LITTLE BUFFALO CREEK STREAM MITIGATION PROJECT

Cabarrus County, NC
Yadkin River Basin
Cataloging Unit: 03040105
EEP Project Number: 94147

Prepared for:

North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
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Little Buffalo Creek Stream Mitigation Plan
Final

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1. Executive Summary/Project Abstract

The Louis Berger Group, Inc. (Berger) proposes to restore the Little Buffalo Creek Stream Mitigation Site (Site) in Cabarrus County, North Carolina to provide the North Carolina Ecosystem Enhancement Program (NCEEP) with approximately 6,557 stream mitigation units needed to compensate for projects occurring within the Yadkin-Pee Dee River basin.

The Little Buffalo Creek Stream Mitigation Site consists of six reaches along the mainstem and seven unnamed tributaries (UTs) (Figure 1). The mainstem of Little Buffalo Creek as well as UT 4 and UT 7 are perennial streams. The remainder of the UTs are intermittent. Photographs of each reach and UT can be found in Appendix 1. North Carolina Division of Water Quality (NCDWQ) Stream Classification Forms can be found in Appendix 3. This stream mitigation project includes reaches of restoration, enhancement, and preservation along the mainstem and its associated UTs. In total, the Site will provide 13641 linear feet of restoration, enhancement, and preservation. At a 1:1 ratio for restoration, 1.5:1 for enhancement level I, 2.5:1 for enhancement level II, and a 5:1 ratio for preservation, the NCEEP will receive approximately 6,679 stream mitigation units from the Site. In addition, approximately 47 acres of riparian buffer will be protected within a conservation easement. The fourteen reaches are detailed below.

Mitigation Types by Reach (Linear Feet)

Reach Name	*Restoration*	*Enhancement I*	*Enhancement II*	*Preservation*
Reach 1	438	0	1,862	0
Reach 2	0	0	1,248	0
Reach 3	267	0	808	0
Reach 4	0	120	721	0
Reach 5	0	0	952	0
Reach 6	0	0	0	2,053
UT 1	0	0	109	0
UT 2	0	0	616	335
UT 3	197	515	763	0
UT 4	0	397	431	0
UT 5	0	0	184	0
UT 6	0	0	151	0
UT 7	1,374	0	0	0
UT 8	100	0	0	0

The original stream channel has been altered by years of ranching activities, including cattle access to the stream and riparian zone. Several reaches of the stream have bedrock in their streambed and vertical migration of the stream has been confined to a small percentage of the project site. The stability in the vertical direction coupled with the loss of vegetation along the stream due to cattle accessing the stream via the streambank have led to streambank failures and lateral stream migration on several stream reaches throughout the Site.

The goals of the proposed Little Buffalo Creek Stream Restoration project include, but are not limited to, the enhancement of water quality and aquatic/terrestrial habitat, stream stability improvement, and erosion reduction. The uplift of these stream functions specifically requires:

- Protecting and improving water quality through the removal or minimization of the biological, chemical, and physical stressors,
  - reducing sediment input into the stream from erosion,

  - reducing non-point pollutant impacts by removing livestock access (including restoring forested buffer,
  - protecting headwater springs
- Improving aquatic and terrestrial wildlife habitat,
  - moderating stream water temperatures by improving canopy coverage over the channel; and,
  - restoring, enhancing, reconnecting, and protecting valuable wildlife habitat.
- Restore floodplain connectivity
  - reestablishing floodplain connection thereby dissipating energy associated with flood flows.

In addition to the ecological uplift that the project will provide to the Site through the improvement of the stream functions, this project establishes the following environmentally advantageous goals:

- providing a water source for livestock removed from the stream and riparian corridor;
- reducing the number of locations that livestock are able to cross the stream; and
- providing a safe and environmentally appropriate stream crossing points for livestock.

In order to achieve the project goals, Berger proposes to accomplish the following objectives:

- fence the cattle out of the stream and riparian corridor,
- remove invasive vegetative species from the riparian corridor,
- restore and enhance unstable portions of the stream,
- preserve the stream channel and banks through a conservation easement, and
- plant the riparian corridor with native tree and shrub vegetation.

The expected ecological benefits and goals associated with the Little Buffalo Creek site mitigation plan serve to meet objectives consistent with the resource protection objectives detailed in the Yadkin-Pee Dee River Basinwide Water Quality Plan, 2008.

2. Project Site Identification and Location

Berger proposes to restore the Little Buffalo Creek Stream Mitigation Site (Site) in Cabarrus County, North Carolina to provide the North Carolina Ecosystem Enhancement Program (NCEEP) with approximately 6,557 stream mitigation units needed to compensate for projects occurring within the Yadkin-Pee Dee River basin. This Restoration Plan describes existing project site conditions and details the restoration process. This report continues the regulatory review process through the NCEEP.

The Little Buffalo Creek Stream Mitigation Site consists of six reaches along the mainstem and seven unnamed tributaries (UTs) (Figure 1). The mainstem of Little Buffalo Creek as well as UT 4 and UT 7 are perennial streams. The remainder of the UTs are intermittent. Photographs of each reach and UT can be found in Appendix 1 and North Carolina Division of Water Quality (NCDWQ) Stream Classification Forms can be found in Appendix 3. This stream mitigation project includes reaches of restoration, enhancement, and preservation along the mainstem and its associated UTs. In total, the Site will provide 13,641 linear feet of restoration, enhancement, and preservation. At a 1:1 ratio for restoration, 1.5:1 for enhancement level I, 2.5:1 for enhancement level II, and a 5:1 ratio for preservation, the NCEEP will receive approximately 6,679 stream mitigation units from the Site. In addition, approximately 47 acres of riparian buffer will be protected within a conservation easement.

2.1. Directions to the Project Site

From Raleigh: follow US-1 south. Merge onto US-64 W via Exit 98B toward Pittsboro/Asheboro. Stay on US-64 for approximately 62 miles. Turn left onto NC-49. Turn right onto NC-49 S. Turn right onto Stokes Ferry Road. Turn left onto Old Beatty Ford Road. Turn left onto St. Stephen Church Road. Turn right onto Old Mine Road. The upper and middle sections of the project can be accessed by parking on Old Mine Road. The lower sections of the project can be accessed by parking on Kluttz Road.

2.2. USGS Catalog Unit, Hydrologic Unit Code and NCDWQ River Basin Designation

The Site is located in Cabarrus County southwest of the Town of Gold Hill, in the Rocky River basin, US Geologic Survey (USGS) Catalog Unit (CU) 03040105 (Hydrologic Unit Code (HUC) and Targeted Local Watershed (TLW): 03040105020060), of the Yadkin-Pee Dee River basin (Figure 1). Streams in the uppermost reach of the Rocky River watershed, including Little Buffalo Creek, are located primarily in the Southern Outer Piedmont ecoregion. They are characterized by sandy substrates and generally consistent summer flow regimes (Griffith et al. 2002). The Rocky River, the largest tributary of the Yadkin River, flows for approximately 25 river miles from its headwaters near Mooresville in Iredell County to its confluence with Irish Buffalo Creek in Cabarrus County. Outside of this region's numerous small urban areas, land use is primarily agricultural (NCDWQ 2007).

According to the NCDWQ 2008 Yadkin Pee-Dee River Basin Plan, 13 benthic and 21 fish sites were sampled as part of the five-year basinwide sampling program. Of the sites that were sampled in both 2001 and 2006, over 30 percent declined in bioclassification while just 20 percent showed an improvement. Further, the total number of samples increased by 41 percent and corresponded to a 37 percent increase in the number of impaired sites. This suggests that as further investigations are performed, more water quality problems are uncovered. In response to existing impacts from agricultural land uses and anticipated residential growth, the

NCEEP targeted the Rocky River Watershed for water quality and habitat quality improvements (NCEEP 2009b).

The site is located in Targeted Local Watershed (TLW) 03040105020060. By the year 2015, the population within this area is expected to increase by 4000. According to the 2009 Lower Yadkin Pee Dee River Basin Restoration Priorities Report (NCEEP 2009b), the goals for CU 03040105, which encompasses this watershed, include: improved management of stormwater runoff, protection of threatened and endangered wildlife resources, continued mitigation of impacts resulting from rapid urbanization, and restoration of water quality in DWQ-identified impaired streams.

2.3. Project Vicinity

Located in Cabarrus County, North Carolina, the Site is approximately 12 miles east of Kannapolis and two miles southwest of Gold Hill. The Site starts at the Rowan/Cabarrus county line (Figure 1).

2.4. Project Components and Structure

A summary of the project components is available in Table 1 and Figure 3 displays mapped soils and proposed mitigation.

Reach 1 begins at the Rowan/Cabarrus county line and continues 2,300 feet south until Old Mine Road bridge. The existing riparian buffer extends approximately 10 feet on both sides. Both sides of the bank are open to cattle pasture. The floodplain is generally flat and slopes upward to the east and west from each streambank. Soils along this reach are Chewacla sandy loam (Ch), Tatum silt loam (2-8 percent slopes) (TaB), and Goldston very channery silt loam (15-45 percent slopes) (GoF) (USDA 2009a). Reach 1 will include restoration and enhancement level II. The restoration component will provide stable channel geometry and improvement in water quality, and aquatic and terrestrial wildlife habitat. Enhancement level II will provide improved water quality through the removal or minimization of the biological, chemical, and physical stressors. This effort will also improve aquatic and terrestrial habitat over time as invasive species are removed and natural species returned.

Reach 2 begins just below the Old Mine Road bridge and continues downstream for 1,248 feet. The existing riparian buffer extends approximately 10 feet on both sides. Both sides of the bank are open to cattle pasture. The floodplain is generally flat and slopes upward to the east and west from each streambank. Soils along this reach are Chewacla sandy loam (Ch) and Goldston very channery silt loam (15-45 percent slopes) (GoF) (USDA 2009a). Reach 2 will include enhancement level II efforts.

Reach 3 begins where Reach 2 ends and continues 1,075 feet south to UT4. The existing riparian buffer extends approximately 10 feet on the west stream bank, but is more forested along the east bank. Both sides of the bank are open to cattle pasture. The floodplain is generally flat and slopes upward to the east and west from each streambank. Soils along this reach are Chewacla sandy loam (Ch) (USDA 2009a). Reach 3 will include restoration for the central portion and enhancement level II for the upper and lower portions.

Reach 4 begins at UT 4 and continues 841 feet south to UT 3. The existing riparian buffer extends approximately 10 feet on both sides. Both sides of the bank are open to cattle pasture. The floodplain is generally flat and slopes upward to the east and west from each streambank.

Soils along this reach are Chewacla sandy loam (Ch) (USDA 2009a). Reach 4 will include enhancement level I and enhancement level II. Enhancement level I provides improved water quality through the removal or minimization of the biological, chemical, and physical stressors. Additionally, this effort will improve aquatic and terrestrial wildlife habitat over time as invasive species are removed and natural species are returned.

Reach 5 begins at UT 3 and continues for 952 feet past UT 5 and UT 6. The existing riparian buffer extends approximately 10 feet on both sides. Both sides of the bank are open to cattle pasture. The floodplain is generally flat and slopes upward to the east and west from each streambank. Soils along this reach are Chewacla sandy loam (Ch) (USDA 2009a). Reach 5 will include enhancement level I and enhancement level II.

Reach 6 begins where Reach 5 ends and extends 2,053 feet to the end of the mitigation reach at Kluttz Road. The existing riparian buffer extends approximately 10 feet on the west bank, but is more forested on the east bank. The west bank is open to cattle pasture. The floodplain is generally flat and slopes upward to the east and west from each streambank. Soils along this reach are Chewacla sandy loam (Ch) (USDA 2009a). Reach 6 consists of only preservation.

UT 1, north of the first cattle crossing, flows into Reach 1 from the west. Only 109 feet of this reach upstream of the confluence with Little Buffalo Creek will be enhanced as the landowner was unwilling to allow more for this project. There is no riparian buffer and both sides of the bank are open to cattle pasture. Soils along this reach are Chewacla sandy loam (Ch) (USDA 2009a). UT 1 will include enhancement level II.

UT 2 flows into Reach 2 from the west. This reach extends 951 feet from the pond outlet to the mainstem of Little Buffalo Creek. For 336 feet below the pond, the existing riparian buffer is greater than 50 feet wide on each side of the bank. Below that point, there is no riparian buffer. This area is open to cattle pasture. Soils along this reach are Chewacla sandy loam (Ch) (USDA 2009a). The section of the reach with the riparian buffer will include preservation, while the section below will include enhancement level II.

UT 3 flows into the end of Reach 4 from the west. Mitigation for this reach starts at Old Mine Road and continues 1,475 feet to the mainstem. There is no existing riparian buffer and both banks are open to cattle pasture. Soils along this reach are Chewacla sandy loam (Ch), Georgeville silty clay loam (2-8 percent slopes) (Geb2), and Badin channery silt loam (8-15 percent slopes) (BaD) (USDA 2009a). UT 3 will include restoration, enhancement level I and enhancement level II.

UT 4 flows into the end of Reach 3 from the east and will be mitigated for approximately 828 feet. The existing riparian buffer extends approximately 10 feet on the south bank, but is forested along the north bank. The south bank is open to cattle pasture. Soils along this reach are Chewacla sandy loam (Ch) and Goldston very channery silt loam (15-45 percent slopes) (USDA 2009a). UT 4 will include enhancement level I and enhancement level II.

UT 5 flows into Reach 5 from the east. The riparian buffer is intact along the north bank of the stream, but the south bank is open to cattle pasture. Soils along this reach are Goldston very channery silt loam (15-45 percent slopes) (GoF) and Chewalca sandy loam (0-2 percent slopes) (Ch) (USDA 2009a). Mitigation for UT 5 will include approximately 184 feet of enhancement level II.

UT 6 also flows into Reach 5 from the east. The riparian buffer is intact for a portion upstream along the south bank. The north bank is open to cattle pasture. Soils along this reach are Goldston very channery silt loam (15-45 percent slopes) (GoF) and Chewalca sandy loam (0-2 percent slopes) (Ch) (USDA 2009a). Mitigation for UT 5 will include approximately 151 feet of enhancement level II.

UT 7 is a larger tributary flowing into Reach 6 from the west. The existing riparian buffer extends approximately 10 feet from each bank. Stream geometry is severely incised. Soils along this reach Chewalca sandy loam (0-2 percent slopes) (Ch) (USDA 2009a). The original length of UT 7 is approximately 1,374 feet. Mitigation consists of restoration This restoration effort also includes a short segment of UT 8. The lower half of the stream's geometry is severely incised because of head cutting due to the incision of UT 7. The flow from the UT 8 to UT 7 will be redirected to join UT 7 at a new location upstream of the current confluence and at a more natural elevation.

3. Watershed Characterization

3.1. Drainage Area

The Little Buffalo Creek Stream Mitigation project has a total drainage area of approximately 4,039 acres (Figure 2). The watershed is mostly agricultural with forested areas. UT 1 has a drainage area of approximately 293 acres, UT 2 has 193 acres, UT 3 has 62 acres, UT 4 has 254 acres, UT 5 has 8 acres, UT 6 has 16 acres, and UT 7 has 1,222 acres. Little Buffalo Creek flows south into Dutch Buffalo Creek, which then flows into Reedy Creek. Reedy Creek flows to the Rocky River, which eventually drains into the Yadkin Pee-Dee River. Table 4 in Section 12 displays the drainage area, easement area, and surface water classification associated with each project reach.

3.2. Surface Water Classification / Water Quality

The CU 03040105 subbasin is located adjacent to the City of Charlotte where rapid development and limited stream waste assimilation capacity is having a major impact on water quality. Of the monitored waters, 29 percent are supporting and 65 percent are impaired. New impairments corresponded with an increase in number of sample sites, indicating as more monitoring is done more water quality problems will likely be detected. A macro-benthos survey specifically for the Site was completed in October 2010. The results from the survey are included in Appendix 10.

The network of ambient monitoring sites in the Rocky River watershed indicate that turbidity and nutrients (nitrogen and phosphorus) are notably higher in this area than in other parts of the Yadkin – Pee Dee River basin. Fecal coliform bacteria, iron, and copper are also pollutants of concern in this watershed. Iron and copper occur naturally in the soils of this region and further investigation is needed to determine the groundwater contribution of these metals to surface waters. Other possible sources include nonpoint source runoff from urban areas and waste land-application sites. Land use in this subbasin is mostly comprised of cultivated cropland, although there are large numbers of swine and poultry operations (NCEEP 2009b, NCDWQ 2008a).

- *Water Supply Watershed*
  The Little Buffalo Creek Stream Mitigation Site is not located within a water supply watershed. Little Buffalo Creek is classified as C: freshwaters protected for

secondary recreation, fishing, aquatic life including propagation and survival, and wildlife (NCDWQ 2010). Several segments of Dutch Buffalo Creek as well as several tributaries to Dutch Buffalo Creek are listed as High Quality Waters (HQW). These segments are downstream of Little Buffalo Creek.

- *Pollution Sources within the Subbasin*
  Subbasin CU 03040105 has eight major and 45 minor facilities with National Pollutant Discharge Elimination System (NPDES) permits to discharge wastewater into its waterways. All major and minor facilities are either located downstream of Little Buffalo Creek or in other watersheds. No facilities are located on Dutch Buffalo Creek. In 2001, a fish community (F-8) was sampled at SR 2622 (NC 200) and rated 'Good.' In 2004, the community was resampled and dropped to a 'Good-Fair' rating (NCDWQ 2007).

- *303d-Listed Stream or Watershed*
  Several streams are listed as impaired on the 2008 final 303d list within the CU 03040105. Many streams listed as impaired occur within the Charlotte, Concord, and Kannapolis vicinity. No streams are listed as impaired within the Dutch Buffalo Creek watershed, upstream of its confluence with Reedy Creek. The entire stretch of the Rocky River within the 03040105 watershed is listed as impaired due to copper and turbidity (NCEEP 2009b, NCDWQ 2008b).

- *NCWRP Targeted Watershed*
  Several 14 digit HUCs of 03040105 are listed as NCEEP Targeted Local Watersheds, including HUC 03040105020060 (NCEEP 2009b).

