Black Oak Lake Watershed Protection Program (Phase 4): Protection & Restoration of Riparian Shorelines

The Black Oak Lake Preservation Foundation

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Black Oak Lake Watershed Protection Program (Phase 4): Protection & Restoration of Riparian Shorelines

Report for a WDNR Lake Planning Grant (Phase 4)

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Chapter

1

Introduction

The Black Oak Lake Watershed Protection Program is an ongoing endeavor composed of annual phases that progress toward the overall vision. The Black Oak Lake Preservation Foundation (formerly, Black Oak Lake Riparian Owners Association) is the lead organization in this long-range effort. White Water Associates, Inc. has been the organization's consultant throughout the history of the program.

In Phase 3 of the program, we conducted a qualitative, quantitative, and photographic documentation of the condition of the littoral and riparian zones of Black Oak Lake. This information led directly to Phase 4 that seeks to prevent establishment of Aquatic Invasive Species (AIS) in Black Oak Lake through protection and restoration of littoral zone and riparian habitat and monitoring of boat/trailer traffic at Black Oak Lake through the Clean Boats, Clean Waters Program. In Phase 4, data were analyzed and areas selected for potential "demonstration restoration projects." A restoration plan was prepared for each site. This report presents these activities and becomes part of the overall adaptive management plan for the Black Oak Lake Watershed Protection Program. It is a required report to the Wisconsin Department of Natural Resources (WDNR) Lake Planning Grants Program. A planning grant funded for this project.

Project participants continue to embrace the concept of "adaptive management" in their approach to the Black Oak Lake Watershed Protection Program. Simply stated, adaptive management uses findings from planned monitoring activities to inform future management actions and periodic refinement of the plan. An adaptive management plan accommodates new findings by integrating this information into successive iterations of the comprehensive plan (Walters 1986). The plan is therefore a dynamic entity, successively evolving and improving to fit the needs of the Black Oak Lake watershed. A central premise of adaptive management is that scientific knowledge about natural ecosystems is uncertain and therefore a practical management plan allows for ongoing adjustments in management designed to "adapt" to changing conditions and new information or understanding. Monitoring the outcomes of plan implementation is essential to the process of adaptive management.

Besides this introductory chapter, this report contains three additional chapters. Chapter 2 describes the background and study area. Chapter 3 lays out the methods we followed in carrying out this project. Chapter 4 presents and discusses the results of Phase 4.

Chapter
2

Background

Black Oak Lake is a 584 acre lake located near the town of Land O'Lakes in northern Vilas County, Wisconsin. It is a deep lake (more than 80 feet in places) and has a high diversity of aquatic habitats (from shallow to deep water). Black Oak Lake can be best described as a "Groundwater Drainage Lake" although the outflow stream has been dry for many years. It is an oligotrophic lake. Its outflow stream is small. There is a public park with swimming beach, picnic area, and boat landing. Black Oak Lake is an important resource used by the public. In recent years its water levels have dropped fairly dramatically, affecting littoral zone elements in the lake and providing some open habitat for colonizing plant species.

The Black Oak Lake landscape has several lakes including Anderson Lake, Dollar Lake Big Donahue Lake, Little Donahue Lake, Little Bateau Lake, Big Bateau Lake, Spring Lake, Lake Elaine (formerly Lonewood Lake), and George Lake. This complex of aquatic habitats forms an abundance of riparian habitats for birds, mammals, amphibians, reptiles, and invertebrates that require this kind of habitat.

The land matrix of this complex of lakes is largely forested, with some prime examples of northern hardwoods forest stands. Large tracts of undeveloped land exist offering high quality habitat for many terrestrial organisms and very stable surroundings that are protective of the lake environment. The Conserve School property of 1200 acres is included in the watershed. Immediately adjacent to the north of the watershed is the Sylvania Recreation Area – a wilderness area in Michigan's Upper Peninsula.

Black Oak Lake has a remarkable aquatic biota that to our knowledge does not currently include aquatic invasive plant species. In many parts of the lake, the riparian area is naturally forested. In other areas of shoreline, development has altered the riparian area (in some cases, dramatically so). There are occurrences of invasive terrestrial plant species in the Black Oak Lake riparian area.

The project phases that have preceded Phase 4 provided the baseline understanding necessary to proceed with restoration planning. Black Oak Lake has a shoreline of nearly 7½ miles and comprised of 173 ownership parcels. Large stretches of shoreline on the north shore are undeveloped. The Black Oak Lake Preservation Foundation is particularly focused on this project since impacts to lake ecosystems typically emanate from development and degradation of the riparian area. According to the U.S.EPA's 2007

National Lakes Assessment, poor lakeshore habitat (riparian vegetation) is the number one stressor of lake ecosystems. Poor littoral zone habitat is number two. The study further indicates that lakes with poor lakeshore habitat are three times more likely to exhibit poor biological condition as measured by the planktonic community (food web). By managing for healthy and naturally functioning lakeshores (littoral & riparian zones), we can make a difference in the lake's ecological health.

