU-AWRI
7. LaFarge
8. Heritage Landing – County and City of Muskegon
9. Division Street Outfall
10. YMCA
11. Hartshorn Marina and Hartshorn Center – City of Muskegon & Private Landowners

Restoration Work for Downtown and Ryerson Creek Focus Area 3

- A total of 2,775 linear feet of hardened shoreline will be softened and restored to improve water quality and aquatic habitat conditions for edge-tolerant species and to re-connect isolated and fragmented habitats for improved fish spawning, waterfowl nesting and wildlife travel corridors.
- A total of 6.76 acres of unnatural fill is targeted for a combination of removal and improvement to restore aquatic fish and wildlife habitat. Restoration will include the removal of under water debris and establishment of open water and emergent wetland plants. Restoration will also include the establishment of native plant rain gardens and native, vegetative stormwater filters along the shoreline. Restoration projects and practices will be designed to meet improvement goals for water quality and aquatic habitat.
- The restoration of 8.3 acres of wetland will include removal of fill and planting of native vegetation. This is expected to be accomplished, in part, through restoration at the mouth of Ryerson Creek, Heritage Landing's "scrap bay," and in the Hartshorn Marina area as part of a Great Lakes Legacy Act contaminated sediment cleanup project.
- Eleven (11) potential habitat restoration sites and landowners have been identified as potential habitat restoration partners, although restoration activities are not limited to the 11 sites. It is expected that a flexible approach of involving multiple variations of new and existing landowners will be necessary to reach restoration targets.

Table 3: Focus Area 3 BUI Removal Targets – Muskegon Lake AOC

BUI Removal and AOC Delisting Parameter	Current Condition	Restoration Target	Restoration Needed	Monitoring Approach
Hardened Edge	87.4% (21,954 linear feet)	76% (19,179 linear feet)	11.4% softened (2,775 linear feet or 925 yards)	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC.
Emergent and Upland Wetlands	11.36 acres	14.69 acres	+3.3 acres	Great Lakes Marsh Monitoring Program; Bird Studies Canada and W. MI Volunteer Coordinators
Open Water Wetlands	1.45 acres	6.45 acres	+5 acres	Fisheries IBI; GVSU-AWRI
Fill	144.71 acres	143.11 to remain	1.6 acres removed	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC
	144.71 acres	139.55 to remain	5.16 acres improved	“ “
	144.71 acres	137.95 to remain	6.76 acres combined removal and improvement	“ “
Benthos	Lakewide baseline	(see Division St/Ryerson target)	Monitoring	GVSU-AWRI
Aesthetics				MDEQ statewide monitoring program and locally developed site restoration plans

* A combination of population-based indicators and spatial, habitat-based measurements will be used to demonstrate a positive trajectory for restoration at specific sites. See Appendix for Monitoring Approach Protocols and/or Procedures

** Open Water Wetlands acreage is based on the 1995 Muskegon Lake Aquatic Plant Assessment, Dr. Mark Luttenton

Related Ongoing Planning Processes

Division Street Outfall/Hartshorn Bay:

A Great Lakes Legacy Act / Clean Michigan Initiative project is underway to remediate contaminated sediments in a 30-acre area of open water. Project partners, including the MDNR are discussing habitat restoration and a 35% non-federal match for the GLLA.

Ryerson Creek Bay:

A public/private partnership group is meeting to explore ways to continue with an existing GLLA project to remediate contaminated sediments in the mouth of Ryerson Creek. Landowners, city officials and developers have expressed strong interest in cleaning up the bay and in restoring habitat and related aesthetics.

Heritage Landing and YMCA:

An effort to purchase the YMCA property and add it to the Muskegon County-owned park, Heritage Landing is underway. Community partnerships to purchase and improve the properties for fishing and public access are developing.

Scope of Work for Focus Area 3

1. Timetable: approximately 5-8 years
2. Funding: approximately \$2.5 million
3. Responsible Entities: The Muskegon Lake Watershed Partnership's Habitat Committee with support from the West Michigan Shoreline Regional Development Commission will be the responsible parties who will ensure that the restoration plans are developed and actions are complete. MLWP and WMSRDC will work with restoration partners, subcontractors and landowners, including Muskegon River Watershed Assembly, Muskegon Conservation District, City of Muskegon, GVSU Annis Water Resources Institute, and Bird Studies Canada to ensure that monitoring and evaluation is complete in conjunction with habitat plans and projects carried out in Focus Area 3.
4. Indicator and Monitoring: Monitoring restoration in this area will require confirmation of the removal and enhancement of fill for improved aquatic habitat and a spatial increase of riparian habitat and visual observations to ensure survival rate of native plant species is suitable to establish a trajectory for recovery of riparian habitat. The Great Lakes Marsh Monitoring Program will be used to monitor marsh birds and/or amphibians as indicators of restoration progress in a representative habitat within the focus area and the Fisheries IBI will be used to indicate the presence of suitable aquatic vegetation that meets the MDNR Fisheries Division goals for healthy fisheries.
5. Public Involvement: Annual Spring and Fall Stewardship events and other special, restoration project-related events will involve the community in restoration activities and the maintenance of the native plant habitats.

