



September 11, 2013

TN DEPT OF ENVIRONMENT
AND CONSERVATION

SEP 30 2013

DIV OF WATER RESOURCES
RECEIVED

Mr. Mark Carnes
U.S. Army Corps of Engineers
Regulatory Branch
3701 Bell Road
Nashville, TN 37214-2660

Subject: Second Year Wetland and Stream Monitoring Report, Bledsoe County Correctional Complex, Pikeville, TN

Dear Mr. Carnes:

Enclosed for your review is a hard copy and electronic copy of the second annual wetland and stream monitoring report for the Bledsoe County Correctional Complex (BCCX) located in Pikeville, Tennessee (DOA File/Permit Number 200502425, TDEC §401 Water Quality Certification Number NRS 09.009). This document has been compiled to fulfill the requirements of the above cited permits. The report generally follows the format provided in the Corps' October 2008 Regulatory Guidance Letter 08-03, but, owing to the complexity of the project; we have exceeded the recommended page limits in a number of sections.

Please be aware that future monitoring of the BCCX mitigation site will be the responsibility of EnSafe, Inc. since that firm now holds the Tennessee Department of General Service-Environmental Services Contract. It is my understanding that the BCCX project will be managed out of their Nashville office. Should you need to contact EnSafe, their number in Nashville is 615-255-9300.

In the meantime, if you have any questions about this current submission please call me at 865-689-1395.

Sincerely,

Helen S. Hennon, P.E.
Vice President of Environmental Services

c: M. Lee, TDEC-Nashville - CD/Copy
J. Innes, TDEC-Chattanooga - CD/Copy
G. Steck, TDFA - Copy
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File BC.142.013.09



Quantum Environmental &
Engineering Services, LLC

**Second Year Wetland and Stream Mitigation
Monitoring Report
For
Bledsoe County Correctional Complex**

**Second Year Wetland and Stream Mitigation Monitoring Report
Bledsoe County Correctional Complex
Pikeville, Bledsoe County, Tennessee
(DOA File/Permit 200502425)
(TDEC §401 Water Quality Certification 09.009)**

September 23, 2013

Submitted To:

**U.S. Army Corps of Engineers, Nashville District
&
Tennessee Department of Environment and Conservation**

Prepared By:

**Water Resources, LLC
4208 Eiffel Lane
Knoxville, TN 37938-2943**

Under Subcontract to:

**Quantum Environmental & Engineering Services, LLC
126 Dante Road
Knoxville, TN 37918**

Mitigation Site Name: Bledsoe County Correctional Complex (BCCX), Pikeville, TN

DOA Permit Number: 200502425

TDEC Permit Number: NRS 09.009

Party Responsible for Monitoring: Paul C. Durr/Water Resources, LLC under subcontract to Quantum Environmental and Engineering Services, LLC

Monitoring Dates: June 20-24, 2013. Please note that this is the second monitoring effort. Monitoring did not occur during the 2012 calendar year. Initial (year 1) site monitoring was conducted on September 26-30, 2011.

Project Description: In February 2010 the Tennessee Department of Environment and Conservation (TDEC) granted the Tennessee Department of Finance and Administration a §401 Water Quality Certification to allow the filling of 1.96 acres of jurisdictional wetlands and alteration of 560 linear ft of streams and 715 ft of wet weather conveyances. Impacts to these aquatic resources were determined to be necessary to facilitate the development of a major prison expansion project. In June 2010 U.S. Army Corps of Engineers-Nashville District (USACE) granted a §404 permit for the same project. After minor modification, the final TDEC permit was reissued in December of that year.

Mitigation for the wetland and stream impacts was initiated in early October 2010. Wetland mitigation occurred entirely onsite and involved the creation (establishment) of 4.18 acres of palustrine wetlands (4:1 ratio) and the enhancement of 6.12 acres of existing degraded wetlands (5:1 ratio). The entire wetland mitigation site was then planted with water-tolerant tree species which are indigenous to the local watershed. Planting was done at an approximate rate of 435 stems/acre. Stream mitigation was also undertaken onsite. It involved Level 1 enhancement of 2,660 ft of intermittent headwater tributaries to Bee Creek. Riparian zones of four tributary segments were planted with native shrubs. Twenty-five foot-wide upland buffers lying on either side of the streams and wetlands were also planted. Additional details can be found in the document titled: *Aquatic Resources Mitigation Plan, Bledsoe County Correctional Complex Bee Creek Mile 11.4, Right Bank, Pikeville, Tennessee* drafted by Water Resources, LLC.

Particularly intense rainfall events in November 2010 and March 2011 caused flooding and attending erosion within the wetland creation area. In April 2011 efforts were made to lessen further damage by controlling the rate of inflow to the site by re-contouring the splitter pond, reinforcing and reconstructing spreader berms, and placing coir log erosion barriers in areas shown to be especially prone to erosion. While these actions were partly successful, they did not control the erosion of soil to the extent desired. Soil loss, the presence of a shallow fragipan on northern portions of the creation area, and a protracted drought during the summer of 2011, were thought to be largely responsible for low survivorship of planted trees and shrubs. Failure to meet desired performance standards were documented in the first year monitoring report.

In response to the reported failure, the USACE and TDEC requested that the permittee submit a revised work plan. The revised plan was submitted on October 1, 2012. The plan recommended a variety of corrective actions most important of which were the installation of more than 2,500 ft of coir log erosion dams and the replanting of 5,650 wetland-adapted trees and shrubs. (See below for dates of corrective/maintenance actions).

Project Location: The mitigation site is centered approximately 1,100 ft north-northeast of the intersection of SR 285 and SR 301 in rural Bledsoe County, Tennessee (N35.7508, W85.2359). (See Section 4 for a general location map).

Dates When the Mitigation Project Began and Was Completed: Initial mitigation construction began in September, 2010 and was completed in October, 2011. Initial wetland and riparian buffer vegetation planting was completed on December 11, 2010.

Performance Standards:

Created (Established) Wetlands - The site's performance standards for hydrology and herbaceous-layer vegetation have been met, but have not yet been met for soils. They have been conditionally met for planted woody vegetation in terms of average density, but more than one individual species exceeds 20% of the stocking density.

Enhanced Wetlands -Performance standards have been met for planted woody vegetation, herbaceous-layer vegetation, hydrology, and soils.

Streams – Performance standards have been conditionally met with respect to planted woody vegetation. Because it was often not possible to distinguish planted individuals from naturally occurring ones, it was especially difficult to assess performance in terms of stem density or survival. Furthermore, since many of the species develop a multi-stemmed growth form as they mature and merge together into a colony which may support hundreds of distinct stems, actual individual population densities were not possible to discern (See further discussion in Section 2, pages 4 & 5). Irrespective of these technical issues, it is clear that the mitigated stream reaches are highly stable and that the combination of planted and invasive colonial species are beginning to provide significant cover for these formerly degraded waterways.

Other - Signs designating the area as a protected wetland have not yet been installed. The declaration of restriction for protecting the site in perpetuity has been prepared but has not yet been executed. In the mean time, the danger of disturbance is very low since the site lies on state-owned property.

Dates of Corrective Actions or Maintenance: Fall 2011: Divert excess water coming from the splitter pond to the western half of the mitigation site. Also repair breaches in rock spreader berm. October 22, 2012: Complete mowing of enhancement area to prepare for planting. January 8-9, 2013: Install coir log erosion dams in creation area and replant both enhancement and creation areas.

Recommendations for Additional Corrective Actions: We recommend that no corrective actions be taken on the wetland or stream mitigation sites at this time (see Section 5 for additional discussion). In the near future, once it is clear that all performance standards have been attained and are sustainable, the state should execute the declaration of restrictions for the mitigation site. The installation of signs, identifying protected aquatic resources, should also occur during this same time frame. These steps, especially deed restrictions, will be critical for the perpetual protection of these sensitive aquatic resources.

****Wetlands****

Performance Standards	Year 1 Monitoring & Monitoring Conditions	Performance Standards Met?	Data References (see Sections 3 & 4)
<p>Onsite mitigation will involve the creation of 4.18 acres of wetlands and the enhancement of 6.12 acres of wetlands in the headwaters of Bee Creek. Bare root seedlings will be planted at the rate of 435 stems/ac. No one species shall comprise more than 20% of the total.</p> <p>The entire wetland mitigation is to be protected in perpetuity through deed restriction and signage erected to indicate the protected status of the property.</p> <p>The specific performance standards associated with the mitigation action are summarized below.</p>	<p>Vegetation demographics were determined from 0.05-acre fixed area sample plots (for woody species) and 1-yd² plots (for herbs). Sampling methods are described in the site's final Aquatic Resource Mitigation Plan.</p> <p>Because native hydric soils were not known within the creation area prior to mitigative actions, soil profiles will be taken annually at each of the vegetation monitoring plots in order to document the transition to the hydric condition.</p> <p>The principal means used to judge the successful restoration of positive wetland hydrology will be the establishment of wetland vegetation. Other primary and secondary hydrologic indicators will be noted during monitoring.</p>		
<p>Creation Area: Success will be measured as a function of wetland plant dominance and the presence of positive wetland hydrology. At the end of five years, approximately 70% of herbaceous plant cover must be comprised of wetland-adapted species and survival rates for planted woody species must be at least 75% (326 stems/ac). Areal coverage of exotic invasive species must be less than 5%. While the development of hydric soils is a desired goal, it is understood that hydric soil formation may take greater than 5 years to occur.</p>	<p>Vegetation: Total herbaceous plant cover is 65.81%. This is a significant increase since the last monitoring effort when cover was determined to be just 43.75%. 58.73% of the cover is comprised of wetland-adapted species. Although good progress is being made, the relatively slow establishment of herb cover in the creation area appears to be most closely tied to low soil fertility (low organic matter content). Above average precipitation has caused shallow but prolonged ponding in parts of the creation site and this has slowed plant establishment as well. Encouraging is that fact that 63 discernible taxa were identified. This indicates that species diversity is higher in the creation area than in the enhancement area (see next page).</p> <p>Current density of planted woody species is 405 stems/ac. During the last monitoring in 2011, density stood at only 65 stems/ac. This stark increase is directly related to replanting efforts, and to a lesser extent, natural regeneration. 83% of the species are considered wetland-adapted. Two species exceed 20% of the stocking density (buttonbush 35.80% and sweetgum 22.22%).</p>	<p>Herbaceous Vegetation:</p> <p>Woody Vegetation:</p> <p>Conditionally Yes</p>	<p>Section 3: Table 1 Table 3</p> <p>Section 3: Photos 1-8, 31-38</p> <p>Section 4: Maps 1 & 2</p>

