



**Lake Galena Northern Shoreline Stabilization Project  
PALMS Lake BMP Mini Grant Final Report**

May 31, 2012

Prepared By: Bucks County Conservation District  
1456 Ferry Road, Suite 704  
Doylestown, PA 18901

## **Acknowledgements**

The Lake Galena Northern Shoreline Stabilization Project would not have been possible without the financial support of the Pennsylvania Lake Management Society (PALMS) who awarded a Lake Best Management Practice Mini Grant to the Bucks County Conservation District (BCCD) with a portion of their 2009 Pennsylvania Department of Environmental Protection Growing Greener Grant. The District sincerely appreciates the support of both PALMS and PA DEP in making this project possible.

The District would like to thank the County Commissioners and the District Board of Directors for their support of the Lake Galena Northern Shoreline Stabilization Project. The District would also like to thank the Bucks County Department of Parks and Recreation (BCPR), and specifically Mr. Bill Mitchell, Executive Director of the Parks and Recreation Department, for their cooperation and assistance throughout the duration of this restoration project.

## **Project Summary**

This project restored 75 linear ft of severe shoreline erosion, installed a 125 linear ft bioswale and established a 20,000 ft<sup>2</sup> buffer along the northern shoreline of Lake Galena. The shoreline was regraded and bioengineered in January 2012, and BCCD and volunteers planted native vegetation to establish an upland buffer.

## **Introduction**

### **Background**

Lake Galena is a 365-acre multi-use reservoir and the focal point of Peace Valley Park, maintained by the Bucks County Department of Parks and Recreation. The lake was created in 1974 by constructing an earthen dam across the North Branch of the Neshaminy Creek to provide flood control, water supply and recreational opportunities. A drinking water withdrawal for the Forest Park water facility, jointly owned by North Penn and North Wales Water Authorities, is located approximately two miles downstream of the Lake Galena outfall on the North Branch of Neshaminy Creek. The facility supplies water to approximately 150,000 people in Bucks and Montgomery Counties. The lake and its surrounding parkland are open year-round and provide park visitors with a wide variety of recreational opportunities including fishing, boating and picnicking. Walking, jogging and cycling are also popular activities along the park's improved pathway that encircles the entire lake.

In 2002, a TMDL assessment was completed for the entire Neshaminy Creek watershed, which includes the North Branch of Neshaminy Creek and Lake Galena. The TMDL noted a significant increase in residential development and rapid population growth in the Lake Galena watershed in the 10 years following the 1995 Phase I study that initially placed the lake on the Commonwealth's 303(d) List of Impaired Waters. This increased development was identified as a significant source of sediment to the lake during this time period, while concurrently; several farms (formerly considered the predominant cause of nonpoint source contaminants) became inactive or were converted to other land uses. Per the 2002 assessment, Pennsylvania's 303(d) listing was updated to attribute nutrient and suspended solids to a combination of on-site wastewater, agriculture, urban runoff/storm sewers, and other sources. To address the changes in the watershed and additional sources of impairment identified in the TMDL, Bucks County Conservation District completed the Lake Galena & North Branch Neshaminy Creek Watershed Implementation Plan in 2010, to update the Phase I Study. The Watershed Implementation Plan (WIP), while focused on restoration priorities in the upper portion of the watershed, also noted that the restoration of shoreline buffers on the lake will be instrumental in achieving the nutrient and sediment loading reductions established in the Neshaminy Creek TMDL. In addition to working within the upper portions of the watershed, BCCD and BCPR have since been seeking funding opportunities to mitigate nutrient and sediment loading along the lake shoreline to improve water quality both in the lake and downstream.

### **Project Objectives**

The objective of the Lake Galena northern shoreline stabilization project was to improve water quality by reducing sediment and nutrient loading to Lake Galena via installation of a vegetated cribwall along a severely eroded section of the northern lake shoreline. Prior to the completion of this project, the shoreline was severely eroded, with an approximately 4.5 ft vertical bank along 75 ft of shoreline, which posed a water quality concern as a direct source of sediment loading to the lake. In addition, due to the close proximity of the heavily used multi-use park path, the area presented a significant public safety hazard. BCCD proposed stabilizing the shoreline via construction of a cribwall or similar structure. In addition, BCCD proposed installing vegetation immediately upslope of the path to slow runoff from the park's turfgrass and parking area which was exacerbating the shoreline erosion.

### **Project Tasks**

#### **Contractor Selection**

After the grant contract and landowner agreements were fully executed, BCCD compiled a request for proposals (RFP) packet to solicit design-build teams from contractors and consulting

firms who had previously completed similar projects. Four firms received the RFP packet which included project information and photos, notification of a pre-proposal site visit with BCCD, and final proposal submission deadline. Packets were distributed via mail in mid-April 2011 and set a pre-proposal site meeting for May 6, 2011. Of the four firms BCCD contacted, three sent representatives to attend the pre-proposal meeting; however, only two proposals were submitted by the deadline for review by BCCD and BCPR. After careful review, BCCD and BCPR selected a joint proposal prepared by Envirosapes, Inc. and CLEER Environments, LLC for design-build services as the most responsible proposal to complete the project objectives on time and within budget. BCCD notified Envirosapes, Inc. that their proposal was accepted on June 9, 2011. BCCD finalized the contract with Envirosapes, Inc. and received required bonding and insurance documentation on June 23, 2011.