Restoring riparian areas that involve private property is certainly a sensitive undertaking, one that is best accomplished through a process that includes education and orientation of the landowners and other stakeholders. We believe that a few carefully selected sites, once successfully restored, will serve to demonstrate the ecological advantages and natural beauty of native plantings and allow a conversation among Black Oak Lake residents regarding the value of a healthy riparian area to the health of Black Oak Lake.

The Black Oak Lake Preservation Foundation takes a long range perspective on instituting restoration in the riparian area of Black Oak Lake. This perspective includes the importance of engaging future generations of lake property owners by providing good examples of intact and restored riparian area. Crucial junctures in the stewardship and lake health occur as family properties are conveyed to children and grandchildren and other private properties sold to people who are new to lake ownership. These are points in time when decisions about the property are made that have direct influence on lake quality. It is the Preservation Foundation's hope that the preponderance of these decisions favors the ongoing quality of Black Oak Lake. Through good examples of stewardship, including high quality and attractive restoration projects, and other education opportunities, both long-time residents of Black Oak Lake and newcomers will be exposed to good stewardship practices with regard to the riparian area.

Chapter
3

Methods

The overarching goal of the Phase 4 project is to prevent the establishment of AIS in Black Oak Lake. We followed two principal approaches to achieve this goal: (1) we selected and planned demonstration projects for planning protection/restoration actions and (2) we continued the monitoring of watercraft traffic into Black Oak Lake through the Clean Boats, Clean Waters Program. Six objectives supported our goal: (1) review and analyze the photographic, qualitative, and quantitative data collected during Phase 3 on the littoral zone and riparian area conditions of Black Oak Lake; (2) select candidate demonstration protection/restoration projects; (3) create a protection/restoration plan for each demonstration area; (4) integrate the Phase 4 demonstration plans into an updated Black Oak Lake adaptive management plan; (5) continue with the Black Oak Lake "Clean Boats, Clean Waters Program," and (6) manage and administer the Phase 4 Project. This Chapter describes the methods we followed to accomplish these objectives.

Part 1 — Shoreland Restoration Plans

Phase 3 of the Black Oak Lake Stewardship Program created an Image-Based Waterfront Archive using lake association volunteers to collect a large data set that characterized the riparian and littoral zones of Black Oak Lake. This archive documented 2008 shoreline conditions for the purpose of verifying extent and origin of future human-caused changes or natural changes. To allow efficient data storage and retrieval, we created a web-based product to interface with and access photos and data. Topographic maps and aerial photos are part of the database as well. The data archive can be accessed, navigated, and reviewed from CD-ROM.

White Water staff reviewed the entire data set (including photographs) along with aerial photography and topographic information in order to select areas where some degradation exists and might be improved by rehabilitation actions.

Phase 3 of the Black Oak Lake Stewardship Program also produced a Quantitative Assessment of Littoral and Riparian area of Black Oak Lake using two methodologies –

one published by the US-EPA and the other by the WDNR. These focused on littoral zone and shoreline activities of Black Oak Lake. To characterize the near-shore habitats and conditions (both littoral zone and riparian area), the survey team established and evaluated ten evenly spaced "physical habitat" stations around the lake. These data were also reviewed for our selection of sites on Black Oak Lake.

White Water consultant, Barbara Gajewski, and Preservation Foundation board member Walt Bates conducted a field reconnaissance in late summer 2011 to review possible sites. After the initial field reconnaissance, Barbara Gajewski visited the sites with Mariquita (Quita) Sheehan (Vilas County Lake Conservation Specialist) to review possible actions and suitable plant species for use in restoration. Finally, a field trip that included Gajewski and Dean Premo (White Water) and several members of the Preservation Foundation Board (Walt Bates, John Annin, Bob Pierce, and Tom Allman) was conducted in October 2011 to view and discuss candidate sites. After the October field trip, Gajewski drafted restoration plans and corresponded with affected landowners.

Four sites were selected including: a portion of the island, a section of the Lowenstein property, the Pierce property and the Kegel property. An important theme incorporated in the restoration plans is the creation of a natural buffer zone of native vegetation along the shoreline. Shoreland buffers mitigate surface runoff that can cause erosion and deliver unwanted nutrients to the lake. Also shoreland buffers create critical habitat for species of birds, amphibians and insects that require natural shorelands and the related habitat for their existence.