Downtown / Ryerson Creek							
Focus Area 3							
Public Input / Needs Identified at February 26, 2007 MLWP Public Meeting	Timeline						
	2008	2009	2010	2011	2012	2013	2014
Preserve habitat with Ryerson Valley "Charter Park" Designation		X					
Identify environmental status of Ryerson Creek Scrap Yard		X	X				
Ryerson Creek Sewer Spill Assessment, Muskegon County	X						
Ryerson Creek Sediment Investigation, GL Legacy Act	X	X	X	X			
Ryerson TMDL, Stormwater Mgt Plan and Phase II Progress		X	X				
Install Ryerson Creek watershed rain gardens in new and existing developments to protect downstream habitat	X	X	X	X	X	X	X
Purchase VerPlank shoreline property as habitat preserve		X	X				
Identify environmental status of former Lakey Foundry/Mich Con	X	X	X				
Enhance Terrace Point habitat & public access north , east and west of Shoreline Inn (Muskegon Lake shore to Ryerson Creek)		X	X	X			
Develop natural area east of Mart Dock			X				
Continue enhancement and diversity of LaFarge native habitat landscape and connect to Heritage Landing "bay" & peninsula	X	X					
Clean up scrap in shallow/littoral zone at Heritage Landing "bay" between Heritage Peninsula and LaFarge Property		X	X	X			
Remove any contaminated fill at Heritage Landing's east or west ends and adjoin habitat with adjacent landowners			X	X			
Rehabilitate YMCA riparian shrub scrub and littoral zone. Remove fill rubble and re-plant emergents, shrubs and trees. Re-connect habitat to Heritage Landing/east & Hartshorn/ west		X	X				
Enhance Hartshorn Marina by re-establishing native plants. Reconnect habitat corridor to Foundry Park peninsula to west.		X	X	X			

Project Reporting

All progress on associated targets will be reported to MDEQ via the MLWP support staff or MLWP chair. Progress reports will be made on a biennial basis in written format and discussed with the Muskegon Lake AOC coordinator from MDEQ. Specific MLWP roles for restoration, monitoring and reporting tasks will be further defined during project planning by the MLWP Habitat Committee with staff support from WMSRDC (as grant project and staff support funding allows). The MLWP Muskegon Lake AOC BUI Removal Strategy will also be used to track progress, adding an additional layer of assurance that the restoration strategy is being carried out effectively.

Focus Area 4: Muskegon Lake East and River Mouth

Description of Impairment and Location

The loss of fish and wildlife habitat and the resulting degradation of populations occurred in Focus Area 4, located at the east end of Muskegon Lake within the mouths of the Muskegon River North Branch, Middle Branch and South Branch. The extensive filling of open water and wetlands with commercial, industrial and municipal waste eliminated aquatic habitats and altered natural stream channels and flows.

Impairments:

Loss of Fish and Wildlife Habitat and Degraded Fish and Wildlife Populations

Although historical data is not available for specific species impacted by the significant amount of fill and shoreline hardening on Muskegon Lake, Table 2 (page 5) presents a list of fish and wildlife that were likely impacted.

Current Physical Habitat Conditions in Focus Area 4:

- 47.7% of the shoreline is hardened/armored
- 426.52 acres of lake, littoral zone and wetland are impacted by unnatural fill
- 134.5 acres of wetland are present, based on 2005 aerial vegetation
- 33.35 acres of macrophytes are present.

³References – Muskegon County Museum Archives and GVSU-AWRI Information Services

EXHIBIT 9

Muskegon Lake AOC Focus Area 1 Restoration Sites and Unnatural Fill Map



Potential Habitat Restoration Sites:

1. Muskegon Nature Preserve (MERES)
2. North Branch (south side) (Consumers Energy)
3. Former Celery Flats (Bosma Property)
4. Consumers Wetland (preservation/enhancement)
5. Causeway Landfill (City of Muskegon)
6. Richards Park (City of Muskegon)
7. South Branch & Middle Branch (Consumers, Verplank)
8. Verplank Property (wetland preservation/enhancement)
9. Fishermans Landing (fill improvement)

Restoration Work for Muskegon Lake East and River Mouth, Focus Area 4

- A total of 3,267 linear feet of hardened shoreline will be softened by removing armoring and installing BMPs, including shoreline and riparian geo-web native plantings and native, vegetative shoreline buffers and wildlife corridors.
- A total of 49.6 acres of unnatural fill is targeted for improvement, preferably with 27.6 acres removed and 22 restored by installing native habitat wildlife plots, wetland enhancements and wetland restoration.
- The restoration of 46.5 acres of emergent and upland wetland and 9 acres of open water wetland is desired as one outcome of habitat restoration work within this focus area.
- Nine (9) potential habitat restoration sites and landowners have been identified as potential habitat restoration partners, although restoration activities are not limited to the 9 sites. It is expected that a flexible approach of involving multiple variations of new and existing landowners will be necessary to reach restoration targets.