### **Design & Permitting**

After securing additional site specific information from BCCD and BCPR, CLEER Environments prepared a draft design in mid-September 2011. Although BCCD's initial approach was to install vegetated cribwalls to stabilize the eroded bank, the CLEER Environments design included large boulder riprap along the toe of slope to protect against wind and wave action as well as winter ice. The remainder of the work utilized bioengineering methods: regrading the banks to a 3:1 slope, installing a row of live fascines immediately behind the toe protection and at the top of the bank to provide extra reinforcement and installing brush mattresses and live stakes to promote vegetation establishment and protect the newly reshaped bank. In addition, the design proposed creating a swale, planted with native herbaceous vegetation, between the multi-use path and the restored bank to protect from the erosive forces from water draining off of the adjacent hill and undermining this section of repaired shoreline.

After the draft plans were prepared, Envirosapes and CLEER Environments met with BCCD and BCPR at the District office on September 28, 2011 with two objectives: 1) to hold a pre-application meeting for the Erosion and Sediment Control Plan (E&S Plan) and 2) for BCPR and BCCD to advise the consultants on plan changes necessary to limit the strain of heavy equipment traffic on park resources and to reduce safety concerns for park patrons. Requested changes were incorporated into the construction plans, Pennsylvania Natural Diversity Index (PNDI) reviews were completed and State Programmatic General Permit 3 (GP-3) and E&S Plan were submitted shortly after the meeting. An adequate letter was issued shortly thereafter for the E&S Plan; however, PA DEP required additional construction notes to restrict construction activity to the winter to avoid conflict with the redbelly turtle nesting season before the GP-3 could be authorized. After another round of plan modifications to address the PA DEP requests, the final plan set was approved by the end of November 2011. Final approved plans are

included in Appendix A. New Britain Township was also contacted and advised the District that because the project was occurring within the park, no municipal plan reviews were required.

### **Shoreline Construction**

In BCCD's initial proposal to PALMS, construction was targeted for late summer/early fall 2011; however, several delays were encountered, notably the project selection and contracting period with PALMS, as well as BCCD's subcontractor selection and permitting. In addition, significant rainfall precluded heavy equipment traffic along the Lake Galena shoreline throughout fall 2011. Once permits were approved, BCCD, BCPR, Enviroscapes, and CLEER Environments held a pre-construction meeting at Peace Valley Park on December 6, 2011. At that time, construction was targeted to start on the northern shoreline the week of December 13, 2011. Unfortunately, additional rainfall just prior to the construction start date left the site too wet to begin work as scheduled, and the project was postponed to avoid extending the work over the holidays.

Construction on the northern shoreline was initiated on January 9, 2012 and the total duration was five and one half days. First, large boulders and geotextile fabric were positioned along the edge of the shoreline. Then, the bank was cut back to a 3:1 slope and covered with coir matting. The crew then dug two trenches to hold the live fascines (consisting of *Cornus sericea* and *Cornus amomum*): one on the downslope side of the proposed swale and the other immediately upslope of the boulder toe protection. The 125 ft by 2.5 ft swale was then constructed above the recently regraded bank. The crew then worked by hand covering the remaining area of the bank with brush mattresses, which were secured in place with dead stout stakes and coir rope. In addition, live stakes (*Cornus amomum*, *Cornus sericea*, and *Viburnum dentatum*) were installed into the brush mattress on 18 inch centers. All of the dormant plant material was then covered with a few inches of topsoil, to settle into any small voids and to promote good soil contact with the vegetation and the entire areas was covered with straw mulch. Other disturbed areas were seeded with a native seed mix (Ernst Mix 132-1) and covered with straw mulch. Photos of the construction process are included in Appendix B.

### **Adjacent Upland Vegetated Buffer**

BCCD requested additional funding through the TreeVitalize Watersheds grant program, a program whose goal is to reforesting riparian areas throughout southeastern Pennsylvania, to complete the adjacent upland planting. BCCD received \$1,057.50 in funding through the program from Aqua Pennsylvania for this small reforestation effort.

Following the completion of shoreline construction, BCCD drafted press releases and newsletter articles to inform the public about the recently completed work. In addition, BCCD presented on the status of several projects in the watershed, including an update on the lake shoreline

projects, at the North Branch Watershed Association's (NBWA) Annual Membership meeting. In addition to engaging the public and helping them understand the benefits of bioengineering for the shoreline, BCCD also aimed to recruit volunteers to assist with installing the adjacent upland vegetated buffer. BCCD drew on the existing strong partnership as sources of potential volunteers, working specifically with Delaware Valley College and NBWA.