Part 2 — Clean Boats / Clean Waters

As previously stated, the overarching goal of the Phase 4 project is to prevent the establishment of AIS in Black Oak Lake. Part 1 of the methodology has presented an approach to protecting and restoring sites on Black Oak Lake so that they provide a "natural armor" - that is, a healthy habitat with diverse native biota in both riparian and littoral zone areas that prevents establishment of AIS if/when they are accidentally introduced. The second, and equally important, approach to prevent establishment of AIS in Black Oak Lake is to minimize the opportunities for introduction of AIS propagules on recreational watercraft through the Clean Boats, Clean Waters Program. Since 2004, watercraft inspection has been a significant part of Wisconsin's AIS prevention efforts. Research has shown that inspections play an important role in helping contain AIS to already affected water bodies, preventing the spread of invasive species to new waters.

Black Oak Lake has participated in the Clean Boats, Clean Waters Program since 2008. The WDNR and University of Wisconsin Extension (UWEX) have developed a well-defined protocol for carrying out this program. In 2011 BOLROA carried out the CBCW program and submitted data collected by boat landing monitors to the SWIMS database.

The Black Oak Lake CBCW monitor worked Saturdays and Sundays, two shifts each day, 6:00-10:00 AM, and 3:00-7:00 PM. The boat landing was staffed April through September. The monitor's duties were to greet each person that arrived to launch a boat, and briefly explain the CBCW program, and the laws regarding AIS. The monitor would inspect the boat, fishing gear, trailer, and tow vehicle, for any AIS and gather and record information on DNR forms.

Chapter

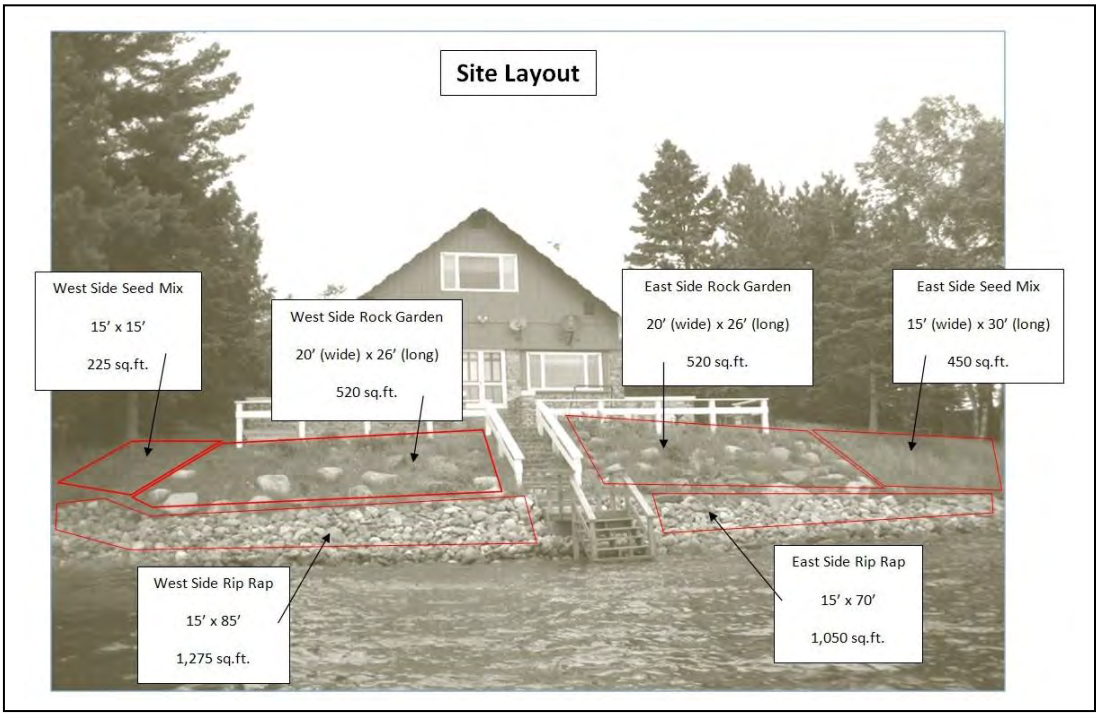
4

Results and Discussion

In this Chapter, restoration plans are described for the four sites identified in Phase 4. The general format is to present the plan using site photographs and captions to describe the recommended actions. Several photos of each site are provided for plan description and documentation of conditions as they existed in 2011. In each plan, a table provides details regarding recommended plant materials. Each plan concludes with a summary of estimated restoration costs.