Performance Standards	Year 1 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
	Soils:	Soils in the creation area have been mapped by the Natural Resources Conservation Service as containing Lily loam and Morehead-Bonair complex. The latter contains inclusions of hydric Bonair soils in low-lying areas and depressions. Indeed, residual hydric soils with depleted matrices were confirmed in 75% of the samples.	Soils:	No	Section 3: Table 6
	Hydrology:	A variety of primary and secondary hydrologic indicators are present in the creation area. These include scattered surface inundation, soil saturation within the upper 12 in., drift lines, surface soil cracks, and drainage patterns.	Hydrology:	Yes	
<p>Enhancement Area: The same performance standards described above for the creation area shall also apply for the enhancement area. However, because the enhancement area is already a jurisdictional wetland and contains hydric soils, it will not be monitored for that parameter.</p>	Vegetation:	Herbaceous plant cover is 90.75% . This is distributed among 47 distinct taxa. 89.36% of the cover is comprised of wetland-adapted species. If just the most-dominant species are considered (based on sampling frequency and cover), then 100% are wetland adapted. Although not captured in sample plots, site investigators located two small populations of sedge species that are listed as "Endangered" by TDEC's Division of Natural Areas. These include brown bog sedge and southern long sedge. Brown bog sedge is considered an "S1" species meaning that there are five or fewer known occurrences in the state. The southern long sedge is an "S2" species indicating less than 20 known occurrences. Combined density of planted and naturally-invasive woody species is 600 stems/ac. This represents a nearly 300% increase since last monitoring when stem counts were 153.33 stems/ac. Nearly half of the density, however, is the result of the encroachment of swamp rose, a native wetland shrub. When considered in the absence of swamp rose, planted vegetation occurs at the rate 333.67 stems/ac. Of the 13 woody taxa identified, 10, or 76.92% are wetland-	Herbaceous Vegetation: Woody Vegetation:	Yes	Section 3: Table 2 Table 4 Section 3: Photos 9-20, 39-42 Section 4: Maps 1 & 2

Performance Standards	Year 1 Monitoring & Monitoring Conditions		Performance Standards Met?	Data References (see Sections 3 & 4)
	<p>Soils:</p> <p>Hydrology:</p>	<p>adapted. Most tree seedlings appear to have been planted except perhaps red maple and sweetgum which have seed sources in the vicinity.</p> <p>Morehead-Bonair complex. This series is recognized as containing inclusions of hydric Bonair soils in low areas and depressions. Hydric soils were confirmed by the USACE during a jurisdictional determination visit to the site in November 2008.</p> <p>Several hydrologic indicators were observed during the monitoring survey. These include soil saturation, shallow inundation, sediment deposits, drift lines, drainage patterns, crayfish burrows, and geomorphic position.</p>	<p>Soils: Yes</p> <p>Hydrology: Yes</p>	
<p>Upland Buffer Area: 25 ft-wide buffers, external to riparian buffers (see next page) are to be planted with upland oaks in order to provide extra protection to the restored streams. Initial planting is to be at 435 stems/ac but no performance standards for seedling survival are stipulated.</p>	<p>Vegetation:</p> <p>Soils:</p> <p>Hydrology:</p>	<p>Total stocking density within upland buffer zones is 292.50 stems/ac. Density of planted oak species alone is 205 stems/ac. With the exception of a few silky dogwoods that were inadvertently placed in upland areas, the remaining species are all naturally invasive.</p>	<p>Vegetation: Not Applicable</p> <p>Soils: Not Applicable</p> <p>Hydrology: Not Applicable</p>	<p>Section 3: Table 5</p> <p>Section 3: Photo 21</p> <p>Section 4: Maps 1 & 2</p>
<p>Gooseberry Transplant Area: Multi-stemmed granite gooseberry shrubs are to be removed from the prison expansion footprint and transplanted to an upland area on the stream and wetland mitigation property. This effort will be undertaken in an attempt to preserve this exceptionally rare shrub. No performance standards for shrub survival are stipulated. (This action was completed in March 2009.)</p>	<p>Vegetation:</p> <p>Soils:</p> <p>Hydrology:</p>	<p>Because of its highly colonial nature, it was not possible to make an accurate count of individual stems. Instead, an estimate of the plants' areal coverage was obtained by measuring the major and minor axes of all shrubs that could be located within the transplant area. This year 24 shrubs covering a total of 2,725 ft² were tallied. Such results are particularly encouraging since this indicates a nearly 37% increase in coverage since 2011.</p>	<p>Vegetation: Not Applicable</p> <p>Soils: Not Applicable</p> <p>Hydrology: Not Applicable</p>	<p>Section 3: Photo 22</p>

****Streams****

Performance Standards	Year 1 Monitoring & Monitoring Conditions	Performance Standards Met?	Data References (see Sections 3 & 4)
<p>Stream mitigation will involve the enhancement of 2,660 ft of headwater tributaries to Bee Creek. Four individual segments are to be treated. Riparian shrub vegetation shall be planted 25-ft along both banks. Plantings shall be at least three rows deep along each channel staggered on 10-ft centers. Bare root or containerized stock is permissible. No one species can comprise more than 20% of the total.</p> <p>Stream mitigation areas are to be protected in perpetuity through deed restriction and signage erected to indicate the protected status of the properties.</p> <p>The performance standards for the mitigation actions are described briefly below.</p>	<p>Pre-construction stream habitat conditions were documented in 2008 using EPA/TDEC habitat assessment methodologies. Post-construction conditions were determined by employing Level I protocols set forth by TDEC in the <i>Stream Mitigation Guidelines for the State of Tennessee</i> (TDEC 2004).</p> <p>Riparian zone vegetation surveys made use of staggered 200 x 25 ft fixed area sample plots spaced 200 ft apart on each of the stream segments in order to determine survivorship of planted material and establishment of naturally invading woody species.</p>		
<p>Enhancement of Unnamed Tributary to Bee Creek Stream Segment 1 (1,793 ft): Success will be determined by the establishment of a wateryway that is stable, has a discernible bed and bank, and has typical in-stream habitat. The banks must be stable and non-eroding with adequate vegetative cover to prevent eroding sediments from entering the stream. This includes a 75% survival rate for planted trees and shrubs for five consecutive years (45 stems/100 ft of stream channel).</p>	<p>Channel Conditions: Even though the site has experienced a number of rather extreme weather events since mitigation was initiated, the stability of the waterway has remained intact. The channel contains well-defined bed and bank, and while some limited portions of the reach have eroded down to bedrock, most areas are silt and mud-dominated. Relatively flat terrain has given rise to a stream that contains only scattered riffle-run sequences. Stream depths at the time of the survey ranged from about 6 in. in upstream areas to over 4 ft in several pools near the middle and downstream end.</p> <p>Vegetation: Combined density of planted and naturally-occurring woody species within riparian zones is estimated at 3,212.2 stems per 100 ft of stream bank length. Planted densities alone contain an estimated 1,731.0 stems per 100 ft. Since most of the shrub species are multi-stemmed and highly colonial, individual stem counts could not be made. Instead, they had to be inferred from sample averages. Several 10 ft-long clumps of silky dogwoods for example, were found to contain an average of 35 stems each. By measuring the linear extent of all silky</p>	<p>Channel: Yes</p> <p>Vegetation: Conditionally Yes</p>	<p>Section 3: Table 7 Section 3: Photos 23-27 Section 4: Maps 1 & 2</p>