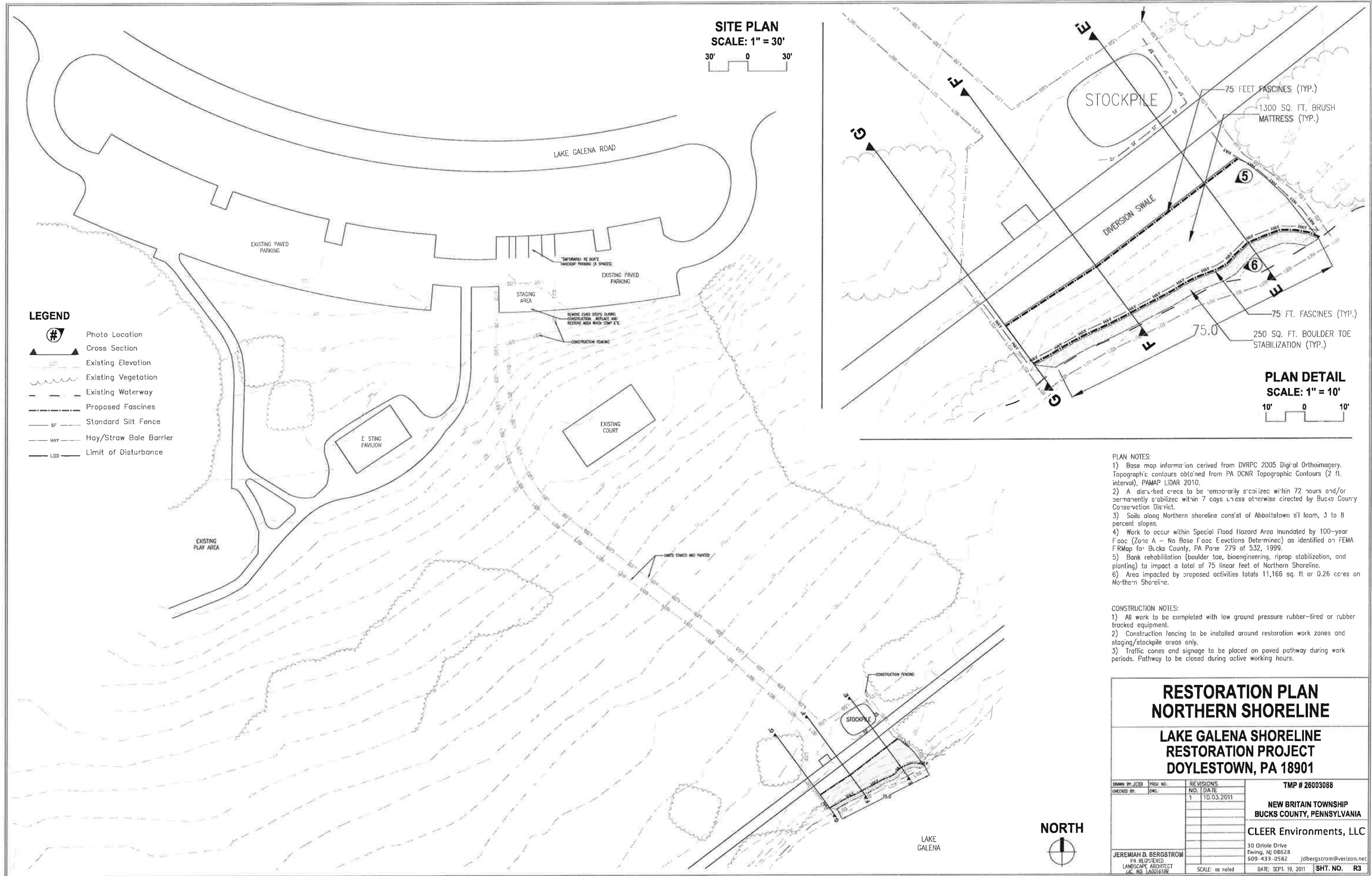
On April 21, 2012, a total of twenty-five volunteers contributed a combined 63.25 hours installing a vegetated buffer in the adjacent upland portion of the park which drains to the restored section of shoreline and was formerly maintained as turf grass. After a brief training session volunteers installed the native woody shrubs and trees as well as tree shelters, to provide necessary protection against deer browse and buck rub. Native trees and shrubs installed included eastern redbud (*Cercis canadensis*), sweet birch (*Betula lenta*), common hackberry (*Celtis occidentalis*), tulip poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*), red oak (*Quercus rubra*), white oak (*Quercus alba*), black chokeberry (*Aronia melanocarpa*), red-osier dogwood (*Cornus sericea*) and sweet pepperbush (*Clethra alnifolia*). In addition, the volunteers installed the herbaceous material in the swale next to the multi-use path, as those plant materials were not available and could not be installed in January. Herbaceous material included New England aster (*Aster novae-angliae*), turtlehead (*Chelone glabra*) and Joe pye weed (*Eupatorium purpureum*). Following the volunteer effort, BCCD returned to the site over the next few days to adjust any plants that were incorrectly planted and adjusted the tree shelters as needed.