Part 1. Conserve School Lowenstein Lakefront Restoration

An area of older development on Black Oak Lake exists on Conserve School property. This is known as the Lowenstein property. Long ago the riparian area was modified by placing rock rip-rap and converting natural shoreline vegetation to a lawn. The restoration plan for this site is considered in this subsection.



General Site Plan

- Plant native vegetation into current rock gardens.
- Planting arrangement will mimic a more native arrangement and less formal.
- Remove cultivated shrubs.
- Removal of marsh thistle below the OHWM across all shoreland area, by cutting base of plant off – soil disturbance is permitted
- Deer prevention program required (Fencing and spraying)

Use of native shrubs appropriate to live stake into the current rip rap. OHWM will determine the extent of this planting. If planting occurs below the OHWM a WDNR permit may be required. (Allow minimum of 60 days to obtain permit.)

Option 1: Plant directly into the hillside. Mulch bare areas.

Option 2: Seed hillside with native seed mix. Cover seeded area with a non-woven erosion control blanket.

	Potential Plants for Restoration					
	Latin Name	**Common**	**Characteristics**	**Herbarium Link**	**Bloom**	**Color**
Shrubs	*Aronia melanocarpa*	Black Chokeberry	flowers are white to pink	Black Chokeberry	June	
	Comptonia peregrina	Sweet-fern	2 - 3' tall, great scent, likes more sterile soils	Sweetfern	June-July	
	Corylus cornuta	Beaked Hazelnut	up to 10' tall, decorative fruit, good wildlife shrub	Beaked Hazelnut	June	
	Diervilla lonicera	Northern Bush Honeysuckle	1-3' tall, flowers are yellow to red, good fall color	Northern Bush Honeysuckle	June-July	
	Rosa blanda	Smooth Rose	3'-4' tall, white to pink flowers	Smooth rose	June-July	
	Viburnum rafinesquianum	Downy arrow-wood	6'-12' tall, great fall colors, blue berries	Downy arrow-wood	June	
Forbes	*Achillea millefolium*	Yarrow	8"-40" tall, flat-topped inflorescence of small white flowers	Yarrow	July-August	Multiple
	Anaphilis margaritacea	Pearly Everlasting	1'-3' tall, flowers are white with yellowish disk in the middle	Pearlyeverlasting	July-August	
	Asclepias syriaca	Common milkweed	3'-6' tall, pink to cream flower monarch butterfly food	Common milkweed	June-August	
	Epilobum angustifolium	Fireweed	2'-6' tall, pink to purple flowers,	Fireweed	June-Sept.	
	Euthamia graminifolia	Grass-leaved Goldenrod	1'-4' tall, flat-topped yellow clusters	Grass-leaved goldenrod	July-October	
	Liatris aspera	Rough blazing star	1'-3' tall, pink flowers late summer - fall	Rough blazing star	August-October	
	Lupinus perennis	Wild lupine	8"-24" tall, blue to white flowers, early summer	Wild lupine	May-June	
	Monarda fistulosa	Wild Bergamot	2'-4' tall, pale purple to pink flowers	Wild Bergamot	July-October	
	Rudbeckia hirta	Black-eyed Susan	1'-3' tall, yellow/brown flowers	Black-eyed susan	June-October	
	Solidago canadensis	Canada goldenrod	1'-3' tall, colonial plant with yellow flowers	Canada goldenrod	July-October	
	Solidago nemoralis	Old Field goldenrod	1' to 1.5' tall, yellow flowers, grey stems	Old Field Goldenrod	July-October	
Grasses	*Danthonia spicata*	Poverty oat grass	grows 1-2'	Poverty oats	June	
	Oryzopsis asperfolia	Rough-leaved rice cut-grass	1'-2' tall, evergreen bunchgrass	Rough-leaved rice cut-grass		

