

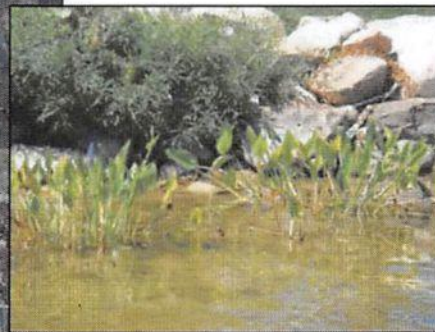
Lake Maxinkuckee Shoreline Revegetation Project - 2007



**Please do not boat too
close, plants growing**
**Shoreline Vegetation
Project By**

HatUrtkuckee'

For more information call 574-842-
3686



PREPARED FOR:

**LAKE MAXINKUCKEE ENVIRONMENTAL COUNCIL 116 N.
MAIN ST.
CULVER, INDIANA 46511**

PREPARED BY:

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SEPTEMBER 2, 2009

EXECUTIVE SUMMARY

V3 Companies (V3) was contracted by the Lake Maxinkuckee Environmental Council (LMEC) to complete a shoreline restoration project. The LMEC received a grant in March 2006, from the Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife through the Lake and River Enhancement Program (LARE) to fund the shoreline restoration project. The grant provided funding for a shoreline restoration project to vegetate approximately 300 linear feet of shoreline, including shoreline emergent and submergent vegetation.

Lake Maxinkuckee is a 1,864-acre oligotrophic lake adjacent to the Town of Culver in Marshall County, Indiana. Three private homeowners, who own the project shoreline, expressed interest in restoring native shoreline and emergent plant communities once found along the shoreline of Lake Maxinkuckee. The improvement of the approximately 300 linear feet of shoreline would demonstrate to other lake residents the benefits of this type of restoration effort through wildlife and fishery enhancement, physical shoreline stabilization, and improved water quality. The planted shoreline would also enhance the natural aesthetics of the lake.

The shorelines on the three properties were evaluated in the field and then a planting plan was created. The planting design included four separate planting zones including shoreline plants, shallow emergent plants, deep emergent plants, and floating aquatic plants. A list of plants was also created for each zone. The planting plan was presented to the property owners and LMEC for approval. A planting crew installed the plants in the project area on June 22, 2007 within the four vegetation zones of Lake Maxinkuckee. A total of 1,217 native plant plugs were installed during the planting effort. An ecologist monitored the progression of the plants, changes in hydrology, and the temporary construction measures on a monthly basis post-installation. Monitoring of the plant community continued through the fall of 2007 and monitoring resumed in the summer of 2008.