- *Significant Natural Heritage Area*
  A significant natural heritage area is an area that contains one or more threatened or endangered species or exemplifies a naturally occurring ecological community that exists within North Carolina. Within the HUC subbasin 03040105020060, the Natural Heritage Program (NCNHP) has identified nine significant natural heritage areas and one managed area (NCDENR 2010):

  - Butcher Branch Forest is located 3.3 miles south of the Site;
  - Charity Church Hardwood Forest is located 4.6 miles southwest of the Site;
  - Dutch Buffalo Creek Aquatic Habitat is located 4.7 miles southwest of the Site;
  - Dutch Buffalo Creek Dam is located 3.1 miles southwest of the Site;
  - Georgeville Sunflower Site is located 13.5 miles southwest of the Site;
  - Lower Butcher Branch Depression Swamps are located 2.1 miles south of the Site;
  - Miami Church Hill Rare Plant Site is located 12 miles southwest of the Site;
  - Stephens Church Forest is located 12.5 miles southwest of the Site;
  - Walker Road Hardpan Forest is located 7.8 miles southwest of the Site; and
  - The Gold Hill Rail Trail (managed area) is located 0.15 miles northeast of the Site.

3.3. Physiography, Geology, and Soils

The Site is located within the Carolina Slate Belt ecoregion of the Piedmont physiographic province of North Carolina, along the edge of the Southern Outer Piedmont ecoregion. The Carolina Slate Belt extends from southern Virginia, across the Carolinas, and into a small part of eastern Georgia. The mineral-rich metavolcanic and metasedimentary rocks with slatey cleavage tend to be finer-grained and less metamorphosed than other parts of the Piedmont (except for the Triassic Basins) and is somewhat less resistant to erosion.

The Carolina Slate Belt has been an important region of mineral production and is thought to have the potential for containing undiscovered deposits of gold and silver, as well as copper, lead, zinc, molybdenum, and tin. The volcanic slates are deeply weathered in places forming clay and shale, and soils generally have high silt contents. The more silty and silty clay soils of the Carolina Slate Belt contrast with the loam and sandy loam soils often found in other parts of the Piedmont. Streams tend to dry up and water yields to wells are low as this region contains some of the lowest water-yielding rock units in North Carolina (Griffith *et al*. 2002).

The Southern Outer Piedmont extends from Alabama, across large portions of the Georgia and South Carolina Piedmont, and into northern North Carolina. It covers the middle portion of the North Carolina Piedmont in the south. The ecoregion has lower elevations, less relief, and less precipitation than the Southern Inner and Northern Inner Piedmont ecoregions, and tends to have more cropland than those Inner Piedmont regions. The landform class is mostly irregular. Gneiss, schist, and granite are typical rock types, and the rocks are intensely deformed and metamorphosed.

Streams within each area are affected by the soils, geology, vegetation, and topography characteristic of the physiographic region. Overall, streams in the Southern Outer Piedmont ecoregion are characterized by sandy substrates and generally consistent summer flow regimes, while streams in the Carolina Slate Belt are characterized by low summer flows, extensive bedrock formations, and the prevalence of boulder and cobble substrate. The characteristics of the regional geology is expressed within the Little Buffalo Creek project reach through its eroding banks where the stream has carved out the moderately erodible soils and at halted headcuts where the stream degraded to bedrock.

3.4. Historical Land Use and Development Trends

As specified in the NCDWQ Basin Plan and the NCEEP River Basin Restoration Priorities Report, this subbasin is located adjacent to the City of Charlotte where rapid development and limited stream waste assimilation capacity is having a major impact on water quality. Thirteen benthic and 21 fish sites were sampled as part of the five-year basinwide sampling program. NCDWQ's biological and ambient data indicate streams in urbanizing areas of the Rocky River Watershed are demonstrating negative water quality impacts (NCDWQ 2008a, NCEEP 2009b). Of the sites that were sampled in both 2001 and 2006, over 30 percent declined in bioclassification while just 20 percent showed an improvement. As further investigations were performed as part of the sampling program, more water quality problems were uncovered.

In response to existing impacts from agricultural land uses and anticipated residential growth, the NCEEP targeted the Rocky River Watershed for water quality and habitat quality improvements. The severe bank erosion, shifting sandy substrates, channelization, and sedimentation point to an overall pattern of habitat degradation in the watershed. In addition, turbidity violations are common throughout the Rocky River watershed. It is likely that a combination of human caused land disturbances and natural erosion are causing the majority of

turbidity violations in this watershed, with human causes being the leading contributor (NCEEP 2009b, NCDWQ 2008a).

WARSSS Analysis

In addition to the standard analysis, the Environmental Protection Agency's (EPA) Watershed Assessment of River Stability and Sediment Supply (WARSSS) Reconnaissance Level Assessment (RLA) methodology was used as a basis to conduct a table top assessment of Little Buffalo Creek. This methodology examines land and river management activities and attempts to identify sediment sources and channel stability problems linked to these activities.

Multiple data sets were compiled to aide in this assessment, including USGS topographic maps, high altitude aerial photography, and US Department of Agriculture, Natural Resources Conservation Service (USDA NRCS) soils data. Synthesis of the data was done using ESRI ArcMAP GIS software. A comparative analysis was done using aerial photography from 1983 and 2005/2006 to determine if trends could be identified as influencing river stability and sediment supply (USDA 1983; USDA 2005; USDA 2006). (Aerial photography was available from 2005 for Cabarrus County and from 2006 for Rowan County. The timeframe encompassing both sets of aerial photography will herein be referred to as 2006.) The 4,039-acre Little Buffalo Creek watershed was divided into two sub-watersheds, UT 7 and the main stem of Little Buffalo Creek for this analysis.

WARSSS Exhibit 1. Size of Little Buffalo Creek watershed and sub-watersheds.

	Little Buffalo Creek Watershed	**Main Stem Sub-Watershed**	**UT 7 Sub-Watershed**
Total Size (acres)	4,039	2,817	1,222
300 ft Riparian Buffer (acres)	1,526	1,026	500

Analyses conducted as part of the WARSSS analysis are summarized below.

- Riparian Buffer Evaluation
  LBG applied a 300-foot buffer to the centerline of the stream features to determine the extent of the riparian zone within each reach.

- Bedload Transport Sampling
  Conducted bed load sampling (via buckets buried side by side through the length of each cross section) to confirm sediment transport calculations.

- Land Use Analysis
  Land use polygons were digitized from 1983 and 2006 aerial photography to satisfy spatial analysis requirements (USDA 1983; USDA 2005; USDA 2006). The land use analysis found that the acres of forested land, the miles of roadways, the area of surface mining, the number of structures, and the number of water impoundments increased within the Little Buffalo Creek watershed from 1983 to 2006. Detailed results for land use analysis are presented in Exhibit 2.

  WARSSS Exhibit 2. Little Buffalo Creek land use/land cover analysis

	Little Buffalo Creek Watershed		Main Stem Sub-Watershed		UT 7 Sub-Watershed	
	1983	**2006**	**1983**	**2006**	**1983**	**2006**
Forested Land (ac)	2,152	2,300	1,451	1,531	701	800
Forested land: 300 ft Riparian Buffer (ac)	1,033	1,089	658	690	375	399
Non-Forested Land (ac)	1,872	1,694	1,325	1,245	547	448
Non-Forested Land: 300 ft Riparian Buffer (ac)	493	437	368	336	125	101
Mines/Quarries (ac)	2.1	31.6	0	26.5	2.1	7.1
Roads (miles)	18.2	30.3	11.6	21.6	6.6	8.7
House/Structures	179	385	108	262	71	123

- Soils Analysis

  Potentially erodible soil within the Little Buffalo Creek watershed were identified soils using NRCS web soil surveys for Cabarrus and Rowan Counties (USDA 2010), as well as soil survey area shapefiles obtained from the Soil Data Mart (http://soildatamart.nrcs.usda.gov) (USDA 2009a; USDA 2009b). A soil type was identified as "erodible" if it had an erosion factor of moderate or severe. Detailed results for soil analysis can be found in Exhibit 3.

WARSSS Exhibit 3. Little Buffalo Creek Highly Erodible Soils Analysis

	Little Buffalo Creek Watershed		Main Stem Sub-Watershed		UT 7 Sub-Watershed	
	1983	**2006**	**1983**	**2006**	**1983**	**2006**
Erodible Soils (ac)	630	630	511	511	119	119
Erodible Soils - 300 ft Riparian Buffer (ac)	382	382	302	302	80	80
Forested Erodible Soils (ac)	452	487	349	376	104	111
Non-Forested Erodible Soils (ac)	178	143	163	136	15	8
Forest Erodible Soils: 300 ft Riparian Buffer (ac)	289	314	216	237	73	77
Non-Forested Erodible Soils: 300 ft Riparian Buffer (ac)	93	68	85	645	8	3

Conclusions

From this table top exercise one can conclude that watershed processes are not likely the cause of channel instability within the main stem sub-watershed. From 1983 to 2006 the sub-watershed experienced a doubling in the number of house/structures and an increase in miles of roads. These increases were relatively insignificant relative to the size of the sub-watershed. The main stem sub-watershed remains rural without significant urbanization. Land use did not

significantly change. The sub-watershed did not experience a significant change in the size or number of impoundments. These factors make it likely that watershed driven hydrological processes are not the source of channel of instability.

A 26.5 acre quarry was constructed between 1983 and 2006 within the sub-watershed, but this acreage is less than one percent of the sub-watershed size. This quarry is not likely a significant source of sediment to the stream. Furthermore, erodible soils, both within and outside the 300-foot riparian buffer, experienced a slight increase in forested land use. It is not likely that land use changes are leading to watershed-driven sediment supply and, therefore, is not likely a major factor leading to channel instability.

It is unlikely that UT 7 sub-watershed has experienced significant changes in watershed processes leading to stream instability. UT 7, similar to the main stem sub-watershed, experienced a doubling in the number of house/structures, but only a two mile increase in roadways. Both of these are insignificant relative to the sub-watershed size. The number or size of impoundments did not significantly change between 1983 and 2006. UT 7 experienced a slight (non-significant) increase in forested acres. This suggests that, as within the main stem, watershed driven hydrological processes are not the source of channel instability.

UT 7 did not experience watershed changes leading to an increase in sediment supply. The mine within the sub-watershed increased in size by five acres; this is insignificant when one considers that the sub-watershed is over 1,200 acres in size. Land use on erodible soils did not significantly change. Forested land on erodible soils slightly increased within the 300-foot riparian buffer, as well as in the sub-watershed as a whole. This suggests that watershed driven sediment supply is not contributing to channel instability.

From this table top exercise it appears that the Little Buffalo Creek watershed is not experiencing significant watershed driven processes leading to channel instability. The watershed has not experienced significant changes in hydrological processes or land use changes leading to changes in sediment supply. It is likely that localized processes, (i.e. cattle grazing and direct stream access), and/or localized stream features (i.e. undersized culverts) that are the major forcing functions driving channel instability.

3.5. Endangered / Threatened Species

The US Fish and Wildlife Service (USFWS) and NCNHP listed two species for Cabarrus County that are offered protection by the Endangered Species Act of 1973, as amended (USFWS 2008 and NCNHP 2010). Species listed are the Carolina heelsplitter (*Lasmigona decorata*) and the Schweinitz's sunflower (*Helianthus schweinitzii*). Both species are listed as endangered.

Suitable habitat for the Carolina heelsplitter includes mud, muddy sand, or muddy gravel substrates in streams and rivers along stable, wellshaded stream banks (USFWS 2008). Suitable habitat for the Schweinitz's sunflower includes roadsides, power line clearings, old pastures, woodland openings and other sunny or semi-sunny situations (USFWS 2008). The project area includes degraded stream channels with little riparian vegetation and poor water quality from nutrient loading. The majority of the mainstem of Little Buffalo Creek and its UTs are open to cattle pasture. Due to the Site's disturbed nature, suitable habitat for the Carolina heelsplitter and Schweinitz's sunflower is not anticipated to occur on Site. In addition, the NCNHP shapefile did not indicate any federally threatened or endangered species within a mile of the Site (NCDENR 2010).

A letter was sent to the USFWS dated November 16, 2009 requesting any known information on these species in the county. No response was received; therefore; it is assumed that the USFWS does not have any comments nor do they have information relevant to this project. A copy of the letter sent to USFWS can be found in Appendix 11.

3.6. Cultural Resources

Berger conducted a cultural resources records review for the Site on November 24, 2009. The archaeological field work was conducted from January 6 through January 7, 2010. The official archaeological site inventory and National Register files at the North Carolina State Historic Preservation Office (SHPO) and the Office of State Archaeology (OSA) in Raleigh were reviewed for the presence of previously recorded archaeological sites and historical properties within the boundaries of the parcel that contains the Site and within a one mile radius of that location. No previously recorded archaeological sites are located within one mile of the Site. The Daniel Isenhour House and Farm (District #0000392) is the only nearby architectural property listed on the National Register of Historic Places. The proposed project is not expected to have an effect on the ca. 1843 house or the contributing outbuildings and landscape. No other architectural properties determined eligible, or under consideration, for inclusion in the National Register of Historic Places are located within one mile of the Site. Outside the project boundary, the remains of a gold mine, identified as the Whitney Mine in Cabarrus County Architectural Survey files, is present immediately above one of the unnamed tributaries proposed for preservation. The mine depression has been converted into a pond through the construction of an earthen dam.

Fieldwork included a pedestrian reconnaissance of the Site. This was accomplished by walking the perimeter of the Site. Locations with good surface visibility, such as cutbanks, exposed ground surfaces, and erosional features, were also inspected in order to identify structural remains, cultural deposits, and any other cultural features. The area was photographed and its topographic and vegetative characteristics noted. A total of three shovel tests were excavated within the boundaries of the Site. An additional shovel test was excavated in the vicinity of the mine. Shovel Test 1 was excavated in a pasture along the level upper reaches of the project marked for restoration. Shovel Test 2 was excavated in a sparsely wooded area near the center of the project area. Shovel Test 3 was excavated on the grassy slope overlooking the old mine. Shovel Test 4 was excavated in an area of tall grass and weeds near the confluence of the creek and its southern most tributary in the project area. No artifacts were collected in Shovel Test pits 2, 3, and 4. The location of Shovel Test 1 has been temporarily designated an archaeological site (Temp Site 4555-1). The artifacts recovered from Shovel Test 1 include rhyolite early reduction flakes, a rhyolite biface reduction flake, and an unidentified chert flake showing possible signs of utilization. Although much of the terrain along the eastern bank of Little Buffalo Creek is steeply sloped, the northern, western, and southern portions of the project area are characterized by floodplains sufficiently wide for human occupation. The presence of prehistoric artifacts suggests there is a moderately high potential for additional prehistoric cultural resources within the project boundary.

A letter summarizing the findings of the cultural resources records review and the archaeological reconnaissance was submitted to the NC SHPO on January 22, 2010. A response letter, dated February 2, 2010, from the NC SHPO stated that “We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.” As a result, no further

investigations were performed. Letters of coordination, including the NC SHPO concurrence, are provided in Appendix 11.

These findings were also summarized in the Categorical Exclusion (CE) document submitted March 8, 2010. The CE was approved on March 23, 2010 for the Little Buffalo Creek Stream Mitigation Project and a copy of this approval is provided in Appendix 11. Therefore, the proposed project is not likely to affect cultural resources.

3.7. Discharge

A flow meter was used to take flow measurements at various stages at the reference reach and at UT 7. A rough stage discharge curve was created, but high flows did not occur during the sampling period, limiting the utility of this data. Roughness coefficients were calculated using velocity, slope, and flow area data collected during the field effort and used in the hydrologic and hydraulic modeling effort.

3.8. Potential Constraints

3.8.1. Property Ownership and Boundary

The Site is enrolled in a perpetual conservation easement held by the state of North Carolina. Documentation of this enrollment and the property boundary survey are provided in Appendix 12. The conservation easement is also mapped on the design plan sheets found in Section 14.

3.8.2. Site Access

The northern portion of the Site can be accessed from Old Mine Road. The southern portion of the Site can be accessed from Kluttz Road. Areas requiring work can also be accessed through several pastures on Site. It is not anticipated that site access would act as a constraint.

3.8.3. Utilities

Based on a deed and title search, in addition to landowner input, there are no known utility right of ways that traverse the Site.

3.8.4. FEMA / Hydrologic Trespass

There are no Federal Emergency Management Act (FEMA) studied streams within the project reach and; therefore, FEMA coordination is not anticipated for this project. H&H models were used to confirm that there will be no hydrologic trespass as a result of this project. The results are provided in Appendix 8.

4. Project Site Streams - Existing Conditions

4.1. Existing Conditions Survey

The Site is comprised of the mainstream of Little Buffalo Creek from its entrance into Cabarrus County southward to its crossing of Kluttz Road at the downstream end of the Site. Four first order tributaries, two second order tributaries, and one third order tributary feed the mainstem from parcels belonging to three landowners. The upstream two thirds of the

mainstem are flanked by sparse vegetation, with the exception of one short reach. The downstream third of the Site is stable and well buffered.

Within the project site Little Buffalo Creek is a predominantly a Rosgen C-type channel. Little Buffalo Creek is a second order stream until its confluence with UT 1. From UT 1 to UT 7, Little Buffalo is a third order stream. The mainstem turns into a fourth order stream at its confluence with UT 7. Representative photos of the reaches of Little Buffalo Creek are provided in Appendix 1. The upstream two thirds of the mainstem of Little Buffalo Creek are primarily characterized by a vertically stable stream channel with a cobble/gravel substrate and numerous bedrock outcroppings. Portions of the mainstem are laterally unstable as evidenced by a bankfull width range of approximately 10 feet to more than 30 feet in areas with little persistent vegetation. Comparable bankfull widths within stable, preservation reaches range from 20 to 25 feet. Some sections of the mainstem have fairly good vegetation; however, unimpeded cattle access has reduced the ability of existing vegetation to absorb stream energy resulting in over widened channel dimension.

Within this upper section many of the small UTs originate from small farm ponds or springs located onsite. Seven UTs will receive some level of mitigation as part of the project. Currently cattle have access to all of the tributaries and only half of them have any vegetation beyond grass.

Land cover immediately to the north and south of the Site is primarily forest. Further upstream and downstream there are large agricultural fields adjacent to the creek. The majority of the Site is in cow pasture while the riparian areas consist of Piedmont/Mountain Bottomland Forest with a sparse understory (Schafale and Weakley 1990).

The widths of the existing mature forest buffer along the segments of Little Buffalo Creek and its tributaries vary but are generally forested immediately along the channel. The buffer is only about 10 feet in width at many locations. More detailed descriptions of the individual project reaches can be found in Section 2.4 above and in Section 4.1.5 below. Existing conditions are also displayed on the design sheets found in Section 14.

4.2. Channel Classification

Stream Classification was performed using the Rosgen Classification System which is predicated on combinations of morphological variables including dimension, pattern, profile, slope, and available sediment.