## Conclusions & Recommendations

The Lake Galena Northern Shoreline Stabilization Project was successful in restoring 75 linear ft of severe shoreline erosion and establishing a 20,000 ft<sup>2</sup> buffer in the adjacent upland area. The new BMPs will slow overland flow, increase infiltration and reduce sediment loading from the shoreline into Lake Galena, and ultimately, Neshaminy Creek. Although BCCD encountered some delays from our initial timetable, the project was still completed within PALMS deadline and under budget. Through varied outreach efforts, BCCD also educated the residents of Bucks County on the benefits of bioengineering and riparian buffers.

At this time, work is still needed to reduce sediment and nutrient loading to Lake Galena and the North Branch Neshaminy Creek to address the goals of the Neshaminy Creek TMDL. Therefore, it is recommended that BCCD, BCPR, and their partners seek additional funding to address additional shoreline problem areas on Lake Galena and other sources of nonpoint source pollution as identified in the North Branch Neshaminy Creek Watershed Implementation Plan.

## **Appendix A. Project Construction Plans**



**SITE PLAN**  
**SCALE: 1" = 30'**  
 30' 0 30'

**PLAN DETAIL**  
**SCALE: 1" = 10'**  
 10' 0 10'

- LEGEND**
- Photo Location
  - Cross Section
  - Existing Elevation
  - Existing Vegetation
  - Existing Waterway
  - Proposed Fascines
  - Standard Silt Fence
  - Hay/Straw Bale Barrier
  - Limit of Disturbance

- PLAN NOTES:**
- 1) Base map information derived from DVRPC 2005 Digital Orthomagey. Topographic contours obtained from PA DCNR Topographic Contours (2 ft interval), PAMAP LIDAR 2010.
  - 2) A disturbed area to be temporarily scarified within 72 hours and/or permanently stabilized within 7 days unless otherwise directed by Bucks County Conservation District.
  - 3) Soils along Northern shoreline consist of Abbotstown silt loam, 3 to 8 percent slopes.
  - 4) Work to occur within Special Flood Hazard Area inundated by 100-year Flood (Zone A - No Base Flood Elevations Determined) as identified on FEMA FIRM for Bucks County, PA Page 279 of 532, 1999.
  - 5) Bank rehabilitation (boulder toe, bioengineering, riprap stabilization, and planting) to impact a total of 75 linear feet of Northern Shoreline.
  - 6) Area impacted by proposed activities totals 11,166 sq. ft or 0.26 acres on Northern Shoreline.

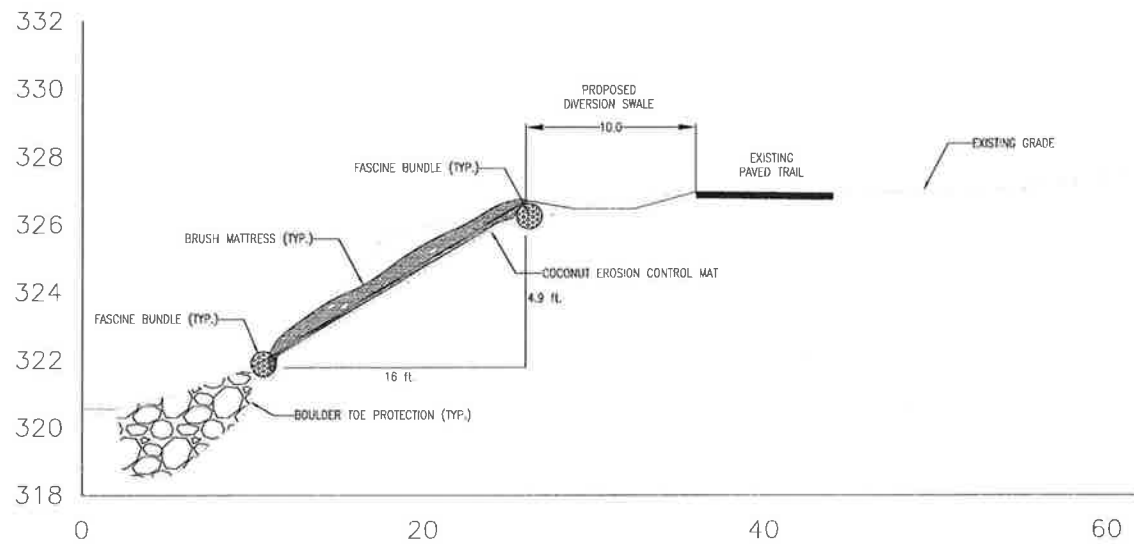
- CONSTRUCTION NOTES:**
- 1) All work to be completed with low ground pressure rubber-tired or rubber tracked equipment.
  - 2) Construction fencing to be installed around restoration work zones and staging/stockpile areas only.
  - 3) Traffic cones and signage to be placed on paved pathway during work periods. Pathway to be closed during active working hours.

