Cloverleaf Lakes Shoreland Restoration Demonstration Project

WDNR Lake Planning Grants: LPL-1246-09 & LPL-1247-09

Prepared for

Cloverleaf Lakes Protective Association

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4664 Golden Pond Park Ct., Hobart, WI 54155 Voice: 920-499-5789 Fax: 920-662-9141

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PURPOSE

This report was prepared by NES Ecological Services (NES) on behalf of the Cloverleaf Lakes Protective Association (CLPA) to fulfill obligations related to two Lake Planning Grants awarded to CLPA by the Wisconsin Department of Natural Resources (WDNR). It is the hope of NES and CLPA that this report can be used to address the current and future land development pressures associated with the shorelines of the Cloverleaf Lakes. The ultimate goal of these grants was the production of two publications that: 1) educate the residents around the Cloverleaf Lakes about the important interactions that occur between a lake and its shoreline, 2) provide *shoreland restoration* options and guidance to those individuals that want to undertake their own project, and 3) supply descriptions and photographs of shoreland restoration projects implemented around the lake system. The third objective of the grant has been completed and is reported on in this document.

INTRODUCTION

The development of Wisconsin's shorelands has increased dramatically over the last century and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to the destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects. The maintenance of the newly created area decreases water quality by considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreline. Removal of *native* plants from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving associated lake sediments vulnerable to wave action. Furthermore, the dumping of sand to create beach areas destroys spawning, cover, and feeding areas utilized by aquatic wildlife. The removal of fallen trees and other woody debris from shoreline areas in an attempt to maintain a clean appearance also removes habit and food for aquatic and *terrestrial flora* and *fauna*. Combined, these actions have helped lead to noticeable decreases in the quality of Wisconsin's lakes.

In recent years many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic predevelopment conditions. An area of shore restored to its natural condition, both in the water and on shore, is commonly called a *shoreland buffer zone.* The shoreland buffer zone creates or restores the ecological habitat and benefits lost through land development and traditional suburban landscaping. Many Wisconsin counties have realized the importance of shoreland buffer zones and have instituted incentives to encourage restoration. In addition to the incentives, Chapter NR 115 – Wisconsin's Shoreland Management Program has been recently revised. One of the changes includes shoreland restoration requirements as a way to *mitigate* for development impacts. Each county will be responsible for adopting rules that will address these requirements and when they must be implemented.

Shawano County, Wisconsin, has a total of 134 named and unnamed lakes with a total water surface area of 8,912 acres. Natural lakes account for about 85% of the lake surface area, while the other 15% are impounded waters. All of the natural lakes are relatively shallow warm water fisheries in the *mesotrophic* to *eutrophic* class supporting various game and pan fish populations. The Cloverleaf Lakes consist of 3 interconnected lakes: Round, Grass and Pine Lake. Round Lake is approximately 26 acres, Grass Lake approximately 80

acres and Pine Lake totals approximately 208 acres. These lakes are fed primarily by groundwater flowing in an east-southeast direction and drains to the Embarrass River. The Cloverleaf Lakes are a recreationally popular chain for fishing, boating, water skiing, bird watching and hunting. Recent management of the Cloverleaf Lakes has focused on the control of Eurasian Watermilfoil, an *exotic invasive* plant. Eurasian Watermilfoil was first discovered in the Cloverleaf Lakes in the early 1990's.

Along the developed shorelines of the Cloverleaf Lakes, much of the woody cover and understory has been removed. This woody debris is critical habitat to support many species of mammals and birds. In addition to the absence of woody debris, much of the Cloverleaf Lakes are developed with residential housing; thus, the natural *landscape* of the lakes has changed. A public swimming beach, owned by the Town of Belle Plaine, can be found on Pine Lake. Grass Lake offers a public boat ramp with parking. A public fishing pier, with handicap accessibility, is located on Round Lake.

The sections that follow provide a general description of site conditions around Cloverleaf Lakes, and examples of shoreland restoration projects that were designed with WDNR Lake Planning Grant funding, but implemented and funded by Cloverleaf Lakes landowners committed to improving their property and lake. As an added incentive to complete these projects, the CLPA implemented a matching funds program to help off-set costs. The association also held educational events to promote restoration covered by the WDNR Lake Planning Grants and their shoreline program.

SITE CONDITIONS

Topography and Natural Land Features

A majority of land surrounding the three Cloverleaf lakes has moderate to steep topography that slopes down to the water's edge. The sloping topography in conjunction with a high concentration of development and loss of the understory with *buffers* around the lakes has increased the potential for surface water *runoff* from impervious surfaces. Soil erosion near areas of concentrated flow from structures (i.e., downspouts) and paved surfaces such as roads and sidewalks were observed at properties on Grass and Pine Lakes. As soil is transported into the lake so to are the nutrients attached to the soil particles; the result is reduced water clarity, quality and increased nutrient loading, which can spark undesirable plant growth. Constructing *rain gardens* and installing native plant buffers help capture, contain and slow down surface water runoff to address or prevent erosion issues. Several projects discussed below implemented one or both of these items to address their existing or potential surface water runoff problems.

Ice ridges are land features caused by the natural pushing action against the shore from the expansion and contraction of ice. The northeast portion of Pine Lake is the only area in which these features were observed. The likely reason is a prevailing southwesterly wind during the spring when the lake ice begins to break-up. During this time loose, floating ice is pushed inland. The weight of the ice and force of the wind and water allow rocks, soil and other materials to be moved. Most are small ridges of sand, but there are a few areas where trees have been uprooted in the process. These ridges are beneficial as they prevent surface water runoff from entering the lake and they further protect the shoreline. Two landowners that have ice ridges present on their property chose to incorporate the ridge into their landscape plan by installing native species on them to improve and further protect their shoreland buffer.

Erosion

Although high velocity surface water runoff can damage shorelines, the cause often times is the water found within the adjacent lake. Waves created during storm events and windy days can crash relentlessly into the shoreline; however, weather events are not the only culprit. An increased use of personal watercraft are also responsible, which can be observed during a nice, summer day on the water; this is especially true on those areas of the lakes that do not have slow no-wake regulations. Wave energy produced by watercraft may not be as significant as those caused by storm events, but they do act as an additional stressor. Most healthy shorelines will remain relatively unaffected during these events; the damage occurs when the aquatic and/or shoreline vegetation has been significantly altered or removed. Dense stands of *emergent vegetation* are able to diminish wave energy prior to reaching shore while roots from herbaceous and woody plants bind and hold soils found on the shoreline. Trees that have fallen into the water and the aforementioned ice ridges are also capable of reducing damage done by wave action.

Round Lake has a well established emergent plant community around the perimeter of the waterbody; and, slow no-wake boating regulations are enforced. The combination of these two factors has resulted in very little shoreline erosion around the lake.

Grass Lake has a few emergent plant communities along its southern shore and in the cove on its eastern end. Slow no-wake regulations are enforced in the channel located between Grass and Pine Lakes. As with Round Lake, these items help limit shoreline erosion within these areas. Although waves are generated by weather events and boating activities, Grass Lake's rather small size and configuration limit wave energy and the amount of erosion occurring along its shoreline.

Pine Lake only has one small patch of emergent wetland vegetation. The lack of vegetation and size of Pine Lake has resulted in more severe erosion issues, particularly on the east, northeast and southeast sides of the waterbody. Generally, winds in the area are from a westerly (NW, W or SW) direction; therefore, the eastern side of the lake receives more frequent and stronger wave action due to the amount of open water over which the wind travels, referred to as the *fetch length*. Although the fetch length is similar for those properties located directly across the lake on the western shoreline, the wind is often pushing water away from the shoreline. These properties, however, are not immune to the impacts of watercraft generated waves. Pine Lake is utilized frequently by larger boats, jet skis and for water-skiing activities. It is likely these activities are responsible for minor erosion issues on the western side of the lake and enhance issues elsewhere.

Although erosion may seem moderate to extreme on Grass and Pine Lakes, NES conducted an erosion energy review of several shoreline properties and found them to be ranked as low energy systems, which means existing walls or rip-rapped shoreline can be repaired or replaced provided specific requirements are followed. New installation of these heavy armoring techniques, however, will likely not be permitted; therefore, landowners must use *biostabilization* techniques to restore their shorelines. Several projects discussed below installed *biologs* and native plants to address their existing shoreline erosion issues.

Since most shoreline stabilization projects will require some work below the *ordinary high water mark*, a permit(s) will be required from the State of Wisconsin and possibly the federal government, except for those activities that are exempt. An individual should consult with their local WDNR Water Management Specialist if they have questions about a project.

Soil Properties

Table 1 and Figure 1 depict the *soil units* mapped by the Natural Resource Conservation Service (NRCS) around Cloverleaf Lakes. In general, all the soil units except those listed as *mucks* and the Wainola series have profiles of loamy sand underlain by sand. The Cormant series profile is similar; however, it also contains a thin layer of muck near the soil surface. The depth at which the loamy sand changes to sand varies among the units, but most often times occurs between 10" to 13" below the surface. The Seelyville, Markey and Cathro series are composed of muck profiles that extend >30" deep. The Wainola series is the only mapped unit that has a profile composed entirely of sand.

Table 1. Mapped Soil Units within the Shoreland of the Cloverleaf Lakes.

Soil Series	Hydric Inclusion*	Drainage
Au Gres loamy sand, 0-3% slopes (AuA)	Cormant mucky loamy fine sand	somewhat poorly drained
Cormant mucky loamy fine sand (Co) †	Brevort mucky loamy sand Markey and Cathro mucks Surface is very stony Surface layer is fine sand	poorly/very poorly drained
Croswell loamy sand, 0-3% slopes (CtA)	--	moderately well drained
Mahtomedi-Menahga loamy sands, 12-30% slopes (MaD)	--	excessively drained
Markey and Cathro mucks (Mk) †	--	very poorly drained
Menahga loamy sand, 0-2% slopes (MnB)	--	excessively drained
Menahga loamy sand, 6-12% slopes (MnC)	--	excessively drained
Rousseau loamy fine sand, 2-6% slopes (RsB)	--	moderately well drained
Seelyeville muck (Sd) †	--	very poorly drained
Wainola fine sand, 0-3% slopes (WaA)	Cormant mucky loamy fine sand	somewhat poorly drained

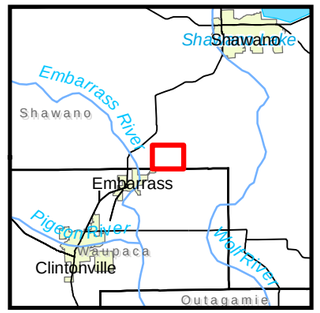
* NRCS Wisconsin Hydric Soils List (2008)
† NRCS Listed Hydric Soil

During the plant survey and additional restoration site design work, soils around the lakes were investigated. Soil pits were dug to approximately 20" and the soil texture(s) within the profile was recorded. Although the soil map indicates the presence of muck series along the shoreline in several areas around the three lakes, this soil texture was only found in a few locations. The southern and eastern shorelines of Grass Lake and the western and northeastern edges of Gibson Island were the only areas out of the water that have muck soils. In addition to these areas, the near shore lake *substrate* around the perimeter of Round Lake and the southern and eastern portions of Grass Lake was composed of muck. These areas correlate to the emergent vegetation communities mapped on the lakes (Figure 1). The remaining substrate found throughout the lake system is sand, similar to the soil described in the Wainola series. Even though Seelyeville, Markey and Cathro series are mapped around Pine Lake, no evidence of muck soils was observed. This could be due to inaccurate mapping or the fact that many of these areas were historically filled to allow development. For these sites, the homeowner will need to determine the soil texture. Most of the remaining shoreline areas around the three lakes have soil profiles composed of loamy sand underlain by sand; and, the top horizon contains moderate amounts of *organic* material. In a few areas, sand was the only texture identified.

In addition to observing soil textures within profiles around the lakes, pH was measured using a hand held meter. Readings ranged between 6.5 and 7.5, which indicate a neutral condition. Therefore, no soil amendments are required for native plant installation.

Figure 1
Restoration Areas, Soils and Native Vegetation

Cloverleaf Lakes Protection Association
Project No. 14747002
Town of Belle Plaine, Shawano County, Wisconsin



Extent of large view shown in red.

Rosenfeldt
Letven
Thornton
Sorenson
Thomas
Krubsack
Wendelborn
Bleck
Essmann
Odders
Anunson

AuA CtA Co MnB SfC Dp SfB MaD MnC W Mk Pt RsB Sd WaA

Legend

- Restoration Site
- Soil Map Unit

Native Vegetation

- Alder Thicket
- Emergent
- Northern Dry-Mesic Forest
- Northern Mesic Forest
- Northern Wet Forest
- Shrub-carr

Map Scale:
0 300 600
Feet

N

January 11, 2011

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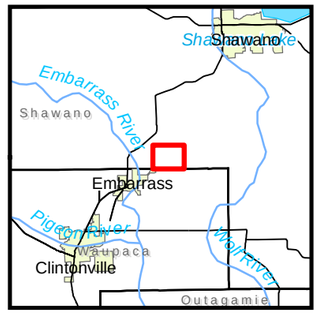
File:

Figure 2
Invasive Species Locations

Cloverleaf Lakes Protection Association
Project No. 14747002
Town of Belle Plaine,
Shawano County, Wisconsin



Extent of large view shown in red.

Invasive Species

- Black Locust
- Bull Thistle
- Canada Thistle
- Common Reed
- Creeping Bellflower
- Crown Vetch
- Honeysuckle
- Reed Canary Grass
- White Sweet-clover

Map Scale:
0 300 600
Feet

N

January 11, 2011

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Moisture Regime

Due to the sloping topography around the lakes, saturated soil conditions are only found at the very edge of or in the lake for many properties. There are, however, areas along Grass Lake, particularly the southern and western shorelines, that have narrow strips of nearly level land directly adjacent to the lake. These areas may only be a few inches to a foot above the lake level. Soils within these areas will have saturated soil conditions or water levels present within 12" of the soil surface for at least a portion of the growing season. Those shoreline areas that contain muck soils also exhibit saturated soil conditions.

Conducting an on-site investigation for the presence of water during the spring or early summer is the best way to determine the presence of water; however, information pertaining to water table levels can also be found in the description for each soil map unit (Table 1). Those soils that are moderately to excessively well drained will usually have water tables >6 feet below the soil surface; where as, somewhat poorly drained soils have water tables one to three feet below the surface. Poorly and very poorly drained soils often time have water tables at the soil surface or have standing water present.

Although no emergent plantings were conducted in the below restoration projects, noting water elevations is important if aquatic plants are to be installed. Generally, most plants are installed in water that does not exceed 1.5' to 2' in depth. During high water conditions, as exhibited this year in the three lakes, the amount of area that could potentially be planted will decrease. In most cases the installed plants will survive in shallower water or saturated soil conditions when the water levels recede; however, the same can't be said if restoration is conducted during low water periods. If plants are installed at their preferred water depths during low water years and water levels begin rising, many of the plants will struggle to survive.

Sun Exposure

The location of a property in relation to the sun's position throughout the day along with tree cover will dictate the amount of sunlight any given shoreland will receive. In general, those properties that face east and north will receive sun in the morning. Given the fact that much of the shoreline on all three lakes has significant tree cover present, areas facing these directions may only receive $\leq$ 4 hours (shade) of sunlight per day. Areas located further inland with scattered trees can expect filtered sunlight, which usually results in < 4 hours of sun per day. Less tree canopy could increase sunlight exposure to between 4 and 8 hours (partial shade/sun). South and west facing properties will receive late morning and afternoon sunlight. In most cases between 4 and 8 hours of sunlight can be expected due to tree coverage, but there may be a few locations that receive full sunlight ($\geq$8 hours). The amount of light received could vary throughout a property; therefore, sunlight conditions should be well documented for each restoration area so plants can be chosen accordingly.

Vegetation Communities

NES conducted a plant survey on the three lakes to determine dominant species found within terrestrial and aquatic (wetland/emergent) zones. A list of the plant species recorded along with their dominance, exotic/invasive status and community association can be found in Appendix A. Invasive species of greatest concern were located with a GPS and are identified on Figure 2. As can be seen from the map, reed canary grass (*Phalaris arundinacea*), is the most common invasive species found around the lakes.

According to the main vegetation species identified within a portion of the two intact and relatively undisturbed forested communities (Gibson Island and the southern portion of Round Lake)(Figure 1), found around the lakes, the dominant terrestrial community type is Northern Dry-Mesic Forest (Curtis 1959). Site conditions within this community generally include well drained, loam-sand soils with filtered sun (< 4 hours). Natural openings within the forest canopy or edges could receive additional sunlight. Although much of the understory has been removed from shorelines around the lakes, the dominant tree species that remain indicate that most of Cloverleaf Lake's terrestrial shoreline was historically a Northern Dry-Mesic Forest.

Wetland communities within the area include two shrub (Alder Thicket & Shrub-carr) and two forested (Northern Mesic Forest & Northern Wet Forest) communities. Three of the four are present on Gibson Island. Although these communities may have been historically present in other areas around the lakes, representative communities were not identified during the survey. Wet meadows were also likely more prevalent around the three lakes, but only scattered species associated with this community type were recorded. Site conditions for these four communities generally include poorly or very poorly drained mucky soils that have standing water and/or saturated. Due to the canopy of the trees and shrubs, sunlight will be filtered. The Alder Thicket and Northern Mesic Forest landscape positions most likely limit their sunlight exposure to <4 hours, while the Shrub-carr and Northern Wet Forest may receive slightly more sun (4-8 hours), particularly the edges.

Emergent wetland communities were found within all three lakes; however, Pine Lake only had three very small stands of chairmakers rush (*Schoenoplectus pungens*). This species is growing in water depths ranging from 6-12" on a sand substrate, which was visible during the vegetation survey. The two stands found in the northeast corner of the lake appear to receive full sun, while the stand located in the southwest corner gets 4-8 hours of sunlight. Other than watercraft generated waves, the southwest emergent community is rather sheltered, while the other two stands receive significant wave action. From our experience, stands of emergent vegetation on this lake are nearly non-existent due to the presence of a sand substrate and significant wind and watercraft generated wave action.

Grass Lake has the largest emergent vegetation stand within the Cloverleaf Lakes chain. Dominant plants within the stand include hardstem bulrush (*Schoenoplectus acutus*), pickerel weed (*Pontedaria cordata*) and water shield (*Brasenia schreberi*). To the south are several more small stands of emergent plants. Hardstem bulrush and bristly sedge (*Carex comosa*) were the two dominant species identified. A third stand located on the eastern edge of the lake, adjacent to the Gibson Island causeway, is composed of three main species: hardstem bulrush, pickerel week, and broad-leaved cattail (*Typha latifolia*). In addition to these three stands there are two small stands located on the west side of the island and in the northeast corner of the lake. Both emergent communities are dominated by hardstem bulrush and broad-leaved cattail. *Secchi disk* readings in these emergent stands ranged from 12" to 26" in depth, the beginning of the mucky substrate. The two small stands along with the largest stand appear to receive more than 8 hours of sunlight per day. The remaining two, due to their landscape position, likely get 4-8 hours of light. Although their position within the lake would suggest that wave action is not an issue, all the emergent stands except those found on the southern shore receive moderate wave energy generated by watercraft. Many areas on this lake that do not contain stands of emergent vegetation have sand substrate. As mentioned above, the sand along with frequent wave action leads us to believe these are factors that prevent the establishment or sustainability of emergent communities.