Little Buffalo Creek is predominantly a “C4” stream type as the overwhelming majority of the stream within the project reach has a width/depth ratio greater than 12 and has formed a riffle/pool bedform sequence with a gravel bed. Much of the stream lies on bedrock and has a fairly sinuous low flow channel. Stream banks are low but suffer instability, primarily due to hoof shear from to cattle intrusion rather than shear stress. In a few short reaches the stream narrows considerably due to a combination of lack of bedrock bed and fairly good bank vegetation and would be considered and “E4” stream type, but these reaches make up a very small fraction of the onsite length. Similarly there are a few small sections of stream that are wider and more entrenched and would be classified an “F4” stream type.

The upper end of UT 7 is a wide flat stream as it exits the two culverts under Old Mine Road. A head cut extends nearly half way from the confluence back to the culvert, UT 7 is an “F4” stream type that is itself entrenched albeit not as much as the head cut section. The stream has

cut down to bedrock and the beginnings of a "C4" stream type are starting to form within the "F4" due to the vertical stability being provided by the rock and culvert. Downstream from the confluence of UT 7 and the mainstem of Little Buffalo Creek, the stream narrows, and is even more severely entrenched. The stream's side slopes are vertical and beginning to fall in on themselves, slowly widening the stream.

The other stream reaches and tributaries are proposed to undergo enhancement or preservation and therefore their classifications are listed in Table 4 instead of discussed here.

4.3. Valley Classification

Valley Classification was performed using the Rosgen Classification System. Both Little Buffalo Creek and UT 7 were classified as having valley type 8 (Rosgen 1996). This valley type is defined as long and broad with gentle relief; alluvial terraces and floodplains are the predominant depositional landforms and most often stream type "C" and E" form riffle/pool bedforms (Rosgen 1996).

UT 5 and UT 6 were not classified as they are spring fed and have valleys of less than 200 feet. Similarly the portion of UT 1 being protected was less than 200 feet and therefore was also not classified.

UT 2, UT 3, and UT 4 were classified as having valley type II. This valley type is defined as having moderate relief, moderate side slope gradients, and valley floors developed from parent material alluvium and colluvium (Rosgen 1996). Due to low sediment supply, the stream type "B" is most often found as the stable type within this valley and each of these tributaries exhibits predominantly "B" streams.

4.4. Discharge

The bankfull discharge of Little Buffalo Creek and UT7 were calculated by calibrating bankfull discharge at the nearby USGS Gage Station, gage # 02125000 (Big Bear Creek near Richfield, NC), and relating the flows comparing drainage areas (Rosgen 1996). Calibration of return intervals considered 53 years of available data. The discharge associated with field surveyed bankfull indicators corresponded with a return interval of approximately 1.14 years. Appendix 7 shows annual peak flows from 1955-2007.

Bankfull discharge for Little Buffalo Creek was determined to be 115 cubic feet per second (CFS) in the upstream restoration reach and 163 CFS in the lower restoration reach. UT 7 was calculated to have a bankfull discharge of 96 CFS (UT 7 enters Little Buffalo Creek downstream of the lower restoration reach).

The NC Regional Curve for Rural Piedmont streams was consulted as well; however, the curve calculated data resulted in a flow that was field calibrated to a feature deemed to be inner berm. This feature was fairly distinct and therefore was incorporated into the natural channel design of both Little Buffalo Creek and UT 7.

4.5. Channel Morphology (pattern, profile)

A portion of Reach 1, a portion of Reach 3, and all of UT 7 are going to be fully restored with a natural channel design that will result in the construction of a completely new channel in

each instance. Since the other reaches (enhancement and preservation) will receive less manipulation of morphology only the three restoration reaches will be discussed in this section.

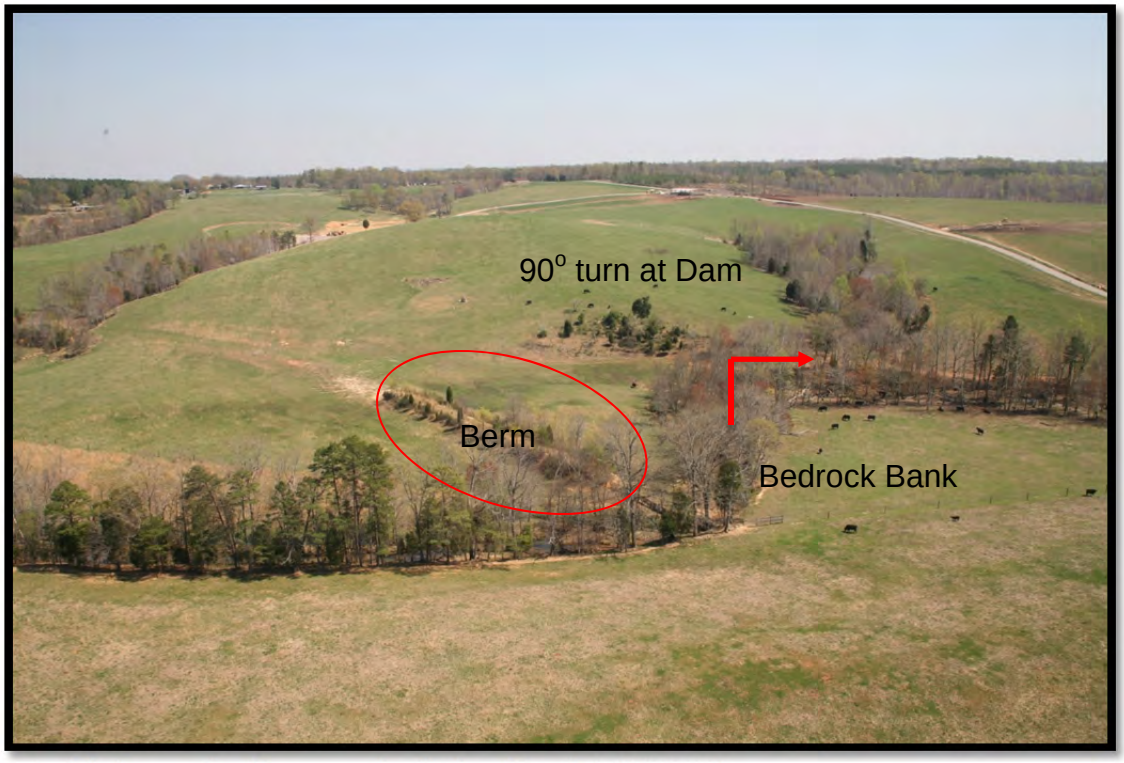
Reach 1

The portion of Reach 1 that is to be restored lies within a portion of the landscape that appears to have been a pond at some point in time. At the upstream end of the reach, the stream squeezes through an opening defined by a right bank of bedrock and a left bank that is several feet higher than the surrounding grade. The left bank appears to be the remnants of the berm that defined the back of the pond historically. The stream hugs the high bank on the right while the left floodplain is low and flat as it was the old pond bed. The end of the reach is defined by the stream taking a 90 degree right turn. The remnants of the stone dam are still present on the terrace high above the left stream bank.

A comprehensive list of dimension measurements for the 438 feet of proposed restoration of Reach 1 is shown in Table 5. The bankfull widths range from 46 to 83 feet and the width to depth ratios range from 33 to 128. Since the stream was pushed up against the valley wall, it has virtually no pattern, or a sinuosity of nearly 1.0, in this section. Similarly the stream rests on bedrock for more than half its length, so there is not a common step-pool morphology found in this reach.

Reach 1 (upstream limit of restoration reach) - Bedrock Bank on the right. (3/29/2010)

Reach 1 (downstream limit of restoration reach) – Remnants of dam (circled). (12/9/2009)



Aerial photograph of the restoration limits of Reach 1. (4/2/2010)

Reach 3

The portion of Reach 3 that is to be restored has been pushed up against the left wall of the valley and has cut a vertical bank over time. In addition to being placed at the toe of the valley slope, the restoration reach occurs in a section that is transitioning from one of the widest parts of Reach 3 to some of the narrowest of Reach 3.

Reach 3 – restoration to begin where narrow channel leaves wide channel on left. (6/18/2008)

Reach 3 – restoration will relocate the restored channel to the right, away from steep bank. (6/18/2008)

Reach 3 – restored channel will tie into narrower, stable channel downstream. (6/18/2008)

A comprehensive list of dimension measurements for Reach 3 is shown in Table 5. The bankfull widths range from 34 to 48 feet and the width to depth ratios range from 19 to 40. The entire restoration reach, 267 feet of stream, forms one long curve pushed up against the valley wall and has no additional pattern to be measured. This portion of the reach rests on bedrock so there is not a common step-pool morphology found in this reach. The bedrock is adding to the stress on the high bank as the stream can no longer cut down to dissipate energy and instead is migrating laterally.

UT 7

UT 7 is proposed as restoration. Though the mean bankfull depth is only a foot, the high streambanks are over six feet deep in the shallow portions and over 10 feet deep in some areas. In the upstream half of the reach the right bank is the low bank, about at the midpoint they even out, and the downstream portion has the low bank on the left. The reach will be reconnected just upstream of its current confluence and the cut from the new channel will be used to fill much of the existing channel.

Since UT 7 has cut down to bedrock and reached vertical stability, consideration was given to only performing streambank enhancement activities and allowing the channel to remain in place. However, it was decided that the banks were too steep and the best design approach would be to reestablish the channel on the historic floodplain in order to preserve the existing mature vegetation. Both the H&H modeling and sediment transport analysis indicated the need for a wider, shallower channel than what exists currently.

Placing the stream channel back onto the historic floodplain also allows for the creation of a wider, shallower, and more sinuous channel more in character with the channel's natural condition. Upstream of the culverts under Old Mine Road, the channel has a very high width to depth ratio. Downstream of the two culverts, the channel has downcut to the bedrock and is beginning to widen back to its equilibrium point, but has not yet reached the appropriate width. Establishing the proper width to depth ratio would allow for a gradually changing flow and sustainable sediment transport.

Also by raising the bed of the stream close to the invert of the culvert, there will no longer be a drop of several feet from the invert of the downstream end of the culvert to the water's surface in the scour pool. This proposed condition is better for fish passage through the culverts. The increased bed elevation will not cause hydrologic trespass.

Currently, UT 8 joins enters UT 7just a few tens of feet below the confluence with Little Buffalo Creek. Both UT 7 and UT 8 have downcut due to the elevation of the mainstem. UT 7 has cut all the way back to the culverts at Old Mine Road; UT8 has only headcut halfway back to the road due to a bedrock outcropping in its halting the cut. A short portion of UT 8 will be restored and connected to UT 7 further upstream in order to avoid raising its bed.

UT 7 – The culverts under Old Mine Road are the upstream limit of the restoration reach. (3/29/2010)

UT 7 – Looking downstream within the upper portion of UT-7. The higher bank is on the left (3/29/2010).

UT 7 – Downstream section of UT-7 looking upstream right after a storm event. (12/9/2009)

A comprehensive list of dimension measurements for UT 7 is shown in Table 5. The bankfull widths range from 20 to 30 feet and the width to depth ratios range from 20 to 32. Aside from the initial plunge pool below the culverts, this entire reach is littered with bedrock and there is a weak step-pool profile found. Even the low bank within the reach is several feet higher than the bed. With the stream having reached bedrock it is now transferring the stress onto the streambanks. With the depth of the channel now below the root zone of most trees, the added shear stress and lack of roots has allowed the stream to start undercutting the stream banks in some places. The stream is predominantly straight until after its confluence with its UT then it has a gentle curve until it reaches the mainstem.

4.6. Channel Evolution

The mainstem of Little Buffalo Creek has likely been a "C4" channel for the recent past and will continue for the foreseeable future. Much of it sits on bedrock and it is at the bottom of a wide valley where it is not constrained so it is in a state of equilibrium except for a few places where it has been moved or cattle have caused bank trauma.

The UT 7 channel likely started as a "C4" stream type that over the years has devolved into an "F4" over the years in response to a combination of the farmers straightening it, the cattle creating bank instability, and the increased flow due to mining practices directly upstream.

Through their evolution, both Little Buffalo Creek and UT 7 have downcut until they have reached bedrock. In their unstable reaches, both streams have created vertical banks. Over time these streams would undercut the banks causing them to fall in on the stream, lowering the bank height as the stream attempts to reach a state of equilibrium by accessing its newly

formed floodplain. The design channels restore the state of equilibrium without having to erode the existing landscape.

4.7. Channel Stability Assessment

The Bank Erodibility Hazard Index (BEHI) method was used to assess streambank stability throughout the project site (Rosgen 2006). The majority of the mainstem of Little Buffalo Creek rated as low or very low on the BEHI assessment. The exceptions being portions of the stream that are to undergo restoration or enhancement level 1 mitigation; those reaches scored as follows:

- Little Buffalo Creek Reach 1(Restoration portion), BEHI rating of Very High
- Little Buffalo Reach 3 (Restoration portion), BEHI rating of Very High
- Little Buffalo Reach 4 (all of reach including concrete removal area), BEHI rating of Moderate

The same is true for the tributaries; they had BEHI ratings of low or very low except for the following reaches:

- UT-3 (E-I portions), BEHI rating of High
- UT-4 (E-I portions), BEHI rating of High
- UT-4 (E-II portions), BEHI rating of Moderate
- UT-7 (Lower Restoration portion), BEHI rating of High
- UT-7 (Upper restoration portion), BEHI rating of Very High

4.8. Bankfull Verification

The bankfull indicators in the disturbed portions of the site were somewhat obscured due to the cattle onsite accessing the stream regularly. Reaches immediately upstream and downstream were used to compare indicators. In the more stable sections, the field indicators used to identify bankfull included the back of point bars, the upper break in slope of the bank, and the presence of inner berms. In the more disturbed areas, depositional features provided the best indication of bankfull.

Project reach bankfull discharges were compared to the NC Rural Piedmont Regional Curve (Harman, W.H. *et al.* 1999) and the bankfull verification data LBG collected at the USGS Big Bear Creek Gage data (USGS, 2010). The regional curve underestimated bankfull discharges for the project reach, but aligned well with the inner berm elevations. Therefore, this information was not relied upon for verifying bankfull. Assuming a linear relationship between bankfull discharge and drainage area, the bankfull discharges for the reference reach corresponded well to the verified Big Bear Creek gage bankfull discharge.

4.9. Vegetation Community Type(s) Descriptions and Disturbance History

The Site consists mostly of cow pasture; the historical vegetative community has been almost completely disturbed. Areas along the stream banks of the mainstem and its tributaries consist of Piedmont/Mountain Bottomland Forest with a sparse understory and several invasive species. Along most riparian segments, the buffer is 10 feet in width. Only the southern portion of the east bank of Little Buffalo Creek has an intact, riparian buffer forest of greater than 50 feet wide.

The vegetative communities present vary depending on several factors; exposure to cattle grazing, position relative to channel dimension, seasonal soil moisture availability and invasive species presence. Portions of the main stem not subjected to grazing have a prominent shrub structural layer dominated by common privet (*Ligustrum sinense*), likey a result of past grazing, with spice bush (*Lindera benzoin*) and greenbriar (*Smilax rotundifolia*) common native species on the bankfull terrace and higher alluvial terraces. The tree structural layer is comprised of green ash (*Fraxinus pennsylvanica*), sweet gum (*Liquidambar styraciflua*) and tulip poplar (*Liriodendron tulipifera*) on the bankfull terrace and higher alluvial terraces. The composition of the community shifts to a tree layer dominated by river birch and sycamore (*Platanus occidentalis*) with a patchy shrub layer of primarily silky dogwood (*Cornus amomum*) and hazel alder (*Alnus serrulata*) which occurs along the low flow channel and inner-berm channel features up to the bankfull terrace. Seasonal moisture availability next to ephemeral and intermittent channels on the terrace of the main stem favor tulip poplar and spicebush while drier areas of floodplain terrace favor white oak (*Quercus alba*) and red bud (*Cersis canadensis*). Grazed sections of the main stem have a thin to absent shrub layer but the tree layer is much the same only sparse and that tree of heaven (*Ailanthus altissima*) replaces tulip poplar in community structure.

All of UT 7 is subject to grazing. The riparian vegetation exists on an alluvial terrace above bankfull as the channel has incised and the groundwater table driving stream flow is disconnected from the immediately adjacent riparian vegetation. There is no shrub structural component to the vegetative community. Vegetation includes some invasive species such as tree of heaven, mimosa (*Albizia julibrissin*), Chinese privet, and microstegium (*Microstegium vimineum*). Tree of heaven is abundant however a few large sweet gums have persisted.

5. Reference Streams

5.1. Watershed Characterization

The reference reach used for the project was the upstream-most portion of Reach 1 of Little Buffalo Creek (Figures 6 through 10). This reach extended from the gate crossing upstream to the property line. This portion of the reach had little sign of degradation due to cattle, fair vegetation, and in many cases was sitting on bedrock which helps yield stable morphology. The reference reach watershed is fairly undeveloped and consists primarily of low density residential areas, forested areas, and pastures.

Some additional dimension and pattern measurements were made immediately upstream of the property line. Additional dimension and pattern measurements were made throughout the mainstem of Little Buffalo Creek within the project bounds.

5.2. Channel classification

The reference channel is slightly entrenched with a width to depth ratio that ranges from 31 to 64 with an average ratio of 47. Additionally the reference reach had a high sinuosity of 1.25, a slope of 0.38, and a gravel bed. These factors key out to a Rosgen classification of a “C4” stream.

5.3. Discharge (bankfull, trends)

A flow meter was used to take flow measurements at various stages at the reference reach. A rough stage discharge curve was created, but high flows did not occur during the sampling period limiting the utility of this data. Roughness coefficients were calculated using velocity, slope, and flow area data and used in the hydrologic and hydraulic modeling effort.

5.4. Channel Morphology (pattern, dimension, profile)

Supplemental data was collected throughout the project site and even one property upstream, but only the data from the cross sections is shown in the morphological table.

Dimension

Four riffle cross sections were surveyed and the following minimum, **average**, and maximum measurements were obtained:

- $W_{Bankfull}$ = 43, **52**, 64 (ft.)
- $A_{Bankfull}$ = 55, **59**, 65 (sq. ft.)
- $D_{Bankfull}$ = 0.98, **1.16**, 1.98 (ft.)
- W/D = 31, **47**, 64 (dimensionless)

Additionally, in both straight-pools and curved-pools, cross sections were surveyed to collect data for use in creating the design pools.

Pattern

The reference reach was relatively straight, so pattern measurements were sought out in many of the other stable reaches throughout the project site as well as stable sections immediately upstream of the project reach. Additionally, pattern measurements of the inner berm were taken in both locations. The natural channel design pattern was made more conservative to address the fact that the new channel will not have the mature vegetation the reference reaches currently contain.