**RESTORATION PLAN**  
**NORTHERN SHORELINE**  
**LAKE GALENA SHORELINE**  
**RESTORATION PROJECT**  
**DOYLESTOWN, PA 18901**

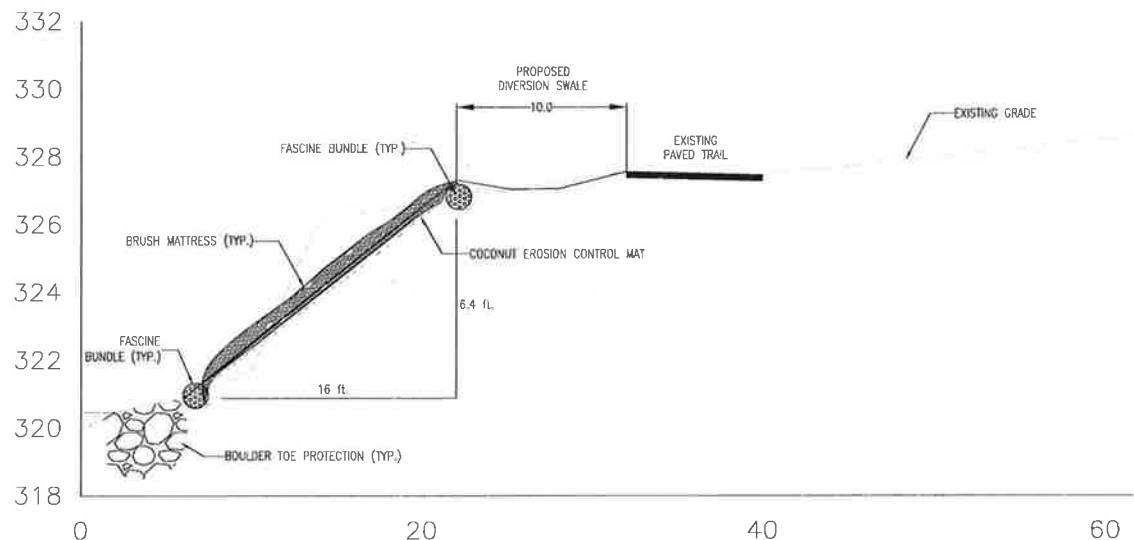
DESIGNED BY: JDB	PROJECT NO: 26003088	REVISIONS	TMP # 26003088
CHECKED BY: JDB	DATE: 10.03.2011	NO. DATE	NEW BRITAIN TOWNSHIP BUCKS COUNTY, PENNSYLVANIA
			CLEER Environments, LLC
			30 Oriole Drive Ewing, NJ 08628 609-433-0582 jdbergstrom@verizon.net
JEREMIAH D. BERGSTROM PA REGISTERED LANDSCAPE ARCHITECT LIC. NO. LA002610R	SCALE: as noted	DATE: SEPT. 19, 2011	SHT. NO. R3



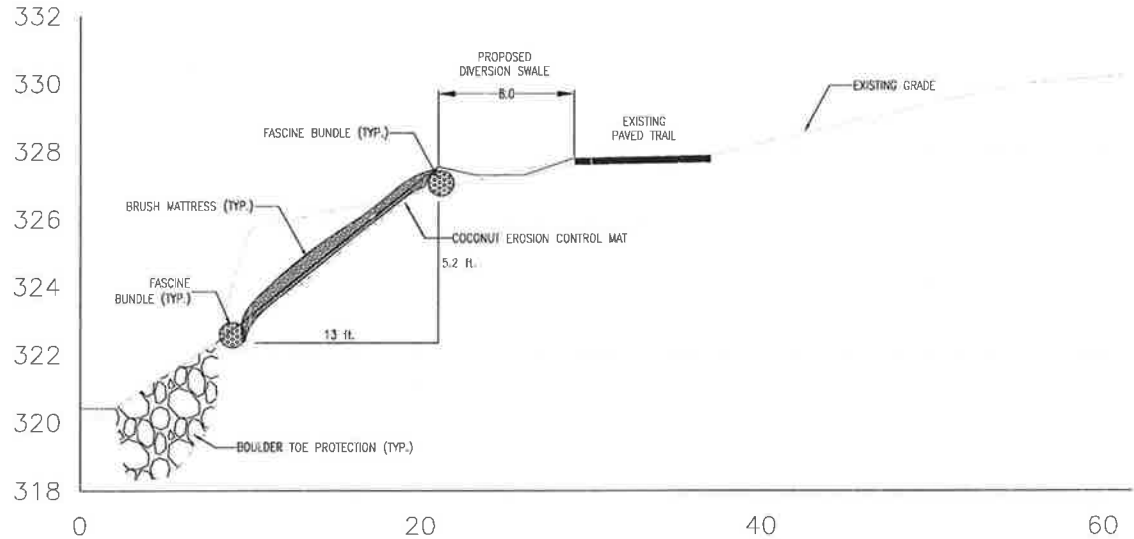




CROSS SECTION E-E'