Compared to the other two lakes, Round Lake has a rather intact emergent vegetation community around much of its shoreline. Dominant species, listed in order of highest occurrence, within these stands includes hardstem bulrush, broad-leaved cattail, long-bracted tussock sedge, bristly sedge, white water-lily (*Nymphaea odorata*),

bull-head pond-lily (*Nuphar variegata*), pickerel weed, and bald spikerush (*Eleocharis erythropoda*). Secchi disk readings in these emergent stands ranged from 12" to 43" in depth, the beginning of the mucky substrate. The deepest reading occurred in a patch of floating leaved vegetation (lilies). Except for the stands located along the southern shoreline, aquatic vegetation receives ≥8 hours of sunlight. Southern areas appear to be limited to 4-8 hours of light per day. Reduced light condition is likely responsible for the absence of additional emergent vegetation along this shoreline because growing conditions as a whole are good and there is low wave energy due to lake size and slow no-wake regulations. Of the three lakes, emergent vegetation could most easily be restored on Round Lake.

Wildlife

While conducting the vegetation survey, wildlife species (Table 2) using the lake system were noted. All of the amphibian species utilize the emergent vegetation and wetland communities scattered throughout the three lakes. An absence of these communities around Pine Lake, however, limits populations due to the lack of habitat. Bird species were observed within each terrestrial and aquatic community. Although some only utilize the immediate shoreline and open water to feed, there is nesting habitat available due to a few larger patches of aquatic vegetation and the presence of good tree coverage around the three lakes. In particular, the south side of Round Lake and Gibson Island provide good, intact forested communities that benefit both avian and mammal species. Except for the muskrat, all the observed mammal species rely on forested habitat to survive. Recent studies have found intact shorelines to be important factors in sustaining diverse wildlife populations and a healthy lake ecosystem. Maintaining or restoring native vegetation within shoreland areas around these lakes will achieve this goal.

Table 2. Wildlife Species Observed on the Cloverleaf Lakes.

Scientific Name	Common Name
Amphibians	
Bufo americanus	American Toad
Chelydra serpentina	Common Snapping Turtle
Pseudacris crucifer	Northern Spring Peeper
Rana catesbeiana	Bullfrog
Rana pipiens	Northern Leopard Frog
Birds	
Agelaius phoeniceus	Red-winged Blackbird
Anas discors	Blue-winged Teal
Anas platyrhyncos	Mallard
Archilochus colubris	Ruby-throated Hummingbird
Branta canadensis	Canada Goose
Bubo virginianus	Great Horned Owl
Cardinalis cardinalis	Northern Cardinal
Carpodacus mexicanus	House Finch
Carpodacus purpureus	Purple Finch
Cardulus tristis	American Goldfinch
Corvus brachyrhynchos	American Crow
Cyanocitta cristata	Blue Jay
Cygnus buccinator	Trumpeter Swan
Gavia immer	Common Loon
Haliaeetus leucocephalus	Bald Eagle
Icterus galbula	Baltimore Oriole
Larus argentatus	Herring Gull
Melanerpes carolinus	Red-bellied Woodpecker
Pandion haliaetus	Osprey
Passer domesticus	House Sparrow
Pheucticus ludovicianus	Rose-breasted Grosbeak
Picoides pubescens	Downy Woodpecker
Poecile atricapilla	Black-capped Chickadee
Sitta carolinensis	White-breasted Nuthatch
Tachycineta bicolor	Tree Swallow
Turdus migratorius	American Robin
Zenaida macroura	Mourning Dove
Mammals	
Ictidomys tridecemlineatus	13-lined Ground Squirrel
Odocoileus virginianus	White-tailed Deer
Ondatra zibethicus	Muskrat
Sciurus carolinensis	Gray Squirrel
Sciurus vulgaris	Red Squirrel
Tamias striatus	Eastern Chipmunk

SHORELAND RESTORATION CASE STUDIES

In order to provide examples to the residents on the Cloverleaf Lakes and citizens of Shawano County, CLPA and NES assisted eleven landowners with shoreland restoration assessments and designs on Pine and Grass Lakes in the Town of Belle Plaine, Shawano County (Figure 1). Although there was interest by one landowner on Round Lake, their shoreline was in relatively good shape so they decided not to participate. Nine of the eleven participants implemented their projects during the past three years. The following section describes the methods that were used or recommended at each site, gives an account of each site's development, and provides a description of the positive and negative outcomes that occurred at each site, if applicable. Appendix B contains restoration designs for those that were developed and their associated plant lists. Two of the properties conducted assessments of their existing site conditions, but did not develop designs; however, a list of native plant species was generated based on the observed conditions. These lists are included within the relevant case study section below.

Soil pH was found to be neutral around the lakes; therefore, no amendments were added at any of the following restoration sites. Shredded hardwood bark mulch, however, was added to assist with moisture retention and weed control in all the rain gardens and live planting zones, excluding the biologs.

Bleck Residence – Pine Lake

Restoration Goal(s): 1) Control Surface Water Run-off Entering Pine Lake
2) Enhance and Stabilize Shoreline

	Planting Zone(s)		
Site Conditions	**Rain Garden**	**Upland Shoreline**	**Water's Edge**
Soil	Sand	Sand	Sand
Sun Exposure	Shade	Sunny	Sunny
Moisture Regime	Moist	Dry	Moist

Prior to conducting an assessment, the Bleck Family had determined that one of their goals was to reduce surface water run-off through the installation of a rain garden. Dan Bleck knew how water was moving across their lot and had an idea of where the rain garden should be constructed. NES ecologists met with Mr. Bleck to review the chosen area and assist with assessing existing site conditions on their Pine Lake property (Figure 1). During the site visit the above data were collected so a native plant list could be generated for the garden. At this time we noticed exposed soil along the shoreline (Photo 1). Dan indicated that he was not concerned with erosion, but would be open to planting some of the bare areas to help stabilize the soils. In this particular case some native vegetation was present so these species were recorded along with the other site conditions so a plant list could be compiled.

Mr. Bleck is by profession an architect so he designed the landscape plan found in Appendix B. Two rain gardens were designed to intersect on-site runoff and let it infiltrate before it reaches the lake. An upper rain garden is located where runoff from the adjacent property and runoff from the roof of a cottage on-site collects. This rain garden is separated from the lower swale and rain garden by a low berm. The lower swale and rain garden collects water from the main cottage on-site. In the summer of 2008, Dan and his family constructed the rain gardens (Photo 2) and installed the native plants, which were scattered planted within each zone.

Photo 1

Photo 2

Although we recommend the installation of protectors around newly planted trees and shrubs to prevent herbivore damage, the protectors can also help denote the plants location, especially small individuals. The Bleck family learned this when a few of their shrubs were accidentally mowed down because they were no longer marked.

This project is a good example of how rain gardens and supplemental native plants can be incorporated into a designed landscape to retain stormwater and also increase the floral diversity and aesthetics of the site.

Krubsack Residence – Pine Lake

Restoration Goal(s): 1) Enhance and Stabilize Shoreline

	Planting Zone(s)	
Site Conditions	**Wet Meadow**	**Upland Shoreline**
Soil	Sand	Sand
Sun Exposure	Partial Shade/Sun	Partial Shade/Sun
Moisture Regime	Moist	Dry

NES ecologists met with Joy and Dennis Krubsack to assess existing site conditions on their Pine Lake property (Figure 1). During this site visit we noted the presence of a small ice ridge that had exposed soil along the shoreline (Photo 3). Except for the lack of vegetation, the shoreline appeared to be in good shape because the sand ridge was left natural; however, the exposed soils were prone to erosion. We suggested installing native plants along the shoreline to help stabilize the area. Both Dennis and Joy agreed, but they had concerns about continued use of the area for recreation and how plant height would impact their view. After much

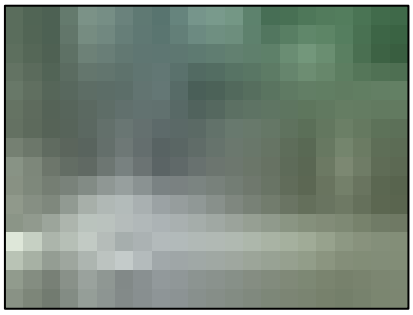

Photo 3

discussion, they decided to confine restoration activities to an area in front of the boathouse (Photo 4) and the east side of their lot (right side of Photo 4). To ensure they had walking access to the lake they decided to incorporate a walking path between areas within their eastern planting zone. Based on their final decision, NES collected the above site condition data for the two areas and drew a preliminary sketch of the restoration site. Using the above conditions and taking into consideration the Krubsack's concerns regarding plant height, NES generated a suitable plant list and added them to the sketch (Appendix B). Upland shoreline plants chosen for the site do not generally exceed three feet in height, while those selected for the wet meadow zone grow 2-5' in height. This particular zone is lower in elevation than the upland zone; therefore, species that grow a little taller could be utilized.

In the summer of 2008, Joy and Dennis installed the native plants, which were scattered planted within each zone and mulch added (Photo 5). The combination of upland and wetland planting allowed the Krubsack's to increase floral diversity and stabilize their shoreline.

Photo 4

Photo 5

Thornton Residence – Grass Lake

Restoration Goal(s): 1) Enhance Shoreline Aesthetics & Wildlife Value

	Planting Zone(s)			
Site Conditions	**Upland Terrace**	**Biolog – Lower**	**Biolog – Upper**	**Shoreline Slope**
Soil	Sandy Loam	--	--	Loam
Sun Exposure	Partial Shade/Sun	Sunny	Sunny	Partial Shade/Sun
Moisture Regime	Dry	Wet	Moist/Wet	Dry

Prior to NES becoming involved with this project, Dennis and Jan Thornton had begun restoring their shoreland. Their property is located on a steep bank along the north shore of Grass Lake (Figure 1); therefore, they have created *terraces* from their house down to the lakeshore. With the help of his brother, a horticulturalist, Dennis designed and planted the western half of the upper terrace with native plants in hopes of attracting butterflies; however, his goal to restore their shoreline to a more natural state for increased aesthetics and wildlife value did not stop there. In 2008, NES ecologists met with Dennis to assess existing

Photo 6

site conditions on the lowest terrace, which was being maintained as lawn (Photo 6). During this site visit we did not notice erosion issues either on the steep slope or along the shoreline; however, we did note the presence of reed canary grass growing within the rock located along the water's edge (Photo 6). The Thornton's wanted a more natural looking shoreline so they were allowing the vegetation to grow not knowing it was a very aggressive, non-native species. Although Dennis was focused on restoring the lower terrace, he was open to suggestions regarding the shoreline area; therefore, NES collected site condition data within the terrace area and along the shoreline. For this particular site neither NES nor the Thornton's created a base map. Dennis marked the desired planting areas with flags and we measured them so the number of plants required could be calculated. Since height was not a concern for the planting area, NES chose the below species to add floral diversity, texture, color and wildlife value. The plants were scattered throughout the zone to provide a more natural appearance. Except for a small area for the fire pit and two narrow paths to the pit and pier, the entire terrace was planted. In the summer of 2008 restoration activities were completed by the Thornton's. Dennis applied herbicide to the grass and then convinced his brother, who was visiting from Oregon, to help him install the plants and add shredded hardwood bark mulch (Photo 7).

Photo 7

Upland Terrace Species List

Scientific Name	Common Name
Aquilegia canadensis	Columbine
Asclepias tuberosa	Butterflyweed
Aster azureus	Sky Blue Aster
Aster ericoides	Heath Aster
Dalea purpurea	Purple Prairie Clover
Geranium maculatum	Wild Geranium
Koeleria macrantha	June grass
Liatris aspera	Rough Blazingstar
Lupinus perennis	Lupine
Monarda fistulosa	Bergamot
Ratibida pinnata	Yellow Coneflower
Schizachyrium scoparium	Little Bluestem
Solidage rigida	Stiff Goldenrod
Sorghastrum nutans	Indiangrass
Sporobolus heterolepis	Prairie Dropseed
Tradescantia ohiensis	Common Spiderwort
Verbena stricta	Hoary Vervain

In the summer of 2009, the Thorntons conducted the second phase of their restoration by eliminating the reed canary grass along their shoreline and replacing the rocked shoreline with more natural materials. Dennis began by carefully applying herbicide to the invasive grass near the water, while leaving the existing sedges. He then began the pain staking process of digging and removing by hand more than a foot of 2"-3" rock that was historically placed in front of his property. Two rows of biologs were then installed and secured at the

water's edge (Photo 8). The Thornton's location on Grass Lake limits wave energy; therefore, 2" wooden stakes were used to secure the materials. Once secured, the biologs were backfilled with topsoil, creating a terraced slope from the waterline to the top of the existing shoreline (Photo 7). The biologs and slope were then planted with a mixture of sedges, grasses and wildflowers suited for each of the growing conditions present, see above table. A list of species for each zone can be found below.

Photo 8

Photo 9

Although Dennis conducted the site preparation work, much of the installation work was performed by students and neighbors that participated in the "Shoreland Restoration Day" (Photos 8 and 9). The educational hands-on event was held by the Cloverleaf Lakes Association to give landowners and individuals an opportunity to see and participate in shoreline restoration techniques including site preparation, material installation and planting. On the Thornton project, participants learned proper biolog installation, use of *erosion control blankets* and the installation of live plants. In addition to planting plugs, a *cover crop* of oats was hand seeded prior to staking the erosion blanket into place.

Shoreline Slope Species List

Scientific Name	**Common Name**
Aquilegia canadensis	Columbine
Asclepias verticillata	Whorled Milkweed
Aster laevis	Smooth Blue Aster
Aster novae-angliae	New England Aster
Elymus virginicus	Virginia Wild Rye
Gentian andrewsii	Bottle Gentian
Liatris pycnostachya	Prairie Blazing Star
Monarda fistulosa	Wild Bergamont
Panicum virgatum	Switchgrass
Ratibida pinnata	Yellow Coneflower
Rudbeckia hirta	Black-eyed Susan
Schizachyrium scoparium	Little Blue Stem
Solidago nemoralis	Old Field Goldenrod
Solidago rigida	Stiff Goldenrod
Sorghastrum nutans	Indian Grass
Tradescantia ohiensis	Common Spiderwort

Aside from occasional weed pulling, the Thornton's report very little maintenance is required to keep up the planting. They have also noticed an increase in birds, bees and butterflies and enjoy the aesthetic beauty of the wildflowers and grasses. Negative aspects of the planting that were incurred include the expense of implementing the restoration (cost of materials and plants) and the loss of time spent waiting for the plants to mature. This project is a good example of how a landowner can use natural building materials to reshape their shoreline to match in with existing bulkheads or retaining walls, and also demonstrates how using both upland and shoreline areas can increase floral diversity and aesthetic value (Photo 10).

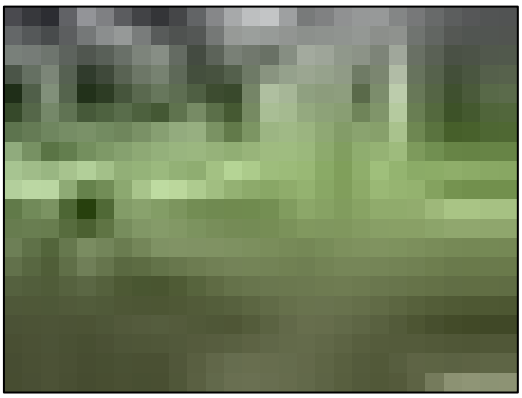

Photo 10

Upper Biolog Species List

Scientific Name	Common Name
Anemone canadensis	Canada Anemone
Asclepias incarnata	Swamp Milkweed
Aster lateriflorus	Calico Aster
Aster novae-angliae	New England Aster
Calamagrostis canadensis	Bluejoint Grass
Carex bebbi	Bebb's Sedge
Elymus virginicus	Virginia Wild Rye
Eupatorium maculatum	Spotted Joe Pye Weed
Eupatorium perfoliatum	Boneset
Helenium autumnale	Sneezeweed
Lobelia siphilitica	Great Blue Lobelia
Pycnanthemum virginianum	Common Mountain Mint
Rudbeckia laciniata	Wild Golden Glow
Scirpus atrovirens	Green Bulrush
Scirpus cyperinus	Wool Grass
Verbena hastata	Blue Vervain

Lower Biolog Species List

Scientific Name	Common Name
Asclepias incarnata	Swamp Milkweed
Carex comosa	Bristly Sedge
Carex lacustris	Lake Sedge
Eupatorium maculatum	Spotted Joe Pye Weed
Eupatorium perfoliatum	Boneset
Glyceria striata	Fowl Manna Grass
Iris versicolor	Blue Flag Iris
Juncus effusus	Common Rush
Leersia oryzoides	Rice Cut Grass
Lobelia cardinalis	Cardinal Flower
Mimulus ringens	Monkey Flower
Schoenoplectus acutus	Hardstem Bulrush

Letven Residence – Grass Lake

Restoration Goal(s): 1) Control Surface Water Run-off & Eliminate Soil Erosion on Steep Slope
2) Enhance Shoreline Aesthetics & Wildlife Value

	Planting Zone(s)	
Site Conditions	**Shoreline**	**Rain Garden**
Soil	Sandy Loam-Fine Sand	Sand/Mulch
Sun Exposure	Sunny	Shade
Moisture Regime	Dry	Moist

NES ecologists met with Marv and Esther Letven in April of 2009 to assess existing site conditions on their Grass Lake property (Figure 1). During the on-site meeting they expressed concerns regarding soil erosion on their steep slope leading down to the lake. Upon further review we discovered a shallow gulley that had formed due to a concentration of water that was being funneled from a portion of Cloverleaf Lakes Road and the Letven's asphalt parking area (Photo 11). Our suggestion was to capture and infiltrate the surface water run-off prior to reaching the steep slope. Based on the configuration of their lot, tree and structural locations, and degree of slope, it appeared a small rain garden near the parking area would be beneficial. Although any size garden could have been constructed, the goal was to reduce surface water run-off that was causing soil erosion. For this reason, elevations were surveyed on the road, parking lot and slope leading down to the lake to determine surface water flow patterns and the drainage basin size. Based on the elevations we determined that water from roughly a 750 ft^2 area was flowing through their property; therefore, in order to adequately capture and infiltrate most rain events based on the soil(s) present, a 7' x 16' rain garden approximately eight inches in depth with six inch berms was designed. The garden had to be worked in between the property line and existing sidewalk and around a tree, but a creative design allowed for its construction (Appendix B). During the site visit the above data were also collected so a native plant list could be generated for the rain garden.