Performance Standards	Year 1 Monitoring & Monitoring Conditions	Performance Standards Met?	Data References (see Sections 3 & 4)
	<p>dogwoods within a given sample plot, the total number of stems within the plot could be extrapolated. (See bottom of Table 7 for further information). Additionally, given that it was often not possible to discern planted individuals from native ones, it was also not possible to determine survivorship levels. Irrespective of these sampling issues, it is clear that the intent of the performance standards is being met. Woody stem populations along these formerly degraded reaches are thriving, and in doing so, are providing bank stabilization, cooling shade for the creek, and dietetic diversity for local wildlife.</p> <p>Aquatic Biota:</p> <p>No formal surveys for aquatic organisms were undertaken. Nonetheless, a variety of organisms were observed in or around the channel. These include fish (undetermined species), green frogs, snapping turtles, and caddisfly larvae.</p>	<p>Aquatic Biota:</p> <p>Not Applicable</p>	
<p><u>Enhancement of Unnamed Tributary to Bee Creek Stream Segment 2 (224 ft):</u> The same performance standards described above for Stream Segment 1 shall apply to this unnamed tributary.</p>	<p>Channel Conditions:</p> <p>Stream Segment 2 was not impacted by wetland creation efforts so its channel and riparian zones are stable. Bed and banks are well-defined. Riffles and runs are very widely scattered because of low gradients and flow regimes.</p> <p>Vegetation:</p> <p>Combined density of planted and naturally-occurring woody species within riparian zones is estimated at 4,368 stems per 100 ft of stream bank length. Planted densities alone average 2,488 stems per 100 ft. Again, since riparian shrub counts involved highly colonial, intergrading populations, it was difficult to assess survivorship. Because stream banks are stable and well vegetated with a variety of species (12), we suggest that performance standards are conditionally being met.</p> <p>Aquatic Biota:</p> <p>Fish and green frogs were observed in a pool located just to the east of SR 301.</p>	<p>Channel:</p> <p>Yes</p> <p>Vegetation:</p> <p>Conditionally Yes</p> <p>Aquatic Biota:</p> <p>Not Applicable</p>	<p>Section 3: Table 7 Section 3: Photo 28 Section 4: Maps 1 & 2</p>

Performance Standards	Year 1 Monitoring & Monitoring Conditions		Performance Standards Met?	Data References (see Sections 3 & 4)
<p>Enhancement of Unnamed Tributary to Bee Creek Stream Segment 3 (388 ft): The same performance standards described above for Stream Segment 1 shall apply to this unnamed tributary.</p>	<p>Channel Conditions: Vegetation: Aquatic Biota:</p>	<p>See comments for Stream Segment 2 above. Density of planted woody species is 64 stems per 100 ft of stream bank length. Remaining invasive species occur at an estimated density of 492 stems per 100 ft. Fish and green frogs were observed in a pool located just to the east of SR 301 and in another just upstream of the confluence with Stream Segment 1.</p>	<p>Channel: Vegetation: Aquatic Biota:</p> <p>Yes Conditionally Yes Not Applicable</p>	<p>Section 3: Table 7 Section 3: Photo 29 Section 4: Maps 1 & 2</p>
<p>Enhancement of Unnamed Tributary to Bee Creek Segment 4 (255 ft): The same performance standards described above for Segment 1 shall apply to this unnamed tributary.</p>	<p>Channel Conditions: Vegetation: Aquatic Biota:</p>	<p>See comments for Segment 2 above. Flow regimes and riffle/run complexes could not be judged since water was restricted to scattered pools in the downstream section of the reach. Combined density of planted and naturally-occurring woody species within riparian zones is an estimated 8,414 stems per 100 ft of stream bank length. Planted densities alone average 1,404 stems per 100 ft. Notable here was the extremely strong presence of indigenous swamp rose which, in the absence of disturbance, has almost completely colonized the entire length of Segment 4 along both banks. Presumably because of restricted flow, no aquatic organisms were detected during our non-formal survey. The pond immediately above Segment 4, however, supports numerous fish, frogs, aquatic insects, snapping turtles, and water-dependent birds.</p>	<p>Channel: Vegetation: Aquatic Biota:</p> <p>Yes Conditionally Yes Not Applicable</p>	<p>Section 3: Table 7 Section 3: Photo 30 Section 4: Maps 1 & 2</p>
<p>Note: Multiflora rose, an Asiatic shrub is becoming invasive along all four of the stream enhancement areas. It is particularly evident at the lower (south) end of Stream Segment 1. It is also beginning to spread within adjoining upland areas. While not yet a problem, it has the potential to rapidly overtake open, sunny areas such as those found on the mitigation site. Consideration should be given to controlling this species before it has a chance to spread further. The Tennessee Exotic Pest Plant Council offers suggestions for mechanical, biological, and chemical control for multiflora rose on its website (http://www.tneppc.org/invasive_plants/67).</p>				

Section 3

**Summary Data
Tables & Photographs**

Table 1. Substrate/Herbaceous Species Frequency and Average Cover Percent, BCCX Wetland Creation Area, Pikeville, TN, June 2013.

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
Bare Soil	---	93.75	29.44	-12.19
Open Water	---	6.25	1.81	1.81
Twig/Leaf Litter ¹	---	75.00	2.94	-11.69
three-seeded mercury (<i>Acalypha rhomboidea</i>)	Facu	0.00	0.00	-2.38
red maple (<i>Acer rubrum</i>)	Fac	12.50	0.50	0.50
slender-leaf false foxglove (<i>Agalinis tenuifolia</i>)	Fac	6.25	0.31	0.31
common ragweed (<i>Ambrosia artemisiifolia</i>)	Facu	68.75	2.00	-11.75
broomsedge (<i>Andropogon virginicus</i>)	Facu	75.00	4.50	3.75
sweet vernal grass (<i>Anthoxanthum odoratum</i>)	Facu	6.25	0.06	0.06
bearded beggar ticks (<i>Bidens aristosa</i>)	Facw	25.00	0.50	0.50
devil's beggar ticks (<i>Bidens frondosa</i>)	Facw	18.75	0.25	0.25
hirsute sedge (<i>Carex complanata</i>)	Facu	37.50	0.94	0.94
fox sedge (<i>Carex vulpinoidea</i>)	Obl	12.50	0.31	0.31
horseweed (<i>Conyza canadensis</i>)	Facu	0.00	0.00	-0.25
straw-color flatsedge (<i>Cyperus strigosus</i>)	Facw	0.00	0.00	-0.25
orchard grass (<i>Dactylis glomerata</i>)	Facu	6.25	0.13	0.13
Queen Anne's-lace (<i>Daucus carota</i>)	Upl	6.25	0.19	0.19

¹ Bolded entries indicate dominant species or substrates (i.e. cover contributions exceed 3% and frequency values are greater than 10%).

Table 1 (continued)

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
tapered rosette grass (<i>Dichanthelium acuminatum</i>)	Fac	93.75	10.50	9.75
deer-tongue grass (<i>Dichanthelium clandestinum</i>)	Fac	25.00	0.50	0.50
cypress witch grass (<i>Dichanthelium dichotomum</i>)	Fac	6.25	1.25	1.25
open-flower rosette grass (<i>Dichanthelium laxiflorum</i>)	Facu	25.00	1.13	1.13
broom rosette grass (<i>Dichanthelium scoparium</i>)	Facw	43.75	2.88	2.88
panic grass (<i>Dichanthelium sp.</i>)	--	0.00	0.00	-0.13
smooth crab grass (<i>Digitaria ischaemum</i>)	Upl	0.00	0.00	-0.63
Virginia buttonweed (<i>Diodia virginiana</i>)	Facw	68.75	1.13	-1.12
barnyard grass (<i>Echinochloa crus-galli</i>)	Fac	0.00	0.00	-0.38
slender spikerush (<i>Eleocharis tenuis</i>)	Facw	25.00	3.13	3.13
prairie fleabane (<i>Erigeron strigosus</i>)	Facu	6.25	0.06	0.06
creeping eryngo (<i>Eryngium prostratum</i>)	Obl	6.25	0.38	-0.07
boneset (<i>Eupatorium perfoliatum</i>)	Facw	6.25	0.50	-0.38
late-flowering thoroughwort (<i>Eupatorium serotinum</i>)	Fac	31.25	1.13	1.13
slender fimbry (<i>Fimbristylis autumnalis</i>)	Facw	0.00	0.00	-0.25
velvet grass (<i>Holcus lanatus</i>)	Fac	6.25	0.19	0.19
orangegrass (<i>Hypericum gentianoides</i>)	Upl	0.00	0.00	-0.25
dwarf St. John's-wort (<i>Hypericum mutilum</i>)	Facw	25.00	0.38	-0.07
taper-tip rush (<i>Juncus acuminatus</i>)	Obl	12.50	0.25	0.00

Table 1 (continued)

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
greater poverty rush ² (<i>Juncus antheratus</i>)	TBD	62.50	3.375	2.75
soft rush (<i>Juncus effusus</i>)	Facw	6.25	0.13	0.13
grass-leaved rush (<i>Juncus marginatus</i>)	Facw	18.75	0.88	0.00
Japanese clover (<i>Kummerowia striata</i>)	Facu	93.75	14.19	13.31
sweetgum (<i>Liquidambar styraciflua</i>)	Fac	0.00	0.00	-0.25
Indian-tobacco (<i>Lobelia inflata</i>)	Facu	0.00	0.00	-0.25
annual rye grass (<i>Lolium multiflorum</i>)	Upl	6.25	0.13	0.13
marsh seedbox (<i>Ludwigia palustris</i>)	Obl	6.25	0.19	0.19
common evening primrose (<i>Oenothera biennis</i>)	Facu	0.00	0.00	-0.38
slender yellow woodsorrel (<i>Oxalis dillenii</i>)	Facu	0.00	0.00	-0.75
beaked panic grass (<i>Panicum anceps</i>)	Fac	12.50	0.38	0.38
smooth paspalum (<i>Paspalum laeve</i>)	Fac	0.00	0.00	-7.13
English plantain (<i>Plantago lanceolata</i>)	Upl	37.50	1.06	0.43
Pennsylvania smartweed (<i>Persicaria pennsylvanica</i>)	Facw	0.00	0.00	-0.50
dotted smartweed (<i>Persicaria punctata</i>)	Obl	0.00	0.00	-1.13
common cinquefoil (<i>Potentilla simplex</i>)	Facu	62.50	3.00	2.87
heal-all (<i>Prunella vulgaris</i>)	Facu	18.75	0.50	0.50
clustered mountain-mint (<i>Pycnanthemum muticum</i>)	Facw	12.50	0.13	0.13
yellow foxtail grass (<i>Setaria pumila</i>)	Fac	0.00	0.00	-3.00

² In 1999, *Juncus antheratus* was elevated from a variety of *J. tenuis* to the species level. The species has only recently appeared on the 2013 version of the National Wetland Plant List and its indicator status is still under review. Various regional floras such as the Flora of North American Editorial Committee (2000) and Weakley (2011) indicate its preference for wet habitats. We concur and consider it a wetland indicator.