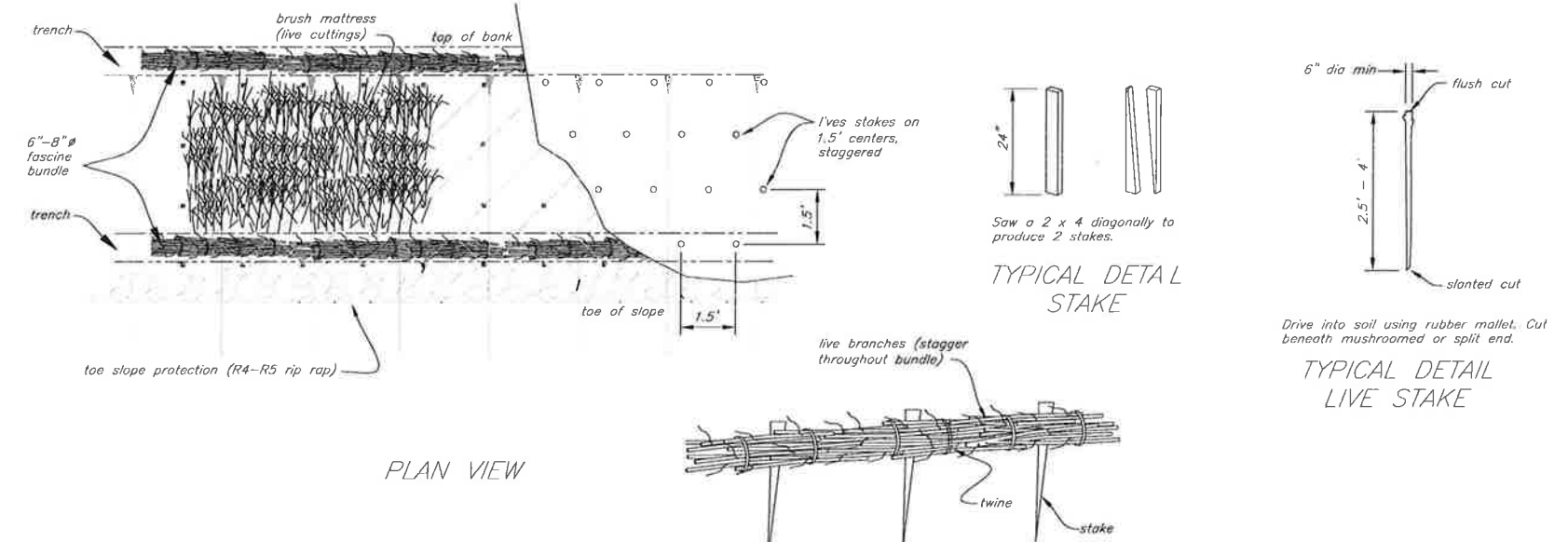


CROSS SECTION F-F'



CROSS SECTION G-G'