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INTRODUCTION AND BACKGROUND

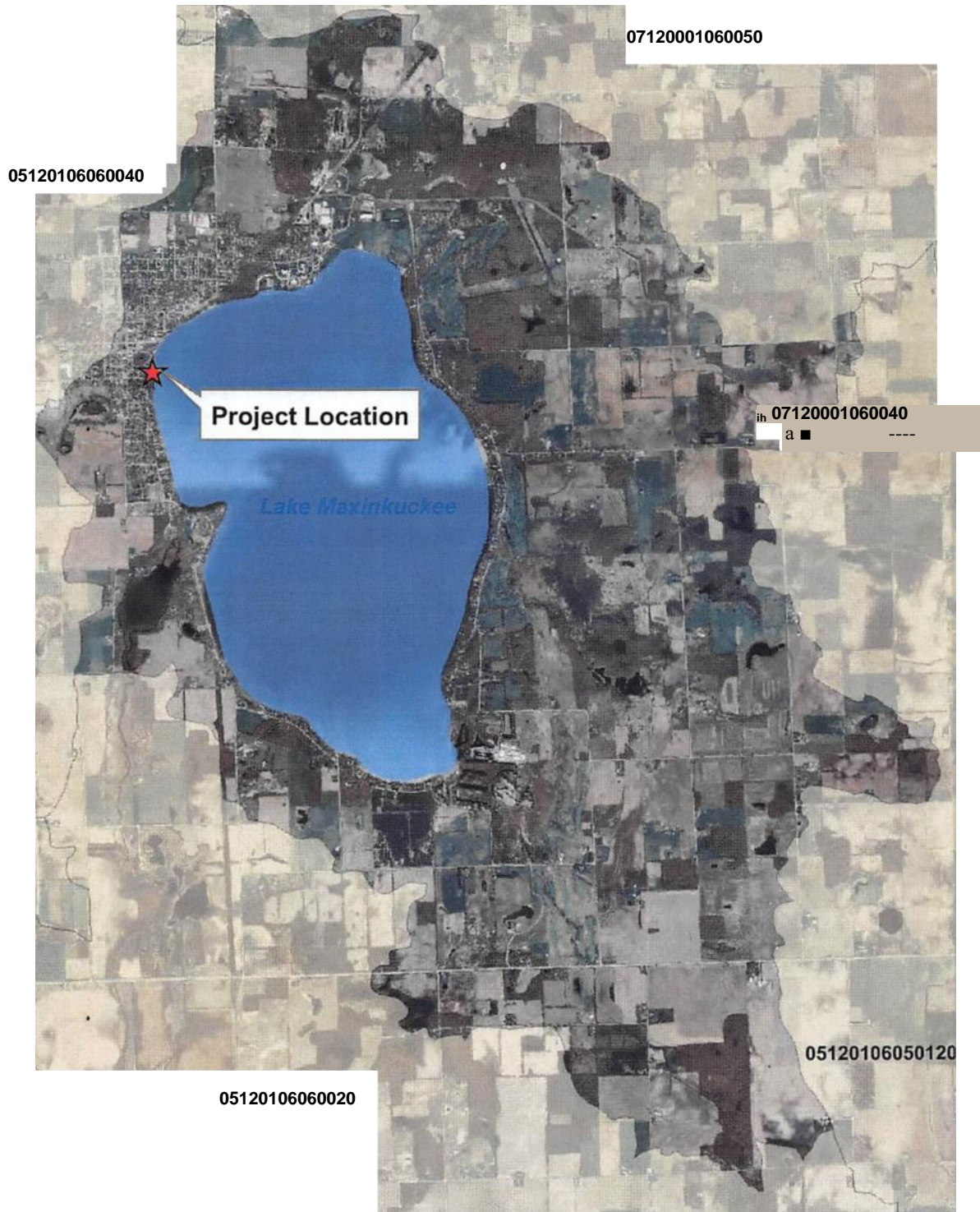
Lake Maxinkuckee is a 1,864-acre lake in Culver, Marshall County, Indiana (Exhibit I). Lake Maxinkuckee comprises 21% of the 8,850 acre watershed and is the second largest lake in Indiana. Lake Maxinkuckee is used heavily for recreational activities such as boating, fishing, swimming, and skiing/tubing. The town of Culver is located along the northwestern shoreline of Lake Maxinkuckee. The majority of the lake's shoreline is privately owned with residential land use. The shores of the lake are heavily developed with single family residences. Two public access boat ramps are located on the lake on the east and west sides of the lake.

The Lake Maxinkuckee Environmental Council (LMEC) received a grant in March, 2006, from the Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife through the Lake and River Enhancement Program (LARE) for shoreline revegetation. The grant covered site evaluation and design, vegetation installation, vegetation management and monitoring, and creation of a report that summarizes the results of the shoreline revegetation efforts. The goals of this project are to improve the near shore aquatic vegetative community in Lake Maxinkuckee and create a demonstration site on the lake. Increasing the amount and diversity of near shore vegetation will increase habitat area for macroinvertebrates and fish which are necessary for a balanced lake ecosystem.

The Lake Maxinkuckee Environmental Council (LMEC) is a not-for-profit organization created in 1982. The LMEC was formed due to growing concern among lake residents over the declining water quality of Lake Maxinkuckee. Since LMECs formation, many management efforts have been implemented to improve and restore the health of Lake Maxinkuckee. Wetland creation and restoration was a management strategy to reduce the amount of sediment and nutrients entering into the lake. Through fundraising and landowner partnership, LMEC was able to create Wilson, Curtiss and Kline wetlands for a total of 90 acres. A watershed management plan was created in 2005 for Lake Maxinkuckee which is a great resource to better understand the surrounding watershed and potential areas for improvement. The Lake Maxinkuckee Shoreline Revegetation Project is part of LMEC's continuing effort to improve the quality of this valuable resource.