Table 4: Focus Area 4 BUI Removal Targets – Muskegon Lake AOC

BUI Removal and AOC Delisting Parameter	Current Condition	Restoration Target	Restoration Needed	*Monitoring Approach
Hardened Edge	47.7% (11,896 linear feet)	34.6% (8,629 linear feet)	13.1% softened (3,267 linear feet or 1,089 yards)	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC.
Wetland	134.50 acres	181 acres	+46.5 acres	Great Lakes Marsh Monitoring Program; Bird Studies Canada and W. MI Volunteer Coordinators
Open Water Wetland	33.35 acres	42.35 acres	+9 acres	Fisheries IBI; GVSU-AWRI
Fill	426.52 acres	398.92 remaining	27.6 acres removed	Spatial measurements and GIS map analysis with visual inspection at habitat restoration sites; WMSRDC
	426.52 acres	404.52 remaining	22 acres improved	“ “
	426.52 acres	376.92 remaining	49.6 acres combined	“ “
Benthos	Lakewide baseline	(see lakewide target)	Monitoring	GVSU-AWRI
Aesthetics				MDEQ statewide monitoring program & locally developed site restoration plans

* A combination of population-based indicators and spatial, habitat-based measurements will be used to demonstrate a positive trajectory for restoration at specific sites. See Appendix for Monitoring Approach Protocols and/or Procedures

** Open Water Wetlands acreage is based on the 1995 Muskegon Lake Aquatic Plant Assessment, Dr. Mark Luttenton

Related Ongoing Planning Processes

South Branch Muskegon River:

- A design for softening shoreline and removing fill to enhance fish and wildlife habitat along the South Branch of Muskegon River is being funded through a 2008/2009 NOAA Great Lakes Habitat Restoration Program cooperative agreement between NOAA, Great Lakes Commission and WMSRDC. Landowner partnership involves Consumers Energy, Verplank, City of Muskegon

North Branch Muskegon River:

- The Muskegon Environment, Research and Education Society (MERES) is performing a study to identify existing plants and animals to guide future habitat restoration on the property north of the Muskegon River, west of the Causeway.

Causeway Landfill:

- A proposal to improve the property for upland habitat and wetlands has been developed by Pheasants Forever.

Richards Park:

- Brownfield redevelopment improvement plans are underway to remove the former waste treatment plant building.

Consumers Energy Wetlands:

- Consumers Energy contracted with ECT to design a wetland mitigation plan, as part of a MDEQ / USACE permit for a coal dock seawall repair project.

Scope of Work for Focus Area 4

1. Timetable: approximately 5-7 years
2. Funding: approximately \$2.5 million
3. Responsible Entities: The Muskegon Lake Watershed Partnership's Habitat Committee with support from the West Michigan Shoreline Regional Development Commission will be the responsible parties who will ensure that the restoration plans are developed and actions are complete. MLWP and WMSRDC will work with restoration partners, subcontractors and landowners, including Muskegon River Watershed Assembly, Muskegon Conservation District, City of Muskegon, GVSU Annis Water Resources Institute, Muskegon Community College and Bird Studies Canada to ensure that monitoring and evaluation is complete in conjunction with habitat plans and projects carried out in Focus Area 4.
4. Indicator and Monitoring: Monitoring restoration in this area will require confirmation of the removal and enhancement of fill for improved aquatic habitat and a spatial increase of riparian habitat and visual observations to ensure survival rate of native plant species is suitable to establish a trajectory for recovery of riparian habitat. The Great Lakes Marsh Monitoring Program will be used to monitor marsh birds and/or amphibians as indicators of restoration progress in a representative habitat within the focus area and the Fisheries IBI will be used to indicate the presence of suitable aquatic vegetation that meets the MDNR Fisheries Division goals for healthy fisheries.
5. Public Involvement: Annual Spring and Fall Stewardship events and other special, restoration project-related events will involve the community in restoration activities and the maintenance of the native plant habitats.