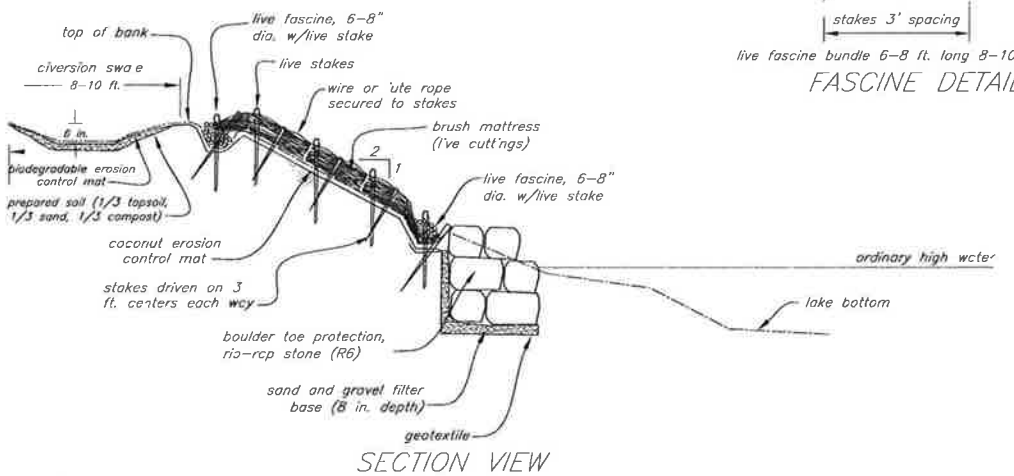
**A** NORTH SHORELINE - CROSS SECTIONS  
HOR. 1"=5' VERT. 1"=2.5'  
**R4**



PLAN VIEW

TYPICAL DETAIL STAKE

TYPICAL DETAIL LIVE STAKE



SECTION VIEW

**B** SHORELINE DETAIL - BRUSH MATTRESS  
**R4** N.T.S.

QTY.	SCIENTIFIC NAME	COMMON NAME	SIZE
<b>HERBACEOUS EDGE (Install Plantings 2 ft. o.c.)</b>			
25	Aster novae-angliae	New England Aster	2", herbaceous plug
25	Chelone glabra	Turtlehead	2", herbaceous plug
25	Eupatorium perfoliatum	Joe-Pye Weed	2", herbaceous plug
25	Labellia siphilitica	Blue lobelia	2", herbaceous plug
<b>FASCINES, BRUSH MATTRESS, &amp; LIVE STAKES (common cuttings installed Nov.-Mar.)</b>			
	Cornus amomum	Silky Dogwood	dormant cuttings
	Salix sericea	Silky Willow	dormant cuttings
	Viburnum dentatum	Arrowwood Viburnum	dormant cuttings
<b>SHRUBS (Install plantings 6 ft. o.c.)</b>			
5	Aronia melanocarpa	Black Chokeberry	12-18" Height, #1-#2 Container
5	Cornus sericea	Red Twig Dogwood	12-18" Height, #1-#2 Container
5	Clethra alnifolia	Sweet Pepperbush	12-18" Height, #1-#2 Container
10	Rosa virginiana	Prairie Rose	12-18" Height, #1-#2 Container

**NATIVE SEED MIX WITH ANNUAL RYEGRASS (ERNMX-132-1)**  
 25% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)  
 23% Deertongue, 'Tioga' (Panicum clandestinum (Dichanthelium c.), 'Tioga')  
 20% Annual Ryegrass (Lolium multiflorum (L. perenne var. italicum))  
 10% Creeping Red Fescue (Festuca rubra)  
 10% Switchgrass, 'Shawnee' (Panicum virgatum, 'Shawnee')  
 5% Fox Sedge, PA Ecotype (Carex vulpinoidec, PA Ecotype)  
 5% Partridge Pea, PA Ecotype (Chamaecrista fasciculata (Cecilia f.), PA Ecotype)  
 2% Autumn Bentgrass, PA Ecotype (Agrostis perennans, PA Ecotype)

**C** NORTHERN SHORELINE PLANT LIST  
**R4** N.T.S.

**TOPSOILING, SEEDING AND MULCHING NOTES**

- ANY UNDISTURBED AREA ON WHICH ACTIVITY HAS CEASED AND WHICH WILL REMAIN EXPOSED FOR MORE THAN 20 DAYS MUST BE SEEDED AND MULCHED IMMEDIATELY. DURING NON-GERMINATING PERIODS, MULCH MUST BE APPLIED AT THE REQUIRED RATES. DISTURBED AREAS WHICH ARE NOT AT FINISHED GRADE AND WHICH WILL BE REDISTURBED WITHIN 1 YEAR SHALL BE SEEDED AND MULCHED WITH A QUICK GROWING TEMPORARY SEEDING MIXTURE AND MULCH. DISTURBED AREAS WHICH ARE EITHER AT FINISHED GRADE OR WILL NOT BE REDISTURBED WITHIN 1 YEAR MUST BE SEEDED AND MULCHED WITH A PERMANENT SEED MIXTURE AND MULCH.
- DIVERSIONS, CHANNELS, SEDIMENTATION BASINS, SEDIMENT TRAPS, AND STOCKPILES MUST BE SEEDED AND MULCHED IMMEDIATELY.
- GRADED AREAS SHALL BE TEMPORARILY SEEDED AND MULCHED IMMEDIATELY FOLLOWING EARTH MOVING PROCEDURES. TEMPORARY SEED SHALL BE ANNUAL RYE GRASS APPLIED AT A RATE OF 3 LBS. PER 1000 SQ. FT.
- AFTER SEEDING, HAY OR STRAW MULCH MUST BE APPLIED AT A RATE OF AT LEAST 3.0 TONS PER ACRE. MULCH SHALL BE ANCHORED BY EITHER CRIMPING WITH A COULTER IMPLEMENT, OR BY STAPLING BIODEGRADABLE NETTING TO THE SURFACE.
- SITE PREPARATION TO UPLAND AREAS: APPLY 1 TON OF AGRICULTURAL-GRADE LIMESTONE PER ACRE PLUS 10-20-10 FERTILIZER AT THE RATE OF 500 LB. PER ACRE, WORK IN WHERE POSSIBLE. SEEDING OF DISTURBED UPLAND AREAS (BEYOND LIMITS OF RIPARIAN ENHANCEMENT AREA) TO BE DONE USING MIX OF FINE FESCUE AT 35 LBS/ACRE (PURE LIVE SEED) PLUS PERENNIAL RYEGRASS AT 15 LBS/ACRE (PURE LIVE SEED).
- TOPSOIL SHALL BE A CLEAN FRABLE LOAM WITH SUFFICIENT ORGANIC CONTENT (2.75%) TO PROMOTE PLANT VIGOR. AMENDMENTS SHALL BE ADDED AS NEEDED TO IMPROVE DEFICIENT SOILS. TOPSOIL SHALL BE RETURNED AT A LOOSE DEPTH OF FIVE INCHES TO ALLOW FOR SETTLEMENT.
- ESTABLISH PERMANENT SEEDING AS SOON AS POSSIBLE AFTER FINAL GRADING IS COMPLETE. UNLESS OTHERWISE INDICATED, PERMANENT SEEDING SHALL BE SEED MIXTURE SPECIFIED IN TABLE.
- SEE TABLES FOR SEED SPECIES MIXTURE AND APPLICATION RATES.
- SEED MIXES AND LIVE STAKES ARE AVAILABLE AT ERNST CONSERVATION SEEDS IN MEADVILLE, PA. WEBSITE: WWW.ERNSTSEED.COM OR PHONE: 1-800-873-3321.
- NATIVE TREES, SHRUBS AND HERBACEOUS PLUGS ARE AVAILABLE AT PINELANDS NURSERY AND SUPPLY, COLUMBUS, NJ. WEBSITE: WWW.PINELANDSNURSERY.COM OR PHONE: 1-800-867-2729.
- NATIVE TREES ARE AVAILABLE AT AMERICAN NATIVE PLANTS, PERRY HALL, MD. WEBSITE: WWW.AMERICANNATIVEPLANTS.NET OR PHONE: 410-529-0552.