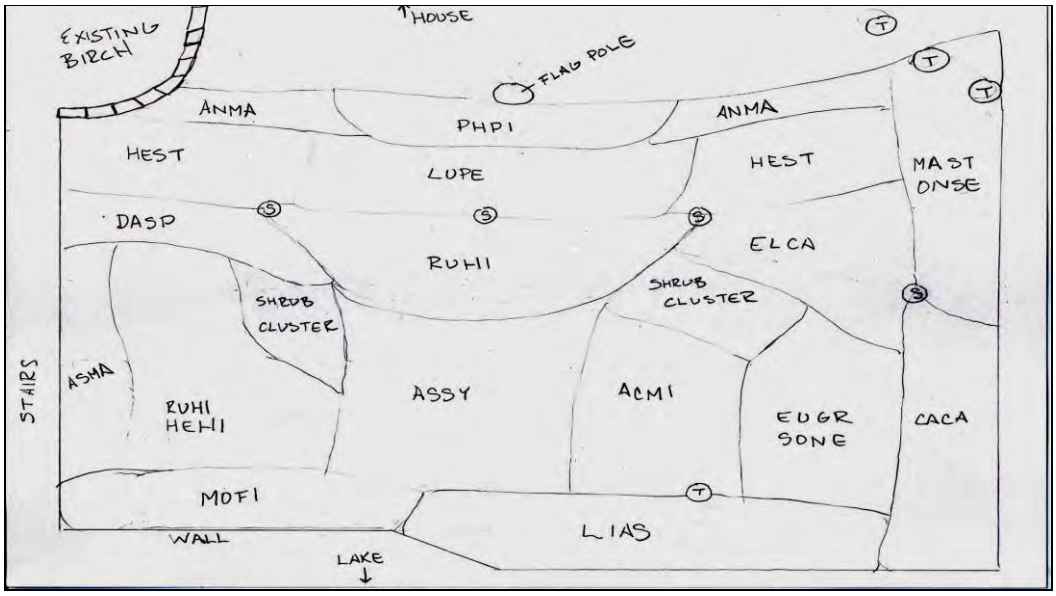
Approximate Cost of Materials for Restoration for Conserve School Site			
Description	**Quantity**	**Price/Unit**	**Cost**
Seed Mix Areas			
West and east shore seed mix (Agrecol Savanna/Woodland Edge) 675 sq.ft.	1 bag (covers 1000 sq.ft.)	95.00	95.00
Seed Shipping	1	15.00	15.00
Excelsior non woven mats	1 roll (720 sq.ft.)	1.20	864.00
Biodegradable stakes	1 box (1000) stakes	120.00	120.00
		TOTAL COST	**1,094.00**
West & East Side Rock Garden Areas			
Native forbs 2.5" container (Hansen's Garden Village)	434	2.45	1063.30
Native grasses 2.5" container (Hansen's Garden Village)	190	2.45	465.50
Shrubs (Hansen's Garden Village)	10	17.50	175.00
Mulch 400 sq.ft.	Bulk scrap from tree service company		50.00
		TOTAL COST	**1,753.80**
West & East Side Rip Rap Areas			
Live Stakes (Students can collect)			
Root stimulator	1 container	20.00	**20.00**
Deer Fencing (Seed mix and rock garden areas only)			
Fencing (264 linear feet)	3 rolls	110.00	330.00
Stakes (8' spacing)	35	6.50	227.50
Zip ties	2 packages	10.00	20.00
		TOTAL COST	**577.50**
		GRAND TOTAL COST	**$3,425**
Note: Costs do not include tax and labor (labor assumed as Conserve School students.			

Part 2. Pierce Lakefront Restoration

On the east end of Black Oak Lake is a property owned by the Pierce family. The near shore riparian area on this property is the subject of this restoration plan that seeks to return native vegetation to the site.

General Site Plan

- Mulch around established trees in front (lake side) of the house as necessary.
- Plant native vegetation into current lawn, minimizing erosion and allowing current seed bank to emerge. Mulch as necessary.
    - Approximately 3750 square feet of planting area with forbs, shrubs, grasses and trees (trees via natural colonization).
- Planting scheme will emphasize accent and color. Paying attention to placement, organization and height.
- Removal of marsh thistle below the OHWM across all shoreland area, by cutting base of plant off – soil disturbance is permitted
- Deer prevention program required (fencing and spraying)



Example of Plant Selection for Pierce Site (subject to change based on owner preference and plant availability. Plant abbreviation key described on plant table)

Additional Site Restoration

- Discontinue removal of leaves along hill side area to promote natural duff layer and minimize soil movement.
- Monitor re-colonization of native vegetation; possibly reseed area with an appropriate native seed mix.
- Future potential for a spring ephemeral site, once an adequate duff layer has been achieved.

Additional Site Restoration

- Remove non-native shrubs.
- Remove flagstone edging and grade into slope.
- Plant with native vegetation.
- Mulch area to minimize erosion.