Profile

Since the reference reach was located on site it was influenced by all of the same parameters that will impact the portions of the project that are scheduled to undergo construction. The slope, soil type, vegetation, abundance of bedrock, and other factors within the reference reach were all as close to exact as one could get to the proposed restoration reaches.

The reference reach consisted of two sub-reaches with respect to its profile or slope, each reach was approximately 50 percent of the overall reach. The upstream end of the reach has a 0.74 percent slope while the second half of the reach is much flatter with only a 0.16 percent. The reaches overall slope is 0.46 percent. Riffle slopes ranged from near one percent to in excess of four percent.

5.5. Channel Stability Assessment

The same BEHI assessment that was conducted throughout the project site was completed on the reference reach. The assessment resulted in “very low” values recorded in the reference reach.

5.6. Bankfull Verification

In the more stable sections, the field indicators used to identify bankfull included the back of point bars, the upper break in slope of the bank, and the presence of inner berms. In the more disturbed areas, depositional features provided the best indication of bankfull. This information was supplemented with anecdotal evidence from the landowners, who have monitored the weather and stream high flow events closely.

Project reach bankfull discharges were compared to the NC Rural Piedmont Regional Curve (Harman, W.H. *et al.* 1999) and the bankfull verification data LBG collected at the USGS Big Bear Creek Gage data (USGS, 2010). The regional curve underestimated bankfull discharges for the project reach, but aligned well with the inner berm elevations. Therefore, this information was not relied upon for verifying bankfull. Assuming a linear relationship between bankfull discharge and drainage area, the bankfull discharges for the reference reach corresponded well to the verified Big Bear Creek gage bankfull discharge.

5.7. Vegetation Community Type(s) Descriptions and Disturbance History

The community types and disturbance history are discussed in section 4.1.9.

6. Project Site Wetlands

Wetland scientists from Berger performed a wetland investigation on the Site in July 2008. The investigation was conducted in accordance with the procedures outlined in the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987). Two small wetland seeps were identified and delineated, one wetland along UT 5 and one wetland along UT 6 (Figure 4). These wetlands were captured in the permanent conservation easement and protected in perpetuity, although no restoration work will occur there.

7. Reference Wetlands

Wetland Mitigation is not proposed as part of this project; therefore, reference wetlands are not necessary.

8. Project Site Restoration Plan

Within the proposed project site, Little Buffalo Creek and its UTs have impaired water quality due to stressors that are biological (bacteria such as fecal coliform), chemical (fertilizers) and physical (cattle on streambanks and riparian zone) in origin. Coupled with the poor water quality, the lack of riparian buffers throughout much of the Site has greatly devalued both aquatic and terrestrial habitat. Berger will mitigate approximately 14,432 linear feet of stream channel along Little Buffalo Creek and its UTs.

Little Buffalo Creek has been divided into six reaches within the project site using the natural divisions of the landscape as points of transition. Additionally, seven UTs are identified of the project site. All of the reaches are shown on Figures 1 through 4. The 13 reaches can be defined in the following way:

- Reach 1 – Upstream property boundary to existing cattle crossing (CC1) at Old Mine Road,
- Reach 2 – Below Old Mine Road to existing cattle crossing (CC2) at first wire crossing,
- Reach 3 – Existing cattle crossing (CC2) to existing cattle crossing (CC3) below UT 4,
- Reach 4 – Existing cattle crossing (CC3) to UT 3,

- Reach 5 – UT 3 to Chains at property boundary (proposed cattle crossing at Reach 5/6 point),
- Reach 6 – Chains at property boundary to Kluttz Road,
- UT 1 – Feeds Little Buffalo Creek immediately upstream of Old Mine Road from the west,
- UT 2 – Feeds Little Buffalo Creek from west in Reach 2 (originates at pond),
- UT 3 – Feeds Little Buffalo Creek from west at Reach 4/5 transition (originates at 2nd pond),
- UT 4 – Feeds Little Buffalo Creek from east at Reach 3/4 transition,
- UT 5 – Feeds Little Buffalo Creek from east within Reach 5,
- UT 6 – Feeds Little Buffalo Creek from east immediately upstream of Reach 5/6 transition, and
- UT 7 – Feeds Little Buffalo Creek from west almost immediately upstream of Kluttz Road, includes UT 8, a tributary to UT 7.

The proposed stream mitigation concept for Little Buffalo Creek consists of a combination of activities along distinct reaches of the mainstem of the creek and its tributaries. Mitigation approaches include stream restoration, enhancement (levels I and II) and preservation. Collectively, the mitigation effort will result in an improved headwater stream system that will improve water quality, stream habitat, and riparian habitat.

Restoration activities will create a new, stable stream channel with the appropriate dimension, pattern, and profile to transport perennial flow and sediment, and will re-connect the stream to its floodplain. Reestablishment of vegetation and cattle exclusion will also occur as part of the restoration activities.

Enhancement activities will include reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. In the case of enhancement level I the activities will also include reshaping or relocating the bed and banks.

Preservation will be conducted within portion of the stream corridors that have intact riparian forests and stable stream reaches.

An illustration of the proposed stream restoration concept for the Little Buffalo Creek Restoration site is provided in Figure 3.

Reach 1 – Restoration and enhancement level II is proposed for this reach. This reach has a section that was previously a mill pond. The stream currently hugs the valley wall from the former inlet of the pond and makes an abrupt 90 degree turn at the exit of the old pond. Restoration will include re-aligning the stream channel for a more natural flow for 438 feet. Two log vanes are proposed along the realignment to slow the energy of the water. This restoration will bring the stream closer to its original landscape position, restore sinuosity, and alleviate the instability associated with the turn. The old channel will be filled. The remaining 1862 feet of the stream length will undergo enhancement level II, which involves reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

Reach 2 – Only enhancement level II is proposed for 1248 feet on this reach. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

Reach 3 – Restoration and enhancement level II is proposed for this reach. This reach is pushing against its left bank and has severely undercut the stream banks, which are now greater than 6 feet high. Restoration will align a new channel for 267 feet where the stream historically existed along the center of the valley floor. The old channel will be filled and the bank will be repaired. Just upstream of the restoration segment, the channel has over-widened. Placing trees along the east bank is proposed to help direct preferential flow towards the center of the channel. The remaining 808 feet of stream will undergo enhancement level II, which involves reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

Reach 4 – Enhancement level I and II are proposed for this reach. Enhancement level I is proposed for the 120 foot segment that contains concrete slabs along the right stream bank just upstream of the confluence of UT 3. The concrete is to be removed and the stream's dimension, pattern, and profile will all be adjusted throughout this segment. The remaining 721feet of stream will undergo enhancement level II, which involves reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

Reach 5 – Only enhancement level II is proposed for 952 feet on this reach. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

Reach 6 – Preservation is proposed for this 2,053 foot reach. This section of channel has intact riparian forest and a stable stream bed.

UT 1 – Only enhancement level II is proposed for 109 feet on this reach. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

UT 2 – Both preservation and enhancement level II is proposed for this reach. The upper 335 feet will be preserved, while the lower 616 feet will be enhanced. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

UT 3 – This reach has a short segment of restoration through a former pond, followed by sections of enhancement level I and enhancement level II. The first 197 feet consists of restoration where the segment was previously ponded and there is no existing concentrated flow path. The stream's dimension, pattern, and profile will all be established throughout this segment by cutting a channel through the ponded area. Additionally the pipe section will be removed from this section. The next 263 feet will consist of enhancement level II. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed. The following 515 feet will consist of enhancement level I. This reach has down cut. The stream banks will have to be laid back throughout this reach in order to reduce the shear stress along the stream banks. These actions will affect the stream's dimension and pattern. Additionally, in some sections the profile will be adjusted and a pipe section will be removed from this section as well. The lower 500 feet will consist of enhancement level II.

UT 4 – Enhancement level I and II are proposed for this reach. The upper 431 feet will be enhancement level II. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any

existing fence will be removed. The lower 397 feet will be enhancement level I. The lower segment of this reach is incised due to head cutting from the confluence of LBC. The stream banks will have to be laid back throughout this reach in order to reduce the shear stress along the stream banks. This reach is fairly well forested and small construction equipment will be necessary, possibly requiring some segments to be completed by hand.

UT 5 – Only enhancement level II is proposed for 184 feet on this reach. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

UT 6 – Only enhancement level II is proposed for 151 feet on this reach. This includes reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

UT 7 –Restoration is proposed for 1,374 feet of UT-7. This reach has been straightened and has downcut several feet until it has reached bedrock. It will be almost entirely reconstructed on its original floodplain and will join the existing channel just above the confluence with LBC. The old channel will be plugged at specified locations and filled with the dirt excavated from the new channel. Two rock cross vanes are proposed, one along the upper section and one below the confluence with UT-8, an unnamed tributary to UT 7. A series of 12 step pools is proposed along the lower segment for approximately 180 feet to account for the drop in elevation. The segments of enhancement include reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. Any existing fence will be removed.

Mitigation Types by Reach (Linear Feet)

Reach Name	*Restoration*	*Enhancement I*	*Enhancement II*	*Preservation*
Reach 1	438	0	1,862	0
Reach 2	0	0	1,248	0
Reach 3	267	0	808	0
Reach 4	0	120	721	0
Reach 5	0	0	952	0
Reach 6	0	0	0	2,053
UT 1	0	0	109	0
UT 2	0	0	616	335
UT 3	0	515	763	0
UT 4	0	397	431	0
UT 5	0	0	184	0
UT 6	0	0	151	0
UT 7	1,374	0	0	0
UT 8	100	0	0	0

Stream mitigation for the Little Buffalo Creek Stream Mitigation Site is being conducted to protect ecologically important streams in perpetuity, through the implementation of a conservation easement owned by the State of North Carolina. Stream mitigation will restore, enhance, and preserve the existing riparian corridor, aquatic habitat and stream hydrology of the stable perennial stream channels by establishing a permanent conservation easement along 13,641 linear feet of stream. The easement protects a minimum 50-foot wide forested buffer along both sides of the creek and encompasses 47 acres. Where necessary, the easement is

protected by fencing to keep livestock out of the 50-foot buffer. The easement was recorded by Cabarrus County and is held by NCEEP. The conservation easement is shown on design sheets 19 to 28 in Section 14.0.

A few areas of invasive floral species were identified in patchy distributions at various densities, particularly along the banks of the mainstem and UT 7. Invasive species along the mainstem include: multiflora rose (*Rosa multiflora*) and Chinese privet. Invasive species along UT 7 include: tree of heaven, mimosa, microstegium, and Chinese privet. No specific control effort is detailed for these species; however, they will be removed during the construction process.

Throughout the project area, native species will be planted in order to re-establish a native Piedmont/Mountain Bottomland Forest, which is currently found upstream and downstream of the Site. Restoring a forested riparian corridor will also provide additional forest habitat as well as provide a connection between the intact hardwood forests to the north of the Site and the forested corridor to the south of the Site. The proposed species for planting can be found on Table 7 in Section 12 of this report.

Berger proposes to exclude cattle from the stream along both sides of the upstream two properties by extending fencing the length of the two properties, tying into existing fencing where possible. Two cattle crossing locations have been agreed upon, in principal, by the landowners (Figure 4). Portions of the downstream two properties will be fenced as needed as cattle do not have access to the properties in their entirety. Agreed upon fencing will be either 4 foot tall woven wire with one strand of barbed wire across the top or electric fence.

8.1. Restoration Project Goals and Objectives

The original stream channel has been altered by years of ranching activities, including cattle access to the stream and riparian zone. Several reaches of the stream have bedrock in their streambed and vertical migration of the stream has been confined to a small percentage of the project site. The stability in the vertical direction coupled with the loss of vegetation along the stream due to cattle accessing the stream via the streambanks have led to streambank failure and lateral stream migration on several stream reaches throughout the Site.

The goals of the proposed Little Buffalo Creek Stream Restoration project include, but are not limited to, the enhancement of water quality and aquatic/terrestrial habitat, stream stability improvement, and erosion reduction. The uplift of these stream functions specifically requires:

- protecting and improving water quality through the removal or minimization of the biological, chemical, and physical stressors,
  - reducing sediment input into the stream from erosion,
  - reducing non-point pollutant impacts by removing livestock access (including restoring forested buffer,
  - protecting headwater springs
- improving aquatic and terrestrial wildlife habitat,
  - moderating stream water temperatures by improving canopy coverage over the channel; and,
  - restoring, enhancing, reconnecting, and protecting valuable wildlife habitat.
- Restore floodplain connectivity
  - reestablishing a floodplain connection thereby dissipating energy associated with flood flows.

In addition to the ecological uplift that the project will provide to the Site through the improvement of the stream functions, this project establishes the following environmentally advantageous goals:

- providing a water source for livestock removed from the stream and riparian corridor;
- reducing the number of locations that livestock are able to cross the stream; and
- providing a safe and environmentally appropriate stream crossing points for livestock.

In order to achieve the project goals, Berger proposes to accomplish the following objectives:

- fence the cattle out of the stream and riparian corridor,
- remove invasive vegetative species from the riparian corridor,
- restore and enhance unstable portions of the stream,
- preserve the stream channel and banks through a conservation easement, and
- plant the riparian corridor with native tree and shrub vegetation.

The expected ecological benefits and goals associated with the Little Buffalo Creek site mitigation plan serve to meet objectives consistent with the resource protection objectives detailed in the Yadkin-Pee Dee River Basinwide Water Quality Plan, 2008.

8.1.1. Designed Channel Classification and/ or Wetland Type

Reach 1

The proposed channel for Reach 1 is merely a continuation of the channel immediately upstream of it, only in a proper location. The existing channel is appropriately sized and has a stable bed as it sits on bedrock; however the right bank is vertical and extremely high. Additionally the valley makes a turn to the right and the channel currently runs directly into the valley wall forcing a 90 degree right turn. The proposed channel is slightly entrenched and will have a width to depth ratio of 26. Additionally the reach will have length added in the form of a curve to replace the 90 degree turn. This will reduce the overall reach slope to 0.38 percent, but will increase the overall reach sinuosity to 1.25. The substrate of the reach will remain a gravel bed. These factors key out to a Rosgen classification of a “C4” stream. The design for this reach is shown on the design plan sheets in Section 14.

Reach 3

The section of Reach 3 to be restored is currently a long curved reach; however, the proposed channel will bypass the curve that is cutting into the high bank and reconnect the stream to its floodplain. The entrenchment ratio will be greater than 2.2 and the width to depth ratio is proposed at 22. This width to depth ratio pushes the lower limit of the reference data, but sections immediately upstream of the impaired reach had even smaller width to depth ratios and were stable. With the implementation of the design, Reach 3’s slope will decrease to 0.46 percent, and the sinuosity will decrease to 1.09. The channel will continue to be considered a gravel bed stream. These factors key out to a Rosgen classification of a “C4” stream for the design channel. The design for this reach is shown on the design plan sheets in Section 14.

UT 7

From immediately downstream of its plunge pool at the foot of the two culverts under Old Mine Road to its confluence with Little Buffalo Creek, UT 7 is disconnected from its floodplain. Elevating this reach will reconnect the two and the result will be an entrenchment ratio greater than 2.2 and the width to depth ratio is proposed at 26. Again this is slightly

narrower and deeper than the reference, but this is to ensure that the reach is able to move some of the larger particles within its bedload. The design channel will have a sinuosity of 1.17 and an overall slope of 0.68 percent. More specifically, the majority of the stream will have a 0.16 percent slope and the step pool section transitioning to the tie in point just about Little Buffalo Creek will have a slope of 3.00 percent. The new channel will be a gravel bed stream that is classified as a Rosgen classification of a "C4" stream. The design for this reach is shown on the design plan sheets in Section 14.

8.1.2. Target Wetland Communities / Buffer Communities

In the areas on Site of agricultural land where the riparian buffer forest canopy is non-contiguous, seedlings of native woody species will be planted. There are no target wetland communities for this project. The goal of the planting scheme will be to establish a riparian forest community consistent with a Piedmont/Mountain Bottomland Forest and to complement the existing riparian vegetation.

8.2. Sediment Transport Analysis

The energy a stream has to transport sediment (or stream power) is directly related to two factors: discharge and slope. As a stream progresses from upstream to downstream, typically its discharge increases and its slope decreases. This dynamic influences the stream's overall power, as well as the stream's balance of the two principal components of its sediment load: bed load and wash load.

As a check that the proposed design will create a stable channel that will not aggrade or degrade over time, but adjusts within stable limits, the competence of the restored channels was evaluated. Sediment transport competency is a measure of the stream's ability to move a particular grain size and is measured in force (lbs/ft^2).

For the purposes of this report, the following calculations are used to make the competence prediction:

Shear Stress

$$\tau = \gamma RS$$

Where:

τ = Shear stress (lb/ft^2)
γ = specific gravity of water (62.4 lb/ft^3)
R= Hydraulic radius (ft)
S = Slope (ft/ft)

Dimensionless Shear stress

$$\tau_c^* = \frac{\tau}{(\rho_s - \rho_w) g D_{50}}$$

Where:

τ_c^* = Dimensionless shear stress
ρ_s = density of rock
ρ_w = density of water
g = acceleration due to gravity (ft/s)
D_{50} = Median grain Size

The table below summarizes the existing and proposed sediment transport competency calculations for the restoration reaches. Enhancement reaches were not analyzed because they are currently stable with respect to sediment transport. For each restoration reach, the proposed conditions reduce the shear forces acting on the channel bottom, resulting in a slight reduction in the grain size that the channel can mobilize. The median movable grain size is still within the gravel range in each case. The bankfull shear stress predicts that each restored reach will be capable of moving particles ranging from 20 – 33 mm, closely corresponding to the existing material on site. The proposed channel dimensions will not increase the potential for vertical incision, but rather will reduce this tendency. Additionally, the use of constructed riffle and pool features and structures throughout the proposed restoration areas will provide additional stability.

	Reach 1 Upper Restoration Area		Reach 3 Lower Restoration Area		UT7	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Hydraulic Radius (ft)	1.14	1.35	1.48	1.76	0.96	0.96
Slope (ft/ft)	0.0047	0.0038	0.0067	0.0047	0.008	0.0068
Dimensionless shear stress	0.35	0.32	0.62	0.52	0.48	0.41
Median Movable Particle at Incipient Motion (mm)	21	20	38	33	30	26

8.3. HEC-RAS Analysis

A hydrologic and hydraulic analysis of Little Buffalo Creek was conducted to verify that the proposed restored Little Buffalo Creek dimensions developed from reference reach and regional curve data are appropriate and to determine what, if any, impacts will occur off-site as a result of the proposed creek/tributary widening and realignment. The hydrologic analysis (surface water hydrology) of Little Buffalo Creek was performed using the United States Army Corps of Engineers Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) model, which yielded the peak flood discharges for four storm events (1.5-year, 2-year, 5-year, and 100-year storm events). The peak discharges from the HEC-HMS model were used in the Hydrologic Engineering Center's River Analysis System (HEC-RAS) to determine water surface profiles, channel velocities and hydrologic trespass resulting from the project implementation. To be able to quantify the impacts that might occur as a result of channel modification, a baseline condition (existing condition) was first modeled and the results were then compared to the proposed channel modification. This information was utilized to develop the proposed restored channel geometry and to determine whether the restored stream will impact the existing condition flood elevations for various storm events. The following report sections describe the methodology, results and conclusions of the hydrologic and hydraulic analyses.