Photo 11

Photo 12

The Letvens were also interested in improving their shoreline. A review of the area indicated the presence of maintained lawn up to a timber retaining wall (Photo 12). Except for a lack of native vegetation, the shoreline appeared to be in good shape because the timbers were preventing shoreline erosion. We suggested replacing the timber wall with a series of biologs similar to the Thornton property to provide a more natural buffer between the water's edge and the shoreline. Our staff also recommended installing native plants in the lawn area behind the wall to improve aesthetics, plant diversity, and wildlife habitat. Both Marv and Esther agreed that they did not want to tackle the removal of the retaining wall at this time, but they liked the idea of replacing some of the lawn. They had concerns about

continued use of their shoreline for recreation; therefore, they decided to confine restoration activities to an area directly adjacent to the Thornton restoration (top portion of Photo 12). Based on their final decision, NES collected the above site condition data for the area and created a design of the restoration site. Using the above conditions and taking into consideration the Letven's desire to have a landscaped feel to the planting, NES generated a suitable plant list and arranged them on the design (Appendix B).

Photo 13

Site preparation of the lawn included a herbicide application, which was conducted by the Letven's neighbor, Dennis Thornton. Although Dennis conducted the site preparation work, much of the installation work was performed by NES, students and neighbors that participated in the "Shoreland Restoration Day". The educational hands-on event was held by the Cloverleaf Lakes Association to give landowners and individuals an opportunity to see and participate in shoreline restoration techniques including site preparation, material installation and planting. On the Letven project, participants learned how to construct a rain garden, use of erosion control blankets, and the installation of live plants (Photo 13).

Photo 14

This project, along with Thornton's was a great example of how well supervised volunteers can greatly decrease the time and workload needed to complete a project. Stand-alone gardens (Photo 14), like the upland garden planted at Letven's, are a great way to add diversity to a property even when shoreline restoration or stormwater control is not necessary.

Sorenson Residence – Grass Lake

Restoration Goal(s): 1) Control Surface Water Run-off & Eliminate Soil Erosion on Steep Slope
2) Enhance Shoreline Aesthetics & Wildlife Value

	Planting Zone(s)
Site Conditions	**Rain Garden**
Soil	Sandy Loam/Sand/Mulch
Sun Exposure	Partial Sun/Shade
Moisture Regime	Moist - Dry

The Sorenson's did not express concerns regarding soil erosion on their property, but they were open to making improvements to their shoreline to help lake health; therefore, NES ecologists met with them in 2009 to assess existing site conditions on their Grass Lake property (Figure 1). A review of the area indicated the presence of maintained lawn up to the water's edge; and except for a lack of native vegetation, the shoreline appeared to be in good shape. We suggested installing native plants in the lawn area along the shoreline to improve aesthetics, plant diversity, and wildlife habitat, but Don was not sure he wanted to change its appearance or use at the time. The Sorenson's, however, wanted to do something so we suggested installing a

Photo 15

rain garden to capture surface water run-off currently discharging from a pipe that was connected to one of the house's downspouts (Photo 15). They liked the idea of controlling the run-off and installing another plant bed on their property. Based on their final decision, NES collected the above site condition data for the area where the rain garden was to be constructed. In addition to this information, NES calculated the roof dimension so we knew the approximate amount of surface water that would discharge to the rain garden. Due to the desired location of the pipe's outfall, the garden would need to be constructed on a steep slope, which can create erosion problems if it is not properly designed. For this reason, elevations were surveyed on the slope leading down to the lake. Our engineers then utilized stormwater modeling to determine the rain garden size and design. Based on the elevations we determined that four 10' x 12' terraced rain gardens should be built below the pipe outfall to adequately slow and infiltrate the run-off. The gardens were designed to be 8"-10" deep and have scour stop weirs that would allow overflow to run downhill to the next inline garden (Appendix B). In most cases a rain garden will have one planting zone within the garden and possibly another on the edge/berms. Due to the complex terraced design, there are two zones within the garden itself plus another zone on its fringe. Both zones within the garden will have moist water regimes, but since there is an area that will pond more water, plants capable of a little wetter condition were chosen. Although part of the garden, the fringe area is designed to be fairly dry since it would only receive water in large rain events. Using the above conditions and taking into consideration the Sorenson's desire to have fern species incorporated into the design, NES generated a suitable plant list, which included native shrubs, grasses, sedges and wildflowers (Appendix B).

Photo 16

In the summer of 2010, the Sorenson's used the plans and constructed the terraced rain gardens. Although Photograph 16 does not show the installed plants, the Sorenson's planted the native species recommended for the site. Extra plants from the terrace project were used to create a small rain garden below their sidewalk. Aside from minor movement of the mulch after a heavy rain, the landowners are very pleased with their terraced rain gardens. This project is a great example of how stormwater runoff can be collected and treated even on steep slopes before it reaches a waterbody.

Wendelborn Residence – Grass Lake

Restoration Goal(s): 1) Enhance Shoreline Aesthetics & Wildlife Value

	Planting Zone(s)
Site Conditions	**Shoreline Buffer**
Soil	Sandy Loam/Loam
Sun Exposure	Partial Sun/Shade
Moisture Regime	Moist

Donald and Laverne Wendelborn were interested in increasing the aesthetic quality of their shoreline and attracting butterflies and other insects and wildlife to their property. The area available to restore was constrained by an access easement, therefore they were limited in the size and scope of design options. The initial site assessment conducted by NES ecologists found that the site was maintained as lawn up to a rip-rap border that continued into the lake (Photo 17). Soils were very poorly drained, loam-silt loam and contained gravel backfill from the rip-rap.

Two areas were selected for restoration: one north of the existing dock and one south. For this site neither NES nor the Wendelborn's created a base map. They marked the desired planting areas with flags and we measured them. Both areas were measured to be approximately 2' x 40'. The total area was then used to determine the number of plants to be installed. In addition to using the above site condition information, the Wendelborn's wished to have a buffer with plants that bloomed throughout the growing season in a variety of colors and were not so tall that they impeded the view of the lake from their patio and porch. Based on this information, NES chose the below species for the site.

Shoreline Buffer Species List

Scientific Name	Common Name
Anemone canadensis	Canada Anemone
Asclepias incarnate	Swamp Milkweed
Aster novae-angliae	New England Aster
Carex vulpinoidea	Brown Fox Sedge
Chelone glabra	Turtlehead
Eupatorium maculatum	Spotted Joe Pye Weed
Iris virginica	Blue Flag
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Blue Lobelia
Onoclea sensibilis	Sensitive Fern
Rudbeckia subtomentosa	Sweet Black-eyed Susan

Site preparation involved the removal of the sod layer and tilling of the upper 6 inches of soil within the two 2' x 40' strips above the rip-rap. Live plants and shredded hardwood bark mulch were added to the site in the summer of 2009. The site was watered and weeded on a regular basis by the Wendelborn's. All the planted species survived the first year. During the growing season, some were clipped by muskrats, but remained alive and were not replaced.

Above normal precipitation and lake level in 2010 greatly increased the growth of the plants and allowed them to increase their coverage of the shoreline buffer (Photo 18). The southern section is approximately 75% covered by planted species, while the northern section is lagging behind with approximately 50% coverage. In addition, several plants were buried in the northern section by woodchips from the pruning of a neighboring tree. The buried plants were replaced by new stock. Additional stock will be planted in 2011 if coverage does not increase in the buffer. A side benefit to the increased plant density and height was the increased reluctance of Canadian geese to use the shoreline, which had become a problem in recent years. They have also noticed an increase in hummingbird activity along the lakeshore and have identified monarch butterfly caterpillars feeding on the vegetation.

This site is a good example of a very minimal design that required relatively little space and physical work but resulted in a dramatic increase in aesthetic quality along with insect and bird use within the shoreline buffer.

Photo 17

Photo 18

Anunson Residence – Pine Lake

Restoration Goal(s): 1) Enhance and Stabilize Shoreline

	Planting Zone(s)	
Site Conditions	**Biolog & Wet Meadow**	**Upland Shoreline**
Soil	NA & Loamy Sand-Sand	Loamy Sand-Sand
Sun Exposure	Partial Shade/Sun	Partial Shade/Sun
Moisture Regime	Wet	Dry

Photo 19

Prior to conducting an assessment, Greg Anunson expressed concern about shoreline erosion. Since Mr. Anunson resides in California, NES conducted a site assessment on his Pine Lake property (Figure 1) with Kery Kafka, Greg's neighbor, in 2007. During the visit our ecologists noted undercut banks along the shoreline due to wave activity (Photo 19). Although soil was eroding and the banks slumping, the amount of damage was minimized due to the fact that the existing shoreline was well vegetated with native herbaceous and woody species. These plant's extensive root systems were helping stabilize much of the shoreline. Since the shoreline was in relatively good shape and Greg's concerns were with the loss of shoreline, NES collected the above data and took measurements of the shoreline so a plan to stabilize the shoreline could be created and a native plant list generated. In this particular case some native vegetation was present on the shoreline so these species were recorded and utilized within the restoration.

Based on the existing conditions, NES proposed a design that included the installation and planting of four 20" biologs that were to be backfilled with topsoil and planted. In the summer of 2009, Mr. Anunson hired NES to implement the restoration plan, which included securing a bioengineering permit from the WDNR. Our staff

then installed the biologs, topsoil, erosion blanket and live plants according to the proposed design. Due to the concern of potential impacts by large waves and ice, the biologs were secured with duckbill anchors and 2" wooden stakes. The biologs create a reinforced shoreline capable of withstanding the constant waves produced by the wind and watercraft on Pine Lake. The added protection will allow both the planted and existing vegetation to become established to help stabilize the soils.

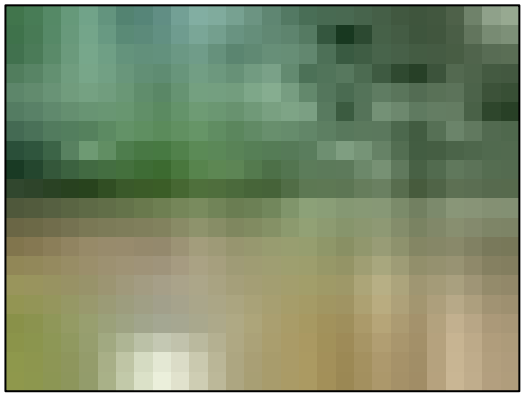

Photo 20

In addition to noting the native species found on-site, our ecologists also observed black locust (*Robinia pseudoacacia*). This tree species was introduced to the U.S. and has become ecologically invasive. There are several locations around Cloverleaf Lakes that have black locust present. To eliminate further spread, NES cut and removed all the individuals identified.

Anunson's was the second of three properties along the east shore of Pine Lake to be restored due to wave induced erosion. It is the smallest of the three properties restored and contained the most natural shoreline, which had led to a very successful restoration (Photo 20).

Odders Residence – Pine Lake

Restoration Goal(s): 1) Stabilize Shoreline
2) Control Surface Water Run-off Entering Pine Lake
3) Increase Wildlife Habitat for Birds & Butterflies

	Planting Zone(s)			
Site Conditions	**Rain Garden**	**Biolog**	**Upland Shoreline Zones 1, 3 & 4**	**Upland Shoreline Zone 2**
Soil	Sand	--	Loamy Sand - Sand	Loamy Sand - Sand
Sun Exposure	Shade	Sunny	Sunny	Partial Shade/Sun
Moisture Regime	Moist	Wet	Dry	Dry

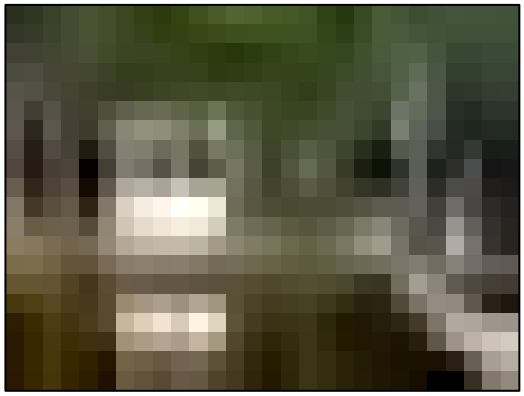

Photo 21

NES ecologists met with Dick and Mary Lee Odders in the summer of 2009 to assess existing site conditions on their Pine Lake property (Figure 1). During the on-site meeting, the Odders' expressed interested in stabilizing their shoreline due to years of erosion caused by wave action. They also brought up concerns regarding soil erosion along the north side of their boathouse. A review of their shoreline indicated rather severe erosion which had exposed previously placed rip-rap and wooden timbers (Photo 21). The only vegetation growing on the steep slope leading down to the water's edge was grass, which does not have a deep root system capable of stabilizing soils. Although the erosion seemed severe, the wave energy for Pine Lake is considered low; therefore, a biostabilization method,

installation of biologs, was recommended for the site to reduce wave energy impacts and provide a natural looking shoreline. The Odders' approved the method so NES took measurements so a design could be completed for the shoreline restoration.

In addition to recommending the biolog installation at the water's edge, our staff also suggested installing native plants on the steep slope behind the biologs to improve slope stability, aesthetics, plant diversity, and wildlife habitat. A review of the area indicated the presence of maintained lawn up to the water's edge (Photo 21). Both Dick and Mary Lee liked the idea of replacing the lawn on the steep slope because mowing that section of lawn was a safety hazard; however, they had concerns about continued use of their boathouse. Traffic into and out off the building was infrequent; therefore, we suggested the installation of ScourStop, a durable plastic product, in front of the boathouse. The material provides extra stability while still allowing vegetation to grow through. Based on their final decision, NES collected the above site condition data for the area and created a design of the restoration site. Using the above conditions and taking into consideration the Odders' desire to restrict plant height, especially in Zone 3 which is located in front of a bench (Photo 21), and attract birds, NES generated a suitable plant list for the various zones (Appendix B).

We then reviewed the north side of the boathouse and discovered a gulley that had formed due to a concentration of water that was running off the pitched boathouse roof (Photo 21). Our suggestion was to first install a gutter and downspout on the north side of the roof so water could be directed to an upslope area. Water run-off could then be captured and infiltrated within a rain garden prior to reaching the steep slope, thus eliminating erosion potential. Following our site visit, the Odders' had a gutter and downspout installed, which discharges to a level area on the northeast side of the boathouse. Although any size garden could have been constructed, the goal was to reduce surface water run-off that was causing soil erosion along the building's foundation; therefore, NES calculated the roof dimension so we knew the amount of surface water that would discharge to the rain garden. Based on the roof surface area on the soil(s) present we determined that a 50 ft^2 rain garden approximately five inches in depth with 2-3" berms was needed to adequately capture and infiltrate the roof run-off (Appendix B). During the site visit the above data were also collected so a native plant list could be generated for the rain garden.

Photo 22

Site preparation began in the late summer/fall of 2009 with a herbicide application of the existing lawn, which was conducted by the company hired by the Odders' to maintain their landscape. After this was completed, Dick and Mary Lee hired NES to help with restoration activities, particularly the shoreline stabilization including biolog installation. Prior to conducting any on-site activities, a bioengineering permit was secured from the WDNR. Once the permit was obtained, our staff began by removing the existing rip rap and timbers from the shoreline. Six 10' x 20" biologs were then installed and secured into the lakebed and shoreline with both 2" wood stakes and duck-bill anchors due to the concern of potential impacts by large waves and ice. The existing ground was then contoured, erosion blanket installed to reduce surface erosion, and the biologs backfilled with topsoil to create a more gentle slope from the waterline to the top of the existing ground elevation per the design details (Photo 22). The biologs and associated plantings create a reinforced shoreline capable of withstanding the constant waves produced by the wind and watercraft on Pine Lake.

Photo 23

The following day NES staff assisted the Odders' and a crew of high school students install a mixture of sedges, grasses and wildflower plants in the biologs and on the slope. Prior to planting, the areas were covered with a 1"-2" layer of shredded hardwood bark mulch. While the shoreline plants were being installed, Dick and a few students constructed and planted the rain garden (Photo 23). Rocks excavated during the biolog installation were used to create a border around the rain garden to help distinguish the garden as part of the landscape. Once the plants were installed, the Odders' placed approximately 4" of straw mulch around them to help them survive the winter since they were installed in a dormant state.

While weather could have played a role in some planting problems, the inexperience of the students led to a significant number of plants having to be replanted by the Odders'. Although not part of the "Shoreland Restoration Day", the students learned and participated in shoreline restoration techniques including site preparation, material installation and planting. Aside from issues with the planting, the project was successfully installed and is growing well after its first growing season (Photos 24 & 25).

High water levels (6"-10" above normal) in Pine Lake, however, caused some issues along the shoreline. Wave action created a situation where water was routinely breaking over the biologs and caused some soil settling and erosion. Although the plants were present, they did not have enough time to become fully established to dissipate the wave energy and fully stabilize the bank. Due to these circumstances, NES installed EnviroLok™ bags in the fall of 2010 along the back side of the biologs. EnviroLok bags are filled with topsoil and can be planted with vegetation. Installation of the bags stopped the erosion and NES will return in the spring of 2011 to plant the bags with native vegetation.

Photo 24

Photo 25

Essmann Residence – Pine Lake

Restoration Goal(s): 1) Stabilize Shoreline

		Planting Zone(s)	
Site Conditions	**Biolog**	**Wet Meadow Shoreline**	**Upland Shoreline**
Soil	--	Sandy Loam	Sandy Loam
Sun Exposure	Sunny	Sunny	Sunny
Moisture Regime	Wet	Moist	Dry

NES ecologists met with Howard Essmann in May of 2009 to assess existing site conditions on his Pine Lake property (Figure 1). During the on-site meeting he expressed concerns regarding soil erosion on their shoreline. Like the Odders and Anunson properties, shoreline erosion was occurring due to frequent wave action (Photo 26). The Essmann shoreline, however, had sparse vegetation growth present, which left the soils open to continued erosion. As with those two properties, NES recommended the installation of biologs and native plants to help stabilize the shoreline. Mr. Essmann liked the concept so NES went ahead with collecting elevations, lengths and the above site conditions and created a design of the restoration site. Using the above conditions and taking into consideration Howard's desire to restrict plant height, especially in upland shoreline zone, NES generated a suitable plant list for the various zones (Appendix B).

Photo 26

Although a design was completed, Howard and his family decided not to implement the plan in 2009. To be sure there was not another alternative Howard's son John submitted a permit to the WDNR for the installation of rock rip-rap along the shoreline. However, the WDNR Water Management Specialists informed Jon that because the lake is considered a low energy system and the shoreline did not currently have rock in place, they were not eligible for a rock permit. The WDNR individual suggested the installation of a biostabilization method like the installation of biologs. Since NES had already designed a plan incorporating the use of these materials, the Essmann family hired NES to implement the restoration plan.

Photo 27

NES staff met with Howard and his daughter in July of 2010 and recommended an herbicide application to the vegetation present along the shoreline. Shortly after the meeting, Howard carefully sprayed the area. Prior to conducting any on-site activities, a bioengineering permit was secured from the WDNR by John. Once the permit was obtained in early August of 2010, our staff along with both John and Howard Essmann began by installing eight 10' x 16" biologs that were secured into the lakebed and shoreline with both 2" wood stakes and duck-bill anchors due to the concern of potential impacts by large waves and ice (Photo 27). The existing ground was then contoured, erosion blanket installed to reduce surface erosion, and the biologs backfilled

Photo 28

with topsoil to create a more gentle slope from the waterline to the top of an existing timber per the design details (Photo 28). Live plants were then installed on the slope and in the biolog. To ease plant installation into the biologs, the Essmann's chose to pay a little more money and have the manufacturer pre-drill holes based on NES' recommended plant spacing.