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A



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TITLE: Shoreline Revegetation
Project Location Map
BASE LAYER: Indiana Spatial Data Portal 2005
Orthophotography
CLIENT: Lake Maxinkuckee
Environmental Council 116 N.
Main St. Culver, Indiana 46511

PROJECT: Lgke **Maxinkuckee Shoreline
Revegetation Project-2007**

PROJECT NO.
06085.01

QUADRANGLE:
NA

EXHIBIT:
I
DATE:
6/22/07

SHEET:
1 OF 1

SCALE:

NTS

LAKE MAXINKUCKEE SITE EVALUATION AND DESIGN

The majority of the Lake Maxinkuckee's shoreline is seawalls. Seawalls reflect wave action and limit the growth of native aquatic plants in shallow areas adjacent to the seawalls. It is generally accepted that natural glacial stone wave breaks or stone seawalls disperse a greater amount of the wave's energy than metal sheetpile seawalls and provides less damage to the vegetative beds.

V3 met with Tina Hissong, former LMEC director, to discuss a revegetation design that would provide vegetative structure within the emergent zone of Lake Maxinkuckee as well as please homeowners participating in the revegetation effort. V3 evaluated the project shoreline shown in Exhibit II. The 300 feet of shoreline was characterized by rip rap shoreline, landscaped day lilies and a steep gradient towards the lake. The planting area was shallow throughout the dock area which limited boat traffic. The lake bottom consists primarily of sand, gravel, muck and marl.



Figure 1: Photographs taken during site evaluation prior to revegetation effort.

The design for shoreline revegetation plantings focused on a diverse community of native plants that would categorically fit within four separate planting zones including: shoreline vegetation (within the existing condition), shallow emergent vegetation (0-3 feet), deep emergent vegetation (3-9 feet), and floating aquatic vegetation (9-18 feet) (Drawing 1). The design planting lists were presented to the property owners for review and discussed in detail before moving forward with installation. Property owners' comments and recommendations were included in the final plant list.



Legend

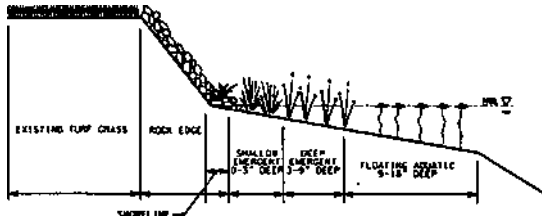
Project Area Depth

Contour Line

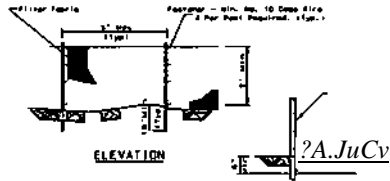
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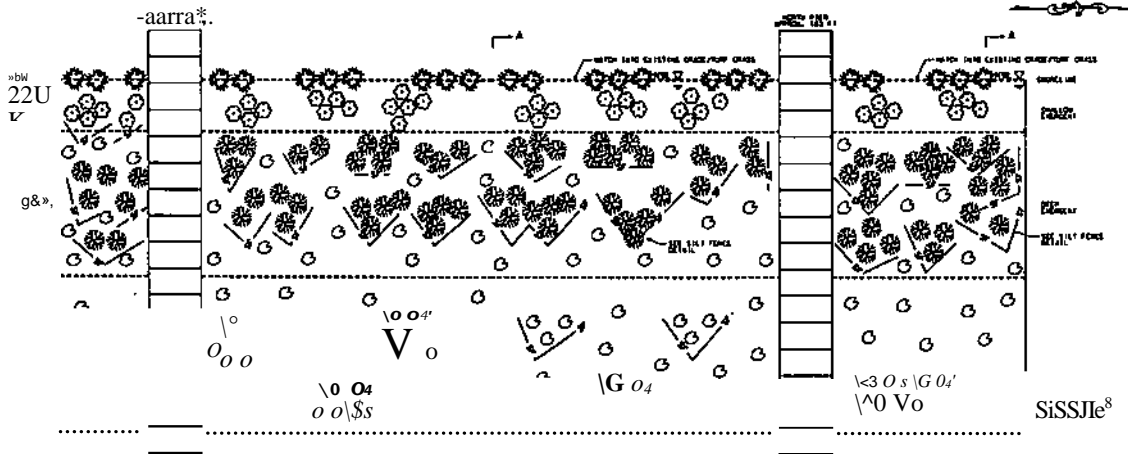
TITLE: Shoreline Revegetation Area Map	PROJECT: Lake Maxinkuckee Shoreline Revegetation Project -2007		
BASE LAYER: Indiana Spatial Data Portal 2005 Orthophotography	PROJECT NO. 06085.01	EXHIBIT: II	Sheet: 1 of: 1
CLIENT: Maxinkuckee Environmental Council 116 N. Main St. Culver, Indiana 46511	QUADRANGLE: N/A	DATE: 6/22/07	SCALE: 1"= 150'