8.3.1. Hydrologic Analysis

The hydrologic analysis for this project incorporated available data and implemented USDA-NRCS recommended procedures to estimate the peak runoff rates for the site drainage system, consisting of an existing main channel of Little Buffalo Creek and its multiple tributaries. Stormwater peak runoff rates (design flood discharges) for the contributing drainage areas of Little Buffalo Creek and its tributaries were calculated using the HEC-HMS (version 3.4) computer program, which simulates precipitation-runoff processes. The Soil Conservation Service (SCS) runoff unit hydrograph approach was used for the flow computation methodology. The SCS method is based on the procedures outlined in the June 1986 edition of Technical Release 55–Urban Hydrology for Small Watersheds (TR-55), published by the U.S. Department of Agriculture, Soil Conservation Service (USDA, 1986).

8.3.1.1. Data Sources

Parameters used to estimate the stormwater peak runoff rates include the drainage area, the runoff curve number, and the watershed lag time. The drainage areas were delineated utilizing available site survey contours. Beyond the limits of the site survey, the survey contours were supplemented with additional 1-ft interval contours that were generated using the U.S. Geological Survey (USGS) National Elevation Dataset (NED) digital elevation models (DEM). The DEM data were imported into ArcMap 9.3, and 1-foot interval contours were generated using the Spatial Analyst and the 3D Analyst extensions. The total contributing drainage area to the downstream terminus of the project site was estimated to be approximately 6.25 square miles. The overall drainage area of the project site was divided into twenty-one sub-areas, which first discharge to the multiple tributaries before finally emptying to the main Little Buffalo Creek. The drainage area was divided based on the available topographic and existing drainage information. Delineated drainage areas for existing and proposed conditions are shown in Appendix 8I.

Soils information for the contributing drainage sub-areas was obtained from the United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) Web Soil Survey for Cabarrus County and Rowan County, North Carolina. The land cover data was obtained from the USGS National Land Cover Dataset (NLCD). The land use classifications of the contributing drainage sub-areas of the Little Buffalo Creek project site are primarily agricultural land and woods. Field visits, supplemented by aerial photograph and county zoning map reviews, were performed to obtain existing and proposed land use information.

8.3.1.2. Weighted Curve Number Computations

The weighted runoff curve number computations were performed using the NRCS Soil-Cover Complex methodology, as outlined in TR-55 and the National Engineering Handbook. Area-weighted averages of runoff curve numbers for each unique combination of land use and soil type (soil-cover complex methodology) were computed to evaluate the weighted curve number for each sub-watershed. The curve numbers assigned for each unique land use-soil hydrologic soil group combination are adopted from TR-55, for antecedent moisture condition II (AMC-II). The weighted runoff curve number calculations for all sub-watersheds are included in Appendix 8B.

8.3.1.3. Watershed Lag Time Computations

The watershed lag time was calculated separately for each sub-watershed to better simulate the peak flow hydrograph responses and flow combinations through the project site. The NRCS Watershed Lag Method (also known as the NRCS Curve Number Method) was used to calculate the time of concentration and the watershed lag time for each sub-watershed, as outlined in the National Engineering Handbook and USDA-SCS Technical Paper 149. The lag time of a watershed may be thought of as a weighted time of concentration. It is related to the physical properties of a watershed such as area, length and slope. NRCS developed an empirical relationship between the watershed lag time and the time of concentration:

$$T_L = 0.6T_C \text{ where,}$$

T_L – Watershed lag time in hours
T_C – Watershed time of concentration in hours
Time of concentration for a watershed can be calculated using the empirical relationship:

$$T_C = \frac{L^{0.8}(\frac{1000}{CN} - 9)^{0.7}}{1140Y^{0.5}} \text{ where,}$$

L – Watershed Hydraulic Length in feet
CN – Watershed Weighted Curve Number (Dimensionless)
Y – Average Watershed Slope (%), which can be determined using the formula

$$Y = {(100CI)}/{A} \text{ where,}$$

C – Total length of contours inside the watershed, in feet
I – Contour Interval in feet, and
A – Drainage area in sq. feet

Based on this method, the lag time for each watershed is calculated. Watershed lag time and time of concentration calculation worksheets for existing and proposed conditions are included in Appendix 8C.

8.3.1.4. Hydrologic Reach Routing

The Muskingum-Cunge reach routing method was utilized to route the peak flows through open channel reaches between each hydrologic point of interest (POI). The input parameters for the Muskingum-Cunge method include reach length, slope, invert, shape of cross-sections and Manning's roughness coefficients for the routed reaches.

8.3.1.5. Peak Discharge Summary

The peak discharges were estimated based on a Type II rainfall distribution (TR-55, 1986), and using 24-Hour rainfall depths obtained from the National Oceanic and Atmospheric Administration (NOAA) Hydrometeorological Design Studies Center for the geometric centroid of the overall Little Buffalo Creek watershed (Appendix 8A). A log-log plot was performed with the NOAA reported 24-hour precipitation depths, to calculate the depth of the 1.5-year 24-Hour rainfall. A 1.5-year rainfall has a probability of exceedance of 66.7 percent in a given 1 year period. Detailed calculations and the logarithmic plot of the values are presented in Appendix 8E. Design flood discharges were determined for the 1.5-year, 2-year, 5-year, and

100-year storms at several points of interest along the existing and proposed reaches. A summary of the computed peak discharges for the modeled storm events at each hydrologic POI location along the existing and proposed reaches is presented in Appendix 8F. POI locations are depicted on the maps and exhibits included in Appendix 8I.

Four separate work areas are proposed inside the overall drainage area to realign and restore the main branch and two tributaries of Little Buffalo Creek. The sinuous longitudinal shapes of the proposed restoration channel sections will provide slightly longer watershed hydraulic lengths, which will result in a slight increase in the watershed lag times. The changes to peak flows will be negligible. A separate proposed condition hydrology was not developed for this study, and the changes in the channel geometry due to the restoration design were evaluated based on the peak flow values as calculated under the existing conditions, to obtain a conservative estimate of the resultant flow velocities and water surface elevations.

8.3.2. Hydraulic Analysis

The open channel hydraulics of Little Buffalo Creek and its major tributaries within the study area were modeled using the HEC-RAS (version 4.1.0) river modeling program, as detailed in the following report sections.

8.3.2.1. Hydraulic Geometry Model

A total of 38 surveyed cross-sections along Little Buffalo Creek and its tributaries were used to develop the HEC-RAS geometry base. In order to properly evaluate the site, the surveyed cross-sections were supplemented with additional cross-sections throughout Little Buffalo Creek and its tributaries based on field survey data, photogrammetric survey prepared by GeoData Corp, and USGS DEM where necessary. Cross-sections cut throughout the creek and tributaries were laid out perpendicularly to the centerline of the channel and the topographic contours. The HEC-RAS geometry took into consideration the three locations of the proposed restoration work. Cross-section locations are identified on the HEC-RAS Cross-Section Location Plan in Appendix 8I.

The proposed channel realignment work at the Little Buffalo Creek site is sub-divided into three areas (see Appendix 8I - HEC-RAS Cross-Section Location Plan), which will be referred to in subsequent discussions as Work Area 1, Work Area 2 and Work Area 3. To determine the impact of the proposed stream restoration work occurring at the three specific proposed work areas and beyond, the proposed condition model was created using the existing condition model cross-sections and roughness values, in addition to the proposed geometric and roughness parameters associated with the proposed stream restoration design. Using the same stream cross-section locations for both the existing and proposed condition models allowed for direct comparison of existing and proposed condition water surface profiles at a given cross-section, thereby allowing for a better evaluation of the hydraulic impacts of the proposed stream restoration on adjacent properties.

Roughness coefficients (Manning's n-values) were calculated based on field data and verified by comparing the results to the HEC-RAS Hydraulic Reference Handbook (USACE, 2002). For the existing condition model, the roughness coefficients selected for the main channel varied from 0.035 to 0.055. The Manning's n-values selected for the overbanks ranged from 0.030 to 0.08 to represent no crop lands, farmlands, and forested areas.

A concrete liner exists in a fourth area, Work Area 4, which will be removed under proposed condition as part of the stream restoration work. A Manning's n-value of 0.013 was selected for this material under existing condition.

For the proposed condition model, the roughness coefficient selected for the main channel of the proposed work areas were equivalent to the existing condition roughness coefficient, as the channel bed material will be the same as the existing bed material. A roughness coefficient of 0.10 was selected for the adjacent floodplain areas of the proposed streams to represent the proposed fifty-foot forested buffers on both sides of the proposed channels. Outside of the fifty-foot proposed forested buffers, Manning's roughness coefficients for the floodplains remained the same as existing condition.

To account for the series of proposed step pools at Work Area 3, a roughness coefficient of 0.050 was used, which was representative of cobbles with boulders so as to mimic the proposed logs in the channel. This roughness value was chosen as the most representative value for the step pool design to account for energy dissipation. No modifications to roughness coefficients were made outside of the proposed work areas.

The HEC-RAS model included nine surveyed hydraulic structures for the existing condition model, which were maintained in the proposed conditions model, as the hydraulic structures will remain in place. A wooden bridge exists on Old Mine Road and two 92"x138" culverts exist on Kluttz Road at their respective crossings of Little Buffalo Creek. The remaining seven hydraulic structures are CMP and RCP culverts of various sizes located along the tributaries that discharge to the main channel. Locations of the hydraulic structures modeled are shown in Appendix 8I – HEC-RAS Cross-section Location Plan.

In addition, the proposed condition model took into consideration the proposed ditch plugs at the proposed work areas as described previously in this report, using the Obstruction tool in HEC-RAS to account for the blockage.

8.3.2.2. HEC-RAS Peak Flow Loading Points Summary

The design floods (peak discharges) that were entered into the HEC-RAS Steady Flow Data Editor were developed from the hydrologic POI locations, as modeled in the HEC-HMS computer program (Appendices 8F and 8G). A steady-state flow simulation (i.e., flow rate not changing with time) was utilized, and normal depth boundary conditions were specified for both the upstream-most and downstream-most cross-sections.

The peak flows generated from the hydrographs in the HEC-HMS model were specified in the HEC-RAS Steady Flow data at appropriate loading points (junctions) along the reaches, for the various modeled storm events.

The peak flow coded inputs for existing and proposed conditions remained the same, as the design of the three proposed reaches did not affect the overall hydrology of the site as described in Section 8.3.1.5. Appendix 8G presents a summary of the HEC-RAS peak flow inputs along the reaches associated with the HEC-HMS POIs.

8.3.2.3. Hydraulic Modeling Results

8.3.8.3.1 Work Area 1

Appendix 8H provides a summary of the HEC-RAS modeling results for existing and proposed conditions for Little Buffalo Creek Work Area 1. It should be noted that even though the same general cross-section locations were used for both the existing and proposed condition models, the existing and proposed "stationing" of each cross-section differed from one another in some areas within the proposed work areas as a result of the proposed changes in the main channel alignment and associated increase in sinuosity. For this reason, the HEC-RAS modeling results summary (Appendix 8H) refers to the proposed condition stationing of each cross-section. As evidenced in Appendix 8H, increases in water surface elevation occurred at cross-sections 11+16 and 13+90 (Main-Reach 1 River Station 4.6 and 3.7, respectively) for the 100-year, 5-year, 2-year and 1.5-year storm under proposed condition. The increases in water surface elevations at cross-section 11+16 are however minor and within the predefined minimum error water surface model default tolerance error of 0.3 ft. Increases in elevations under proposed conditions at cross-section 13+90 can be attributed to the proposed logs slightly downstream of cross-section 13+90. The logs will act as a block to slow velocities in the channel, but will increase the water surface elevation slightly as shown. The increase in water surface elevation will be primarily contained within the channel banks and 50 foot forest buffer and should not impact existing nearby buildings or structures.

The velocity summary presented in Appendix H shows that the average velocities within the proposed main reach exhibits a decrease compared to existing condition velocities with the exception of the cross-sections directly upstream of Work Area 1 and cross-section 13+90 (Main-Reach 1 River Station 3.7). An overall decrease in average velocities within the main channel is expected as the cross-sectional area of the proposed channel is larger than the existing channel. The increases in velocity for the cross-section directly upstream of Work Area 1 can be attributed to the transition between Work Area 1 and the existing channel. The existing channel cross-sectional area is smaller than the proposed channel cross-sectional area. Based on the fundamental concepts of the Continuity Equation, the velocity is expected to increase at the cross-section directly upstream of Work Area 1 under proposed condition in order to satisfy the continuity of flow as it is transitioning into cross-section 11+16 (Main-Reach 1 River Station 4.6), which has a larger cross-sectional area. The same concept can be applied to the minor increase in velocity for cross-section 13+90 (Main-Reach 1 River Station 3.6) as the transition into the existing channels (smaller cross-sectional area) is expected to result in slight increases in velocity. This slight increase in velocity appears to be localized as the difference in velocity between existing and proposed conditions reduces to zero further downstream at cross-section labeled as Main-Reach 1 River Station 3.

8.3.8.3.2 Work Area 2

Appendix 8H provides a summary of the HEC-RAS modeling results for existing and proposed conditions for Little Buffalo Creek Work Area 2. As explained in Section 8.3.2.3.1, the existing and proposed "stationing" of each cross-section differed from one another in some areas, as a result of the proposed changes in the main channel alignment and associated increase in sinuosity. As evidenced in Appendix 8H, an overall decrease in water surface elevation resulted with the proposed realignment at Work Area 2. The only increase in water surface elevation occurs at cross-section 12+60 with the largest resulting in a 0.09 ft increase for the 2-year storm. The increases in water surface elevations are however minor and within the minimum error water surface model default tolerance error of 0.3 ft. This negligible impact

is likely due to the transitioning between the larger proposed cross-sectional area and the smaller existing cross-sectional area, therefore reducing the wetted area.

As shown in Appendix 8H, there are some increases in velocities occurring at cross-section 10+05 (Main-Reach 2 River Station 2) for the 100-year and 5-year storm under proposed condition. Cross-section 10+05 is the upstream transition between the existing channel and proposed channel. The existing channel cross-sectional area is smaller than the proposed channel cross-sectional area. Based on the fundamental concepts of the Continuity Equation, the velocity is expected to increase at the cross-section directly upstream of Work Area 2 under proposed condition in order to satisfy the continuity of flow as it is transitioning into cross-section 11+08 (Main-Reach 2 River Station 1.5), which has a larger cross-sectional area. However, the velocity increase at cross-section 10+05 appears to be localized as the main channel velocities remain essentially the same as existing conditions as shown in Appendix 8H.

8.3.2.3.3. Work Area 3

Appendix 8H below provides a summary of the HEC-RAS modeling results for existing and proposed conditions for Little Buffalo Creek Tributary Work Area 3. As explained in section 8.3.2.3.1, the existing and proposed "stationing" of each cross-section differed from one another at some areas, as a result of the proposed changes in the main channel alignment and associated increase in sinuosity. Work Area 3 consists of various proposed activities including proposed ditch plugs at specific locations of the existing channel, proposed riffles/pool design, rising of the channel bed compared to existing channel bed, and a step pool design. Work Area 3 can also be considered to have the most significant change in re-routing the existing channel compared to all the other proposed Work Areas.

As evidenced in Appendix 8H, some increases and decrease in water surface elevations were observed. The increases in water surface elevations were observed between cross-section 14+20 (LBC 4 River Station 1.7) and cross-section 17+12 (LBC 4 River Station 1.3). As shown in Appendix H, the largest impact occurs at cross-section 16+37 (LBC 4 River Station 1.5) with a 1.31 ft increase in water surface elevation for the 1.5-year storm event. The water surface elevation increases occurring at this location can be largely associated with the proposed ditch plugging of the existing channel. Proposed ditch plugs will be installed at the existing channels located on cross-section 17+12 (LBC 4 River Station 1.3) and Cross-section 18+78 (LBC 6 River Station 3). The ditch plugging of the existing channels at these locations will prevent water from entering into the existing channels, thus reducing a large amount of storage available within the floodplain. This impact extends upstream of cross-section 17+12 (LBC 4 River Station 1.3) until cross-section 12+52 (LBC 4 River Station 1.8) where the proposed impact eventually dissipates as shown in Appendix 8H. From the results, the proposed ditch plugs appear have a pronounced effect on the lower storm events as the proposed impacts significantly reduce for the 100-year storm event. It should be noted that even though there are significant increases in surface water elevations for the lower storm events (1.5 to 5 year storms), the increases are primarily contained within the banks of the stream and are not expected to impact areas adjacent and outside of the project boundary.

The velocity summary indicates a general decrease in main channel velocity for all storm events at Work Area 3 as expected due to the effects of the proposed riffles/pool design, the fifty-foot forested buffers surrounding both sides of the proposed channel, and the proposed step pool design. The only increases in velocity under proposed condition occurs at cross-section 17+12 (LBC 4 River Station 1.3) and cross-section 18+78 (LBC 6 River Station 3).

Unlike the existing condition where the existing channel is relatively straight, all three cross sections under proposed condition are located at or near bends of the meandering channel and the increases in velocities at these locations can be attributed to the bends where velocity of the channel is highest. However, the velocities within the main channel eventually dissipate downstream by cross-section 19+47 (LBC 6 River Station 2) where the proposed step pool begins.

8.3.2.3.4. Work Area 4

Work Area 4 consists of a section of streambanks requiring removal of an existing concrete liner along the right bank of the existing channel (toe of slope to right bank) and slightly increased cross-sectional area while maintaining the same channel alignment. Appendix H provides a summary of the HEC-RAS modeling results for existing and proposed conditions for Little Buffalo Creek Tributary Work Area 4. As evidenced in Appendix 8H, an overall decrease in water surface elevations occurs with the exception of the following cross-sections: Main-Reach 4 River Station 0.9 and Main-Reach 4 River Station 0.5.