The water level on Pine Lake was approximately 6"-8" higher than normal, but the installation went fine and the planting was doing well until a very large rain event (5"+) occurred in September, less than a month after project completion. Wave action created a situation where water was continually breaking over the biologs and causing erosion problems (Photo 29). Although the plants were present, they did not have enough time to become fully established to dissipate the wave energy and fully stabilize the bank. Due to these circumstances, NES installed EnviroLok™ bags in the fall of 2010 along the back side of the biologs. Based on conversations with the Essmann family, installation of the bags stopped the erosion even though a large storm system moved into the area the following day. The storm had sustained winds of 40+mph, which created significant wave action. NES will return in the spring of 2011 to plant the bags with native vegetation.

This project had a number of issues that the design was unable to account for, all of which were due to unforeseen natural events. A positive outcome of the situation is that NES was able to install and test the EnviroLok™ bags, which were found to be extremely easy to install and anchor. The combination of biologs and bags at the Essmann property should provide significant reinforcement of the shoreline. The establishment of vegetation on the biologs, bags and shoreline will help to bind everything together and add another layer of protection against wave action and erosion.

Photo 29

Rosenfeldt Residence – Grass Lake

Restoration Goal(s): 1) Enhance Shoreline Buffer for Wildlife and Aesthetics

	Planting Zone(s)		
Site Conditions	**Mesic/Wet Mesic Forest**	**Mesic Forest**	**Mesic Prairie**
Soil	Loamy Sand-Sand	Loamy Sand-Sand	Loamy Sand-Sand
Sun Exposure	Shade	Partial Shade/Sun	Sunny
Moisture Regime	Moist	Dry	Dry

NES ecologists met with Dave and Sandy Rosenfeldt in the summer of 2009 to assess existing site conditions on their Grass Lake property (Figure 1). Except for the presence of an abundance of reed canary grass, the shoreline appeared to be in good shape (Photo 30). The Rosenfeldt's were aware of the invasive grass and said they were already removing seed heads to prevent further spread. Our ecologists discussed additional removal/treatment options with them so they could eliminate the species if they chose to conduct the work.

The remainder of the buffer was stable, but much of the area was being maintained as lawn (Photo 31). Our staff suggested installing native plants and controlling invasive species within several areas to improve the property's aesthetics, plant diversity, and wildlife habitat. The Rosenfeldts wanted to improve their property and were open to suggestions; therefore, NES collected the above site condition data for the chosen areas and designed a restoration plan for the property. Using the above conditions and native plants found on-site NES generated a suitable plant list and added the planting zones to the plan (Appendix B).

This design was not implemented but is a good example of a site that could have the native vegetation restored to improve the quality of the lake buffer. Site preparation and installation methods would follow those steps discussed in the manual "Cloverleaf Lakes Shoreline Restoration – A Guide for Lake Residents".

Photo 30

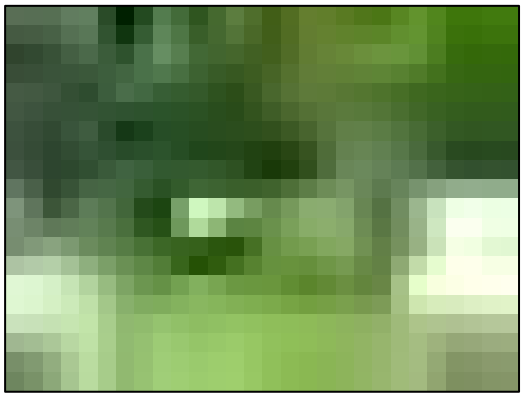

Photo 31

Thomas Residence – Pine Lake

The property owned by brothers Mark and John Thomas has seen severe erosion due to wave action. Over the last 25 year, approximately 4-5 feet of shoreline has been lost. Site investigations found a natural forested shoreline that was helping stabilize the shoreline but was still being undercut due to frequent wave action (Photos 32 & 33). A topographic survey was completed to design a restoration plan; however, the owner's unwillingness to remove any trees and the inability to secure a permit from the WDNR to extend the shoreline into the water prevented the project from going forward; therefore, a full design and restoration plan was not completed. This site is an example of an area within the Cloverleaf Lakes chain that may have been eligible to use more than just biostabilization methods, but shoreline contouring and the loss of trees would have been required, which is sometimes difficult for property owners.

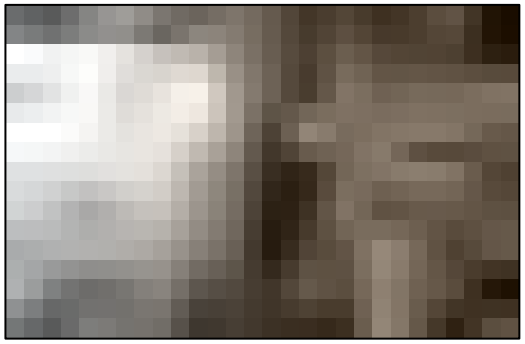

Photo 32

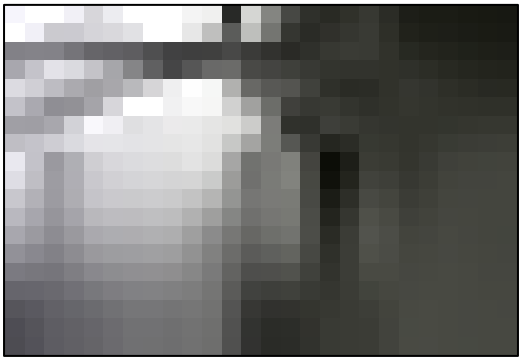

Photo 33

EDUCATIONAL EVENTS

In addition to providing examples of shoreland restorations, the case studies allowed NES and the Cloverleaf Lakes Protective Association to educate landowners about the important relationship that exists between a lake's shoreline and its overall health. As mentioned in several of the projects above, a "Shoreland Restoration Day" was conducted on June 27, 2009 (Appendix C). The event provided NES and the lake association with an opportunity to involve lake residents in actual restoration project activities. Individuals were encouraged to ask questions and participate. Many students from the surrounding schools took the opportunity to learn and receive the hands-on training.

The "Shoreland Restoration Day" also included a pontoon tour of previously completed projects and restoration opportunities around the lakes. James Havel of NES led the tours and answered general questions about shorelines and provided information on assessing site conditions and plant species chosen for restoration sites. More than a dozen lake residents participated in both the tour and demonstration activities. A similar tour was conducted in 2008, which generated interest in shoreline restoration and resulted in a couple of the projects discussed above.

The Cloverleaf Lakes association also has a shoreline restoration committee that is very active. They are responsible for creating fliers with helpful tips (Appendix C); presenting information at their annual meetings; providing signs for lake owners conducting restoration activities (Photo 5); and for overseeing a program that reimburses property owners for some of the expenses incurred to implement restoration projects. The group's involvement and commitment resulted in the implementation of many of the above projects, which were carried out and paid for by willing and concerned lake property owners.

GLOSSARY

Biolog: coconut fiber that is molded into a "log-like" shape that is used to help stabilize shorelines by forming a barrier between a shoreline and waves, thus cushioning the shoreline against wave energy

Biostabilization: a shoreline stabilization method using natural materials such as biologs.

Buffers: a vegetative or physical (ice ridge) zone that reduces impact to the shoreline

Cover Crop: a temporary crop, (commonly oats or annual rye) planted to keep nutrients and soil from eroding and greatly reduces the amount of weed growth

Emergent Vegetation: a rooted herbaceous plant whose stem extends above the water's surface

Erosion Control Blanket: a blanket of plastic fibers, straw or other plant residue designed to protect soil from rainfall and runoff, and helps hold moisture in the soil for plant use

Eutrophic: water or lakes high in nutrient and organic levels that cause a large increase in plant life, especially algae

Exotic Plants: a plant that evolved in another geographic region and was able to become established through the aid of humans

Fauna: the entire complement of animal species which are present in a particular region

Fetch Length: the distance wind travels across open water

Flora: the entire complement of plant species that grows in a particular region

Gulley: large channels formed from concentrated surface water runoff

Ice Ridge: a land feature caused by the natural pushing action against the shore from the expansion and contraction of ice that forms the shore into a ridge

Invasive Species: a plant species that can aggressively spread - it can be native or exotic

Landscape: a continuum of adjacent habitats and communities

Mesotrophic: water or lakes with moderate levels of nutrient and organic levels that can cause an increase in plant life, especially algae

Mitigate: the replacement of an ecological function through the creation or restoration of another function or community

Muck Soils: a soil that formed from the decomposition of organic material, such as leaves or Grasses

Native Plant: a plant species that evolved in a region and that originally occurred in that region

Ordinary High Water Mark: a line on the shore established by the fluctuating water level that indicates by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of little and debris, or other appropriate means that consider the characteristics of the surrounding areas

Organic: the fraction of the soil comprised of the decomposed plant and animal matter

Rain Garden: a planted depression that collects concentrated runoff from impervious areas and allows them to be absorbed into the ground

Runoff: rainwater that flows over the ground surface

Secchi Disk: a circular disk used to measure water transparency

Shoreland Buffer Zone: an area from the ordinary high water mark inland that is left in or restored to a natural state around a lake or river that provides specific ecological functions

Shoreland Restoration: the process of constructing and stabilizing a shoreline into its previous and natural state

Soil Units: the mapped soil that exists in an area as recorded by the USDA/NRCS

Submergent Vegetation: a rooted herbaceous plant that grows under the water's surface

Substrate: the material or soil that is at the bottom of the lake (i.e. rocks, sand, muck)

Terracing: the practice of creating nearly level layers on a slope to reduce erosion potential by reducing runoff velocity

Terrestrial: the upland area dominated by upland flora and fauna and has a water table > 12" below the ground surface

Understory: the plants and smaller woody species (i.e. saplings, shrubs) that grow under the major or larger tress; the young growth.

A

APPENDIX A

Cloverleaf Lakes Shoreland Plant Communities Inventory

Dominant Species
Invasive/Potentially Invasive Species
* Surveyed in Emergent Stands

CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
COMPREHENSIVE SPECIES LIST

Scientific Name	Common Name	Height	Color	Bloom Period	Moisture	Soil	Sun	Community
Acer rubrum	red maple	20-40		Mar-May	D,W,M			NDM
Acer saccharinum	silver maple	40-60		Feb-May	M,W			SW
Achillea millefolium	yarrow	1-3	white	May-Jun	D,M		F	PM
Agrostis alba	redtop							
Alimsa triviale	northern water-plantain	1-3	white	Jul-Sep	W	C,L	F	AQE
Alnus rugosa	speckled alder	3-15	green/brown	Apr-Jun	W,M		F,P,S	AT
Amphicarpaea bracteata	hog-peanut	<1	white/pink	Aug-Sep	M,W			SDM
Apocynum androsaemifolium	spreading dogbane	1-3	pink	Jun-Aug	D,M		F,P	ND
Asclepias incarnata	swamp milkweed	3-5	red/pink	Jun-Jul	W	S,L,C	F	FN
Asclepias syriaca	common milkweed	3-4	purple	Jun-Aug	D,W,M	S,L,C	F,P	PWM
Aster lanceolatus	white panicle aster	2-5	white	Aug-Oct	M,W		P,S	
Aster lateriflorus	calico aster	2-3	white	Sep-Oct	D,M	S,L,C	P,S	SW
Aster puniceus	swamp aster	1-7	white	Aug-Oct	W	C,L	F,P	NS
Betula papyrifera	paper birch	<65			D,M		F,P	NDM
Boehmeria cylindrica	false nettle	1-4	green	Aug-Sep	W			SW
*Brasenia schreberi**	water shield	<1	purple	Jun-Sep	W		F	BOG
Bromus inermis	smooth brome	3-4						
Calamagrostis canadensis	blue joint grass	3-5	purplish	Jun-Aug	M,W	C,L	F,P	FN
Caltha palustris	marsh-marigold	1-3	yellow	May-Aug	W	C,L	F,P,S	FN
Campanula rapunculoides	creeping bellflower	1-3	blue					
Campanula rotundifolia	harebell	1-2	blue	Jun-Sep	D,M	S,G	F,P	CG
*Carex aquatilis**	long-bracted tussock sedge	2-3	green	May-Jun	M,W	C,L	F	AQE
Carex bromoides	brome-like sedge	1-3	greenish/brown	May-Jun	W			SWM
*Carex comosa**	bristly sedge	2-4	green	May-Jun	W	S,L,C	F	NW
Carex crawfordii	Crawford's sedge	1-3	green	June	M,W	S		
Carex crinita	fringed sedge	1-4	green	May-Jun	W	C,L	F,P,S	SWM
Carex pensylvanica	Pennsylvania sedge	1-2	green/brown	April	D	S	F,P,S	SDM
Carex projecta	necklace sedge	1-3	golden-brown	May-Jun	M,W	S,L,C	F,P,S	SWM
Carex stipata	common fox sedge	3-6	golden-brown	May-Jun	W	Wet S,L,C	F,P	SWM
Carex trisperma	three-fruited sedge	1-2	green	May-Jun	W			NW
Carex viridula	green yellow sedge	1-2	green	May-Jun	W	S		BEA
Carex vulpinoidea	brown fox sedge	1-3	golden-brown	May-Jun	W	Wet S,L,C	F	SW
Carpinus caroliniana	American hornbeam	<40			M,W		F,P,S	BF
Cicuta bulbifera	bulbet water-hemlock	1-3	white	Aug-Sep	W			NS
Cornus canadensis	bunchberry	<1	white	May-Jul	M,W		P,S	BF
Cornus foemina	gray dogwood	3-10	white	Jun-Jul	M,W	S,L,C	P,S	SDM
Cornus stolonifera	red-osier dogwood	3-10	white	May-Aug	W,M		P,S	SC
Drosera rotundifolia	sundew	<1	white/pink	Jul-Aug	W		F,P	BOG

W - Wet
M - Medium/moist
D - Dry

C - Clay
L - Loam
S - Sand

F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

Dominant Species
Invasive/Potentially Invasive Species
* Surveyed in Emergent Stands

CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
COMPREHENSIVE SPECIES LIST

Scientific Name	Common Name	Height	Color	Bloom Period	Moisture	Soil	Sun	Community
Dryopteris cristata	crested shieldfern	1-3	green		W		P,S	NWM
Dryopteris carthusiana	spinulose shieldfern	<1	green		M,W		P,S	NWM
*Eleocharis erythropoda**	bald spikerush	1-2	brown/red	May-Aug	W			AQE
Equisetum hyemale	scouring horsetail	1-4	green		W			DUN
Eupatorium maculatum	joe-pye weed	4-6	pink	Aug-Sep	W	S,L,C	F	AT
Eupatorium perfoliatum	boneset	3-4	white	Jun-Oct	M,W	C,L	F,P	FN
Euphorbia corollata	flowering spurge	1-4	white	Jun-Sep	D,M	C,L	S	OB
Euthamia graminifolia	grass-leaved goldenrod	1-4	yellow	Jul-Oct	D,M	S,L	F,P	NS
Fagus grandifolia	American beech	66-115			D,M		P,S	NM
Fraxinus pennsylvanica	green ash	40-55			M		F,P	SWM
Galium asprellum	rough bedstraw	<1	white	May-Aug	W			AT
Glyceria grandis	reed manna grass	3-5	purple	Jun-Sep	W	C,L	F	AT
Ilex verticillata	winterberry	6-16	white	May-Jun	W,M,D		F,P	NWM
Impatiens capensis	orange jewelweed	2-6	orange	Jul-Sep	W			NWM
Iris pseudacorus	yellow flag	2-3	yellow	May-Jun	W			
Iris versicolor	wild blue flag	2-3	blue	Jun-Jul	W	S,L,C	F,P	BOG
Juncus effusus	soft rush	1-4	green/brown	Jun-Jul	M,W	C,L	F	SS
Lilium philadelphicum	orange-cup lily	1-3	orange	Jun-Aug	M,W	L	F,P	PM
Linaria vulgaris	butter and eggs	1-3	orange/yellow	May-Sep	D,M	S		
Lycopodium obscurum	flat-branched ground-pine	<1	green		M,W			NDM
Lycopus americanus	American water-horehound	1-2	white	Jul-Sep	W	C	F	FN
Lysimachia nummularia	creeping jennie	<1	yellow	Jun-Aug	M,W			
Maianthemum canadense	wild-lily-of-the-valley	<1	white	May-Jun	M		P,S	BF
Malus pumila	cultivated apple							
Matteuccia struthiopteris	ostrich fern	1-3	green		M		P,S	NS
Myosotis scorpioides	water scorpion grass	1-2	blue	May-Sep	W			DUN
Myrica gale	meadow fern	3-6		Apr-May	W		F,P	BOG
*Nuphar variegata**	bull-head pond-lily	<1	yellow	Jun-Aug	W		F	BOG
*Nymphaea odorata**	white water-lily	<1	white	Jul-Sep	W		F	BOG
Oenothera biennis	bastard evening-primrose	2-6	yellow	Jun-Oct	D,M,W	S,C	F,P	PDM
Onoclea sensibilis	sensitive fern	<1	green		M,W	S,L,C	F,P	AT
Osmunda regalis	royal fern	3-6	green		W	S,L,C	F,P,S	SWM
Parthenocissus quinquifolia	Virginia creeper	varies	green	May-Jun	D,M		F,P,S	SDM
Pedicularis canadensis	Canadian lousewort	1	yellow	May-Jun	D,M,W	S,C	F,P	CG
Phalaris arundinacea	reed canary grass	2-6	green		M,W		F,P	SC
Physocarpus opulifolius	common ninebark	6-9	white	Jun-Jul	W			CLE
Pilea pumila	clearweed	1-2	green	Jul-Sep	M,W		S	SW
Pinus resinosa	red pine	50-80			D,M		F,P	ND

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S - Shade (0-4 hours)

CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
COMPREHENSIVE SPECIES LIST