Additional Pierce Site Photo


Additional Pierce Site Photo

	Potential Plants for Restoration					
	Latin Name	**Common**	**Characteristics**	**Herbarium Link**	**Bloom**	**Color**
Shrubs	*Comptonia peregrina*	Sweet-fern **COPE**	2 - 3' tall, great scent, likes more sterile soils	Sweetfern		
	Cornus stolonifera (C. sericea)	Red Osier Dogwood **COST**	3'-10' tall, white flowers, good fall and spring color	Red osier dogwood	June	
	Diervilla lonicera	Northern Bush Honeysuckle **DILO**	1-3' tall, flowers are yellow to red, good fall color	Northern Bush Honeysuckle	June-July	
	Rosa blanda	Smooth Rose **ROBL**	3'-4' tall, white to pink flowers	Smooth rose	June-July	
	Rosa palustris	Swamp Rose **ROPA**	3 - 7' tall, pink flowers, red hips	Swamp rose	June	
	Spirea alba	White meadow sweet **SPAL**	grows 3-4' tall, flowers are white	White meadow sweet	June	
Forbes	*Achillea millefolium*	Yarrow **ACMI**	8"-40" tall, flat-topped inflorescence of small white flowers	Yarrow	August	Multiple
	Anaphilis margaritacea	Pearly Everlasting **ANMA**	1'-3' tall, flowers are white with yellowish disk in the middle	Pearlyeverlasting	August	
	Asclepias syriaca	Common milkweed **ASSY**	3'-6' tall, pink to cream flower monarch butterfly food	Common milkweed	June	
	Aster macrophylus	Big leaved aster **ASMA**	1'-3' tall, pale blue flowers	Big-leaved aster	July-October	
	Euthamia graminifolia	Grass-leaved Goldenrod **EUGR**	1'-4' tall, flat-topped yellow clusters	Grass-leaved goldenrod	July-October	
	Fragaria virginiana	Wild Strawberry **FRVI**	4"-6" tall, white flowers	Wild strawberry	June	
	Gaultheria procumbens	Wintergreen **GAPR**	4"-8" tall, white flowers, red berries	Wintergreen	April-May	
	Helianthus hirsutus	Rough sunflower **HEHI**	2'-4' tall, large bright yellow flowers	Rough sunflower	August-Sept	
	Helianthus strumosus	Woodland sunflower **HEST**	2"-6" tall, woodland edges	Woodland sunflower	August	
	Liatris aspera	Rough blazing star **LIAS**	1'-3' tall, pink flowers late summer - fall	Rough blazing star	August	
	Lupinus perennis	Wild lupine **LUPE**	8"-24" tall, blue to white flowers, early summer	Wild lupine	June	
	Monarda fistulosa	Wild Bergamot **MOFI**	2'-4' tall, pale purple to pink flowers	Wild Bergamot	June	
	Phlox pilosa	Prairie phlox **PHPI**	8'-15' tall, bright pink	Prairie phlox	July	

	Rudbeckia hirta	Black-eyed Susan **RUHI**	1'-3' tall, yellow/brown flowers	Black-eyed susan	July-August	
	Solidago nemoralis	Old Field goldenrod **SONE**	1' to 1.5' tall, yellow flowers, grey stems	Old Field Goldenrod	July-August	
	Tradescantia ohiensis	Ohio spiderwort **TROH**	2'-3' tall	Ohio spiderwort	July-August	
	Verbena stricta	Hoary vervain **VEST**	2'-4' tall, tall purple flowers	Hoary vervain	August	

Grasses	*Calamagrostis canadensis*	Blue-joint grass **CACA**	grows 2'-3'	Blue Joint Grass	June	
	Danthonia spicata	Poverty oat grass **DASP**	grows 1-2'	Poverty oats	June	
	Oryzopsis asperfolia	Rough-leaved rice cut-grass **ORAS**	1'-2' tall, evergreen bunchgrass	Rough-leaved rice cut-grass		
	Bouteloua curtipendudla	Side oats grama **BOCU**	2'-3' tall	Side oats grama	June	
	Elymus canadensis	Wild rye **ELCA**		Wild rye		
	Carex brevior	Plains oval sedge **CABR**		Plains oval sedge		

Ferns	*Matteuccia strupteroperis*	Ostrich Fern **MAST**	2'-3' tall, Vaselike shape, fertile fronds overwinter	Ostrich Fern		
	Onoclea sensibilis	Sensitive fern **ONSE**	1'-2' tall, good texture,	Sensitive fern		

Approximate Cost of Materials for Restoration for the Pierce Site			
Description	**Quantity**	**Price/Unit**	**Cost**
Planting Area Approximately 3375 sq.ft. Forbs/Grasses planting area approximately 3205 sq. ft. Shrub planting area approximately 170 sq.ft. Plant spacing every 6-10 inches			
Native forbs/grasses 2.5" containers	2,500	2.45	6,125
Shrubs (bare root shrubs; require early spring installation)	25	9.00	225
Chipper mulch for erosion areas (from tree service company)	Bulk scrap		100.00
		TOTAL COST	**6,450.00**
Deer Fencing			
Fencing (250 linear feet)	3 rolls	110	330
Stakes (8' spacing)	35	6.5	227.5
Zip ties	2 packages	10	20
		TOTAL COST	**577.50**
		GRAND TOTAL COST	**$7,028**
Note: Costs do not include tax, labor, and mobilization (acquiring and delivering supplies.			

