

Creating and Maintaining Sand Islands at Wolf Lake

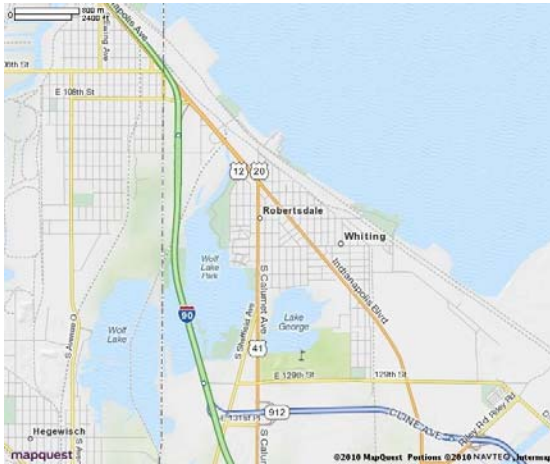
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Background

Wolf Lake is an 800-acre natural water body on the Indiana/Illinois border near Hammond, Indiana. In pre-settlement days it was part of a vast complex of dunes, lakes, marshes, and wooded uplands; ecologists refer to this area, the former bed of Lake Michigan, as the Lake Plain. Development impacts, including dredging to obtain construction fill, filling with construction spoil, industrial discharges, invasive species encroachment, and other nonpoint sources of pollution have significantly altered Wolf Lake. In the 1950s the Indiana Toll Road (I-90) was built through the middle of the lake.

Despite these impacts, Wolf Lake still attracts fishermen, boaters, wind surfers, birders, and other nature admirers. It also offers habitat for a wide variety of wildlife and plants, including species listed as threatened or endangered such as the lake sturgeon and banded killifish.



Map of project area

The Wolf Lake Project was initiated by the U.S. Army Corps of Engineers (USACE) Chicago District under Section 206 of the Water Resources Development Act of 1996, which gives USACE authority to undertake restoration projects in aquatic ecosystems.¹ Major project features include restoring a mile of eroded shoreline, creating 25 acres of aquatic and upland native plantings by constructing more than 30 islands, restoring natural water levels, improving boat channels, and controlling invasive plants.²

The Plan

¹ The city of Hammond was a major project collaborator and provided a percentage of matching funds for this \$6.5 million project.

² In 2009 the City of Hammond received a U.S. Environmental Protection Agency/Chicago Wilderness Conservation and Native Landscaping Award for the Wolf Lake Aquatic Ecosystem Restoration project

Wolf Lake is an unusual restoration project in that wetland and upland habitats were created in shallow open water lake areas by constructing islands formed by hydraulic dredging of bottom sand. Material removed from the lake bottom created deep holes, which enhanced benthic diversity, while the extracted sand created elevations suitable for emergent wetlands that transitioned first to wet prairie and then to sand prairie at the highest island elevations.



Hydraulic dredging of lake bottom sand to create islands

This innovative concept was not without several inherent problems. Most of the Wolf Lake bottom contains little organic matter or nutrients, making it a less than ideal planting medium. The lake's high winds, appreciated by wind surfers, were anticipated to hinder stabilization of the newly formed sand islands. Wave and ice action accompanying these winds had been destructive to previous shoreline restoration and stabilization efforts. Herbivory, particularly by muskrats, carp, and the resident Canada goose population, was also expected to be a challenge in the early successional stages.

The plan called for several measures to mitigate these harsh conditions, including installing erosion blankets anchored with 18-inch landscape pins along the shoreline to protect the wet prairie seed, and securing emergent plant plugs with 8-inch steel staples. Plant species selected for the seed and plug mix included fast-growing stabilization workhorses like Chairmaker's rush (*Scirpus pungens*) and Softstem bulrush (*Scirpus validus*), along with annual rye and oats for quick cover. The plant and seed mix contained more than 100 native species in the hope that a majority would become established, creating a diverse plant community representative of pre-settlement ecosystems. A system of 18-inch tall chicken wire fencing and nylon cord was designed to protect the 15-foot wide emergent planting zone from predatory geese, muskrats, and carp. In critical energy zones, unvegetated sacrificial barrier islands were created to protect vegetated islands during the early plant establishment years.



Before plant installation



After plant installation and establishment

Island construction began in late summer 2006, and seeding and planting commenced in spring 2007. The prime contractor, Luedtke Engineering of Frankfort, Michigan, performed the hydraulic dredging and island construction; JFNew provided all plant materials, installation, and initial maintenance.