**GENERAL NOTES**

- Coconut erosion control blanket shall be 'geacore 700' or approved equal, able to withstand 10 fps water velocities and 4.45 psf shear stress. Fabric embedment 3.0 ft.
- Fascines will contain dormant live woody material 1/2 to 2 inches in diameter forming bundles that are 8" minimum diameter and not less than 6 feet in length (L). The plant material should be dormant, stripped of leaves and irrigated.
- Fascine bundles shall be tied with untreated twine every 1 to 2 feet.
- Place and firmly compact soil over and around fascine leaving approximately 30% of upper branches exposed.
- Stakes used to secure the live fascines should be 2 feet long, untreated, 2x4 lumber, cut diagonally. Stakes shall be driven in at required contour interval.
- Structural measures such as rip-rap or drainage to be installed prior to fascines. Slope shall be shaped and graded to slope indicated on drawing. Riprap stone shall be P6 (7"-24") placed at 30" depth. Riprap shall be installed on 8" gravel filter base with filter fabric placed between soil and stone.

**GENERAL LANDSCAPING NOTES**

- All plant materials shall conform to the American Association of Nurserymen's American Standard for Nursery Stock (latest edition).
- Inspection of Planting Beds - The Landscape Architect shall inspect all planting areas before any topsoiling or planting is begun to insure that adequate drainage exists. If any areas to be landscaped show evidence of poor drainage, the Landscape Architect shall notify the Owner immediately for corrective action.
- The Landscape Architect shall approve all plant material and staked plant locations prior to installation.
- All trees, shrubs, and groundcover shall be placed in continuous mulched beds 3" in depth. Mulch shall be shredded hardwood bark.
- All trees, shrubs, and groundcovers shall be as specified and shall be installed in accordance with the details and comments noted on the Drawings.
- Topsoil for planting is available at the site. Topsoil shall be relocated by the Landscape Contractor for planting pits according to the details.
- Prepared topsoil for backfilling around tree balls shall be a mixture of volume of the following materials in quantities specified: 1/3 compost, 2/3 topsoil.

**DETAILS AND SCHEDULES  
NORTHERN SHORELINE**

**LAKE GALENA SHORELINE  
RESTORATION PROJECT  
DOYLESTOWN, PA 18901**

DESIGNED BY: JDB	SCALE: N.T.S.	DATE: SEPT. 19, 2011	SHEET NO. R4
CHECKED BY: JDB			
PROJECT NO.:			
NO.:			
DATE:			
1		10.03.2011	
TMP # 26003088			
NEW BRITAIN TOWNSHIP BUCKS COUNTY, PENNSYLVANIA			
CLEER Environments, LLC			
30 Oriole Drive Ewing, NJ 08628 609-433-0582 jdb@cleer.com			
JEREMIAH D. BERGSTROM PA REGISTERED LANDSCAPE ARCHITECT LIC. NO. 100000000			

## **Appendix B. Project Photos**



**Photo 1. Project area immediately before start of construction**



**Photo 2. Placement of geotextile and boulder toe protection.**



**Photo 3. Enviroscapes, Inc. crew regrading bank**



**Photo 4. Installation of coir matting and live fascines.**



**Photo 5. The crew secures the brush mattresses and installs live stakes**



**Photo 6. Newly restored bank after final stabilization**