Scientific Name	Common Name	Height	Color	Bloom Period	Moisture	Soil	Sun	Community
Pinus strobus	white pine	80-110			D,M		F,P	NDM
Poa palustris	fowl bluegrass	1-5	green/purple	Jun-Sep	W			NS
Poa pratensis	Kentucky bluegrass	1-1.5						OO
Polygonum hydropiper	smartweed	1-2	greenish/pink	Jul-Sep	W			BEA
*Pontederia cordata**	pickerel-weed	1-3	blue	Jun-Aug	W	S,L,C	F,P	AQE
Populus deltoides	eastern cottonwood	<100			M,W		F,P	SW
Populus grandidentata	big-tooth aspen	60-80			D,M		F,P	ND
Prenanthes alba	lion's-foot	1-5	pink/white	Aug-Sep	D		S	SDM
Pteridium aquilinum	bracken fern	2-5	white	Aug-Oct	D,M	S,L	P,S	BG
Pycnantheum virginianum	Virginia mountain mint	1-3	white	Jul-Sep	M,W	C,L	F,P	PWM
Quercus alba	white oak	<80			D,M	S,L	F,P	SDM
Quercus rubra	red oak	<100			D,M	S,L	F,P	SDM
Rhus typhina	staghorn sumac	4-15		Jun-Jul	D	S,L	F	OB
Robinia pseudoacacia	black locust							
*Rosa palustris**	swamp rose	1-7	pink	Jul-Aug	W		F,P	
Rubus flagellaris	northern dewberry	<1	white	May-Jun	D,M,W	S,G		
Rubus strigosus	American red raspberry	1-7	white/greenish	May-Aug	D,M			BF
Rudbeckia hirta	black-eyed susan	1-3	yellow	Jun-Sep	D,M	S,L,C	F,P	PWM
*Sagittaria latifolia**	common arrowhead	1-3	white	Jul-Sep	W	C,L	F,P	AQE
Salix babylonica	weeping willow	<40			W			
Salix bebbiana	Bebb's willow	8-20			M,W		F,P	SC
Salix exigua	sandbar willow	3-12	yellow	May-Jun	W		F	DUN
Salix nigra	black willow	<65						SW
Saponaria officinalis	bouncing-bet	1-3	white/pink	Jul-Oct		S		DUN
*Schoenoplectus acutus**	hardstem bulrush	3-9	grey/brown	May-Sep	W	C,L	F	AQE
*Schoenoplectus pungens**	three-square bulrush	1-5	red/brown	Jun-Aug	W		F	AQE
Schoenoplectus tabernaemontani	softstem bulrush	3-6	red/brown	May-Aug	W	C,L	F	AQE
Scirpus atrovirens	green bulrush	3-6	greenish/brown	Jun-Aug	W	S,C,Peat,Muck	F	AT
Scuttelaria lateriflora	maddog skullcap	1-2	blue	Jun-Sep	M,W		P,S	SW
Silene latifolia	bladder campion	1-4	white	Jun-Oct	D,M			
Solanum dulcamara	climbing nightshade	1-8	purple/blue	Jun-Sep	M			SWM
Solidago gigantea	giant goldenrod	1-7	yellow	Jul-Oct	D,M,W			PW
Spartina pectinata	prairie cord grass	2-7	green	Aug-Sep	M,W	C,L	F,P	PW
Sphagnum spp.	Sphagnum moss	<1	green		W		F,P,S	
Thalictrum thalictroides	rue-anemone	<1	pink/white	Apr-May	D,M			SDM
Thelyptris palustris	marsh fern	1-2	green		W		S	AT

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F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

CLOVERLEAF LAKES PROTECTIVE ASSOCIATION
COMPREHENSIVE SPECIES LIST

Scientific Name	Common Name	Height	Color	Bloom Period	Moisture	Soil	Sun	Community
Toxicodendron rydbergii	poison ivy	1-3	white	Jun-Aug	D,M,W		F,P	SW
Toxicodendron vernix	poison sumac	<20			W			BOG
Trientalis borealis	starflower	<1	white	May-Jun	M			BF
*Typha latifolia**	broad-leaved cattail	3-9	brown	May-Jul	W		S	AQE
Ulmus rubra	red elm	60-110			M		F,P	SM
Urtica dioica	stinging nettle	1-6	white	Jun-Sep	D,M,W			SWM
Vaccinium angustifolium	low bush blueberry	1-2	white	May-Jun	D,M	S,G	F,P,S	ND
Verbena hastata	blue vervain	3-6	blue	Jul-Sep	M,W	S,L,C	F	NS
Veronica americana	American speedwell	<1	blue	Jun-Oct	W			
Vitis riparia	riverbank grape	1-15	green/white	May-Jul	M,W	S	P,S	SW

Plant Communities from "The Vegetation of Wisconsin"*

Code	Community
AQE	Emergent Aquatic
AT	Alder Thicket
BEA	Lake Beach
BF	Boreal Forest
BOG	Open Bog
CG	Cedar Glad
CLE	Exposed Cliff
DUN	Lake Dune
FN	Fen
ND	Northern Dry Forsest
NDM	Northern Dry-Mesic Forest
NM	Northern Mesic Forest
NS	Northern Sedge Meadow
NW	Northern Wet Forest
NWM	Northern Wet-Mesic Forest
OB	Oak Barrens
OO	Oak Opening
PDM	Dry-Mesic Prairie
PM	Mesic Prairie
PWM	Wet-Mesic Prairie
SC	Shrub Carr
SD	Southern Dry Forest
SDM	Southern Dry-Mesic Forest
SS	Southern Sedge Meadow
SW	Southern Wet Forest
SWM	Southern Wet-Mesic Forest

*Curtis, JT 1959. The Vegetation of Wisconsin. University of Wisconsin Press, Madison, WI.

W - Wet
M - Medium/moist
D - Dry

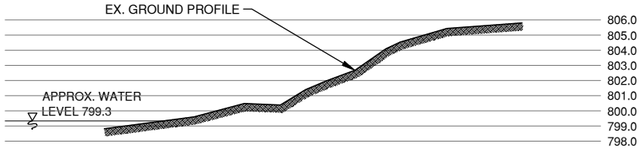
C - Clay
L - Loam
S - Sand

F - Full sun (8+ hours)
P - Partial sun/shade (4-8 hours)
S - Shade (0-4 hours)

B

APPENDIX B

Shoreland Restoration Designs and Their Associated Planting Lists

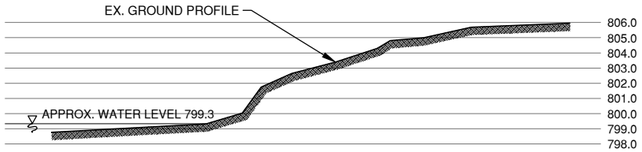


EXISTING CONDITIONS

SECTION A - A1

HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'

PROPOSED CONDITIONS *



EXISTING CONDITIONS

SECTION B - B1

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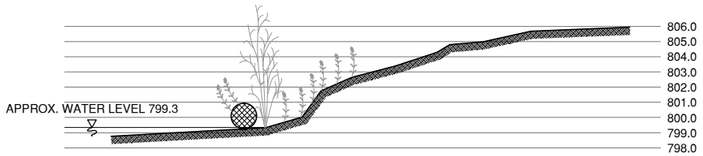
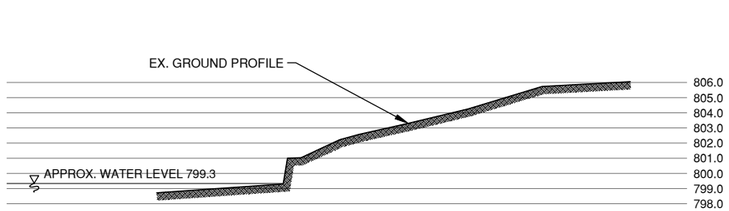


PROPOSED CONDITIONS *



EXISTING CONDITIONS

SECTION C - C1

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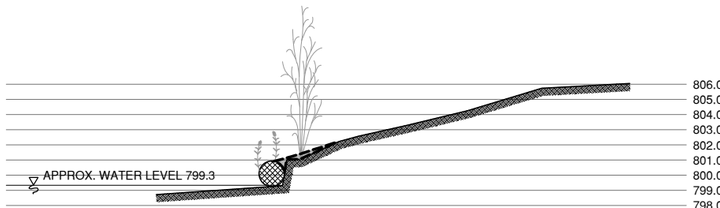
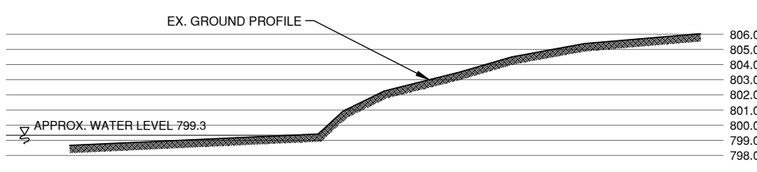
VERT. SCALE: 1" = 5'



PROPOSED CONDITIONS



EXISTING CONDITIONS

SECTION D - D1

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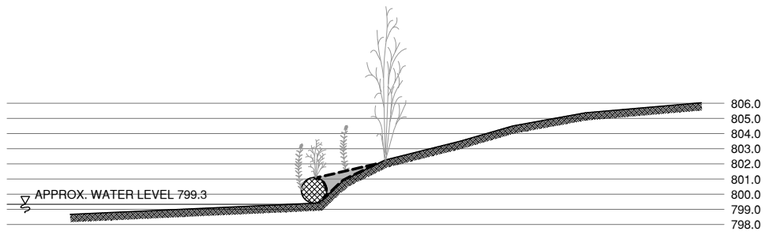
VERT. SCALE: 1" = 5'



PROPOSED CONDITIONS

LEGEND

- 20" BIOLOG (SECURED W/DUCK BILL ANCHORS AND CABLES)
- EROSION BLANKET
- NATIVE SHRUB
- NATIVE HERBACEOUS VEGETATION (PLANTED 1 FOOT ON CENTER)
- TOPSOIL
- PLANTING ZONE #1

*NOTE: BIOLOGS IN THESE TWO AREAS WILL ACT AS WAVE-BREAKS WHILE WETLAND VEGETATION BECOMES ESTABLISHED BEHIND THEM

AFTER

PLANTING AREAS

- BIOLOG AND ZONE 1 (85 SQ. FT.)
- ZONE 2 (25 SQ. FT.)

PROPOSED PLANTING PLAN

BEFORE

EXISTING SITE CONDITIONS

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN: RLR-LLP-KLJ
CHECKED: JRH
DESIGNED: JRH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ANUNSON SITE PLAN

DATE: 07/2009
FILE: 4747002 SITE
JOB NO.: 4747002

Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
4664 GOLDEN POND PARK COURT
HOBART, WI 54155 PHONE:(920) 662-9641
INTERNET: www.releeinc.com FAX:(920) 662-9141

SHEET NO. 1

File: G:\4700\4747\4747002\cad\4747002 SITE PHOTOS.dwg
Plot Date: Jan 05, 2011 - 11:51am
LAYOUT: ANUNSON
PLAN_VIEW: ANUNSON PLAN_ANUNSON "AA=00" "EX-PR"

Anunson Property

Planting Zone: Biolog and Shoreline Buffer – Zone 1
Soil: NA & Loamy Sand-Sand
Sun: Partial Shade/Sun
Moisture: Wet
pH: Neutral (no amendments)

Scientific Name	Common Name
Acorus calamus	Sweet Flag
Asclepias incarnata	Swamp Milkweed
Aster lanceolatus	Panicled Aster
Aster umbellatus	Flat-Top Aster
Calamagrostis canadensis	Canada Bluejoint
Carex crinita	Fringed Sedge
Carex hystericina	Porcupine Sedge
Carex lacustris	Lake Sedge
*Cephalanthus occidentalis**	Buttonbush
Chelone glabra	Turtlehead
*Cornus amomum**	Silky Dogwood
Eupatorium maculatum	Spotted Joe Pye Weed
Eupatorium perfoliatum	Boneset
Gentiana andrewsii	Bottle Gentian
Glyceria striata	Fowl Manna Grass
Helenium autumnale	Sneezeweed
*Ilex verticillata**	Winterberry
Iris versicolor	Blue Flag Iris
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Lycopus americanus	Water Horehound
Mimulus ringens	Monkey Flower
*Rosa palustris**	Swamp Rose
*Sambucus canadensis**	Elderberry
Solidago patula	Swamp Goldenrod
Thalictrum dasycarpum	Purple Meadow Rue

Planting Zone: Shoreline Buffer – Zone 2
Soil: Loamy Sand-Sand
Sun: Partial Sun/Shade
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Anemone canadensis	Canada Anemone
Aster lateriflorus	Calico Aster
Aster novae-angliae	New England Aster
Carex stricta	Tussock Sedge
Carex vulpinoidea	Brown Fox Sedge
Elymus hystrix	Bottlebrush Grass
Elymus virginicus	Virginia Wild Rye
Eupatorium purpureum	Purple Joe Pye Weed
Eupatorium rugosum	White Snakeroot
Geranium maculatum	Wild Geranium
*Physocarpus opulifolius**	Ninebark
Pycnanthemum virginianum	Common Mountain Mint
Solidago flexicaulis	Zig-zag Goldenrod
Veronicastrum virginicum	Culver's Root
*Viburnum lentago**	Nannyberry
Zizia aurea	Golden Alexander

* Shrubs

Bleck Property

Planting Zone: Rain Garden
Soil: Sand
Sun: Shade
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Arisaema triphyllum	Jack-in-the-Pulpit
Aster lateriflorus	Calico Aster
Chelone glabra	Turtlehead
Dodecatheon meadia	Shooting Star
Elymus virginicus	Virginia Wild Rye
Eupatorium rugosum	White Snakeroot
Geranium maculatum	Wild Geranium
Glyceria striata	Fowl Mana Grass
Lobelia siphilitica	Blue lobelia
Mertensia virginica	Virginia Blue Bells
Phlox divaricata	Wild Blue Phlox
Polygonatum biflorum	Solomon's Seal
Veronicastrum virginicum	Culvers root
Zizia aurea	Golden Alexanders

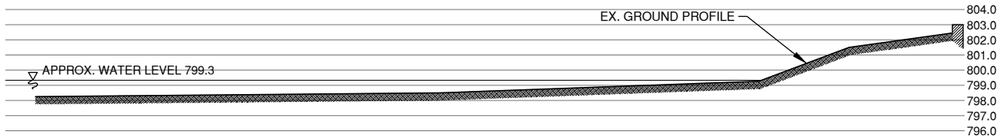
Planting Zone: Native Buffer Strip
Soil: Sand
Sun: Full Sun
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Anemone canadensis	Canada Anemone
Aquilegia canadensis	Columbine
Asclepias syriaca	Common Milkweed
Aster macrophyllus	Large Leaf Aster
Carex pennsylvanica	Pennsylvania Sedge
*Corylus americana**	Common Hazelnut
Geranium maculatum	Wild Geranium
Koeleria cristata	June Grass
Maianthemum stellatum	Starry False Solomon's Seal
Monarda fistulosa	Wild Bergamont
*Rosa blanda**	Wild Rose
Schizachyrium scoparium	Little Bluestem
Sporobolus heterolepis	Prairie Dropseed

Planting Zone: Shoreline/Water's Edge
Soil: Sand
Sun: Full Sun
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Aster novae-angliae	New England Aster
*Cornus racemosa**	Grey Dogwood
Elymus virginicus	Virginia Wild Rye
Eupatorium perfoliatum	Boneset
Eupatorium maculatum One of these is wrong	Fringed Sedge
Helenium autumnale	Sneezeweed

* Shrubs



EXISTING CONDITIONS

SECTION A - A1

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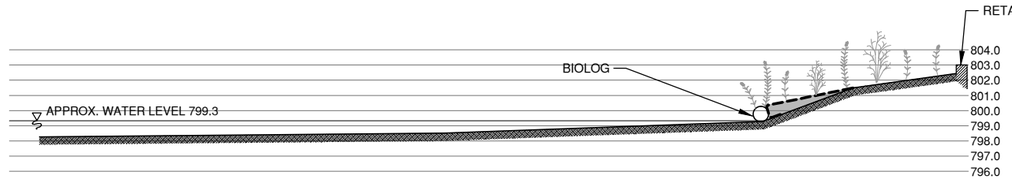

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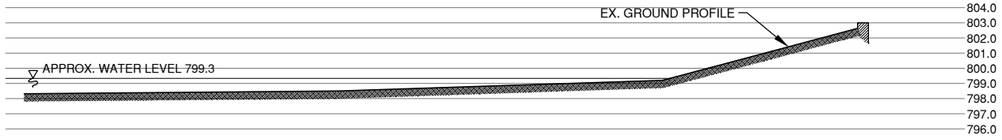

EXISTING CONDITIONS

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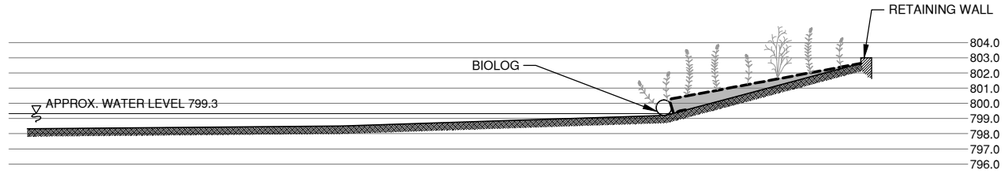
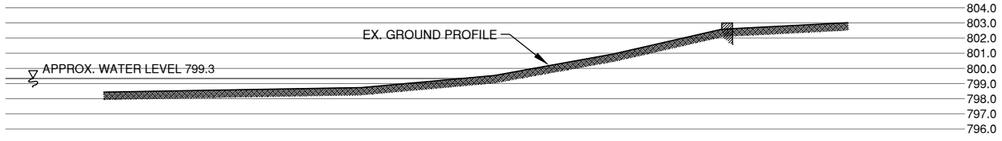


PROPOSED CONDITIONS



EXISTING CONDITIONS

SECTION C - C1

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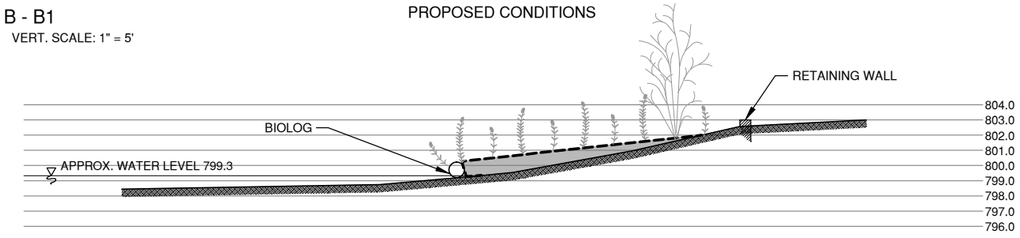
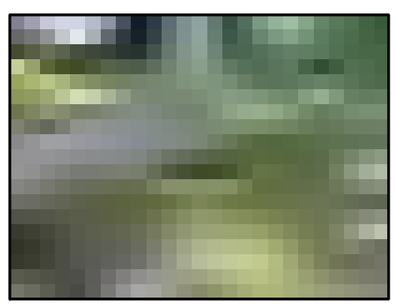
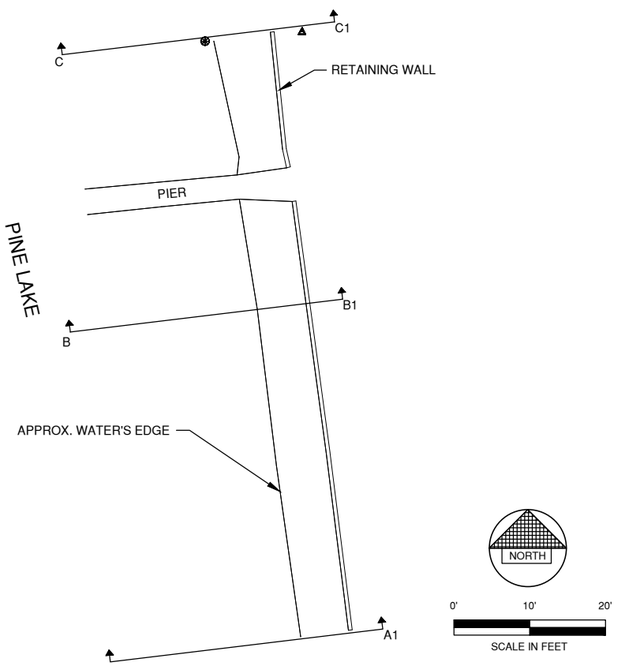