Table 1 (continued)

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
tall fescue (<i>Schedonorus arundinaceus</i>)	Facu	37.50	0.75	0.75
dark-green bulrush (<i>Scirpus atrovirens</i>)	Obl	6.25	0.75	0.75
horse-nettle (<i>Solanum carolinense</i>)	Facu	12.50	1.13	-0.88
late goldenrod (<i>Solidago gigantea</i>)	Facw	18.75	0.88	0.88
wrinkle-leaf goldenrod (<i>Solidago rugosa</i>)	Fac	6.25	0.13	0.13
blue-eyed-grass (<i>Sisyrinchium angustifolium</i>)	Facw	75.00	2.31	2.31
panicked American-aster (<i>Symphyotrichum lanceolatum</i>)	Facw	12.50	0.31	0.31
downy American-aster (<i>Symphyotrichum pilosum</i>)	Fac	25.00	0.63	0.63
yellow clover (<i>Trifolium campestre</i>)	Upl	25.00	0.63	0.63
alsike clover (<i>Trifolium hybridum</i>)	Facu	6.25	0.13	0.13
red clover (<i>Trifolium pratense</i>)	Facu	18.75	0.44	0.44
white clover (<i>Trifolium repens</i>)	Facu	50.00	1.00	-2.75
			$\Sigma =$ 100.00	

Table 2. Substrate/Herbaceous Species Frequency and Average Cover Percent, BCCX Wetland Enhancement Area, Pikeville, TN, June 2013.

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
Bare Soil	---	8.33	0.42	0.42
Open Water	---	16.67	2.92	2.92
Twig/Leaf Litter³	---	83.33	10.33	5.91
red maple (<i>Acer rubrum</i>)	Fac	8.33	0.08	0.08
purple false foxglove (<i>Agalinis purpurea</i>)	Facw	0.00	0.00	-0.25
small-flowered agrimony (<i>Agrimonia parviflora</i>)	Facw	0.00	0.00	-0.42
redtop (<i>Agrostis gigantea</i>)	Facw	8.33	0.17	-1.50
hog-peanut (<i>Amphicarpaea bracteata</i>)	Fac	8.33	0.83	0.42
sweet vernal grass (<i>Anthoxanthum odoratum</i>)	Facu	25.00	1.42	1.42
groundnut (<i>Apios americana</i>)	Facw	8.33	0.42	0.42
devil's beggar-ticks (<i>Bidens frondosa</i>)	Facw	0.00	0.00	-0.58
yellow-fruited sedge (<i>Carex annectens</i>)	Facw	8.33	0.25	0.25
prickly bog sedge (<i>Carex atlantica</i>)	Facw	16.67	1.00	1.00
hirsute sedge (<i>Carex complanata</i>)	Facu	8.33	0.17	0.17
sallow sedge (<i>Carex lurida</i>)	Obl	25.00	0.92	0.75
pointed broom sedge (<i>Carex scoparia</i>)	Facw	25.00	4.17	4.17
blunt broom sedge (<i>Carex tribuloides</i>)	Facw	25.00	0.67	0.67
fox sedge (<i>Carex vulpinoidea</i>)	Obl	58.33	1.42	0.17
mistflower (<i>Conoclinium coelestinum</i>)	Fac	8.33	0.08	-0.42
tapered rosette grass (<i>Dichanthelium acuminatum</i>)	Fac	0.00	0.00	-0.42

³ Bolded entries indicate dominant species or substrates (i.e. cover contributions exceed 3% and frequency values are greater than 10%).

Table 2 Continued

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
deer tongue grass (<i>Dichanthelium clandestinum</i>)	Fac	8.33	1.67	1.09
cypress witch grass (<i>Dichanthelium dichotomum</i>)	Fac	8.33	0.42	-0.25
broom panic grass (<i>Dichanthelium scoparium</i>)	Facw	16.67	1.08	-1.84
Virginia buttonweed (<i>Diodia virginiana</i>)	Facw	16.67	0.50	-0.58
slender spikerush (<i>Eleocharis tenuis</i>)	Facw	25.00	0.67	0.67
marsh bedstraw (<i>Galium tinctorium</i>)	Obl	8.33	0.42	0.42
velvet grass (<i>Holcus lanatus</i>)	Fac	83.33	8.75	8.75
taper-tip rush (<i>Juncus acuminatus</i>)	Obl	8.33	0.17	0.00
greater poverty rush ⁴ (<i>Juncus antheletus</i>)	TBD	50.00	1.67	0.25
soft rush (<i>Juncus effusus</i>)	Facw	66.67	11.50	5.92
grass-leaved rush (<i>Juncus marginatus</i>)	Facw	8.33	0.08	0.08
rice cut grass (<i>Leersia oryzoides</i>)	Obl	16.67	1.00	0.17
marsh seedbox (<i>Ludwigia palustris</i>)	Obl	8.33	0.83	0.83
beaked panic grass (<i>Panicum anceps</i>)	Fac	0.00	0.00	-1.67
redtop panic grass (<i>Panicum rigidulum</i>)	Facw	83.33	23.08	-28.25
swamp smartweed (<i>Persicaria hydropiperoides</i>)	Obl	8.33	0.83	0.83
dotted smartweed (<i>Persicaria punctata</i>)	Obl	0.00	0.00	-0.42
green fringed orchid (<i>Platanthera lacera</i>)	Facw	8.33	0.08	0.08
rough blue grass (<i>Poa trivialis</i>)	Facw	41.67	1.50	1.50
common cinquefoil (<i>Potentilla simplex</i>)	Facu	50.00	1.50	1.25

⁴ In 1999, *Juncus antheletus* was elevated from a variety of *J. tenuis* to the species level. The species has only recently appeared on the 2013 version of the National Wetland Plant List and its indicator status is still under review. Various regional floras such as the Flora of North American Editorial Committee (2000) and Weakley (2011) indicate its preference for wet habitats. We concur and consider it a wetland indicator.

Table 2 Continued

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
clustered mountain-mint (<i>Pycnanthemum muticum</i>)	Facw	8.33	2.08	0.00
Maryland meadowbeauty (<i>Rhexia mariana</i>)	Obl	41.67	2.58	-4.92
brownish beaksedge (<i>Rhynchospora capitellata</i>)	Obl	0.00	0.00	-0.17
swamp rose (<i>Rosa palustris</i>)	Obl	8.33	1.25	0.83
tall fescue (<i>Schedonorus arundinaceus</i>)	Facu	58.33	1.42	1.42
wool-grass (<i>Scirpus cyperinus</i>)	Facw	16.67	4.17	-4.75
dark-green bulrush (<i>Scirpus atrovirens</i>)	Obl	25.00	4.75	2.25
helmet flower (<i>Scutellaria integrifolia</i>)	Facw	8.33	0.75	-0.17
blue-eyed-grass (<i>Sisyrinchium angustifolium</i>)	Facw	16.67	0.33	0.33
horse-nettle (<i>Solanum carolinense</i>)	Facu	0.00	0.00	-0.25
sphagnum moss (<i>Sphagnum sp.</i>)	---	8.33	0.58	0.58
tall ironweed (<i>Vernonia gigantea</i>)	Fac	25.00	1.58	0.91
			Σ= 100.00	

Table 3. Average Density and Frequency of Planted (P) and Naturally-Invading Woody Seedlings, BCCX Wetland Creation Area, Pikeville, TN, June 2013.

Species	Wetland Indicator Status	Average Frequency (%)	Average Density (stems/acre)
red maple (P in part) (<i>Acer rubrum</i>)	Fac	100.0	80.0
common serviceberry (P) (<i>Amelanchier arborea</i>)	Fac	50.0	20.0
false indigobush (P) (<i>Amorpha fruticosa</i>)	Facw	75.0	65.0
buttonbush (P) (<i>Cephalanthus occidentalis</i>)	Obl	100.0	145.0
sweetgum (P in part) (<i>Liquidambar styraciflua</i>)	Fac	100.0	90.0
yellow-poplar (P) ⁵ (<i>Liriodendron tulipifera</i>)	Facu	25.0	5.0
			$\Sigma = 405.0$

Table 4. Average Density and Frequency of Planted (P) and Naturally-Invading Woody Seedlings, BCCX Wetland Enhancement Area, Pikeville, TN, June 2013.