The increase in water surface elevations for Main-Reach 4 River Station 0.9 and Main-Reach 4 River Station 0.5 are considered minor with the largest increase yielding 0.24 feet under proposed condition. The minor increases observed can be attributed to the removal of the existing concrete liner and the proposed pools within the proposed channel. Under proposed conditions, the channel bed will be restored to existing channel conditions with small pools, which is modeled with a Manning's n roughness coefficient of 0.055. Under existing conditions, the concrete liner is modeled with a Manning's n roughness coefficient of 0.013. Although the concrete liner under existing condition exists only along the right bank of the existing channel (toe of slope to right bank), this significant difference between the roughness parameter results in a slightly increased water surface elevation under the proposed condition. The increases in water surface elevations are within the minimum error water surface model default tolerance error of 0.3 ft.

As shown in Appendix 8H, increases in velocity are observed at the upstream transition area of Work Area 4. This is most likely attributed to the increase in slope from the existing channel to the proposed channel. However, within the proposed channel, a decrease in channel velocity results as expected since the proposed condition has a slightly larger cross-sectional area and a rougher channel bed compared to existing with the addition of the pools and the removal of the concrete liner.

8.3.3. Existing Bridges and Hydraulic Structures

In addition to evaluating the flooding impacts at the cross-sections along the proposed work areas, existing bridges and hydraulic structures along or within the vicinity of the proposed reaches were evaluated to determine whether adverse impacts would occur as a result of the proposed stream realignment activities. Appendix 8H presents the computed water surface elevations and velocity summary for the hydraulic structures evaluated.

A wooden bridge exists on Old Mine Road downstream of Work Area 1. The modeling results indicate no impact in the water surface elevations and velocities under proposed condition, with the exception of a negligible 0.01 ft water surface elevation increase and a decrease of 0.01 ft/s velocity for the 1.5-year storm at the downstream cross-section, as summarized in

Appendix H. No impact is expected at this wooden bridge as the proposed Work Area 1 is approximately 653 ft upstream of the wooden bridge. As the modeling results indicate, proposed impacts have already diminished by cross-section Main-Reach 1 River Station 3.3, which is located approximately 472 ft upstream of the wooden bridge.

As described in Section 8.3.2.3.1, two 92"x138" CMP culverts exist on Kluttz Road, at the most downstream section of the overall project site. As evidenced in Appendix H, the modeling results indicate that no impact is anticipated under proposed conditions, as the flood elevation differences between existing and proposed conditions do not change for any of the modeled storm events. In addition, the main channel velocities for the upstream and downstream bounding cross-sections under proposed conditions remained the same as under existing conditions.

Additionally, two hydraulic structures exist upstream of the Work Area 3 tributaries along Old Mine Road. The modeling results indicate an overall decrease in flood elevations, indicating no adverse impacts. One hydraulic structure consists of two 8.5' CMP culverts as shown in Appendix 8I. The modeling results indicate that no adverse impact is anticipated under proposed conditions. No increase in water surface elevations is expected at the bounding upstream cross-section of the hydraulic structure (LBC Trib 4 River Station 3), as the results indicate no changes in water surface elevations for all storm events evaluated. At the downstream bounding cross-section (LBC Trib 4 River Station 2.9), the water surface elevation for the 2-year decrease under proposed conditions; however, these impacts are considered negligible, since it is 0.02 ft. For the 5-year storm and the 1.5 year, the water surface elevation at the downstream bounding cross-section exhibits a 0.03 ft and a 0.04 ft, respectively, increase under proposed conditions, which are also considered negligible. The 100-year storm event results indicate zero impact in water surface elevations under proposed condition. As shown in Appendix 8H, there are no velocity changes under proposed condition at the upstream face of the hydraulic structure. Downstream of the hydraulic structure (cross-section LBC Trib 4 River Station 2.9), the impacts in velocity occur at the 5-year, 2-year and 1.5-year storm event, which yields a maximum increase in velocity of 0.03 ft/s and a maximum decrease in velocity of 0.06 ft/s. These impacts, which can be considered negligible, can be attributed to the transition from the existing channel to the proposed channel, which begins at cross-section 11+95 (LBC 4 River Station 1.85).

The second hydraulic structure upstream of Work Area 3 consists of a 72"x108" CMP culvert. As evidenced in Appendix 8H, the modeling results indicate that no impact is anticipated under proposed conditions, as the flood elevation differences between existing and proposed conditions do not change for any of the modeled storm events. In addition, the main channel velocities for the upstream and downstream bounding cross-sections under proposed conditions remained the same as under existing conditions.

HEC-RAS results for the remaining hydraulic structures (labeled as #2, 3, 4, 5, and 6 in Appendix I - HEC-RAS Cross-Section Location Plan) were not evaluated as the hydraulic structures were located at the headwater of existing tributaries that were not impacted by any proposed work.

Overall, as the modeling results indicate in Appendix 8H, no adverse impacts are expected at the hydraulic structures along or within the vicinity of the proposed work areas.

8.3.4. Hydrologic Trespass for the 100-Year Storm Event

In analyzing for hydrologic trespass, the 100-year storm event was selected to determine whether the 100-year flood elevation extends outside of the adjacent properties as a result of the proposed stream modifications. As evidenced in Appendix 8H, major impacts for the 100-year flood elevations are not anticipated as the modeling results indicate that there is an overall decrease in the 100-yr flood elevations under proposed conditions with the exception of a few localized areas in Work Area 1, Work Area 3 and Work Area 4.

As evidenced in section 8.3.3, water surface elevation impacts are not anticipated for the 100-year storm event at the existing bridges and hydraulic structures (locations shown on Appendix 8I) as there is no difference in the 100-year flood elevations between existing and proposed conditions. Additionally, there is no difference in the 100-year flood elevations at the most upstream and downstream end of the project site as shown in Appendix 8H.

In Work Area 1, the cross-section 13+90 (Main-Reach 1 River Station 3.6) results in a 0.61 ft increase in the 100-year flood elevation under proposed conditions. After evaluation of the surrounding topography, this 0.61 ft increase under proposed condition has a minimal impact as the surrounding areas reach very high grounds with steep slopes on both sides of the proposed stream significantly minimizing the spread of flood water. Cross-section 11+16 (Main-Reach 1 River Station 4.6) results in a 0.05 ft increase in the 100-year flood elevation and cross-section Main-Reach 1 River Station 4.9 results in a 0.14 ft increase. Both of these increases are under the minimum error water surface model default tolerance error of 0.3 ft. Again, Work Area 1 is also surrounded by high grounds that will minimize the spread of flood water.

In Work Area 3, cross-section 12+52 (LBC 4 River Station 1.8) results in a 0.11 ft increase in the 100-year flood elevation under proposed conditions. After evaluation of the surrounding topography, this 0.11 ft increase under proposed condition has a minimal impact as the surrounding areas reach very high grounds with steep slopes on both sides of the proposed stream significantly minimizing the spread of flood water. The only other increase in the 100-yr flood elevation occurring at Work Area 3 is at cross-section 16+37 (LBC River Station 1.5), which results in a 0.08 ft increase in the 100-year flood elevation under proposed conditions. As mentioned previously, Work Area 3 is surrounded by high grounds with steep slopes on both sides of the proposed stream. The 0.08 ft increase in the 100-year flood elevation under proposed conditions is within the water surface model default tolerance of 0.3 ft.

In Work Area 4, cross-section Main-Reach 4 River Station 1 exhibits an increase of 0.24 ft for the 100-year flood elevation under proposed conditions and this increase is below the minimum error water surface model default tolerance error of 0.3 ft. This localized increase will also have minimal spread of flood water due to the surrounding topography. Both sides of the proposed stream extend to extremely steep slopes reaching high grounds with elevations surpassing the 100-year flood elevation under proposed conditions.

The HEC-RAS modeling results indicate that the 100-yr flood elevations actually decrease or do not change under proposed conditions, with the exception of a few minor increases occurring at localized spots described above. After evaluation of the 100-yr flood elevation results, no hydrologic trespass issues are anticipated under proposed conditions.

8.3.5. Conclusions

The hydrologic and hydraulic analyses of the Little Buffalo Creek restoration show that no adverse impacts are anticipated for the 1.5-year, 2-year, 5-year, and 100-year storm events. The HEC-RAS modeling results indicate negligible (a 0.01 ft increase in the 100-year flood) to no increase in water surface elevations at the most upstream cross-section (Main Reach 1 River Station 6) and most downstream cross-section (Main Reach 5 River Station 1) of the overall project site as shown in Appendix 8H. Therefore, adverse flooding impacts are not anticipated to result upstream or downstream of the proposed project site.

As the existing Little Buffalo Creek reach within the project area does not currently have a FEMA-delineated floodplain or floodway, the Conditional Letter of Map Revision (CLOMR)/LOMR process will not be applicable to this project.

8.4 Stormwater Best Management Practices

The project site is almost entirely pastureland for cattle. There are a few small barns and buildings within the site and gravel and paved roads around it. Aside from the precipitation that falls directly on the ponds and stream channel itself, all stormwater generated onsite will be funneled through a riparian buffer on either Little Buffalo Creek or one of its tributaries.

Although not a stormwater best management practice (BMP), but rather an agricultural BMP, drinking wells will be installed now that the cattle are excluded from the stream.

8.5 Hydrological Modifications (for wetland restoration or enhancement)

No wetlands were identified on Site; therefore, hydrological modifications are not necessary.

8.6 Soil Restoration

At this point in time no soil restoration is planned onsite; nearly all of the areas to be planted are existing cattle pasture and aside from minimal compaction due to livestock intrusion, should be suitable for planting. In the area where new channel is proposed, the design does not include excavation into the subsoils and no soil restoration is planned in these sections.

8.7 Natural Plant Community Restoration

8.7.1 Narrative of Plant Community Restoration

In general, the goal of the planting scheme will be to establish a riparian forest community consistent with a Piedmont/Mountain Bottomland Forest. Berger's planting plan will incorporate the use of native trees and shrubs.

8.7.2 Seeding Plan Summary for Vegetation Communities and Zones

For areas of restoration, an herbaceous seed mix will be used to cover the old portions of the stream channel.

8.7.3 Planting Plan Summary for Vegetation Communities and Zones

Tree species will be established through the planting of live stakes and bare root or tubeling seedlings of hardwood species native to the area. The establishment of species will follow the Guidelines for Riparian Buffer Restoration (NCEEP 2004). The overall goal of the planting density is to attain a minimum density of 260 trees per acre at maturity (five years). Planting stock will be obtained from sources within 200 miles of the site. Target plant species can be found in Table 7 of Section 12 in the report.

There will be three planting zones. Zone 1 includes the areas of the inner stream berm up to bankfull in the restoration and enhancement level I mitigation areas. This zone will be planted with livestakes to provide stabilization to the streambank. Zone 1 will consist of black willows (*Salix nigra*) and silky dogwood live stakes planted at 2000 stems per acre. Stakes will be installed along both banks on five-foot centers in a triangular pattern. Zone 2 includes the bankfull bench of the stream and will be planted with bare root or tubeling plants. Zone 2 will consist of nine-foot spacing on center bare root or tubeling of species such as hazel alder, river birch, ironwood (*Carpinus caroliniana*), silky dogwood, green ash, spicebush, sycamore, black willow, and arrowwood (*Viburnum dentatum*). Zone 3 includes the area above the bankfull bench to 50 feet from the top of bank. This zone will also be planted with bare root or tubeling plants. Zone 3 will consist of nine-foot spacing on center bare root or tubeling of species such as ironwood, sugarberry (*Celtis laevigata*), redbud, green ash, sycamore and tulip poplar. Both Zone 2 and 3 will be planted at 500 stems per acre with species consistent with a Piedmont/Mountain Bottomland Forest to enhance the existing riparian buffer. Zones 2 and 3 will be plants for all levels of mitigation except for preservation. The planting summary is detailed in Table 7 of Section 12.0 and shown on design sheets 30 to 41 of Section 14.

Seedlings will be established in a naturalized pattern to avoid creating rows and monotypic stands. Tree species will be established within zones that reflect the preferable hydrologic regimes of each species; areas with the longer periods of inundation will be planted with flood tolerant species. To encourage a higher diversity of woody plant species on the site, planting patterns will include leaving small gaps to provide open areas for recruitment.

8.7.4 Narrative of species management

A few areas of invasive floral species were identified in patchy distributions at various densities, particularly along the banks of the mainstem and UT 7. Invasive species along the mainstem include: multiflora rose (*Rosa multiflora*) and Chinese privet. Invasive species along UT 7 include: tree of heaven, mimosa, microstegium, and Chinese privet. No specific control effort is detailed for these species; however, the woody species will be removed during construction and remaining root stumps treated with an appropriate herbicide.

9. Performance Criteria

9.1 Streams

For stream hydrology, a minimum of two bankfull events must be documented within the standard 5-year monitoring period. In order for the monitoring to be considered complete, the two verification events must occur in separate monitoring years.

All of the morphologic and channel stability parameters will be evaluated in the context of hydrologic events to which the system is exposed.

• Dimension – General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. For stream dimension, cross-sectional overlays and key parameters such as cross-sectional area, and the channel's width to depth ratios should demonstrate relative stability in order to be deemed successful.

• Pattern – Pattern features should show little adjustment over the standard 5 year monitoring period. Rates of lateral migration need to be moderate.

• Profile – For the channels' profile, the reach under assessment should not demonstrate any trends in thalweg aggradation or degradation over any significant continuous portion of its length. Over the monitoring period, the profile should also demonstrate the maintenance or development of bedform (facets) more in keeping with reference level diversity and distributions for the stream type in question. It should also provide a meaningful contrast in terms of bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so with maintenance around design distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallow with greater water surface slopes.

• Substrate and Sediment Transport – Substrate measurements should indicate progression towards, or maintenance of the known distributions from the design phase. Sediment Transport should be deemed successful in by absence of any significant trend in the aggradation or depositional potential of the channel.

9.2 Vegetation

Survival of woody species planted at mitigation sites should be at least 320 stems/acre through year three. A 10 percent mortality rate will be accepted in year four (288 stems/acre) and another 10 percent in year five resulting in a required survival rate of 260 trees/acre through year five. This is consistent with Wilmington District (1993) guidance for wetland mitigation (USACE 2003).

9.3 Schedule/Reporting

Berger will be responsible for the success of the restoration project. Annual monitoring of the site will be carried out for a period of five years after completion of all restoration activities, or until the restoration site is deemed successful. Monitoring will be conducted each year and the subsequent report will be submitted to NCEEP before December 31 of that year. Required documents will also be delivered to Carolina Vegetation Survey as required. Direct sampling and measurement techniques will be employed as well as photo-documentation. Based on field observations and annual monitoring results, Berger will determine if actions are required to reach or exceed the performance criteria outlined in the Mitigation Plan. Monitoring Reports (including the Summary Report) will follow the format established in the NCEEP Full Delivery Templates Version 1.2 (11116/06), which will be obtained from the EEP Project Manager. Additionally, Berger will utilize EEP's monitoring template and guidance V-1.3 (01/15/2010) for this project, available on the website at http://portal.ncdenr.org/web/eep/fd-forms-templates.

10. Preliminary Monitoring

The surface water hydrology at the Little Buffalo Creek Stream Restoration site will be monitored using a stream gage with an automatic data logger. The gage will be established to compare the surface water level in the streams to the mean bankfull stage. The performance criteria prescribed in the Stream Mitigation Guidelines (USACE 2003) requires that at least two bankfull events are documented during the five year monitoring period. If less than two bankfull events occur during the first five years, the annual monitoring will be required to continue until the second bankfull event is documented. The two documented bankfull events must occur during separate monitoring years.

Stream channel stability will be determined by measuring the dimension, pattern, and profile of the stream to determine the rates, magnitude, and direction of stream adjustments. Rosgen methodologies of determining stream stability will be employed. Monumented cross-sections will be installed and surveyed on a yearly basis to monitor vertical bed stability in accordance with NCDENR stream monitoring guidelines. A longitudinal profile will be surveyed along the thalweg of the channel to capture the bed slope and determine the level of aggradation or degradation and capture any changes in the pool/riffle sequence. The stream pattern will be evaluated by measuring the sinuosity of the channel, which will be calculated by dividing the channel length determined during the long profile by the straight-line valley length. Pebble counts will also be performed to assess changes in bed material distribution (i.e., finer substrate in pools and coarser substrate in riffles). As part of the pre-construction visual inspection and during monitoring year 5, a detailed BEHI and Near Bank Stress (NBS) assessment will be performed. The entire project will be classified into the BEHI erosion hazard categories and accompanied by an NBS assessment for the purpose of describing sediment export estimates (tonnage per annum).

Problem areas will be identified based on a visual inspection of vegetative and structural characteristics. Vegetative problem areas will be identified as either lacking vegetation or containing exotic vegetation and the probable cause of the problem will be described, shown in a plan view, and photographed. Invasive species will be observed and documented each monitoring year in the areas of restoration and enhancement level I. If invasive plant populations become problematic, Berger will manage and control them as necessary by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. Structural problem areas will be identified in more descriptive terms by individual issue. Aggradation or degradation of channel slope, instream and engineered structures, bank erosions and other physical stability problems will be measured, described, shown in plan view, and photographed.

Vegetative establishment will be monitored through the use of permanent sample quadrats established at random locations. The quadrats will be monitored annually employing techniques described per the CVS-EEP Protocol for Recording Vegetation- VERSION 4.0 as published at NCEEP's website: http://portal.ncdenr.org/web/eep/process-and-protocol. One representative digital photo of each sample plot will be taken the same day as the vegetative sampling is conducted. A series of fixed photograph stations will be established upon the as-built survey to record a set of representative views during subsequent monitoring years.

10.1 Anticipated Performance Criteria

As stated above, Berger intends to follow the 2003 Stream Mitigation Guidelines and the 2006 CVS-EEP Vegetation Monitoring Protocol as the protocols for monitoring. More specifically, Berger is planning the following assessments:

Cross Sections

- LBC Stations 21+25 through 25+75, 2 riffle and 2 pool cross sections,
- LBC Stations 48+00 through 51+00, 1 riffle and 1 pool cross sections,
- LBC Stations 64+00 through 65+25, 1 riffle and 1 pool cross sections,
- UT 3 Stations 10+00 through 12+00, 1 riffle and 1 pool cross sections,
- UT 3 Stations 14+00 through 20+00, 1 riffle and 1 pool cross sections,
- UT 4 Stations 13+60 through 18+28, 1 riffle and 1 pool cross sections,
- UT 7 Stations 12+00 through 23+00, 2 riffle, 2 pool, 2 step-pool cross sections.

Longitudinal Profiles

- LBC Stations 20+00 through 27+00, no less than 500 linear feet,
- LBC Stations 47+00 through 52+00, no less than 300 linear feet, and
- UT 7 Stations 10+00 through 23+00, no less than 1,100 linear feet.