Muskegon Lake East & River Mouth Focus Area 4							
Public Input / Needs Identified from Public Input and Ranked by MLWP Habitat Committee	Timeline						
	2008	2009	2010	2011	2012	2013	2014
North Branch / Consumer Riparian – Soften NB on south side near fly ash ponds, remove broken concrete		X	X	X			
Muskegon River South Branch & Middle Branch – Improve habitat for juvenile habitat and adult staging area with improved migration corridor. Increase flow for Sturgeon, Pike, Bluegill. Improve connecting corridor.	X	X	X				
Richards Park – 17 acre potential. Used by fisherman, but public health is a potential issue. Brownfield demolition plans underway. Access from Richards Park to the bike path needed.		X	X	X	X		
Causeway Landfill – Used as yard compost site; Construction of landfill cap underway. Evaluate site for use with DSO cleanup to stage and/or soil wash/ beneficial reuse with compost material on site.		X	X	X	X		
MERES – 42 acres with 17-acre restoration potential along riparian areas. A current study is identifying structural components, soils and wildlife.	X	X	X				
Consumers Wetland – Preserve and improve the 10.66-acre wetland. Lake side has greater economic development potential, compared to river side.	X	X	X				
Verplank Wetland – 32-acre brownfield with some wetland along lakeshore and riparian South Branch. Wetland species recovering from past coal ash fill.	X	X	X				
Bosma Wetland in North Branch – Wetland restoration and preservation is a potential. Wetland disconnected from river; could be Great Lakes Musky nursery habitat. It is to be used only as agriculture or wetland.		X	X	X			
Ryerson, Four Mile Marshes and Riparian Corridors - City zoning protects riparian corridors; should continue for stormwater, fish and wildlife. County wastewater retention/habitat project could protect riparian corridors and wetland marshes in watershed.	X	X	X	X			
Fishermans Landing - Acquisition & improvements w/ MDNR fisheries trust; Needs long-term enhancement and maintenance		X	X	X			

Project Reporting

All progress on associated targets will be reported to MDEQ via the MLWP support staff or MLWP chair. Progress reports will be made on a biennial basis in written format and discussed with the Muskegon Lake AOC coordinator from MDEQ. Specific MLWP roles for restoration, monitoring and reporting tasks will be further defined during project planning by the MLWP Habitat Committee with staff support from WMSRDC (as grant project and staff support funding allows). The MLWP Muskegon Lake AOC BUI Removal Strategy will also be used to track progress, adding an additional layer of assurance that the restoration plan is being carried out effectively.

Acknowledgements

The Muskegon Lake Watershed Partnership (MLWP) wishes to thank the public for attending meetings to set fish and wildlife restoration targets and for providing invaluable local input during 2007 and 2008. A special thank you is also extended to the MLWP Habitat Committee and to the community organizations and agency technical advisors who continue to provide valuable guidance, resources and input.

Muskegon Lake Watershed Partnership (MLWP) Habitat Committee and Technical Advisors

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Ryan Archer, Bird Studies Canada / Great Lakes Marsh Monitoring Program
Marc Tuchman, US EPA Great Lakes National Program Office
Karen Rodriguez, US EPA Great Lakes National Program Office
Danielle Green, US EPA Great Lakes National Program Office

References

¹ References to the causes of fish and wildlife-related impairments can be found in the Muskegon Lake 1987 RAP, Michigan Department of Natural Resources: Page 31, Paragraph 4.1; Table 4.1; Page 59, Table 5-2; Muskegon Lake 1994 RAP Update, Public Sector Consultants: Page 32-38; and in the Muskegon Lake Community Action Plan (2002 RAP Update), Muskegon Conservation District: Pages 10, 14, 18, 20, 39, 40, 41.

² References to the fish and wildlife populations likely to be degraded can be found in: O'Neal, R. P. 1997 Muskegon River Watershed Assessment. Michigan Department of Natural Resources, Fisheries Division Special Report 19, Ann Arbor; O'Neal, R. P. 2003. Muskegon River Management Plan, River Management Plan 04, Michigan Department of Natural Resources, Fisheries Division, Ann Arbor; O'Neal, R. P., and G. J. Soulliere. 2006. Conservation Guidelines for Michigan Lakes and Associated Natural Resources. Michigan Department of Natural Resources, Fisheries Division Special Report 38, Ann Arbor; Muskegon Lake Remedial Action Plan, 1987 and 1994; Muskegon Lake Habitat Assessment, 1995, Day & Associates; MDNR Fisheries and Wildlife Divisions and Michigan Natural Features Inventory literature.

³ References – Muskegon County Museum Archives and GVSU-AWRI Information Services

Appendices – Monitoring Approaches and Protocols

1. GVSU-Annis Water Resources Institute - Muskegon Lake Fisheries Index of Biotic Integrity (IBI)
2. Bird Studies Canada Great Lakes Volunteer Marsh Monitoring Program (MMP)
3. West Michigan Shoreline Regional Development Commission GIS Spatial Measurements