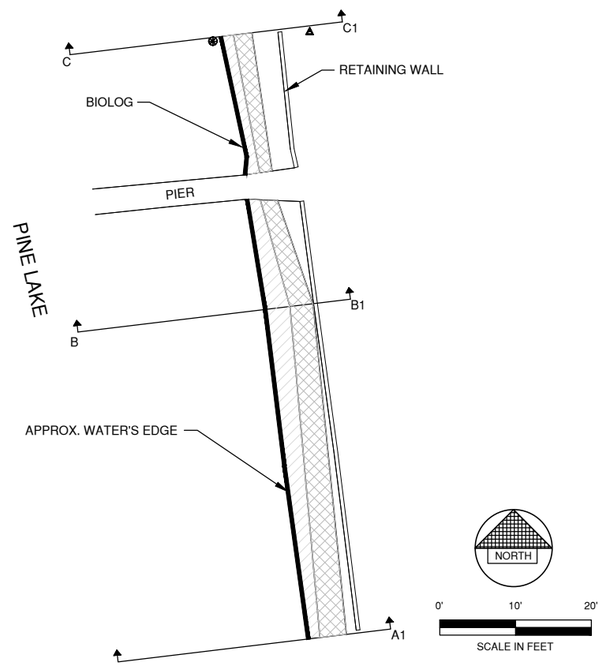
PROPOSED CONDITIONS



BEFORE



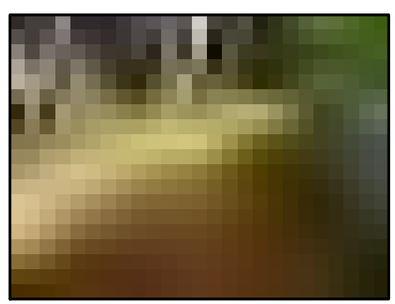
EXISTING SITE CONDITIONS



PROPOSED PLANTING PLAN

LEGEND

- TOPSOIL
- PLANTING ZONE #1
- PLANTING ZONE #2
- NATIVE SHRUB
- NATIVE HERBACEOUS VEGETATION (PLANTED 1 FOOT ON CENTER)
- 16" BIOLOG (SECURED W/DUCK BILL ANCHORS AND CABLES)
- EROSION BLANKET



AFTER

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN: RLR-LLP
CHECKED: JH
DESIGNED: JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ESSMANN SITE PLAN

DATE: 07/2009
FILE: 4747002 SITE
JOB NO.: 4747002

Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
4664 GOLDEN POND PARK COURT
HOBART, WI 54155 PHONE:(920) 662-9641
INTERNET: www.releeinc.com FAX:(920) 662-9141

SHEET NO. 1

Essmann Property

Planting Zone: Biolog
Sun: Sunny
Moisture: Wet

Scientific Name	Common Name
Asclepias incarnata	Swamp Milkweed
Bromus ciliatus	Fringed Brome
Calamagrostis canadensis	Canada Bluejoint
Carex comosa	Bristly Sedge
Carex stricta	Tussock Sedge
Chelone glabra	Turtlehead
Eupatorium maculatum	Spotted Joe Pye Weed
Eupatorium perfoliatum	Boneset
Glyceria striata	Fowl Manna Grass
Iris versicolor	Blue Flag Iris
Juncus effusus	Common Rush
Leersia oryzoides	Rice Cut Grass
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Lycopus americanus	Water Horehound
Mentha arvensis	Wild Mint
Mimulus ringens	Monkey Flower
Scirpus atrovirens	Green Bulrush
Scirpus cyperinus	Wool Grass
Verbena hastata	Blue Vervain

Planting Zone: Wet Meadow Shoreline Buffer – Zone 1
Soil: Sandy Loam
Sun: Sunny
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Allium cernuum	Nodding Pink Onion
Andropogon gerardi	Big Bluestem
Anemone canadensis	Canada Anemone
Aster lateriflorus	Calico Aster
Aster novae-angliae	New England Aster
Carex bebbi	Bebb's Sedge
Carex vulpinoidea	Brown Fox Sedge
Elymus virginicus	Virginia Wild Rye
Gentian andrewsii	Bottle Gentian
Helenium autumnale	Sneezeweed
Hierochloe odorata	Vanilla Sweet Grass
Liatris pycnostachya	Prairie Blazing Star
Monarda fistulosa	Wild Bergamont
Panicum virgatum	Switchgrass
Physostegia virginiana	Obedient Plant
Pycnanthemum virginianum	Common Mountain Mint
Ratibida pinnata	Yellow Coneflower
Rudbeckia laciniata	Wild Golden Glow
Sorghastrum nutans	Indian Grass
*Spirea alba**	Meadowsweet
*Spirea tomentosa**	Steeplebush
Vernonia fasciculata	Ironweed
Veronicastrum virginicum	Culver's Root
Zizia aurea	Golden Alexander

* Shrub

Essmann Property

Planting Zone: Upland Shoreline Buffer – Zone 2
Soil: Sandy Loam
Sun: Sunny
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
*Amorpha canescens**	Leadplant
Anemone cylindrica	Thimbleweed
Aquilegia canadensis	Columbine
Asclepias syriaca	Common Milkweed
Asclepias tuberosa	Butterfly Milkweed
Asclepias verticillata	Whorled Milkweed
Aster laevis	Smooth Blue Aster
Aster oolentangiensis	Sky-blue Aster
*Ceanothus americanus**	New Jersey Tea
*Cornus stolonifera**	Red-osier Dogwood
Elymus canadensis	Canada Wild Rye
Geum triflorum	Prairie Smoke
Heuchera richardsonii	Prairie Alum Root
Koeleria macrantha	June Grass
Liatris aspera	Rough Blazing Star
Lupine perennis	Wild Lupine
Monarda punctata	Horsemint
Rudbeckia hirta	Black-eyed Susan
Schizachyrium scoparium	Little Blue Stem
Solidago nemoralis	Old Field Goldenrod
Solidago rigida	Stiff Goldenrod
Sporobolus heterolepis	Prairie Dropseed
Tradescantia ohiensis	Common Spiderwort
Verbena stricta	Hoary Vervain
*Viburnum lentago**	Nannyberry
*Viburnum trilobum**	Highbush Cranberry

* Shrub

Krubsack Planting Plan

Krubsack Property

Planting Zone: Wet Meadow – Zones 1 and 2
Soil: Sand
Sun: Partial Sun/Shade
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	**Common Name**
Anemone canadensis	Canada Anemone
Aster novae-angliae	New England Aster
Carex comosa	Bristly Sedge
Carex vulpinoidea	Brown Fox Sedge
Chelone glabra	Turtlehead
Helenium autumnale	Sneezeweed
Lobelia siphilitica	Blue Lobelia

Planting Zone: Upland – Zone 3
Soil: Sand
Sun: Partial Sun/Shade
Moisture: Medium-Dry
pH: Neutral (no amendments)

Scientific Name	**Common Name**
Actaea rubra	Red Baneberry
Aquilegia canadensis	Columbine
Asarum canadense	Wild Ginger
Aster cordifolius	Common Blue Wood Aster
Aster macrophyllus	Big Leaf Aster
Carex pensylvanica	Pennsylvania Sedge
*Comptonia peregrine**	Sweetfern
Elymus hystrix	Bottlebursh Grass
Geranium maculatum	Wild Geranium
Lupinus perennis	Lupine
Maianthemum stellatum	Starry False Solomon's-seal
Mitella diphylla	Bishop's Cap
Monarda punctata	Dotted Mint

* Shrub

CLOVERLEAF LAKES ROAD

ASPHALT PARKING

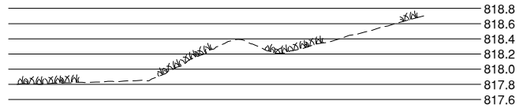
PLANTING BED

PROPOSED RAIN GARDEN

6" BERM

BEFORE

AFTER



EXISTING PROFILE

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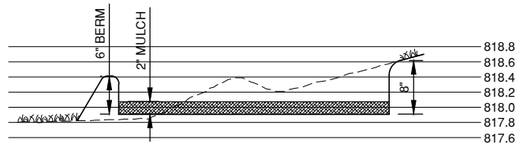
VERT. SCALE: 1" = 1'



PROPOSED PROFILE

HOR. SCALE: 1" = 5'
VERT. SCALE: 1" = 1'

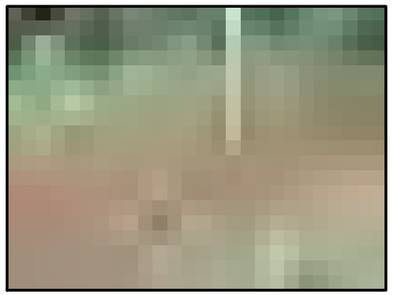
BIRD HOUSE

POWER POLE

PROPOSED PLANTING AREA

EXISTING PLANTING AREA
ON
THORNTON PROPERTY

LAKE



AFTER

BEFORE

File: R:\4700\4747\4747002\Wrk\4747002 SITE PHOTOS.dwg
Plot Date: Jan 05, 2011 - 11:53am

LAYOUT: LETVEN SITE

PLAN VIEW: LETVEN SITE

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN LLP
CHECKED JH
DESIGNED JH

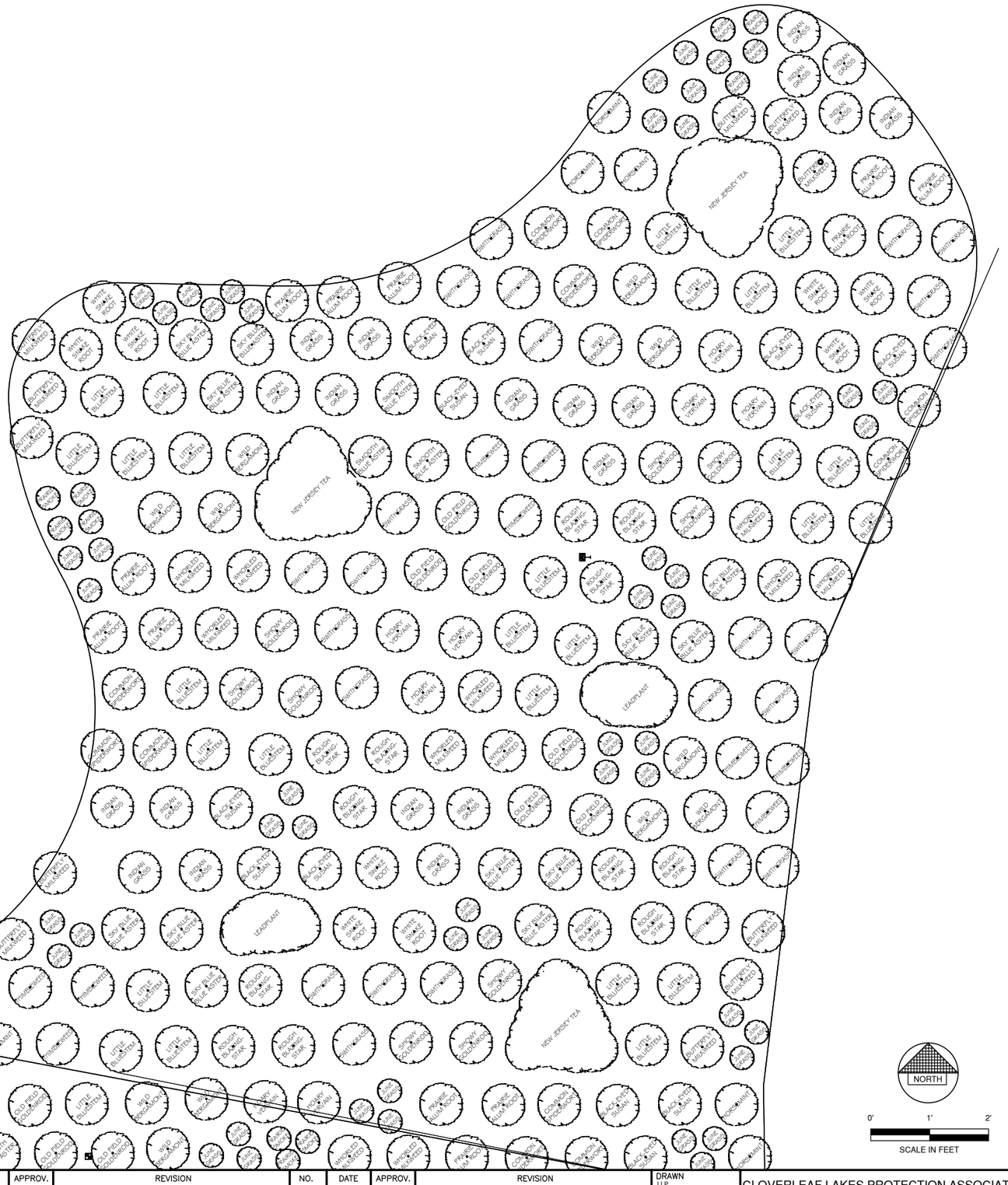
CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

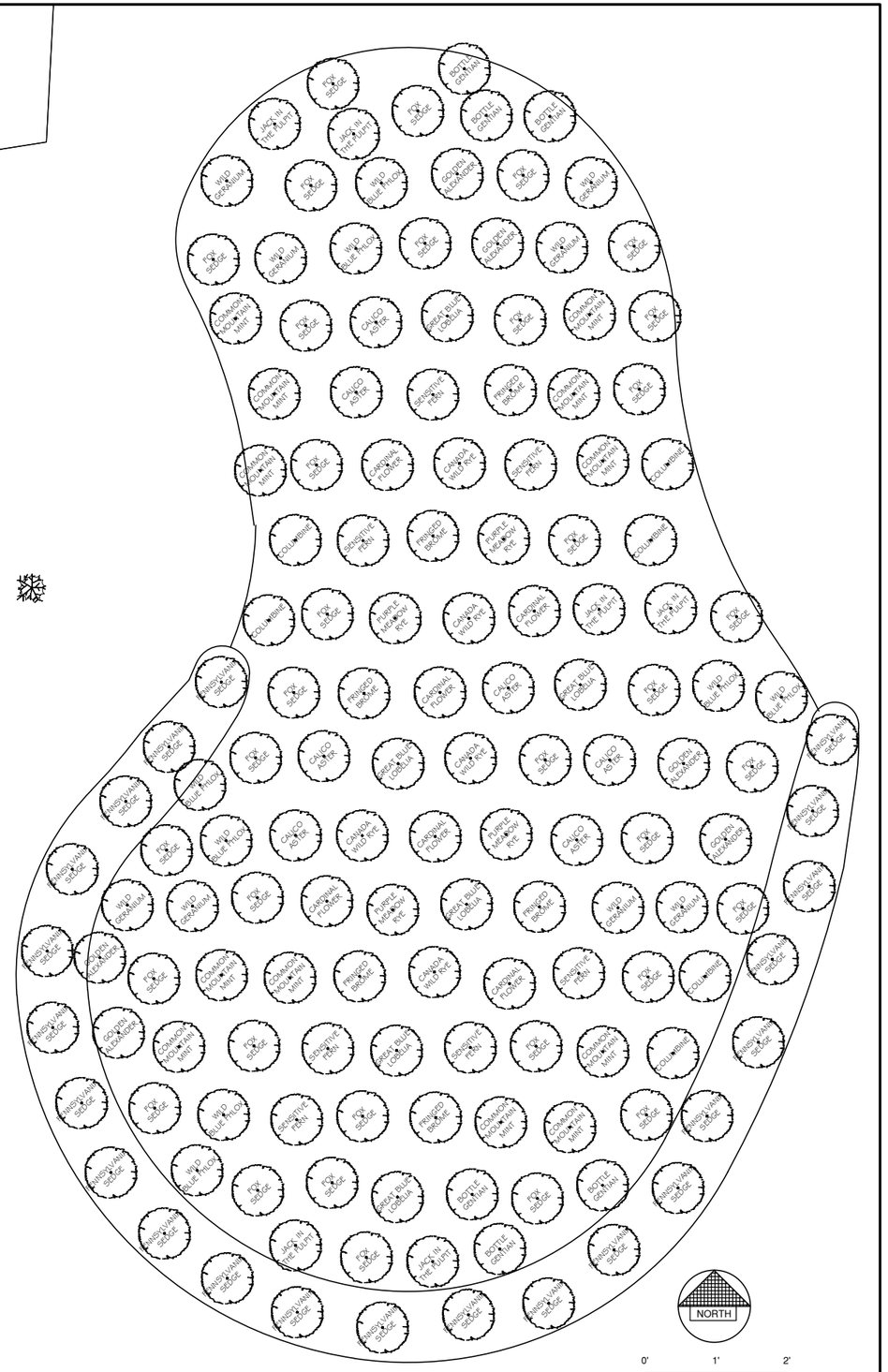
LETVEN SITE PLAN

DATE 6/18/2009
FILE 4747002 SITE PHOTOS
JOB NO. 4747002

Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
4664 GOLDEN POND PARK COURT
HOBART, WI 54155 PHONE:(920) 662-9641
INTERNET: www.releeinc.com FAX:(920) 662-9141

SHEET NO. 1





File: PLI-1700-4747-4747002-dwg-4747002 SITE PHOTOS.dwg
Plot Date: Jan 05, 2017 - 11:35am

LAYOUT: LETVEN PLANTING

PLAN VIEW: PLANTING DETAIL 1 & 2

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN LLP
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

LETVEN PLANTING DETAIL

DATE 09/2009
FILE 4747002 SITE
JOB NO. 4747002

Robert E. Lee & Associates, Inc.
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4664 GOLDEN POND PARK COURT
HOBART, WI 54155 PHONE:(920) 662-9641
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SHEET NO. 2

Letven Property

Planting Zone: Rain Garden
Soil: Sand/Mulch
Sun: Shade
Moisture: Moist
pH: Neutral (no amendments)

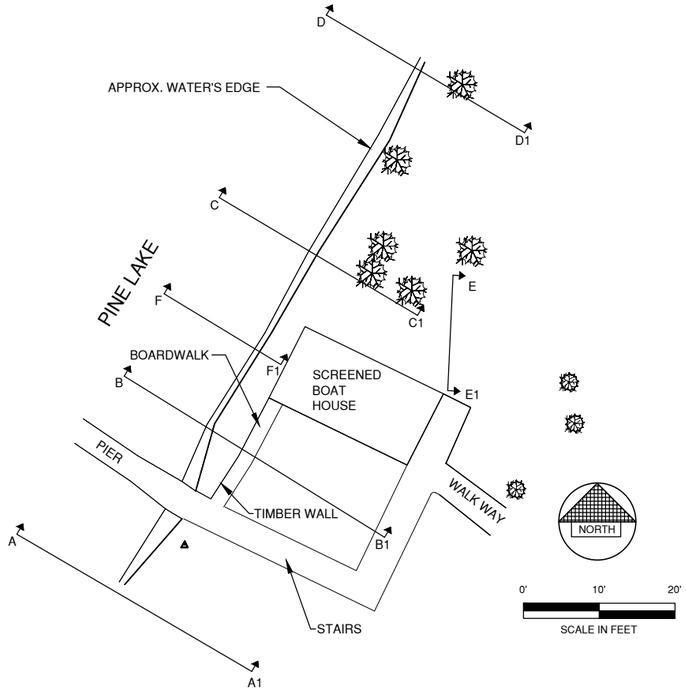
Scientific Name	Common Name
Aquilegia canadensis	Columbine
Arisaema triphyllum	Jack-in-the-Pulpit
Aster lateriflorus	Calico Aster
Bromus ciliatus	Fringed Brome
*Carex pennsylvanica**	Pennsylvania Sedge
Carex vulpinoidea	Brown Fox Sedge
Elymus virginicus	Virginia Wild Rye
Gentian andrewsii	Bottle Gentian
Geranium maculatum	Wild Geranium
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Onoclea sensibilis	Sensitive Fern
Phlox divaricatus	Wild Blue Phlox
Pycnanthemum virginianum	Common Mountain Mint
Thalictrum dasycarpum	Purple Meadow Rue
Zizia aurea	Golden Alexander

*This species was planted on the berms constructed around the rain garden.