Vegetation Plots

Using the CVS-EEP protocol, Berger has determined that 18 vegetation plots will be required within the restoration and enhancement reaches onsite. No vegetation plots will be established in preservation reaches. These plots will be monitored using Levels 1 and 2 plot sampling. The location of these plots has not been established yet.

Photo Points

Berger expects to install and monitor 24 photo points throughout the site. The photo points will capture restoration, enhancement, and preservation reaches and will be in addition to photographs taken at cross sections and vegetation plots. The location of these plots has not been established yet.

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Tables

Table 1: Project Components
Little Buffalo Creek Stream Mitigation Project
EEP Project No. 94147

Reach ID	Existing Feet (linear feet)	Restoration Level and Ratio	Approach	Footage (linear feet)	Stationing	Buffer Area (acres)
Reach 1	2,300	Restoration 1:1 Enhancement Level II 2.5:1	P1	438 R; 1862 EII	10+00 to 33+00	7.7
Reach 2	1,248	Enhancement Level II 2.5:1	NA	1248 EII	33+62 to 46+10	3.8
Reach 3	1,075	Restoration 1:1 Enhancement Level II 2.5:1	P1 P2	267 R; 808 EII	46+10 to 56+85	3.9
Reach 4	841	Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	P2 P2	120 EI; 721 EII	56+85 to 65+26	3.2
Reach 5	952	Enhancement Level II 2.5:1	NA	952 EII;	65+26 to 74+78	2.7
Reach 6	2053	Preservation 5:1	NA	2,053 P	75+05 to 82+48; 91+79 to 104+90	10.0
UT 1	109	Enhancement Level II 2.5:1	NA	109 EII	10+00 to 11+09	0.1
UT 2	951	Enhancement Level II 2.5:1 Preservation 5:1	NA	616 EII; 335 P	10+00 to 19+50	2.7
UT 3	1,475	Restoration 1:1 Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	P1 P2 P2	197 R; 515 EI; 763 EII	10+00 to 24+74	4.2
UT 4	828	Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	P2 P2	397 EI; 431 EII	10+00 to 18+28	1.9
UT 5	184	Enhancement Level II 2.5:1	NA	184 EII	10+00 to 11+84	0.5
UT 6	151	Enhancement Level II 2.5:1	NA	151 EII	10+00 to 11+51	0.4
UT 7*	1,374	Restoration 1:1	P1	1,374 R	10+00 to 23+74	5.9
UT 8*	100	Restoration 1:1	P1	100 R	10+00 to 23+74	

*UT 8 to UT7's flow was redirected to join UT7 at new location.
Note: Stationing based off of proposed lengths; therefore it may not correspond to existing feet. Also, due to rounding some of the values when added may appear to be 1' short of total, this is purely a product of values being rounded to nearest linear foot.

Component Summations

Restoration Level	Stream (linear feet)	Ratio	Stream Mitigation Units
Restoration	2,376	1:1	2,376
Enhancement Level I	1,032	1.5:1	688
Enhancement Level II	7,845	2.5:1	3,138
Preservation	2,388	5:1	478
TOTALS	**13,641**		**6,679**

Table 2: Project Activity and Reporting History
Little Buffalo Creek Stream Mitigation Project
EEP Project No. 94147

Activity or Report	Data Collection Complete	Completion or Delivery
Technical Proposal	June 2009	August 2008
Categorical Exclusion	February 2010	March 2010
Secure Conservation Easement	March 2010	July 2012
Mitigation Plan	August 2010	April 2013
Final Design – Construction Plans	N/A	May 2013
Construction	N/A	August 2013
Fencing Installation	N/A	September 2013
Native Species Planting	N/A	October 2013
Mitigation Plan / As-built (Year 0 Monitoring – Baseline)	November 2013	December 2013
Year 1 Monitoring	November 2014	December 2014
Year 2 Monitoring	November 2015	December 2015
Year 3 Monitoring	November 2016	December 2016
Year 4 Monitoring	November 2017	December 2017
Year 5 Monitoring	November 2018	December 2018

Table 3: Project Contact Table Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147	
Designer Primary Project Design POC	The Louis Berger Group, Inc. 1001 Wade Avenue, Suite 400 Raleigh, NC 27605 Michael O'Rourke (919) 866-4421 Edward Samanns (973) 407-1468
Construction Contractor **Construction contractor POC**	To be determined
Fencing Contractor Fencing Contractor POC	To be determined
Planting Contractor Planting Contract POC	To be determined
Nursery Stock Suppliers	To be determined
Monitoring Performers	The Louis Berger Group, Inc. 1001 Wade Avenue, Suite 400 Raleigh, NC 27605 EEE Consulting
Stream Monitoring POC	Louis Berger Group, Inc., Jennifer Brunton, P.E. (973-407-1365)
Vegetation Monitoring POC	EEE Consulting, Tina Sekula, PWS (919-866-4439)

Table 4: Project Attribute Table Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147						
Project County	Cabarrus County					
Physiographic Region	Piedmont					
Ecoregion	Southern Outer Piedmont					
Project River Basin	Yadkin-Pee Dee River					
USGS HUC for Project (14 digit)	03040105020060					
NCDWQ Sub-basin for Project	03-07-12					
Within extent of EEP Watershed Plan?	No					
WRC Class (Warm, Cool, Cold)	Warmwater					
% of project easement fenced or demarcated	100% of the project easement will be demarcated and approximately 85% will be fenced.					
Beaver activity observed during design phase?	Yes					
Restoration Component Attribute Table (Mainstem)						
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Drainage Area (acres)	1914	2146	2446	2568	2632	4039
Stream order	2/3	3	3	3	3	3/4
Restored (R) /Enhanced (EI or EII) / Preserved (P) length (feet)	438 (R) 1862 (EII)	1248 (EII)	267 (R) 808 (EII)	120 (EI) 721 (EII)	952 (EII)	2053 (P)
Perennial or Intermittent	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial
Watershed type (Rural, Urban, Developing, etc)	Rural	Rural	Rural	Rural	Rural	Rural
Watershed LULC Distribution (e.g.)						
Residential	10	10	10	10	10	10
Ag-Row Crop	0	0	0	0	0	0
Ag-Livestock	40	40	40	40	40	40
Forested	50	50	50	50	50	50
Watershed Impervious cover (%)	5%	5%	5%	5%	5%	5%
NCDWQ AU/Index number	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6
NCDWQ classification	C	C	C	C	C	C
303d listed?	No	No	No	No	No	No
Upstream of a 303d listed segment?	No	No	No	No	No	No

Table 4: Project Attribute Table Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147						
Reasons for 303d listing or stressor	N/A	N/A	N/A	N/A	N/A	N/A
Total acreage of easement	7.7	3.8	3.9	3.2	2.7	10.0
Total vegetated acreage within the easement	4.0	1.3	2.4	0.6	1.5	8.1
Total planted acreage as part of restoration	3.7	2.5	1.5	2.6	1.2	1.9
Rosgen classification of existing	C4/F4	C4/E4	C4/F4	C4	C4/D4b	C4
Rosgen classification of As-built	C4	No Restoration	C4	No Restoration	No Restoration	No Restoration
Valley type	VIII	VIII	VIII	VIII	VIII	VIII
Valley slope	0.48%	0.38%	0.51%	039%	0.47%	0.43%
Cowardin classification	N/A	N/A	N/A	N/A	N/A	N/A
Trout waters designation	N/A	N/A	N/A	N/A	N/A	N/A
Species of concern, endangered, etc.? (Y/N)	No	No	No	No	No	No
Dominant soil series and characteristics						
Series	Chewacla/ Goldston	Chewacla	Chewacla	Chewacla	Chewacla	Chewacla
Depth	6 to 18 in/ 10-20 inches	6 to 18 in	6 to 18 in	6 to 18 in	6 to 18 in	6 to 18 in
Clay %	U	U	U	U	U	U
K	U	U	U	U	U	U
T	U	U	U	U	U	U

Note: N/A is used for items that do not apply, "-" is used for items that are unavailable, "U" is used for items that are unknown and "NA" is used for items that are not applicable due to the fact that the mitigation project is stream preservation only.

Table 4: Project Attribute Table Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147							
Project County	Cabarrus County						
Physiographic Region	Piedmont						
Ecoregion	Southern Outer Piedmont						
Project River Basin	Yadkin-Pee Dee River						
USGS HUC for Project (14 digit)	03040105020060						
NCDWQ Sub-basin for Project	03-07-12						
Within extent of EEP Watershed Plan?	No						
WRC Class (Warm, Cool, Cold)	Warmwater						
% of project easement fenced or demarcated	100% of the project easement will be demarcated and approximately 85% will be fenced.						
Beaver activity observed during design phase?	Yes						
Restoration Component Attribute Table (Unnamed Tributaries)							
	UT 1	UT 2	UT 3	UT 4	UT 5	UT 6	UT 7/UT8
Drainage Area (acres)	293	193	62	254	8	16	1222
Stream order	2	1	1	2	1	1	3/1
Restored (R) /Enhanced (EI or EII) / Preserved (P) length (feet)	109 (EI)	616 (EII) 335 (P)	197 (R) 515 (EI) 763 (EII)	397 (EI) 431 (EII)	184 (EII)	151 (EII)	1474 (R)
Perennial or Intermittent	Intermittent	Intermittent	Intermittent	Perennial	Intermittent	Intermittent	Perennial
Watershed type (Rural, Urban, Developing, etc)	Rural	Rural	Rural	Rural	Rural	Rural	Rural
Watershed LULC Distribution (e.g.)							
Residential	0	0	0	0	0	0	5
Ag-Row Crop	0	0	0	0	0	0	0
Ag-Livestock	20	20	100	20	80	80	45
Forested	80	80	0	80	20	20	50
Watershed Impervious cover (%)	5%	5%	5%	5%	5%	5%	5%
NCDWQ AU/Index number	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6	13-17-11-6
NCDWQ classification	C	C	C	C	C	C	C
303d listed?	No	No	No	No	No	No	No
Upstream of a 303d listed segment?	No	No	No	No	No	No	No

Table 4: Project Attribute Table Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147							
Reasons for 303d listing or stressor	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total acreage of easement	0.1	2.7	4.2	1.9	0.5	0.4	5.9
Total vegetated acreage within the easement	0	0.6	0.2	1.6	0	0.05	1.2
Total planted acreage as part of restoration	0.1	2.1	4.0	0.3	0.5	0.35	4.7
Rosgen classification of existing	NA	B6	B6/G6	B4c	NA	NA	F4
Rosgen classification of As-built	No Restoration	No Restoration	B6	B4c	No Restoration	No Restoration	C4
Valley type	NA	II	II	II	NA	NA	VIII
Valley slope	NA	2.45%	2.35%	2.17%	NA	NA	0.96%
Cowardin classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trout waters designation	No	No	No	No	No	No	No
Species of concern, endangered, etc.? (Y/N)	No	No	No	No	No	No	No
Dominant soil series and characteristics							
Series	Chewacla	Chewacla	Badin/ Georgeville	Goldston	Goldston	Goldston	Chewacla
Depth	6-18 inches	6-18 inches	72+ inches/ 72+ inches	10 to 20 inches	10 to 20 inches	10 to 20 inches	6-18 inches
Clay %	U	U	U	U	U	U	U
K	U	U	U	U	U	U	U
T	U	U	U	U	U	U	U

Note: N/A is used for items that do not apply, "-" is used for items that are unavailable, "U" is used for items that are unknown and "NA" is used for items that are not applicable due to the fact that the mitigation project is stream preservation only. UT 1, UT 5, & UT 6 are not classified as the reaches are 100 feet long or less.

Table 5: Morphological Design Table
Little Buffalo Creek Stream Mitigation Project
EEP Project No. 94147

Item	Existing Conditions	Designed Conditions	Reference Reach
LOCATION	*Reach 1*	*Reach 1*	*Reach 1*
Stream Type	C4/F4	C4	C4
Drainage Area, Ac	1470	1470	1470
Bankfull Width (W_{bkf}), ft	46-57-83	36	43-52-64
Bankfull Mean Depth (d_{bkf}), ft	0.65-1.18-1.60	1.38	0.98-1.16-1.38
Width/Depth Ratio (W_{bkf}/ d_{bkf})	33-57-128	26	31-47-64
Bankfull X-Section Area (A_{bkf}), ft^2	54-63-83	49.5	55-59-65
Bankfull Mean Velocity, fps	1.82	2.32	2.44
Bankfull Discharge, cfs	115	115	115
Bankfull Max Depth (d_{max}), ft	2.54-3.04-3.83	1.5	2.17-2.41-2.50
Depth Ratio d_{max}/d_{bkf}	3.91-2.58-2.39	1.09	2.21-2.08-1.81
Low Bank Height	2.8	1.5	1.89
Bank Height Ratio (BHR)	0.91-1.09-1.37	1	1.15-1.28-1.32
Width Flood-prone Area (W_{fpa}), ft	68-107-177	>88	>150
Entrenchment Ratio (ER)	1.49-1.84-2.17	>1.53	>2.2
Valley Slope (S_{valley}), ft/ft	0.0055	0.0055	0.0055
Channel Slope ($S_{channel}$), ft/ft	0.0047	0.0035	0.0039
Sinuosity (K)	1.05	1.27	1.16
LOCATION	*Reach 3*	*Reach 3*	*Reach 1*
Stream Type	C4	C4	C4
Drainage Area, Ac	2081	2081	1470
Bankfull Width (W_{bkf}), ft	34-41-48	40	43-52-64
Bankfull Mean Depth (d_{bkf}), ft	1.20-1.47-1.80	1.80	0.98-1.16-1.38
Width/Depth Ratio (W_{bkf}/ d_{bkf})	19-30-40	22	31-47-64
Bankfull X-Section Area (A_{bkf}), ft^2	58-60-62	72	55-59-65
Bankfull Mean Velocity, fps	2.73	2.3	2.44
Bankfull Discharge, cfs	163	163	115
Bankfull Max Depth (d_{max}), ft	2.47-2.78-3.09	2.0	2.17-2.41-2.50
Depth Ratio d_{max}/d_{bkf}	2.06-1.89-1.72	1.11	2.21-2.08-1.81
Low Bank Height	1.27	2	1.89
Bank Height Ratio (BHR)	1.94-2.19-2.43	1	1.15-1.28-1.32
Width Flood-prone Area (W_{fpa}), ft	258-265-272	>88	>150
Entrenchment Ratio (ER)	5.3-6.5-7.7	>2.1	>2.2
Valley Slope (S_{valley}), ft/ft	0.0037	0.0037	0.0055
Channel Slope ($S_{channel}$), ft/ft	0.0067	0.0018	0.0039
Sinuosity (K)	1.13	1.39	1.16

Table 5: Morphological Design Table Continued.			
LOCATION	*UT 7*	*UT 7*	*Reach 1*
Stream Type	F4/C4	C4	C4
Drainage Area, Ac	1230	1230	1470
Bankfull Width (W_{bkf}), ft	20-26-30	25	43-52-64
Bankfull Mean Depth (d_{bkf}), ft	0.85-1.00-1.17	0.97	0.98-1.16-1.38
Width/Depth Ratio (W_{bkf}/ d_{bkf})	20-26-32	26	31-47-64
Bankfull X-Section Area (A_{bkf}), ft^2	20-26-31	24.3	55-59-65
Bankfull Mean Velocity, fps	3.7	3.9	2.44
Bankfull Discharge, cfs	96	96	115
Bankfull Max Depth (d_{max}), ft	1.79-2.16-2.95	1.13	2.17-2.41-2.50
Width Flood-prone Area (W_{fpa}), ft	39-54-91	>55	>150
Entrenchment Ratio (ER)	1.45-2.07-3.01	>2.2	>2.2
Meander Length (Lm), ft	NA	NA	NA

*Reach 1, Reach 3, and UT 7 are the only reaches where restoration is proposed.

Table 6: BEHI and Sediment Export Estimates for Project Site Streams
Little Buffalo Creek Stream Mitigation Project
EEP Project No. 94147

Time Point	Reach	Lin. Ft	Extreme		Very High		High		Moderate		Low		Very Low	
			ft	%	ft	%	ft	%	ft	%	ft	%	ft	%
Preconstruction	1 EII	1,862											1,862	100
Preconstruction	1 Rest	438			438	100								
Preconstruction	2 EII	1,248											1,248	100
Preconstruction	3 Rest	267			267	100								
Preconstruction	3 EII	808									808	100		
Preconstruction	4 EII	721							360.5	50	360.5	50		
Preconstruction	4 EI	120							120	100				
Preconstruction	5 EII	952									952	100		
Preconstruction	6 Pres	2,053											2,053	100
Preconstruction	UT 1 EII	109									109	100		
Preconstruction	UT 2 Pres.	335											335	100
Preconstruction	UT 2 EII	616									616	100		
Preconstruction	UT 3 Res	197					197	100						
Preconstruction	UT 3 EI	515					515	100						
Preconstruction	UT 3 EII	763									763	100		
Preconstruction	UT 4 EI	397					397	100						
Preconstruction	UT 4 EII	431							431	100				
Preconstruction	UT 5	184											184	100
Preconstruction	UT 6	151											151	100
Preconstruction	UT 7 Rest	1374					1373	100						
Preconstruction	UT 8 rest	100									100	100		
Project Total		**14,379**			**791**	**5.5**	**2,174**	**15.1**	**1,012**	**7.0**	**3,595**	**25.0**	**6,807**	**47.4**

Note: The percentages are based off the pre-construction linear feet measurements, not SMUs.