Problems Faced

Despite all the protective features incorporated into the design, many planting and seeding areas were lost or damaged by agents of nature, both anticipated and unforeseen. Some of the problems that occurred:

- While most of the lake substrate was sand and contained little organic material, there were some pockets of organic sediment that provided neither adequate base nor sufficient cohesive material for island construction. Preliminary soil borings had not predicted this problem. As a result, several of the islands in the original plan had to be eliminated when it was discovered they were located in zones containing these sediment deposits.
- High water levels during the early planting stages inundated the emergent and wet prairie planting zones, delaying the planting process. The cause of the problem was soon discovered to be beavers that had dammed three culverts on the Illinois side. Concerted effort was required to keep the culverts open so planting could take place at a controlled water level.
- Low water levels during the 2007 midsummer drought threatened the new plantings with insufficient water. This was particularly detrimental to the sand prairie seeding in the highest elevations; installation of erosion blankets and irrigation, not part of the original design, was necessary in this zone.

- After the planting was completed in August 2007, high water levels from rainfall resulted in mortality of the most recently installed emergent zone plants from wave action and inundation.
- The predation barriers were only marginally effective. Geese were able to enter the enclosures from the upland side and destroy young plants. Because the chicken wire mesh could not be securely pinned to the soft sand substrate, carp and muskrats could burrow underneath and damage the plantings.
- During the first year the most exposed reaches of newly created islands suffered severe erosion. Areas adjacent to large open expanses of water that were exposed to prevailing winds lost up to 75 feet of land the first winter, before the native vegetation could become rooted sufficiently to anchor the shorelines.
- The low levels of nutrients and organic matter in the sand meant slow growth of the stabilizing vegetation, prolonging the period of erosive damage to the islands.

Lessons Learned

The restoration community may benefit from the lessons learned on this project. Future designs using dredged spoils to create native plantings should consider the following:

- **Design island shapes for greatest area-to-perimeter ratio.** Erosion on all sides of long, narrow islands can destroy the entire land mass before native vegetation can become sufficiently established to stabilize the substrate. In general, the larger and more circular the shape, the more resistant it will be to erosive attrition.



2007, immediately after construction



2009

- **Use erosion control blankets on all seeded areas.** This will help conserve moisture and slow erosion from wind and rain for faster stabilization.



Effects of straw blanket on sand prairie seeding (left-hand side) and no protection (right-hand side)

- **Control construction timing to allow islands to settle before planting.** Give newly created islands at least three months to become consolidated before doing any planting.
- **Build the islands larger than final desired dimensions.** This will allow for erosive attrition to occur while still maintaining the form and function. Expect greater losses on sides adjacent to large fetches or dropoffs to deep water.
- **Protect all shorelines that have exposure to particularly harsh wind and wave action.** Use hard armor barriers such as log structures or sacrificial islands.



Log barrier protection of an island suffering severe erosive losses

- **Focus on establishing vegetation in the above shoreline zone.** Most vegetative stabilization at Wolf Lake occurred after a dense sod of native grasses, sedges,

and forbs became established in the wet prairie zone adjacent to waterline. Plant establishment in the highly dynamic emergent zone was generally much slower and mortality much greater.

- **Limit emergent plantings.** Focus simply on groupings or "pods" spaced along the shoreline. Completely surround the groups with at least three foot tall netting.
- **Size the emergent plant pods to discourage geese landing.** Keep these areas small, no larger than three feet wide by six feet long. These pods can withstand herbivory after the plants mature and will spread vegetatively and by seed to other areas.
- **Be prepared for nature to trump your plan.** The final results delivered by the grand forces of nature may not conform to your plan, despite your best design efforts. Set reasonable vegetative cover goals, and be prepared to modify the goals to account for the unknowns.

Maintenance

As with any native restoration project, ongoing management is essential to control the advances of non-native aggressive species and maintain biotic integrity. During project design the USACE developed an operations and maintenance manual that will guide long-term management of the native areas. Wolf Lake is particularly vulnerable to the advances of phragmites (*Phragmites spp.*), purple loosestrife (*Lythrum salicaria*), and Eurasian watermilfoil (*Myriophyllum spicatum*).

Project ownership will transition from USACE to the City of Hammond, which will be responsible for managing these species and aggressive native plants like cottonwood and willow. In certain areas, wave and wind erosion requires periodic reinforcement of protective measures such as wave barriers and erosion control blankets, and replanting of native plant plugs. Periodic prescribed burning of upland areas is also planned.