CROSS-SECTION A-A



SILT FENCE DETAIL



SHORELINE STABILIZATION PLAN

REVISIONS

LAKE MAXINKUCKEE

AS-BUILT PLANTING PLAN



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CONSTRUCTION MEASURES FOR SHORELINE RESTORATION

V3 installed temporary structures inside emergent zones to serve as a protective enclosure for the shoreline revegetation plantings. Protective enclosures were installed prior to plant installation and were used as a guide for determining planting zones. The enclosures were made of a porous silt fence material which allows for water to move through while dampening the wave energy. This fencing was attached to wooden stakes that were then driven into the lake substrate (Figure 2). The enclosures were v-shaped with the base of the “v” facing away from the shoreline. The direction of the enclosure was important in functioning as a wave break and dissipating the wave energy so most vegetation was not directly disturbed. A permit was required for the placement of these temporary protective structures. The permit for protective enclosures was issued by the IDNR Division of Water. The protective enclosures would remain in place throughout the growing season to assist with survivorship and establishment of the installed plantings. Goose exclusion was also installed as a deterrent to wildlife species that typically forage vegetation (Figure 2, photo on right). Enclosures were removed in the late fall before ice was present and were not replaced during the 2008 growing season.



Figure 2: Protective enclosures were used to promote growth of vegetation by serving as wave breaks and wildlife deterrents.

INSTALLATION OF VEGETATION

V3 installed 1,029 native plant plugs on June 22, 2007 within the four vegetation zones of Lake Maxinkuckee. The species list was approved by the homeowners before installation. Vegetation within the shoreline and emergent zones was installed by hand with the assistance of trowels when needed. Shoreline species were planted in the riprap where substrate was available. The depth at which plugs were planted was species specific and dependant on the species hydrology tolerance. Plugs were initially installed in a scattered arrangement that would reflect a natural systems species distribution and is representative of the final naturalized restoration. During installation, homeowners felt a clumped arrangement of grouped plants with open water in between, similar to decorative landscaping, was preferable. In response to homeowners' views, V3 uprooted the installed plugs and re-planted in the desired clumped arrangement. Plant installers traversing through the planting zones is an undesired activity as there is potential for damaging the newly installed plants. Uprooting and re-locating is also an undesired plant installation activity. This was discussed on June 22nd, but the decision to move forward in the best interest of the homeowners was deemed the priority. Weighted tubers of white water lily and weighted mesh bags containing two American pondweeds were distributed by hand broadcasting from the shoreline to desired locations within the vegetative clumps.

V3 performed follow up planting installation and protective structure maintenance on June 25th and July 6th, 2007. An additional 38 yellow pond lily rootstocks and an additional 150 weighted white water lily tubers were installed. The final number of native plant plugs installed totaled 1,217, consisting of 587 plugs, 182 rootstock and 448 tubers (Table 1).

Table 1: Plant List for Lake Maxinkuckee

June 22, 2007 Plant Installation Effort			
Scientific Name	Common Name	Planting Depth (in.)	Installed
Shoreline Vegetation			
<i>Carex emoryii</i>	Riverbank sedge	0-1"	49
<i>Carex hystericina</i>	Porcupine sedge	0.5- 1.5"	24
<i>Iris virginica</i>	Blue flag iris	0-2"	10
<i>Carex comosa</i>	Bristly sedge	1 -2"	20
<i>Lobelia cardinalis</i>	Cardinal flower	1-2"	18
<i>Scirpus pangens</i>	Three square	1 -2"	44
			Sub Total
			165
Shallow Emergent Vegetation (0-3 feet)			
<i>Justicia americana</i>	Water willow	1 -2"	174
<i>Juncus effusus</i>	Common rush	1 -3"	3
<i>Hibiscus palustris</i>	Swamp rose mallow	1 -3"	25
<i>Peltandra virginica</i>	Arrow arum	1 -3"	100
<i>Sagittaria latifolia</i>	Common arrowhead	4-6"	62
<i>Sparganium eurycarpum</i>	Common bur reed	2-6"	8
			Sub Total
			372
Deep Emergent Vegetation (3-9 feet)			
<i>Nuphar advena</i>	Yellow pond lily (rootstock)	8-12"	12
<i>Pontederia cordata</i>	Pickereel weed plugs	6-8"	50
<i>Pontederia cordata</i>	Pickereel weed tubers	6-8"	165
			Sub Total
			227
Floating Aquatic Vegetation (9-18 feet)			
<i>Nymphaea odorata</i>	White water lily tubers (weighted)	8-12"	133
<i>Potamogeton nodosus</i>	American pondweed (rootstock)	8-12"	132
			Sub Total
			265
July 6, 2007 Plant Installation Effort			
<i>Nuphar advena</i>	Yellow pond lily (rootstock)	8-12"	38
<i>Nymphaea odorata</i>	White water lily tubers (weighted)	8-12"	150
			Sub Total
			188
			Grand Total
			1,217