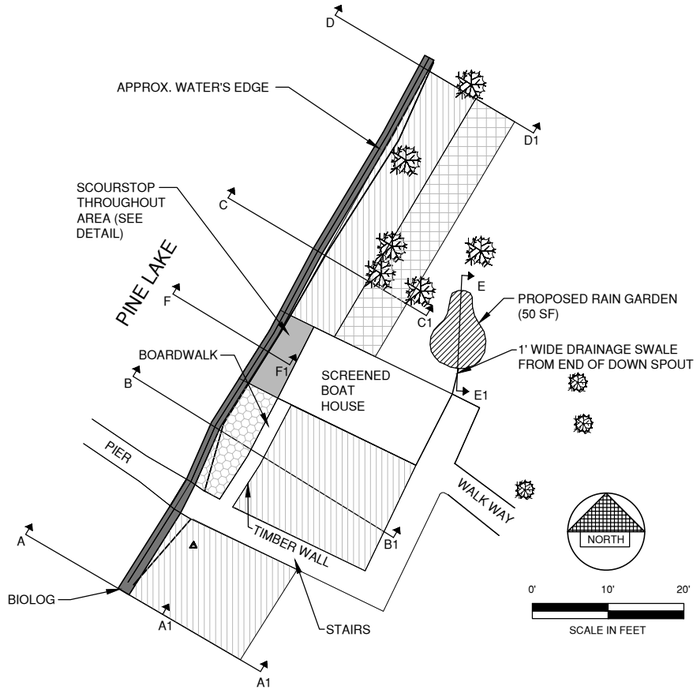
Planting Zone: Shoreline
Soil: Sandy loam-fine sand
Sun: Sunny
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
*Amorpha canescens**	Leadplant
Anemone cylindrica	Thimbleweed
Asclepias tuberosa	Butterfly Milkweed
Asclepias verticillata	Whorled Milkweed
Aster laevis	Smooth Blue Aster
Aster oolentangiensis	Sky-blue Aster
*Ceanothus americanus**	New Jersey Tea
Eupatorium rugosum	White Snakeroot
Geum triflorum	Prairie Smoke
Heuchera richardsonii	Prairie Alum Root
Koeleria macrantha	June Grass
Liatris aspera	Rough Blazing Star
Monarda fistulosa	Wild Bergamont
Monarda punctata	Horsemint
Panicum virgatum	Switchgrass
Rudbeckia hirta	Black-eyed Susan
Schizachyrium scoparium	Little Blue Stem
Solidago nemoralis	Old Field Goldenrod
Solidago speciosa	Showy Goldenrod
Sorghastrum nutans	Indian Grass
Tradescantia ohiensis	Common Spiderwort
Verbena stricta	Hoary Vervain

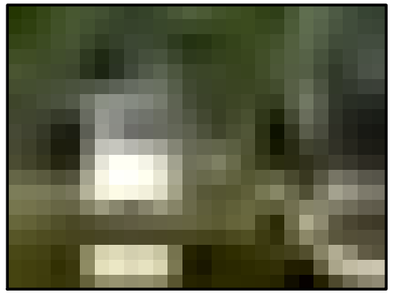
* Shrub



EXISTING CONDITIONS



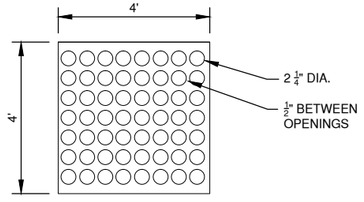
PROPOSED CONDITIONS



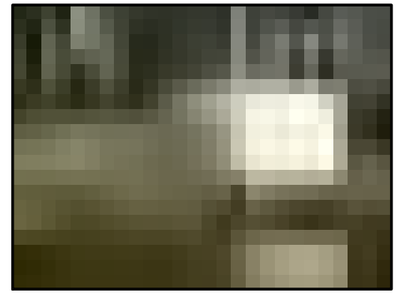
BEFORE

PLANTING AREAS

- PLANTING ZONE #1 (768 SF)
- PLANTING ZONE #2 (217 SF)
- PLANTING ZONE #3 (69 SF)
- PLANTING ZONE #4 (55 SF)
- RAIN GARDEN



SCOURSTOP DETAIL



AFTER

PLAN VIEW: ODDER PLAN, ODDER "AA-D0" "DX-PR", RAIN GARDEN LAYOUT: LETVEN SITE
File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jun 05, 2017 - 11:34am

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN RLR/lg
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ODDER SITE PLAN

DATE 07/2009
FILE 4747002 SITE
JOB NO. 4747002

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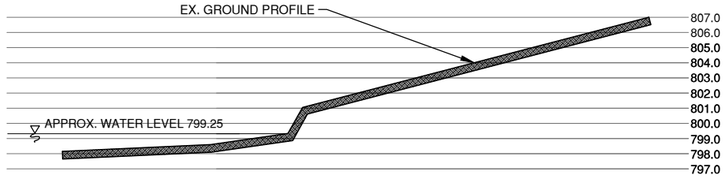
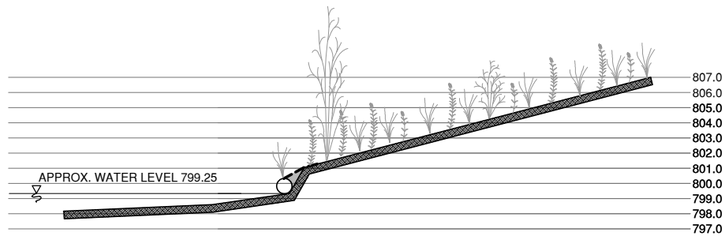
SHEET NO. 1



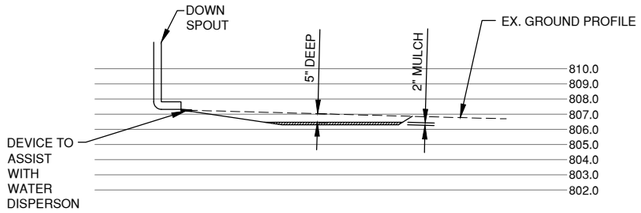
EXISTING CONDITIONS

SECTION A - A1

HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'



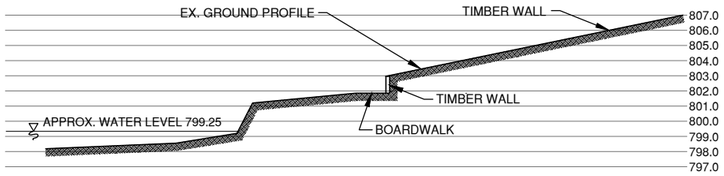
PROPOSED CONDITIONS



PROPOSED RAIN GARDEN

SECTION E - E1

HOR. SCALE: 1" = 5'
VERT. SCALE: 1" = 5'



EXISTING CONDITIONS

SECTION B - B1

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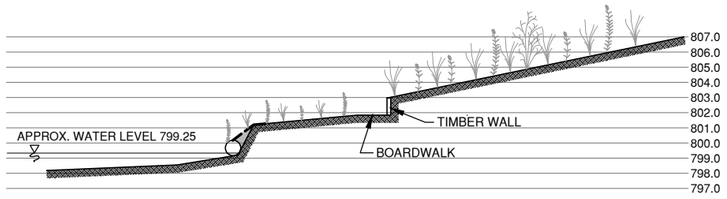
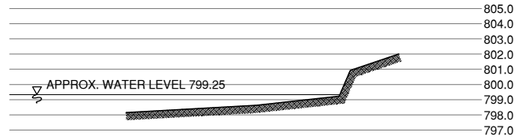
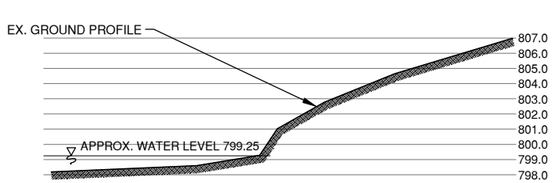


PROPOSED CONDITIONS



SECTION F - F1

HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'



EXISTING CONDITIONS

SECTION C - C1

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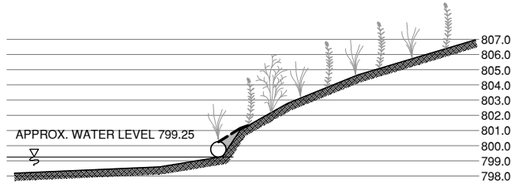
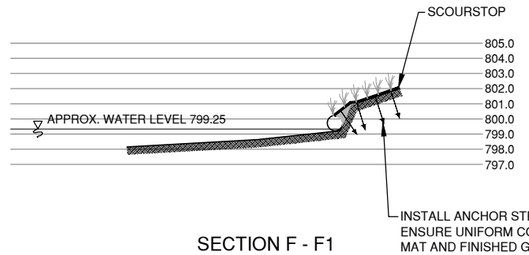
VERT. SCALE: 1" = 5'

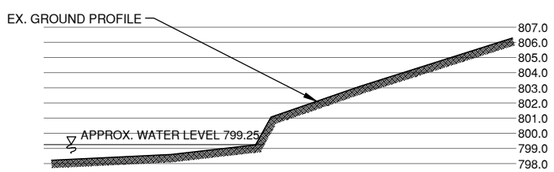


PROPOSED CONDITIONS



SECTION F - F1

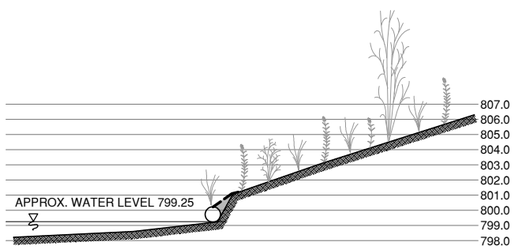
HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'



EXISTING CONDITIONS

SECTION D - D1

HOR. SCALE: 1" = 2.5'
VERT. SCALE: 1" = 5'



PROPOSED CONDITIONS

LEGEND

- TOPSOIL
- NATIVE SHRUB
- NATIVE WILD FLOWERS (PLANTED 1 FOOT ON CENTER)
- NATIVE GRASSES/SEDGES (PLANTED 1 FOOT ON CENTER)
- 16" BIOLOG (SECURED W/DUCK BILL ANCHORS AND CABLES)
- EROSION BLANKET

PLAN VIEW: ODDER PLAN, ODDER "XA-05" "CY-PR", RAIN GARDEN(OUT) LETVEN SITE
File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jan 05, 2011 - 11:45am

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION	DRAWN RLR-llp / CHECKED JH / DESIGNED JH	CLOVERLEAF LAKES PROTECTION ASSOCIATION TOWN OF BELLE PLAINE SHAWANO COUNTY, WISCONSIN	ODDER SITE PROFILE	DATE 07/2009 / FILE 4747002 SITE / JOB NO. 4747002	Robert E. Lee & Associates, Inc. ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES 4664 GOLDEN POND PARK COURT HOBART, WI 54155 PHONE:(920) 662-9641 INTERNET: www.releeinc.com FAX:(920) 662-9141	SHEET NO. 2

Odders Property

Planting Zone: Rain Garden
Soil: Sandy loam-sand
Sun: Shade
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Aquilegia canadensis	Columbine
Arisaema triphyllum	Jack-in-the-Pulpit
Aster lateriflorus	Calico Aster
Bromus ciliatus	Fringed Brome
Carex hystericina	Porcupine Sedge
Carex radiata	Wood Sedge
Carex stipata	Common Fox Sedge
Chelone glabra	Turtlehead
Elymus hystrix	Bottlebrush Grass
Eupatorium purpureum	Purple Joe Pye Weed
Geranium maculatum	Wild Geranium
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Onoclea sensibilis	Sensitive Fern
Polemonium reptans	Jacob's Ladder
Pycnanthemum virginianum	Common Mountain Mint
Thalictrum dasycarpum	Purple Meadow Rue
Veronicastrum virginicum	Culver's Root
Zizia aurea	Golden Alexander

Planting Zone: Biolog
Sun: Sunny
Moisture: Wet

Scientific Name	Common Name
Anemone canadensis	Canada Anemone
Asclepias incarnata	Swamp Milkweed
Calamagrostis canadensis	Bluejoint Grass
Carex bebbi	Bebb's Sedge
Carex comosa	Bristly Sedge
Chelone glabra	Turtlehead
Eupatorium maculatum	Spotted Joe Pye Weed
Eupatorium perfoliatum	Boneset
Glyceria striata	Fowl Manna Grass
Helenium autumnale	Sneezeweed
Iris versicolor	Blue Flag Iris
Leersia oryzoides	Rice Cut Grass
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Mimulus ringens	Monkey Flower
Pycnanthemum virginianum	Common Mountain Mint
Scirpus cyperinus	Wool Grass
Verbena hastata	Blue Vervain

Odders Property

Planting Zone: Shoreline Buffer – Zone 1
Soil: Sandy loam-sand
Sun: Sunny
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Allium cernuum	Nodding Pink Onion
*Amorpha canescens**	Leadplant
Andropogon gerardi	Big Bluestem
Asclepias syriaca	Common Milkweed
Asclepias tuberosa	Butterfly Milkweed
Asclepias verticillata	Whorled Milkweed
Aster laevis	Smooth Blue Aster
Aster novae-angliae	New England Aster
Aster oolentangiensis	Sky-blue Aster
Bouteloua curtipendula	Side-Oats-Grama
*Ceanothus americanus**	New Jersey Tea
*Corylus americana**	American Hazelnut
Desmodium canadense	Canada Tick Trefoil
Echinacea pallida	Pale Purple Coneflower
Geum triflorum	Prairie Smoke
Heuchera richardsonii	Prairie Alum Root
Koeleria macrantha	June Grass
Liatris aspera	Rough Blazing Star
Lupinus perennis	Lupine
Monarda fistulosa	Wild Bergamont
Monarda punctata	Horsemint
Parthenium integrifolium	Wild Quinine
Ratibida pinnata	Yellow Coneflower
Rudbeckia hirta	Black-eyed Susan
Schizachyrium scoparium	Little Blue Stem
Solidago nemoralis	Old Field Goldenrod
Solidago speciosa	Showy Goldenrod
Sorghastrum nutans	Indian Grass
*Spirea alba**	Meadowsweet
*Spirea tomentosa**	Steeplebush
Tradescantia ohiensis	Common Spiderwort
Verbena stricta	Hoary Vervain
Veronicastrum virginicum	Culver's Root

* Shrub

Planting Zone: Shoreline Buffer – Zone 4
Soil: N/A & Sandy loam-sand
Sun: Sunny
Moisture: Wet - Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Carex pensylvanica	Pennsylvania Sedge
Carex vulpinoidea (Biolog)	Brown Fox Sedge

Odders Property

Planting Zone: Shoreline Buffer – Zone 2
Soil: Sandy loam-sand
Sun: Partial Shade/Sun
Moisture: Dry
pH: Neutral (no amendments)

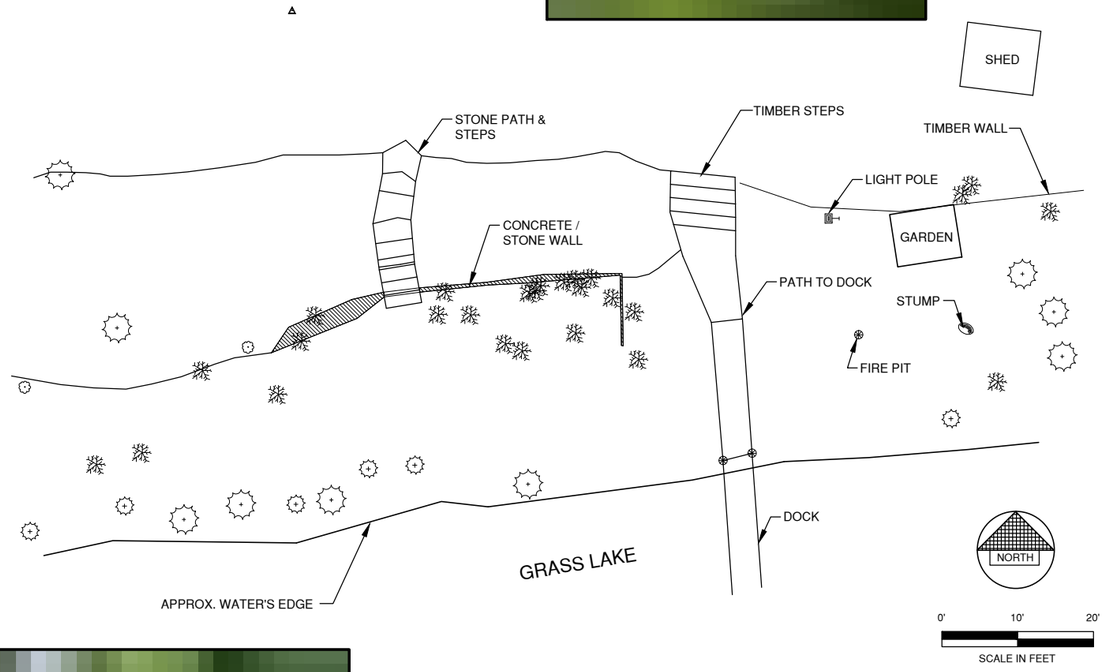
Scientific Name	Common Name
*Amelanchier arborea**	Serviceberry
Anemone cylindrica	Thimbleweed
Aquilegia canadensis	Columbine
Aster cordifolius	Heart-leaved Aster
Aster lateriflorus	Calico Aster
Aster macrophyllus	Large-leaf Aster
Bromus pubescens	Hairy Woodland Brome
Carex pennsylvanica	Pennsylvania Sedge
Elymus hystrix	Bottlebrush Grass
Elymus virginicus	Virginia Wild Rye
Eupatorium rugosum	White Snakeroot
Geranium maculatum	Wild Geranium
Maianthemum racemosum	False Solomon's Seal
Maianthemum stellatum	Starry Solomon's Seal
Phlox divaricata	Woodland Phlox
Solidgao flexicaulis	Zig-zag Goldenrod
Thalictrum dioicum	Early Meadow Rue
*Vaccinium angustifolium**	Early Low Blueberry
Zizia aurea	Golden Alexander