Species	Wetland Indicator Status	Average Frequency (%)	Average Density (stems/acre)
red maple (P in part) (<i>Acer rubrum</i>)	Fac	83.33	90.00
common serviceberry (P) (<i>Amelanchier arborea</i>)	Fac	16.67	6.67
false indigobush (P) (<i>Amorpha fruticosa</i>)	Facw	50.00	20.00
buttonbush (P) (<i>Cephalanthus occidentalis</i>)	Obl	66.67	80.00
winterberry holly (P) (<i>Ilex verticillata</i>)	Facw	33.33	6.67
sweetgum (P in part) (<i>Liquidambar styraciflua</i>)	Fac	66.67	73.33
yellow-poplar (P) (<i>Liriodendron tulipifera</i>)	Facu	16.67	3.33
blackgum (P) (<i>Nyssa sylvatica</i>)	Fac	50.00	26.67
Shumard oak (P) (<i>Quercus shumardii</i>)	Fac	16.67	6.67
multiflora rose (<i>Rosa multiflora</i>)	Facu	16.67	3.33
swamp rose (<i>Rosa palustris</i>)	Obl	16.67	263.33
elderberry (P) (<i>Sambucus canadensis</i>)	Fac	16.67	16.67
hardhack (P) (<i>Spiraea tomentosa</i>)	Facw	16.67	3.33
			$\Sigma = 600.00$

⁵ Yellow-poplar was included on the site planting list since, at the time the mitigation area was designed, it was considered a wetland indicator (Fac). Because the USACE-Nashville District has adopted the National Wetland Plant List, it no longer classifies as a wetland species.

Table 5. Average Density and Frequency of Planted (P) and Naturally-Invading Woody Seedlings, BCCX Upland Buffer Areas, Pikeville, TN, June 2013.

Species	Wetland Indicator Status	Average Frequency (%)	Average Density (stems/acre) ⁶
red maple (<i>Acer rubrum</i>)	Fac	50.0	15.0
silky dogwood (P) ⁷ (<i>Cornus amomum</i>)	Facw	50.0	7.5
Virginia pine (<i>Pinus virginiana</i>)	Upl	25.0	7.5
black cherry (<i>Prunus serotina</i>)	Facu	50.0	12.5
white oak (P) (<i>Quercus alba</i>)	Facu	75.0	57.5
red oak (P) (<i>Quercus rubra</i>)	Facu	100.0	147.5
multiflora rose (<i>Rosa multiflora</i>)	Facu	100.0	45.0
			$\Sigma =$ 292.5

⁶ Performance standards for tree survival in upland buffer areas were not stipulated by the oversight agencies.

⁷ On rare occasions wetland species were inadvertently planted in buffer areas.

Table 6. Soil Profile Descriptions from the BCCX Wetland Creation Area, Pikeville, TN, June 2013.

Sample Location	Depth (Inches)	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle Abundance/ Contrast	Texture, Structure, etc.
Plot C-1	0-2	10YR 5/3			sandy loam
	2-6	10YR 4/2	10YR 5/3	10%	sandy loam, compacted layer at 6 in.
	6-14	2.5Y 6/4	10YR 4/3 10YR 5/8	5% 15%	sandy loam
	14-20	10YR 6/3	10YR 5/8	25%	sandy loam
Plot C-2	0-6	10YR 4/3	2.5Y 5/6	5%	sandy loam, compacted layer at 6 in.
	6-20	2.5Y 6/3	10YR 4/3 10YR 5/8	5% 25%	sandy loam
Plot C-3	0-1	10YR 5/4			sandy loam
	1-10	10YR 4/2	2.5Y 5/6	25%	sandy clay loam
	10-20	2.5Y 6/2	10YR 5/6	35%	sandy loam, compacted layer at 10 in.
Plot C-4	0-6	2.5Y 4/2			silt loam
	6-16	2.5Y 5/6	10 YR 5/8	25%	sandy loam, compacted layer at 6 in.
	16-20	10YR 6/1	10YR 5/8	40%	sandy loam

Table 7. Occurrence of Planted (P) and Naturally-Invading Woody Species Within Riparian Zones. BCCX Stream Enhancement Area, Pikeville, TN, June 2013

Unnamed Tributary to Bee Creek, Stream Segment 1

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
red maple (P in part) (<i>Acer rubrum</i>)	Fac	3.0
stream alder (P in part) (<i>Alnus serrulata</i>)	Obl	3.6
common serviceberry (P) (<i>Aronia melanocarpa</i>)	Fac	1.2
false indigobush (P) (<i>Amorpha fruticosa</i>)	Facw	3.6
buttonush (P in part) (<i>Cephalanthus occidentalis</i>)	Obl	6.0
silky dogwood (P in part) (<i>Cornus amomum</i>)	Facw	1,135.8
hawthorn (<i>Crataegus sp.</i>)	?	0.2
glossy false buckthorn (<i>Frangula alnus</i>)	Fac	0.6
winterberry holly (P) (<i>Ilex verticillata</i>)	Facw	0.2
sweetgum (P) (<i>Liquidambar styraciflua</i>)	Fac	0.8
black cherry (<i>Prunus serotina</i>)	Facu	0.2
white oak (P) (<i>Quercus alba</i>)	Facu	0.8
Shumard oak (P) (<i>Quercus shumardii</i>)	Fac	2.2
multiflora rose (<i>Rosa multiflora</i>)	Upl	617.4
swamp rose (<i>Rosa palustris</i>)	Obl	638.6
black willow (<i>Salix nigra</i>)	Obl	20.0
elderberry (P in part) (<i>Sambucus canadensis</i>)	Fac	573.8
hardhack (<i>Spiraea tomentosa</i>)	Facw	207.8
		Σ (P)= 1,731.0 ⁸
		Grand Σ = 3,212.2

⁸ Totals presented here are for those species which were included on the planting manifest. Because a number of these same species occur naturally along the mitigated stream segments, it was frequently impossible to discern planted individuals from native ones. Also because of the highly clumped nature of some of the shrubs, it was not possible to count individual stems. Instead, an average number of stems per 10 ft of shrub length was determined and these numbers were extrapolated to determine average number of stems per 100 ft of stream (i.e. *Sambucus* = 50 stems/10 ft of plant length, *Rosa palustris*, *Rosa multiflora*, and *Cornus*= 35 stems/10 ft of plant length, and *Spiraea*= 25 stems/10 ft of plant length.)

Table 7 (continued)

Unnamed Tributary to Bee Creek, Stream Segment 2

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
red maple (P in part) (<i>Acer rubrum</i>)	Fac	2.0
false indigobush (P) (<i>Amorpha fruticosa</i>)	Facw	6.0
black chokeberry (P) (<i>Aronia melanocarpa</i>)	Fac	2.0
buttonush (P in part) (<i>Cephalanthus occidentalis</i>)	Obl	10.0
silky dogwood (P in part) (<i>Cornus amomum</i>)	Facw	2,460.0
glossy false buckthorn (<i>Frangula alnus</i>)	Fac	2.0
Shumard oak (P) (<i>Quercus shumardii</i>)	Fac	6.0
winged sumac (<i>Rhus copallinum</i>)	Facu	34.0
multiflora rose (<i>Rosa multiflora</i>)	Facu	216.0
swamp rose (<i>Rosa palustris</i>)	Obl	1,610.0
black willow (<i>Salix nigra</i>)	Obl	18.0
elderberry (P in part) (<i>Sambucus canadensis</i>)	Fac	2.0
		Σ (P)= 2,488.0
		Grand Σ = 4,368.0

Table 7 (continued)

Unnamed Tributary to Bee Creek, Stream Segment 3

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
false indigobush (P) (<i>Amorpha fruticosa</i>)	Facw	10.0
buttonush (P in part) (<i>Cephalanthus occidentalis</i>)	Obl	34.0
glossy false buckthorn (<i>Frangula alnus</i>)	Fac	2.0
spicebush (P) (<i>Lindera benzoin</i>)	Fac	2.0
Shumard oak (P) (<i>Quercus shumardii</i>)	Fac	2.0
multiflora rose (<i>Rosa multiflora</i>)	Facu	210.0
swamp rose (<i>Rosa palustris</i>)	Obl	280.0
elderberry (P in part) (<i>Sambucus canadensis</i>)	Fac	14.0
highbush blueberry (P) (<i>Vaccinium corymbosum</i>)	Facw	2.0
		Σ (P)= 64.0
		Grand Σ = 556.0

Table 7 (continued)

Unnamed Tributary to Bee Creek, Stream Segment 4

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
red maple (P in part) (<i>Acer rubrum</i>)	Fac	10.0
black chokeberry (P) (<i>Aronia melanocarpa</i>)	Fac	6.0
buttonsh (P in part) (<i>Cephalanthus occidentalis</i>)	Obl	16.0
silky dogwood (P in part) (<i>Cornus amomum</i>)	Facw	354.0
glossy false buckthorn (<i>Frangula alnus</i>)	Fac	2.0
black cherry (<i>Prunus serotina</i>)	Facu	4.0
white oak (P) (<i>Quercus alba</i>)	Facu	2.0
Shumard oak (P in part) (<i>Quercus shumardii</i>)	Fac	6.0
multiflora rose (<i>Rosa multiflora</i>)	Facu	2.0
swamp rose (<i>Rosa palustris</i>)	Obl	7,002.0
elderberry (P in part) (<i>Sambucus canadensis</i>)	Fac	1,010.0
		∑ (P)= 1,404.0
		Grand ∑= 8,414.0

Site Photos

***Wetland Creation and Enhancement
Photo Reference Points***



Photo 1.