VEGETATION MANAGEMENT AND MONITORING

V3 performed monthly investigative field visits on August 28, September 15, October 23 and November 20, 2007. One year later, site visits were made on July 8, July 9 and August 19, 2008. During field visits photos were taken to track plant growth within the planting area. Protective enclosures were also evaluated to determine if functionality was maintained. Repairs were made to enclosures as needed during field visits. Lake hydrology was stable throughout field visits. Figures 3 and 4 depict the restoration planting after one year of establishment.



Figure 3: Landward view of established vegetative shoreline and emergent zone communities. (Photo taken August 19, 2008)

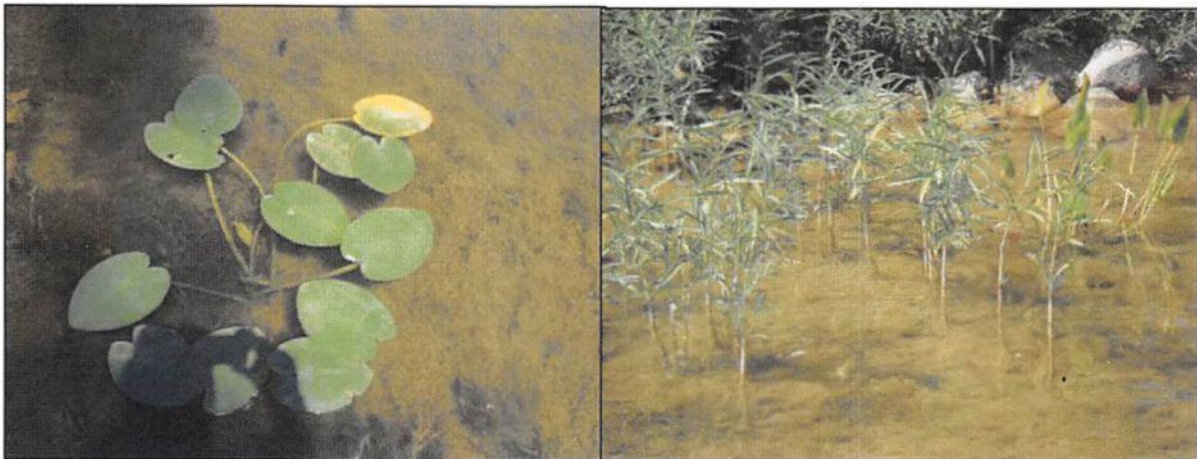


Figure 4: Landward view of established vegetative shoreline and emergent zone communities. (Photo taken August 19, 2008)

Three types of plant material were used for the shoreline revegetation effort. Plugs were the plant material that had the best survivorship followed by tubers. Rootstock was used for yellow water lily and American pondweed and was the least successful type of plant material. The size and buoyancy of the rootstock for yellow water lily negatively affected the survivorship of this species. Measures taken to add weight to the rootstock of yellow water lily also negatively impacted the survivorship of this species.

The shoreline area experienced the most challenges to survivorship which was attributed to human activity and wave action. Unauthorized chemical application and the addition of riprap post planting negatively impacted the survivorship of vegetation within the shoreline zone. The shoreline area also experiences the most impact from wave action, which can negatively impact survivorship. Protective enclosures were in place to dissipate wave energy however wave action was still a factor in plant growth.

Overall the planting was successful as vegetation is present throughout the planting area. The shallow emergent zone and deep emergent zone experienced the most success after the planting effort. Species within the shallow emergent zone that were the most successful included pickerel weed and arrow arum. White water lily was a floating aquatic species that was present throughout the planting area and did well after planting.