* Shrub

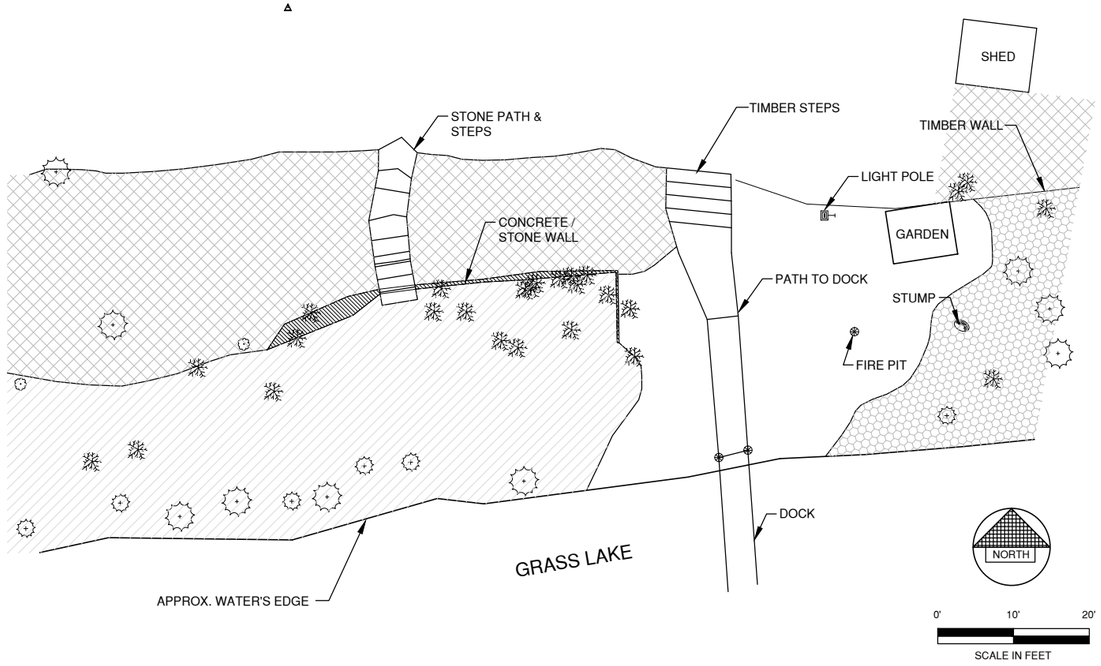
Planting Zone: Shoreline Buffer – Zone 3
Soil: Sandy loam-sand
Sun: Sunny
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Allium cernuum	Nodding Pink Onion
Aquilegia canadensis	Columbine
Asclepias verticillata	Whorled Milkweed
Dalea purpurea	Purple Prairie Clover
Dodecatheon meadia	Shooting Star
Gentian andrewsii	Bottle Gentian
Geum triflorum	Prairie Smoke
Hierochloe odorata	Vanilla Sweet Grass
Koeleria macrantha	June Grass
Lupinus perennis	Lupine
Monarda punctata	Horsemint
Potentilla arguta	Prairie Cinquefoil
Schizachyrium scoparium	Little Blue Stem
Sisyrinchium atlanticum	Eastern Blue-Eyed Grass
Solidago nemoralis	Old Field Goldenrod
Solidago speciosa	Showy Goldenrod
Sporobolus heterolepis	Prairie Dropseed
Zizia aurea	Golden Alexander

BEFORE



EXISTING CONDITIONS



PROPOSED CONDITIONS

BEFORE

PLANTING AREAS

- PLANTING ZONE #1 (2063 SF) - MESIC / WET-MESIC FOREST UNDERSTORY
- PLANTING ZONE #2 (2008 SF) - MESIC FOREST UNDERSTORY
- PLANTING ZONE #3 (550 SF) - MESIC / WET-MESIC PRAIRIE

File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jun 05, 2017 - 12:20pm
LAYOUT: ROSENFELDT
PLAN VIEW: ROSEN-EX, ROSEN-PR

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN LLP
CHECKED JH
DESIGNED JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

ROSENFELDT SITE PLAN

DATE 09/2009
FILE 4747002 SITE
JOB NO. 4747002

Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
4664 GOLDEN POND PARK COURT
HOBART, WI 54155 PHONE:(920) 662-9641
INTERNET: www.releeinc.com FAX:(920) 662-9141

SHEET NO. 1

Rosenfeldt Property

Planting Zone: Mesic Prairie
Soil: Loamy sand-sand
Sun: Sunny
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Allium cernuum	Nodding Pink Onion
*Amorpha canescens**	Leadplant
Andropogon gerardi	Big Bluestem
Anemone canadensis	Canada Anemone
Asclepias syriaca	Common Milkweed
Asclepias tuberosa	Butterfly Milkweed
Asclepias verticillata	Whorled Milkweed
Aster laevis	Smooth Blue Aster
Aster novae-angliae	New England Aster
Aster oolentangiensis	Sky-blue Aster
*Ceanothus americanus**	New Jersey Tea
Dalea purpurea	Purple Prairie Clover
Dodecatheon meadia	Shooting Star
Echinacea pallida	Pale Purple Coneflower
Elymus canadensis	Canada Wild Rye
Filipendula rubra	Queen of the Prairie
Gentian andrewsii	Bottle Gentian
Helenium autumnale	Sneezeweed
Heleopsis helianthoides	False Sunflower
Heuchera richardsonii	Prairie Alum Root
Hierochloe odorata	Vanilla Sweet Grass
Liatris aspera	Rough Blazing Star
Liatris pycnostachya	Prairie Blazing Star
Monarda fistulosa	Wild Bergamont
Panicum virgatum	Switchgrass
Parthenium integrifolium	Wild Quinine
Pycnanthemum virginianum	Common Mountain Mint
Ratibida pinnata	Yellow Coneflower
Rudbeckia hirta	Black-eyed Susan
Schizachyrium scoparium	Little Blue Stem
Sisyrinchium atlanticum	Eastern Blue-Eyed Grass
Solidago nemoralis	Old Field Goldenrod
Solidago rigida	Stiff Goldenrod
Sorghastrum nutans	Indian Grass
Sporobolus heterolepis	Prairie Dropseed
Tradescantia ohiensis	Common Spiderwort
Veronicastrum virginicum	Culver's Root

* Shrub

Rosenfeldt Property

Planting Zone: Mesic\Wet Mesic Forest Understory
Soil: Loamy sand-sand
Sun: Shade
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Anemone virginiana	Tall Anemone
Arisaema triphyllum	Jack-in-the-Pulpit
Aster lanceolatus	Panicled Aster
Aster lateriflorus	Calico Aster
Athyrium felix-femina	Lady Fern
Bromus pubescens	Hairy Woodland Brome
Campanula americana	Tall Bellflower
Carex normalis	Spreading Oval Sedge
Carex radiata	Wood Sedge
Carex stipata	Common Fox Sedge
*Cephalanthus occidentalis**	Buttonbush
Chelone glabra	Turtlehead
*Cornus amomum**	Silky Dogwood
Elymus virginicus	Virginia Wild Rye
Eupatorium purpureum	Purple Joe Pye Weed
Geranium maculatum	Wild Geranium
Glyceria striata	Fowl Manna Grass
Helianthus strumosus	Pale-leaved Sunflower
*Ilex verticillata**	Common Winterberry
Iris versicolor	Blue Flag Iris
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Mertensia virginica	Virginia Bluebells
Onoclea sensibilis	Sensitive Fern
Osmunda regalis	Royal Fern
*Parthenocissus quinquefolia**	Virgina Creeper
*Sambucus canadensis**	Common Elderberry
Solidago patula	Swamp Goldenrod
Thalictrum dasycarpum	Purple Meadow Rue
Thalictrum thalictroides	Rue Anemone
Zizia aurea	Golden Alexander

* Shrub

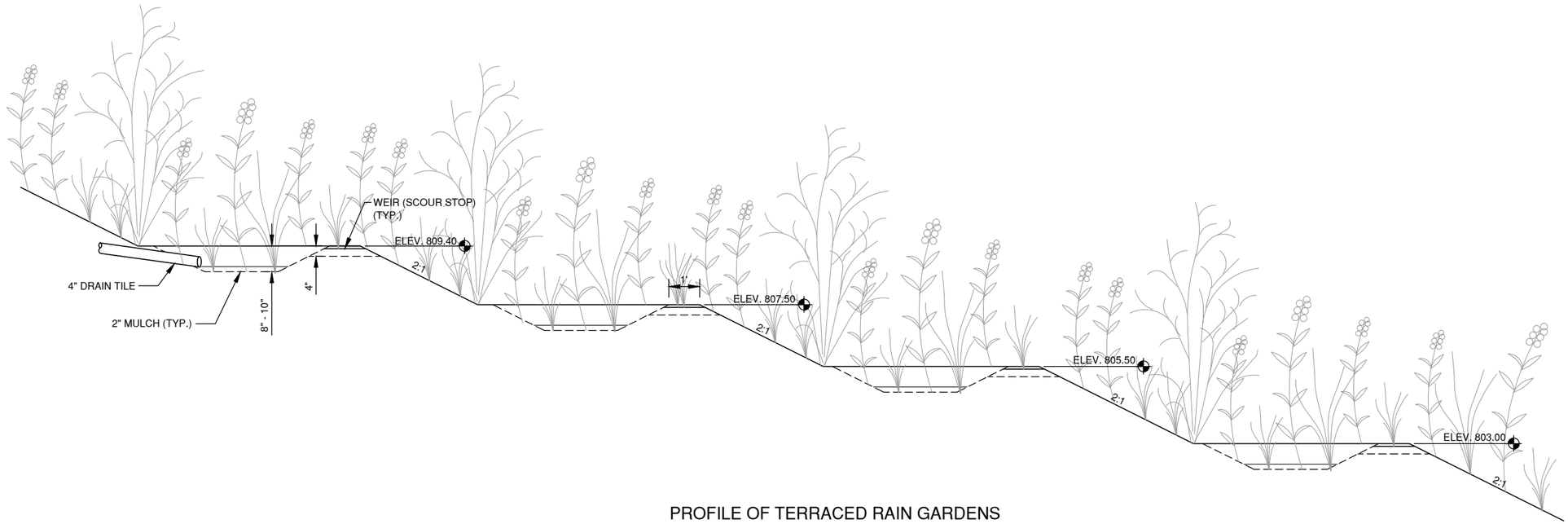
Rosenfeldt Property

Planting Zone: Mesic Forest Understory
Soil: Loamy sand-sand
Sun: Partial Shade/Sun
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
Actaea pachypoda	White Baneberry
Actaea rubra	Red Baneberry
Adiantum pedatum	Maidenhair Fern
*Amelanchier arborea**	Serviceberry
Anemone cylindrica	Thimbleweed
Aquilegia canadensis	Columbine
Asarum canadense	Wild Ginger
Aster cordifolius	Heart-leaved Aster
Aster macrophyllus	Large-leaf Aster
Aster sagittifolius	Arrow-leaved Aster
Carex pennsylvanica	Pennsylvania Sedge
Caulophyllum thalictroides	Blue Cohosh
*Cornus alternifolia**	Alternate-leaf Dogwood
*Corylus americana**	American Hazelnut
*Dirca palustris**	Leatherwood
Elymus hystrix	Bottlebrush Grass
Elymus villosus	Silky Wild Rye
Eupatorium rugosum	White Snakeroot
Geranium maculatum	Wild Geranium
*Hamamelis virginiana**	Witch-hazel
Maianthemum racemosum	False Solomon's Seal
Maianthemum stellatum	Starry Solomon's Seal
Mitella diphylla	Bishop’s Cap
Osmorhiza claytonii	Hairy Sweet Cicely
Phlox divaricata	Woodland Phlox
Podophyllum peltatum	Mayapple
Polemonium reptans	Jacob’s Ladder
Polygonatum biflorum	Smooth Solomon’s Seal
Solidgao flexicaulis	Zig-zag Goldenrod
*Taxus canadensis***	Canada Yew
Thalictrum dioicum	Early Meadow Rue
Trillium grandiflorum	Large White Trillium
Uvularia grandiflorum	Large-flowered Bellwort
*Viburnum lentago**	Nannyberry
*Viburnum trilobum**	Highbush Cranberry

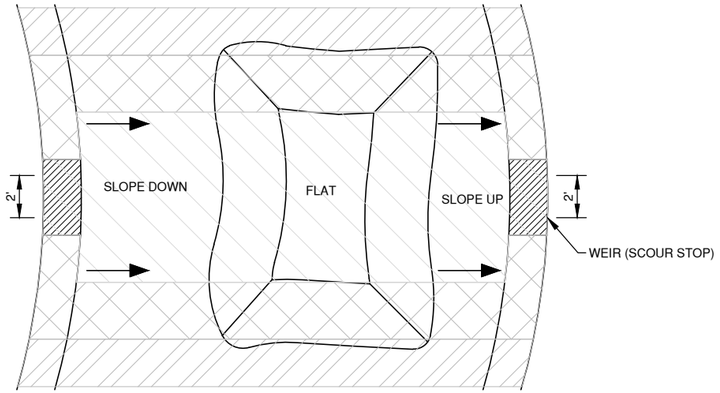
* Shrub

** Shrub that must be protected from deer browse



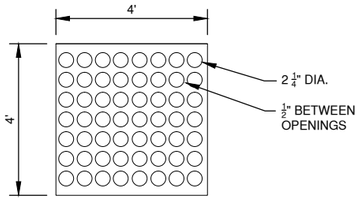
PROFILE OF TERRACED RAIN GARDENS

SCALE: 1" = 2'



PLAN OF TERRACED RAIN GARDENS

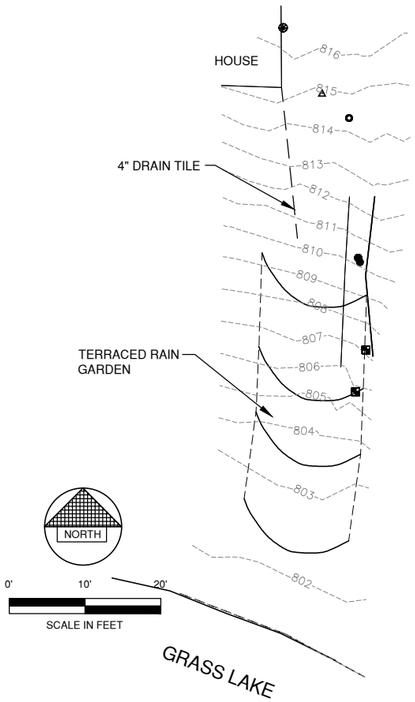
SCALE: 1" = 2'



SCOUR STOP DETAIL

BEFORE

AFTER



RAIN GARDEN PLANTING LEGEND

- PLANTING ZONE #1
- PLANTING ZONE #2
- PLANTING ZONE #3
- NATIVE SHRUB
- NATIVE WILD FLOWERS (PLANTED 1 FOOT ON CENTER)
- NATIVE GRASSES/SEDGES (PLANTED 1 FOOT ON CENTER)

NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

DRAWN: RLR
CHECKED: JH
DESIGNED: JH

CLOVERLEAF LAKES PROTECTION ASSOCIATION
TOWN OF BELLE PLAINE
SHAWANO COUNTY, WISCONSIN

SORENSON SITE PLAN

DATE: 07/2009
FILE: 4747002 SITE
JOB NO.: 4747002

Robert E. Lee & Associates, Inc.
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4664 GOLDEN POND PARK COURT
HOBART, WI 54155
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FAX:(920) 662-9141

SHEET NO. 1

File: R:\4700\4747\4747002\dwg\4747002 SITE PHOTOS.dwg
Plot Date: Jan 06, 2011 - 9:23am
LAYOUT: LEVEL SITE PLAN VIEW

Sorenson Property

Planting Zone: Rain Garden – Zone 1
Soil: Sandy Loam-Sand
Sun: Partial Sun/Shade
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Allium cernuum	Nodding Onion
Anemone canadensis	Canada Anemone
Arisaema triphyllum	Jack-in-the-Pulpit
Aster lanceolatus	Panicled Aster
Aster novae-angliae	New England Aster
Bromus ciliatus	Fringed Brome
Carex normalis	Spreading Oval Sedge
Carex rosea	Rosy Sedge
Calamagrostis canadensis	Bluejoint Grass
Chelone glabra	Turtlehead
Eupatorium purpureum	Purple Joe Pye Weed
Gentian andrewsii	Bottle Gentian
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Blue Lobelia
Onoclea sensibilis	Sensitive Fern
Osmunda regalis	Royal Fern
Pycnanthemum virginianum	Common Mountain Mint
Veronicastrum virginicum	Culver's Root
Zizia aurea	Golden Alexander

Planting Zone: Rain Garden – Zone 2
Soil: Sandy Loam-Sand
Sun: Partial Sun/Shade
Moisture: Moist
pH: Neutral (no amendments)

Scientific Name	Common Name
Adiantum pedatum	Maidenhair Fern
Anemone cylindrica	Thimbleweed
Aster lateriflorus	Calico Aster
Athyrium filix-femina	Lady Fern
Bromus pubescens	Hairy Woodland Brome
Carex radiata	Wood Sedge
Carex scoparia	Broom Sedge
Elymus virginicus	Virginia Wild Rye
Eupatorium rugosum	White Snakeroot
Geranium maculatum	Wild Geranium
Liatris aspera	Rough Blazingstar
Maianthemum racemosum	False Solomon's Seal
Maianthemum stellatum	Starry Solomon's Seal
Monarda fistulosa	Wild Bergamont
Zizia aurea	Golden Alexander

Sorenson Property

Planting Zone: Rain Garden – Zone 3
Soil: Sandy Loam-Sand
Sun: Partial Sun/Shade
Moisture: Dry
pH: Neutral (no amendments)

Scientific Name	Common Name
*Amelanchier arborea**	Serviceberry
Aquilegia canadensis	Columbine
Aster cordifolius	Heart-leaved Aster
Aster macrophyllus	Large-leaf Aster
Carex pennsylvanica	Pennsylvania Sedge
*Cornus alternifolia**	Alternate-leaf Dogwood
Dodecatheon meadia	Shooting Star
Elymus hystrix	Bottlebrush Grass
Phlox divaricata	Woodland Phlox
Rudbeckia hirta	Black-eyed Susan
*Sambucus canadensis**	Common Elderberry
Solidgao flexicaulis	Zig-zag Goldenrod
Thalictrum dioicum	Early Meadow Rue
*Viburnum acerifolium**	Mapleleaf Viburnum
*Viburnum lentago**	Nannyberry

* Shrub

C

APPENDIX C

Education Components