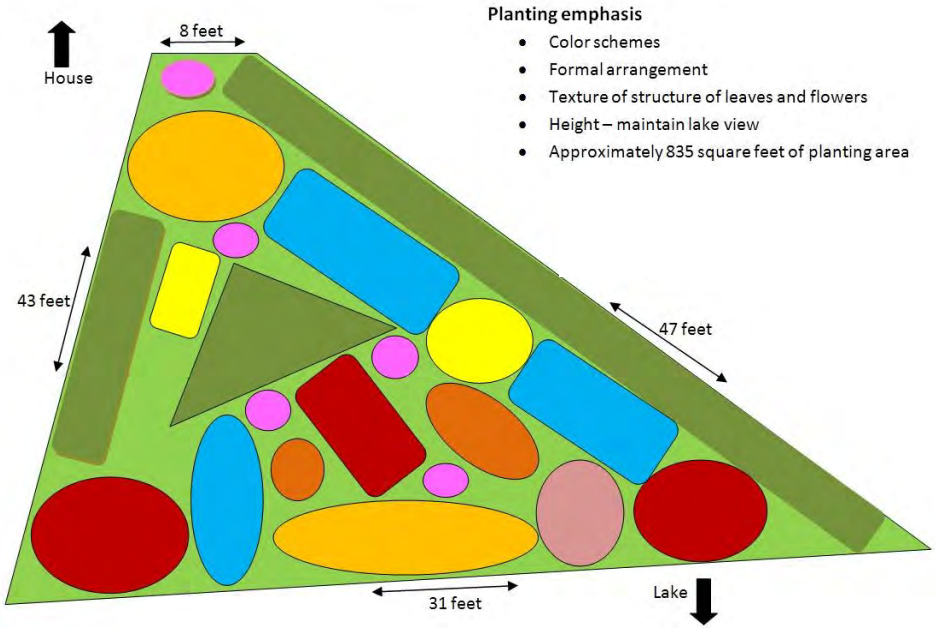
Part 3. Kegel Lakefront Restoration

On the south-central shore of Black Oak Lake is a property owned by the Kegel family. The near shore riparian area on this property is the subject of this restoration plan that seeks to return native vegetation to the site.

General Site Plan

- Dimensions: 8' x 47' x 31' x 43'
- Plant native vegetation directly into hillside. Emphasis will be on accent and color. Paying attention to placement, organization and height to protect view of lake.
- Plant spacing: As appropriate for number of plants purchased
- Remove invasive honeysuckle from site.
- Removal of Marsh Thistle below the OHWM across all shoreland area by cutting base of plant off – soil disturbance is permitted
- Deer prevention program is required. (Fencing and spraying)

Example of color scheme and formal arrangement



Planting emphasis

- Color schemes
- Formal arrangement
- Texture of structure of leaves and flowers
- Height – maintain lake view
- Approximately 835 square feet of planting area

Additional Site Restoration

- Use of native shrubs to accent the established flower bed, paying attention to shape and height of shrubs to protect lake view.
- Monitor the presence of "snow on the mountain;" decide if removal efforts are necessary.

Additional Restoration Effort

Use of a down spout off of the gutters that will divert water away from the edge of the house into a French drain that will run under lawn area towards a wooded area down slope.

Approximate Cost of Materials for Restoration for the Kegel Site			
Description	**Quantity**	**Price/Unit**	**Cost**
Planting Area Approximately 835 sq.ft. Forbs/Grasses planting area approximately 627 sq. ft. Shrub planting area approximately 125 sq.ft. Plant spacing every 6-10 inches			
Native forbs/grasses 2.5" containers	1570	2.45	3846.5
Shrubs	28	17.5	490
Trees	3	65	195
Mulch	16 bags	2.75	44
		TOTAL COST	**4575.50**
Deer Fencing			
Fencing (130 linear feet)	2 rolls	110	220
Stakes (8' spacing)	20	6.5	130
Zip ties	2 packages	10	20
		TOTAL COST	**370**
		GRAND TOTAL COST	**$4,946**
Note: Costs do not include tax, labor, and mobilization (acquiring and delivering supplies.			