Photo 2.

Creation Area, Photo Reference Point C2: North

Dominant Vegetation: broom rosette grass (Facw), tapered rosette grass (Fac), greater poverty rush (TBD), slender spikerush (Facw), red maple (Fac)

Comments: Corrective actions such as installing coir logs has helped a great deal to trap eroding soils and by doing so, provide a growth medium for planted and invasive vegetation.

Creation Area, Photo Reference Point C2: South

Dominant Vegetation: buttonbush (Obl), broom rosette grass (Facw), tapered rosette grass (Fac), slender spikerush (Facw)

Comments: Soils within the creation area are low in organics and in some places are underlain by a shallow fragipan. As a result, bare soils and other non-vegetated substrates currently occupy, on average, about 25% of the surface area.



Photo 3.



Photo 4.

Creation Area, Photo Reference Point C2: East

Dominant Vegetation: broom rosette grass (Facw), tapered rosette grass (Facw), late-flowering thoroughwort (Fac), soft rush (Facw)

Comments: As was planned, seed from adjoining wetland enhancement areas is being naturally transported into the creation zone and helping to revegetate it. Note the tall stand of soft rush in the background that is beginning to encroach.

Creation Area, Photo Reference Point C2: West

Dominant Vegetation: buttonbush (Obl), broom rosette grass (Facw), tapered rosette grass (Fac), greater poverty rush (TBC), sweetgum (Fac)

Comments: More evenly distributed rainfall has been beneficial for establishment of naturally invading herbs. Planted woody species have also benefitted.



Photo 5.



Photo 6.

Creation Area, Photo Reference Point C4: North

Dominant Vegetation: red maple (Fac), buttonbush (Obl), tapered rosette grass (Fac)

Comments: Sparse vegetation in this part of the site is primarily the result of prolonged ponding of water and low soil fertility. Shrub growth is also expected to be slow.

Creation Area, Photo Reference Point C4: South

Dominant Vegetation: buttonbush (Obl), tapered rosette grass (Fac), greater poverty rush (TBD), dark-green bulrush (Obl), soft rush (Facw)

Comments: Though soils are shallow, they are building in depth behind the coir log dams. Even after the dams deteriorate, the remaining soils should be stabilized by plant roots. A series of dams can be seen in this view.



Photo 7.



Photo 8.

Creation Area, Photo Reference Point C4: East

Dominant Vegetation: sweetgum (Fac), tapered rosette grass (Facw), broom rosette grass (Facw), Japanese clover (Facu), late-flowering thoroughwort (Fac)

Comments: Evidence of surface hydrology includes saturated soils, and soil cracking, especially in areas of silt accumulation.

Creation Area, Photo Reference Point C4: West

Dominant Vegetation: greater poverty rush (TBD), tapered rosette grass (Fac), soft rush (Facw), dark-green bulrush (Obl), sweetgum (Fac), buttonbush (Obl)

Comments: Crayfish burrows were noted in this location as well as several other places scattered throughout the mitigation site.



Photo 9.



Photo 10.

Enhancement Area, Photo Reference Point E1: North

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), broom panic grass (Facw), deer-tongue grass (Fac), clustered mountain-mint (Facw), Shumard oak (Fac)

Comments: Dense stands of native and introduced grasses were found throughout each of the enhancement areas.

Enhancement Area, Photo Reference Point E1: South

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), broom panic grass (Facw), deer-tongue grass (Fac), clustered mountain-mint (Facw)

Comments: Enhancement areas were mown in the late fall to facilitate the winter planting of woody vegetation. They now contain over 330 planted tree seedlings per acre but the long-term survival of the seedlings may prove difficult because of root competition from the sod-forming grasses.



Photo 11.



Photo 12.

Enhancement Area, Photo Reference Point E1: East

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), clustered mountain-mint (Facw), tall ironweed (Fac), sweetgum (Fac), swamp rose (Obl)

Comments: Residual wetland shrubs contributed considerably to woody plant densities. In addition to the 330 stems/ac. of planted woody species, swamp rose alone contributed an additional 263 stems/ac.

Enhancement Area, Photo Reference Point E1: West

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), clustered mountain-mint (Facw), helmet flower (Fac), dark-green bulrush (Obl), Maryland meadowbeauty (Obl)

Comments: This is a favored hunting area for northern harriers (marsh hawks).



Photo 13.

Enhancement Area, Photo Reference Point E3: North

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), soft rush (Facw), helmet flower (Fac), greater poverty rush (TBD)

Comments: Non-native velvet grass (*Holcus lanatus*) seems to have benefitted from being mown and is now one of the dominant species in enhancement areas. It is easily identified in this photo by its light tan seed heads. It was probably sown in as a pasture grass years ago during farming operations.



Photo 14.

Enhancement Area, Photo Reference Point E3: South

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), soft rush (Facw), helmet flower (Fac), greater poverty rush (TBD), pointed broom sedge (Facw)

Comments: Velvet grass tends to thrive in damp or wet soils with low fertility but will be outcompeted by native wetland vegetation once disturbance ceases.



Photo 15.

Enhancement Area, Photo Reference Point E3: East

Dominant Vegetation: redtop panic grass (Facw), velvet grass (Fac), soft rush (Facw), blunt broom sedge (Facw), wool-grass (Obl)

Comments: The tall, dense vegetation on the middle and southern portions of the enhancement area provide favored habitat for white-tail deer. Despite the wetness, numerous "deer beds" were observed.



Photo 16.

Enhancement Area, Photo Reference Point E3: West

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), velvet grass (Fac), sweetgum (Fac), boneset (Facw)

Comments: Small inundated depressions, hidden by the dense herb layer, are also occasionally used by foraging snapping turtles. These turtles likely reside in an abandoned farm pond lying near the southeastern boundary of the mitigation area.



Photo 17.



Photo 18.

Enhancement Area, Photo Reference Point E5: North

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), sallow sedge (Obl), prickly bog sedge (Facw), rice cut grass (Obl), slender spikerush (Facw), buttonbush (Obl)

Comments: This reference point lies just below the confluence of two wetland drainages. Consequently it was significantly wetter than other parts of the site.

Enhancement Area, Photo Reference Point E5: South

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), sallow sedge (Obl), prickly bog sedge (Facw), rice cut grass (Obl), slender spikerush (Facw), buttonbush (Obl)

Comments: Some limited areas of standing water were observed between the tussocks of panic grass.



Photo 19.



Photo 20.

Enhancement Area, Photo Reference Point E5: East

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), sallow sedge (Obl), prickly bog sedge (Facw), rice cut grass (Obl), slender spikerush (Facw), buttonbush (Obl)

Comments: Because of additional wetness, plantings were tailored to favor obligate wetland species. Buttonbush occurs here at the average rate of 160 stems/ac.

Enhancement Area, Photo Reference Point E5: West

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), sallow sedge (Obl), prickly bog sedge (Facw), rice cut grass (Obl), slender spikerush (Facw), buttonbush (Obl)

Comments: This is the approximate location where brown bog sedge (*Carex buxbaumii*) was discovered. It is listed as "endangered" by TDEC and is known from five or fewer locations in the state.



Photo 21. **Upland Buffer Zones:** Twenty-five ft-wide buffers, external to riparian buffers, were planted with upland oak species in order to provide extra protection to the restored streams. Areas were first mown to make planting easier. Current oak survivorship averages about 205 stems/ac.



Photo 22. **Gooseberry Transplant Area:** Rare granite gooseberry shrubs, rescued from the prison construction site, and transplanted to the mitigation area in 2009, have survived and appear to be thriving. This year, 24 individual shrubs covering approximately 2,725 ft² were inventoried. This is a 37% increase in coverage since the 2011 monitoring effort.

***Stream Enhancement
Photo Reference Points***

(Photo-reference points were taken at the start of each 200 ft-long monitoring plot looking downstream)



Photo 23.

Stream 1 Enhancement Area, Photo Reference Point 1:

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), wool-grass (Obl), Maryland meadowbeauty (Obl)

Comments: At its upper end, Stream 1 bisects a portion of one of the site's wetland enhancement areas. Because of extreme wetness, planted woody vegetation is somewhat scattered.



Photo 24.

Stream 1 Enhancement Area, Photo Reference Point 2:

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), elderberry (Fac), swamp rose (Obl)

Comments: One of the site's elderberries is visible here. It has expanded greatly in size since it was originally planted in December 2010. The dense riparian vegetation hides the channel from view.



Photo 25.

Stream 1 Enhancement Area, Photo Reference Point 3:

Dominant Vegetation: deer tongue grass (Fac), late-flowering thoroughwort (Fac), silky dogwood (Facw)

Comments: As was often the case, this site contains both planted and naturally-occurring silky dogwood. Distinguishing between the two was not always possible in some areas.



Photo 26.

Stream 1 Enhancement Area, Photo Reference Point 4:

Dominant Vegetation: silky dogwood (Facw), deer tongue grass (Fac), velvet grass (Fac)

Comments: Also, because of the colonial nature of many of the planted shrubs, it was very difficult to determine whether performance standards were being met given the high number of live stems present. Counting individual stems was impractical so counts were based on average number of live sprouts per 10 ft of plant length. Silky dogwoods, for example, were found to contain an average of 35 sprouts per 10 ft of shrub length.



Photo 27.



Photo 28.

Stream 1 Enhancement Area, Photo Reference Point 5:

Dominant Vegetation: rice cut grass (Obl), soft rush (Facw), silky dogwood (Facw), deer-tongue grass (Fac), black willow (Obl)

Comments: Regardless of the technical aspects of determining stem counts and survival rates of planted vegetation, the overall goal of providing a stable, non eroding channel and floristically diverse riparian zone appears to have been realized.

Stream 2 Enhancement Area, Photo Reference Point 1:

Dominant Vegetation: rice cut grass (Obl), soft rush (Facw), winged sumac (Facu)

Comments: Stream Segment 2 is also well-stabilized and supports a high density of herbs as well as planted and naturally invasive woody species. The plunge pool in the foreground lies just downstream of two culverts which pass beneath SR 301. It gives a much exaggerated impression of the size of the waterway.



Photo 29.



Photo 30.

Stream 1 Enhancement Area 3 , Photo Reference Point 1:

Dominant Vegetation: rice cut grass (Obl), soft rush (Facw)

Comments: By contrast, Stream Segment 3 had the lowest density at 64 stems/100 ft of stream. Again, the plunge pool gives a false impression about the size of the waterway. Fish, frogs, and snapping turtles were observed at this location.

Stream 1 Enhancement Area 4, Photo Reference Point 1:

Dominant Vegetation: swamp rose (Obl), soft rush (Facw), small-flowered agrimony (Fac), elderberry (Fac)

Comments: Stream 4 was relegated to scattered pools at the time of the survey. It contained the highest average stem density at over 8,400 woody stems/100 ft of stream length. Most common by far were planted elderberry and the naturally-occurring and highly-colonial swamp rose.

Photo Supplement



Photo 31.



Photo 32.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: Failure to meet performance standards for planted woody vegetation within the creation area was documented in the first annual monitoring report. The most critical cause of the failure was site degradation due to erosion of the thin soils. In order to reduce erosion and trap eroding soils, 23 coir log dams totaling more than 2,500 linear feet were installed perpendicular to the site drainage. Installation took place in early January 2013.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: Each of the coir log dams was placed into a six inch deep trench to prevent them from being undercut by surface flow. Trenching was done with a single-blade plow.



Photo 33.



Photo 34.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: On the day after the coir log dams were installed, the mitigation area received approximately ½ inches of rainfall. As planned, the dams slowed the drainage, spread water across the site, and increased the residence time of water. The succession of dams (spaced approximately 40 ft apart) can be seen in this view.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: Also on the day following dam installation the mitigation property was replanted with 5,650 wetland-adapted tree and shrub seedlings.



Photo 35.



Photo 36.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: By late June of this year the site had clearly begun to revegetate. Although bare soil areas are still rather high at 29%, this is a large improvement over the previous monitoring effort when bare soil constituted almost 42%. Because of low soil fertility, and in some places a shallow fragipan, growth of herbs and woody plants is expected to be slow.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: This contrasting view of approximately the same location (taken in mid-March 2011) shows the improvements that time and site maintenance have made.



Photo 37.



Photo 38.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: Eroding soils have begun to accumulate behind the coir log dams and are providing enough substrate for the survival of planted shrubs such as this buttonbush.

Photo Supplement, Wetland Creation Area Maintenance:

Comments: Somewhat surprisingly, burrowing crayfish have already begun to colonize the creation area.



Photo 39.

Photo Supplement, Wetland Enhancement:

Comments: The wetland enhancement area was found to contain 47 distinct species. Among them were a number of green fringed orchids. While not rare, its known range in Tennessee is limited to only 18 counties.



Photo 40.

Photo Supplement, Wetland Enhancement:

Comments: The wetland enhancement area also supports two small populations of very rare sedges which are listed as "endangered" in the state. One is the brown bog sedge (see Photo 20) and the other, pictured above, is the southern long sedge. Its range in Tennessee is confined to only 2 counties.



Photo 41.

Photo Supplement, Wetland Enhancement:

Comments: Besides supporting a number of interesting plant species, the enhancement area provides needed habitat for a variety of wetland-dependent animal species, particularly waterfowl. This remnant farm pond and emergent wetland have attracted blue-wing teal, mallard ducks, wood ducks, great blue herons, green herons, and, Canada geese. Sandhill cranes have also been observed using open lands adjacent to the pond.



Photo 42.

Photo Supplement, Wetland Enhancement:

Comments: Several snapping turtles were seen in the pond and in stream enhancements. One individual was even observed foraging in the wetland enhancement area approximately 100 yards from the nearest source of open water.

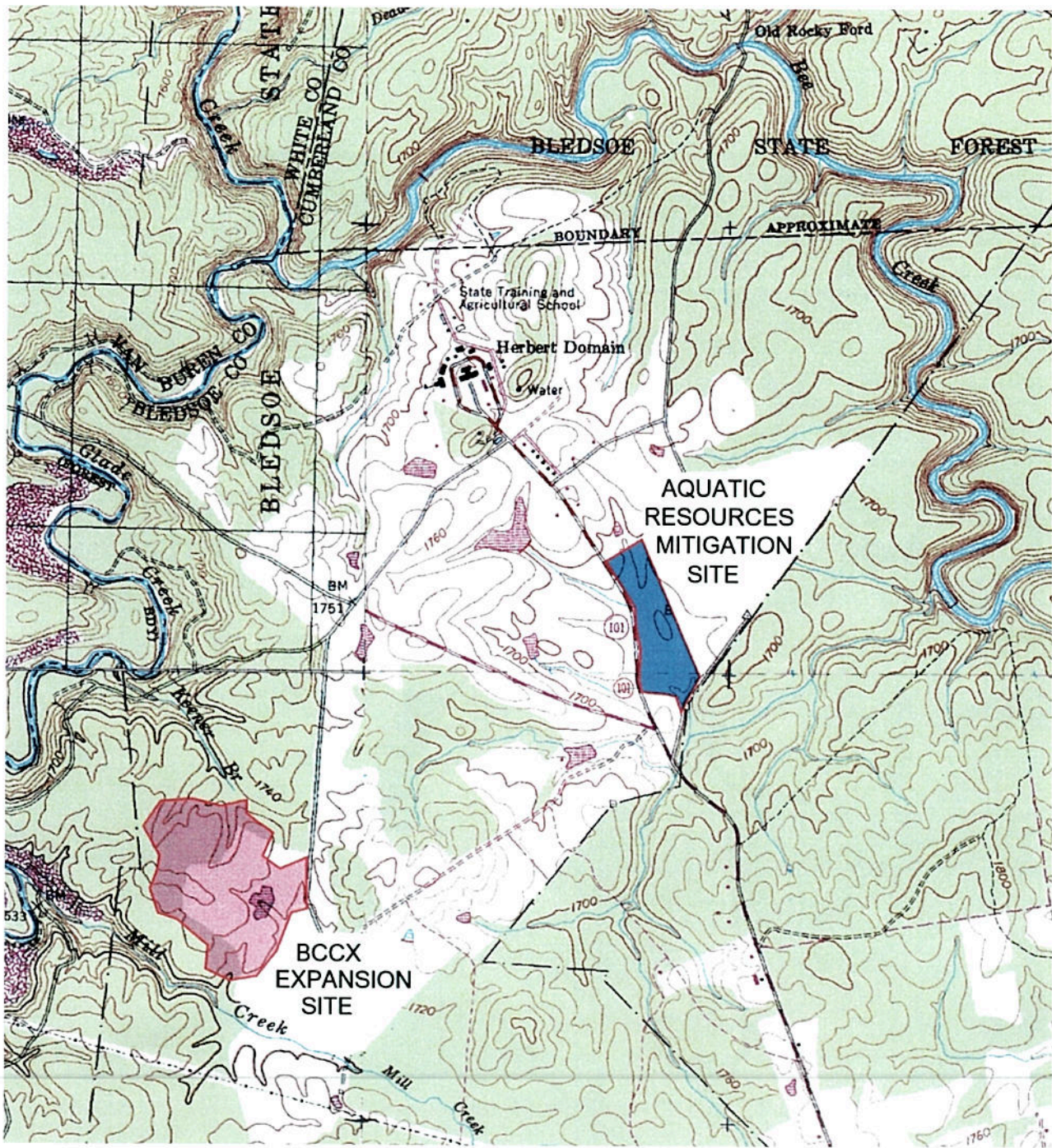
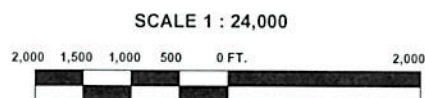
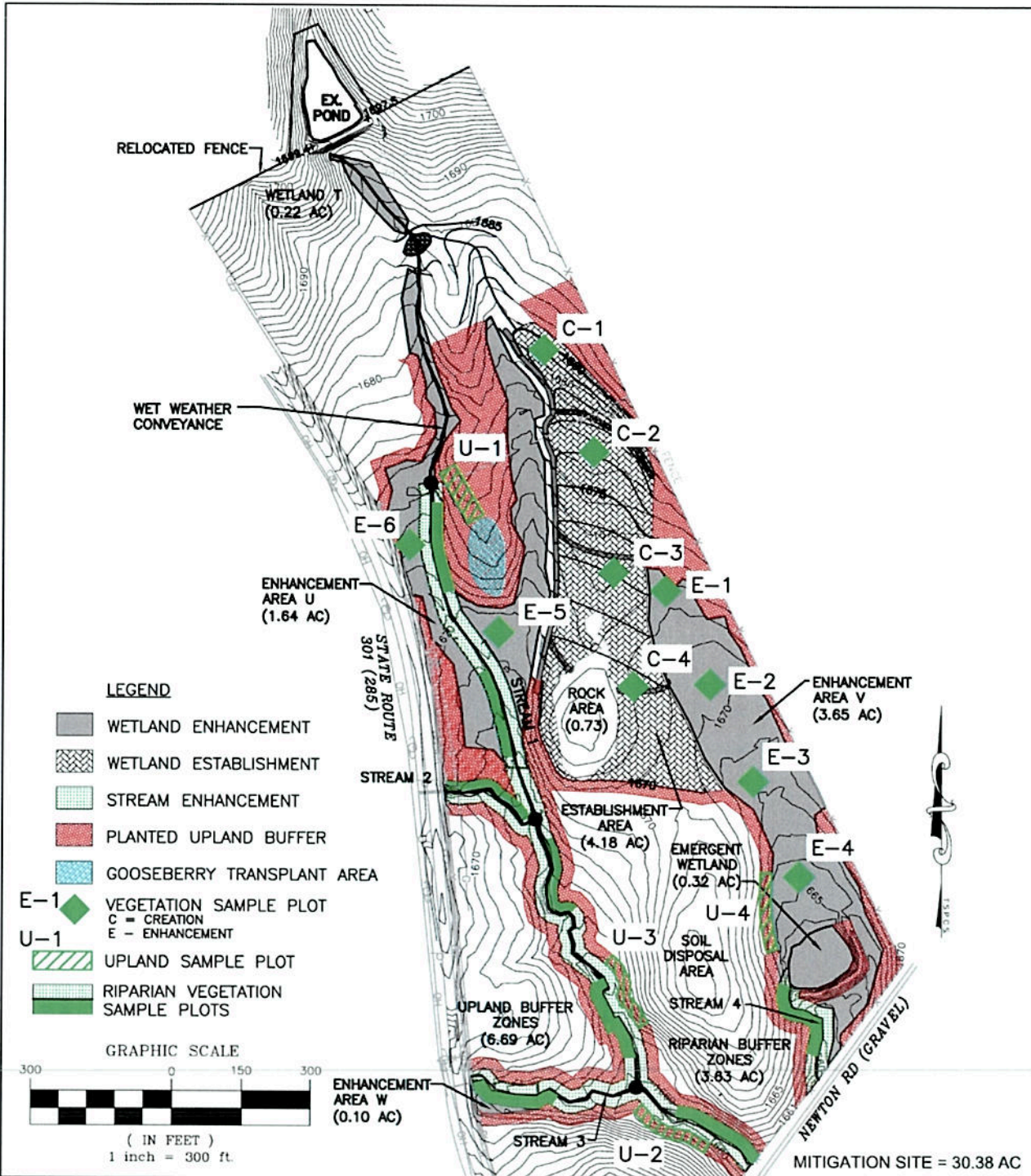