Part 4. Island Erosion Restoration

On the west end of Black Oak Lake is a small island used by the public. The much-used approach to this island is devoid of plant material and is eroding onto the shore and into the lake. Below, we provide options for minimizing erosion and providing some public education. The "EcoGrid" brochure referenced below is contained in Appendix 1.

Minimize erosion in high traffic area

Option 1:

- Install a stair case that would funnel foot use into a single use area. (Note: need to stay above the OHWM.)

Option 2:

- Install an ecogrid-like system to minimize erosion while being able to maintain foot traffic. (EcoGridBrochureWebv3.pdf)

In the case of either option, install a small educational sign about reasons to minimize shoreland erosion.

We estimate that the approximate cost of Option 2 (ecogrid) would be $7,000.

Literature Cited

Walters, C. 1986. Objectives, constraints, and problem bounding. In W.M. Getz, ed., Adaptive Management of Renewable Resources. Macmillan Publishing Company. New York. p. 13+.

Appendix

1

EcoGrid Ground Reinforcement

ecogrid

ECORASTER®

The Ultimate Ground Reinforcement

Improve water drainage and stop erosion. The environmental alternative to paving.

EcoGrid/EcoRaster is a tough, durable, interlocking grid system designed to provide turf protection, ground reinforcement, and erosion control. Manufactured from 100% recycled plastics and providing superior water drainage, this revolutionary system provides an economical and environmentally sustainable alternative to asphalt or paving.

Unbeatable benefits & features:

- Quick and easy to install
- Extremely lightweight
- High strength
- Patented safety interlocking system
- Surface reinforcement with natural drainage
- Extremely versatile due to additional elements (curve wedges, slope angles, car park markings)
- Minimal maintenance
- Non-slip and crack proof
- Weatherproof and environmentally friendly
- Withstands frost and UV radiation
- Cut to size
- Does not expand

Applications Include:

- Parking Lots
- Fire Lanes & Access Roads
- Pathways & Driveways
- Golf Courses
- Green Spaces & Landscapes
- Playgrounds & Public Spaces
- Equestrian & Livestock Facilities
- Green Roofing

terrafirm enterprises

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Vancouver BC V6G 1P4
Website: www.terrafirmenterprises.com

ecogrid

ECORASTER®

Technical Specifications

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Grid Area	33 x 33 cm (13 x 13 inches)				
Wall Thickness	5 mm (0.2 inches)	4 mm (0.16 inches)	3.6 mm (0.14 inches)	5 mm (0.2 inches)	2.5 mm (0.10 inches)
Wall Depth	30 mm (1.2 inches)		40 mm (2.0 inches)	50 mm (2.0 inches)	
Sheet Size	12 pieces = 1.33 m² (14.32 ft²)				
Weight per m² (ft²)	6.93 kg (1.42 lbs)	5.175 kg (1.06 lbs)	5.22 kg (1.07 lbs)	10.917 kg (2.24 lbs)	6.84 kg (1.4 lbs)
Carrying load per m²	up to 150 tonnes	up to 120 tonnes	up to 120 tonnes	up to 350 tonnes	up to 120 tonnes
Material	100 % recycling material PE (polyethylene)				
Dimensional stability	Temperature Range -50°C to 90°C				
Dimensional change	0.5% (with standard temperature +20°C to 80°C)				
Humidity Absorption	0.01%				
Chemical Resistance	Resistant to acids, alkalis, alcohol, oil and petrol (de-icing salt, ammonia, acid rain etc.)				
Estimated Install Time	100 m² (1076 ft²) per person per hour (dependent on ground preparation)				
Suggested Use	Technical Applications (machine rooms), Green Roofs	Low to moderate vehicle traffic, Paths, Paddocks, Green Spaces, Stables	Moderate vehicle traffic, Outdoor Arenas, Paths, Helipads, Green Spaces	Moderate to heavy vehicle traffic, Military, Parking Lots, Roadways	Reduced Load Capacity Slope Stabilization, Golf Course Paths

The patented safety interlocking system sets a new standard.

Ensures a strong connection between individual tiles and prevents lifting and/or sinking.

Installation Info

Filling

EcoGrid/EcoRaster can be filled with wide range of materials including grass seed and gravel.

EcoGrid/EcoRaster

Choose the appropriate EcoGrid/EcoRaster type for the application. Not sure which one to use? Ask us ... we're always happy to help.

Blinding/Leveling Layer

To level any possible unevenness in the base layer and provide a rooting zone if planting grass.

Base Layer

To ensure optimum drainage, install a layer of crushed rock. Depth and size of rock is dependent on application.