Figure 1. Location Map
DeLorme 3-D TopoQuads™
Herbert Domain (1981), Billingsley Gap (1981), Sampson (1974), Lonewood (1983), Tennessee





NOTES:

DESIGNED BY:	KJK	BLEDSOE COUNTY CORRECTIONAL COMPLEX MITIGATION SITE BEE CREEK MILE 11.4 RIGHT BANK BLEDSOE COUNTY, PIKEVILLE, TENNESSEE APPLICANT: TDF&A, (USACE FILE NO. 2005-02425)
CHECKED BY:	HSB	
CADQA BY:	DEH	
DRAWN BY:	DEH	FIGURE 2: STREAM AND WETLAND MONITORING MAP
SCALE:	1" = 300'	
DATE:	10-07-11	PROJECT NO.: 142.013.09
REVISION NO.:	1	



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Wetland Mitigation

Summary Statement: In light of the fact that the BCCX Wetland and Stream Mitigation site failed to attain a number of its planted vegetation performance goals in 2011, several important steps were taken during the early winter 2013 in attempt to rectify the situation. The replanting of 5,650 wetland-adapted trees and shrubs were replanted and more than 2,500 ft of coir log erosion dams were installed. Because of the corrective measures, and a far more cooperative weather pattern, the site appears to finally be progressing towards meeting its principal goals of replacing historic wetlands by providing a diversity of habitats for water-dependent plants and animals and also by providing a variety of important functions such as water storage capacity, soil stabilization, sediment trapping, and groundwater recharge.

Vegetation: Performance standards for herbaceous vegetation have been easily met within the creation area. Planted woody density has also been conditionally met with overall site density averaging 405 stems/ac. While planted survival exceeds the required 326 stems/ac, performance standards stipulate that no one species can comprise more than 20% of the total. Two species, buttonbush and sweetgum, both exceed this threshold. Despite this "conditional" result, we remain pleased given the fact that during the first monitoring effort, two years ago, stem density was only 65 stems/ac.

Vegetation standards for enhancement areas have also been attained. Herbaceous diversity has increased by more than 50% since 2011. Among that diversity are two sedge species that are exceptionally rare and listed by the state as "endangered". Combined density of planted and naturally-invasive woody species is 600 stems/ac. while planted vegetation alone occurs at the rate 333.67 stems/ac. The last time the site was monitored density was only 153 stems/ac.

Soils: Soils in the creation area have been mapped by the Natural Resources Conservation Service as containing Lily loam and Morehead-Bonair complex. The latter contains inclusions of hydric Bonair soils in low-lying areas and depressions. Indeed, residual hydric soils with depleted matrices (NRCS Field Indicator of Hydric Soil, F3) were confirmed in 75% of the samples. Creation areas have been exposed to conditions of augmented hydrology for only a short period of time but are already showing signs of developing hydric characteristics. Although performance standards have not been met within all creation areas, a conversion of the native soils seems to be occurring. As a consequence, we recommend no actions at this time. The rates at which soils evolve hydric indicators vary widely, but hydrologic modification should only be considered if chemical reductions are not observed in non-converted areas after the fifth year of monitoring.

Hydrology: Shallow groundwater monitoring wells were not required as a condition of this permit. Positive wetland hydrology is therefore inferred from the successful establishment of wetland vegetation and a variety of primary and secondary hydrologic indicators. As has been seen, wetland plant dominance occurs throughout the site. Additional hydrologic indicators include: soil saturation, scattered surface inundation, sediment and drift deposits, surface soil cracks, crayfish burrows, and geomorphic position.

Stream Mitigation

Summary Statement: Principal performance goals for the onsite stream segments are to maintain stable, non-eroding embankments and to establish sustainable vegetated riparian and upland buffers for long-term protection. This year's monitoring indicates that stream mitigation efforts have been largely successful.

Channel Conditions: The four enhanced tributaries to Bee Creek each continue to exhibit stable geometries. No problems with erosion were observed despite some very significant rainfall events that have occurred since mitigation was undertaken in 2010.

Vegetation: The relative lack of disturbance has allowed vegetated riparian zones to thrive. The addition of newly planted seedlings, combined with the sprouting from latent root systems of highly colonial species such as swamp rose and silky dogwood, has resulted in a notable increase in the number of woody stems found in these streamside areas. Because the distinction between planted and naturally-invading species could not consistently be made, it was not possible to determine planted tree survival rates. Nonetheless, observed tree densities continue to exceed the performance standards in all cases. Since riparian vegetation is functioning to stabilize the embankments and is beginning to provide shade and cover, we do not recommend any additional plantings.

Upland buffer zones lying adjacent to the stream and wetland mitigation have no specific performance requirements associated with them. They currently support, on average, 227 planted stems/ac, but survival is sporadic. Drought conditions that occurred the summer after planting killed off a significant number of red and white oaks. These are being supplemented in some areas by natural seed rain coming from adjoining forested areas. Red maple, Virginia pine, and black cherry, for example are now contributing 35 stems/ac. Multiflora rose is also beginning to appear in sizable numbers. Because it is an invasive, alien species, consideration might be given to chemical control.

Granite gooseberry transplant efforts appear to be successful in all respects. Transplant populations of this rare, state-listed shrub have increased in areal extent by 37% since the last monitoring report was issued in 2011.

The permittee's commitment to protect the site in perpetuity via deed restriction has yet to be fulfilled. Neither has the requirement to install signage designating the mitigation site as a protected property. These have been delayed until such time that the permittee is certain that all performance standards have been reached and are sustainable. Because the property is state-owned, there are no immediate outside threats to the mitigation area.

References

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- Weakley, Alan S. (2012). *Flora of the Carolinas, Virginia, and Georgia, and Surrounding Areas*. University of North Carolina, Chapel Hill. From <http://www.herbarium.unc.edu/flora.htm>.