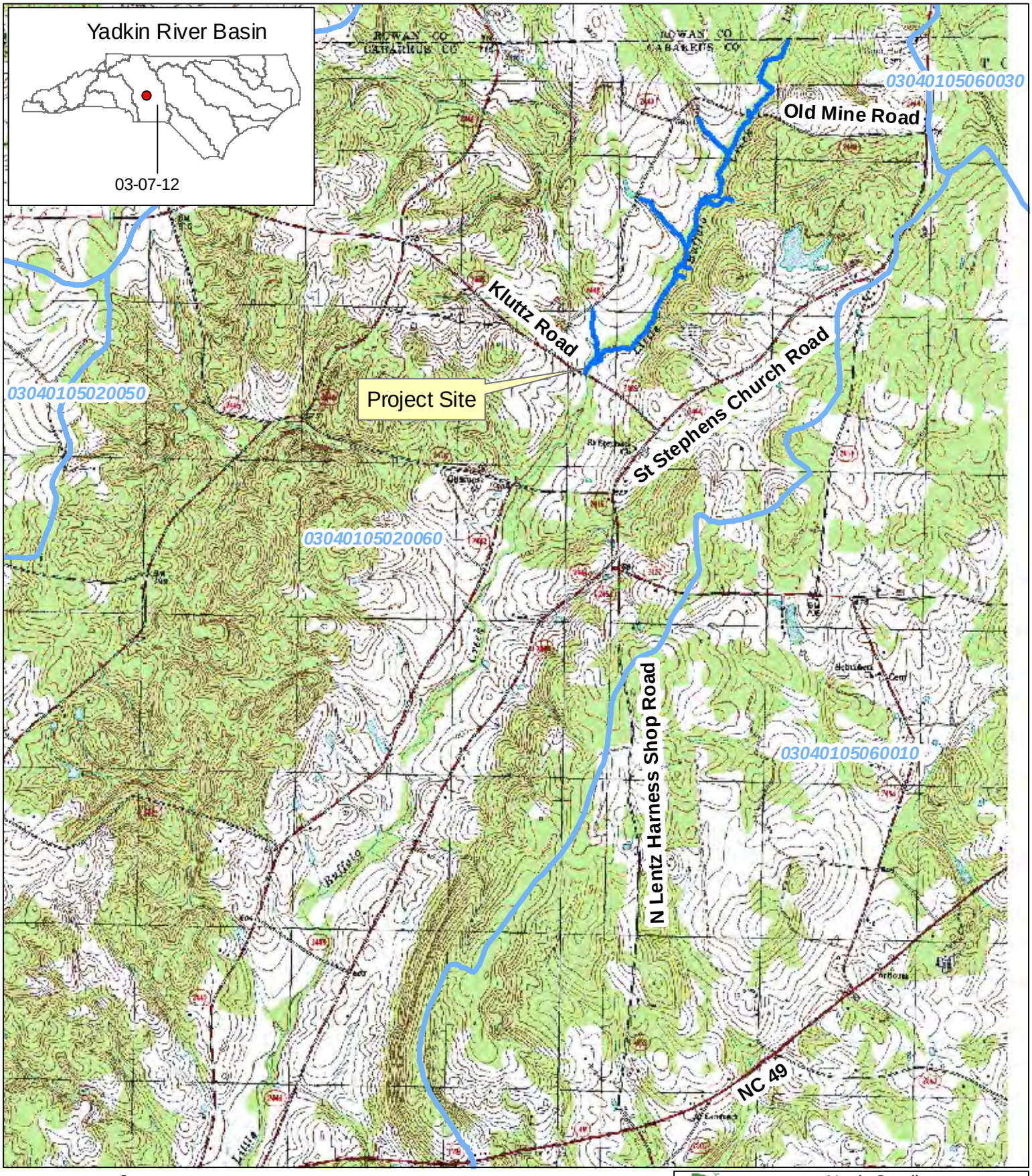
Table 7 – Planting Summary for Vegetative Communities and Zones
Little Buffalo Creek Stream Mitigation Project
EEP Project No. 94147

Zone	Species	Common Name	Type	Species percent	Quantity per Acre	Acreage	Total Quantity
Zone 1 (0.33 acres)	*Salix nigra*	black billow	live stake	60%	1200	0.33	396
	Cornus amomum	silky dogwood	live stake	40%	800	0.33	264
TOTALS					**2000**	**0.33**	**660**
Zone 2 (12 acres)	*Alnus serrulata*	hazel alder	bare root or tubeling	15%	75	11.42	571
	Betula nigra	river birch	bare root or tubeling	10%	50	11.42	571
	Carpinus caroliniana	ironwood	bare root or tubeling	10%	50	11.42	571
	Cornus amomum	silky dogwood	bare root or tubeling	5%	25	11.42	285
	Fraxinus pennsylvanica	green ash	bare root or tubeling	10%	50	11.42	571
	Lindera benzoin	spicebush	bare root or tubeling	10%	50	11.42	571
	Platanus occidentalis	sycamore	bare root or tubeling	15%	75	11.42	856
	Salix nigra	black willow	bare root or tubeling	10%	50	11.42	571
	Viburnum dentatum	arrowwood	bare root or tubeling	15%	75	11.42	856
TOTALS					**500**	**11.42**	**5710**
Zone 3 (12 acres)	*Carpinus caroliniana*	ironwood	bare root or tubeling	10%	50	12.17	608
	Celtis laevigata	sugarberry	bare root or tubeling	10%	50	12.17	608
	Cercis canadensis	redbud	bare root or tubeling	10%	50	12.17	608
	Fraxinus pennsylvanica	green ash	bare root or tubeling	5%	25	12.17	304
	Lindera benzoin	spicebush	bare root or tubeling	10%	50	12.17	608
	Liriodendron tulipifera	tulip poplar	bare root or tubeling	20%	100	12.17	1271
	Quercus alba	white oak	bare root or tubeling	15%	75	12.17	912
	Ulmus rubra	slippery elm	bare root or tubeling	10%	50	12.17	608
	Viburnum dentatum	arrowwood	bare root or tubeling	10%	50	12.17	608
TOTALS					**500**	**12.17**	**6085**

Table 8 – Seeding Summary for Permanent Vegetation Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147	
Scientific Name	**Common Name**
Panicum virgatum var. Shelter	Switchgrass
Panicum clandestinum var. Tioga	Deer tongue
Elymus virginiana	Virginia wild rye
Mixed Wildflowers	Meadow seed mix

Table 9 – Planting Summary for Temporary Sediment and Erosion Control Seed Mix Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147	
Scientific Name	**Common Name**
Lolium multiflorum	Annual rye
Dichanthelium clandestinum	Deer tongue

Figures



Legend

- Project Stream Segments
- USGS 14 Digit HUC

N

0 0.5 1 Miles

Source: USGS Topographic Quads:
Gold Hill, Rockwell, Richfield,
and Mount Pleasant, NC

North Carolina
Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Project Site Vicinity Map

THE LOUIS BERGER GROUP
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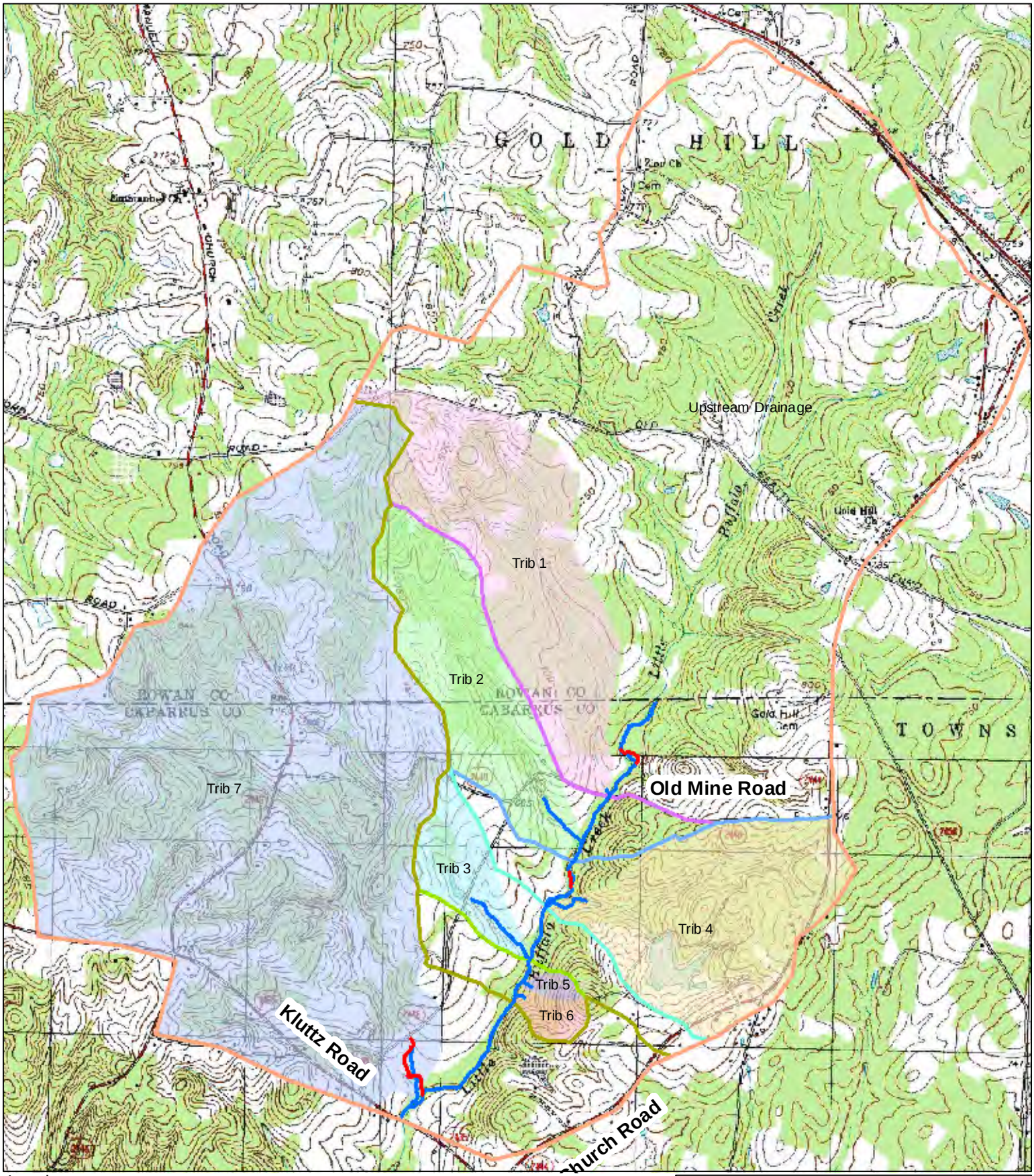
Raleigh, NC 27605

Figure 1

September 2010



Legend

Main Stem Drainage Areas
Reach
- Reach 1
- Reach 2
- Reach 3
- Reach 4
- Reach 5
- Reach 6

Tributary Drainage Areas
Reach
- Trib 1
- Trib 2
- Trib 3
- Trib 4
- Trib 5
- Trib 6
- Trib 7

- Project Stream Segments
- Restoration Segments

N

0 0.5 1 Miles

Source: USGS Topographic Quads: Gold Hill, Rockwell, Richfield, and Mount Pleasant, NC

North Carolina
Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Project Site Watershed Map

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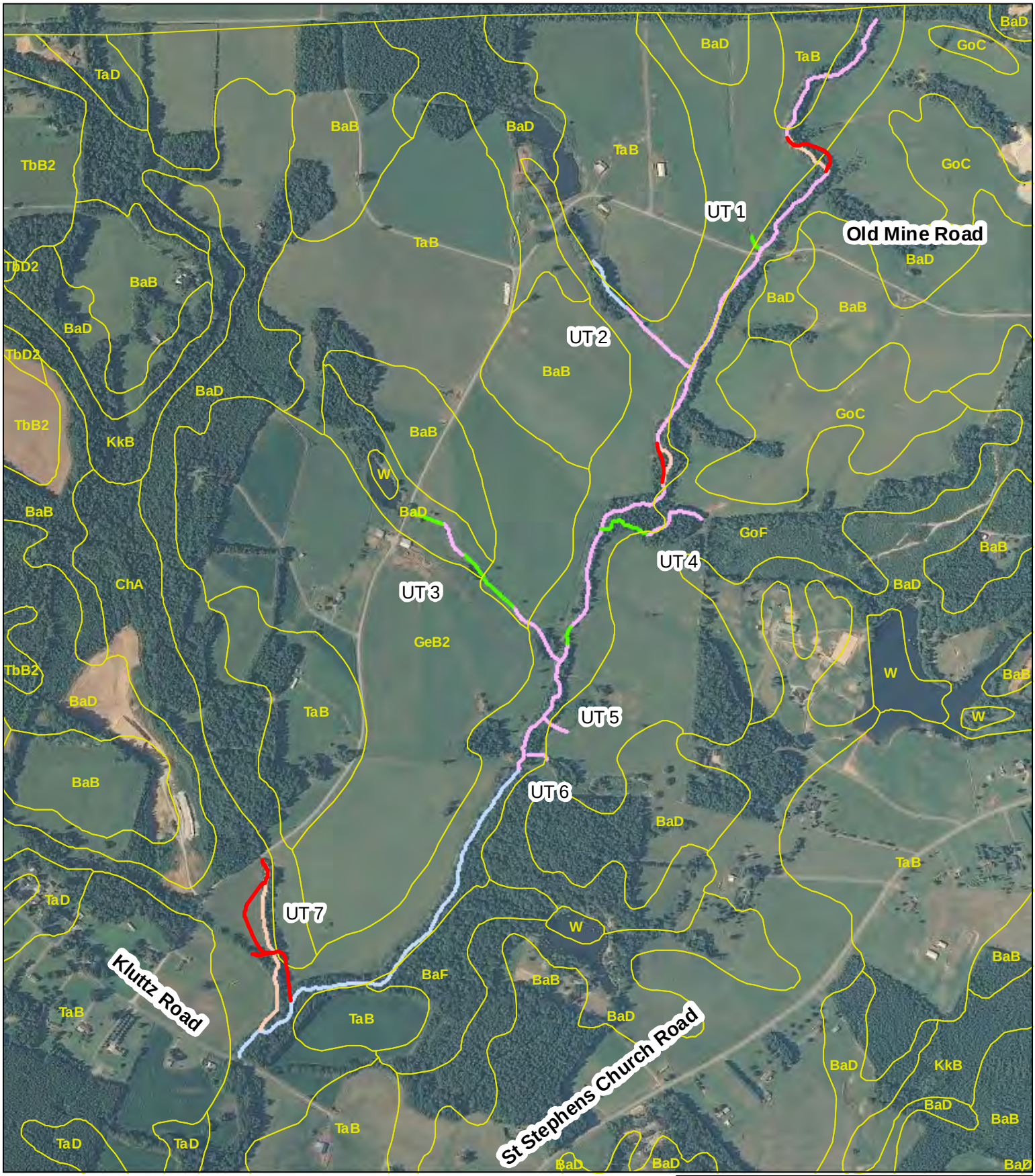
Figure 2

September 2010



Legend

- NRCS Soil

Project Stream Segments

Mitigation

- Enhancement Level I
- Enhancement Level II
- Existing
- Preservation
- Restoration

N

0 250 500 1,000 1,500 2,000 2,500 Feet

Source: USDA, Aerial Photography Field Office, North Carolina, 2009

North Carolina
Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Project Site NRCS Soil Survey Map

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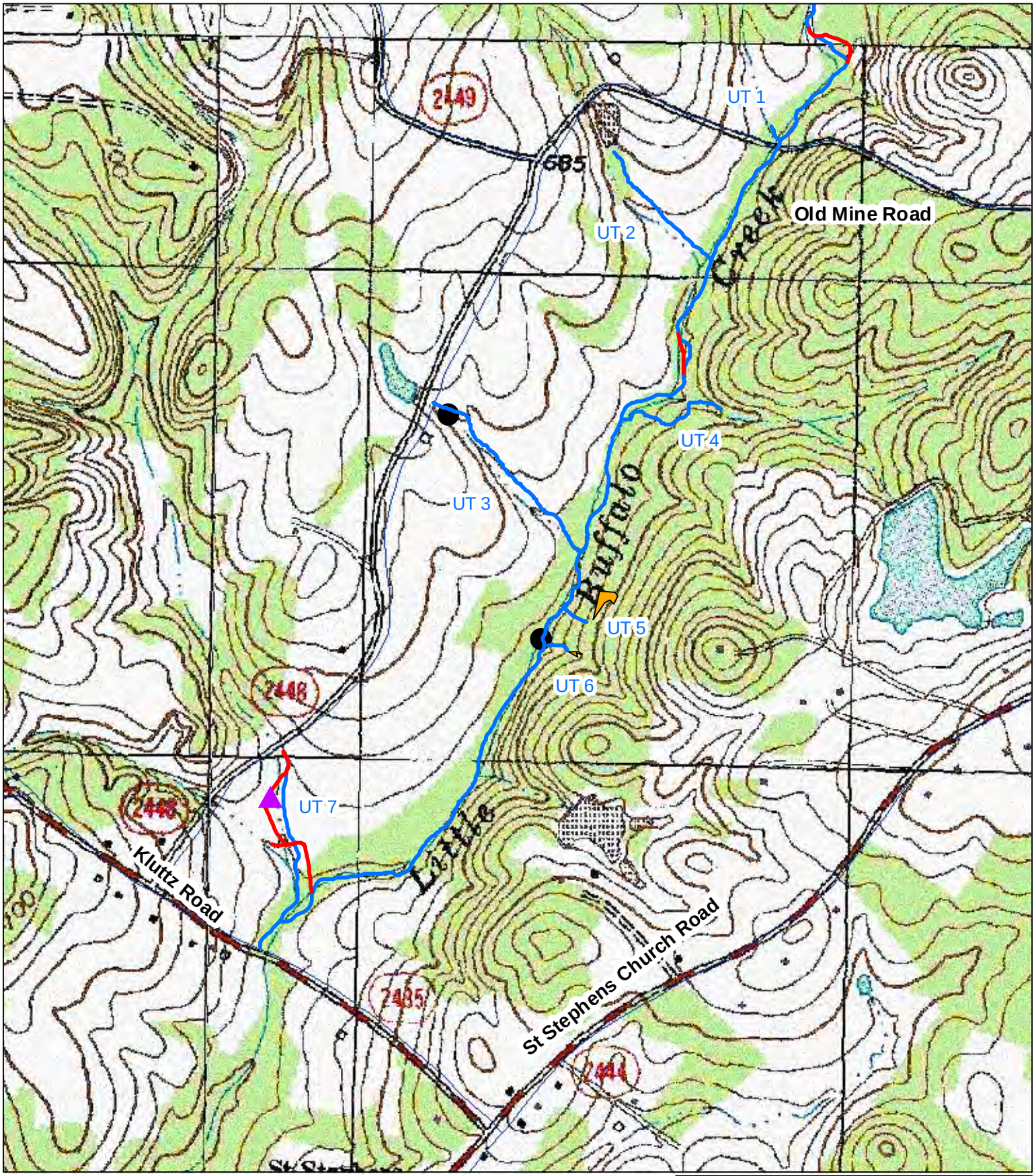
Figure 3

September 2010



Legend

- Stream Guage Locations
- Proposed Cattle Crossing
- Restoration Segments
- Project Stream Segments
- Wetlands

Source: USGS Topographic Quads: Gold Hill, Rockwell, Richfield, and Mount Pleasant, NC

N

0 250 500 1,000 1,500 2,000 Feet

North Carolina
Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Project Site Hydrological Features
with Gauge Locations

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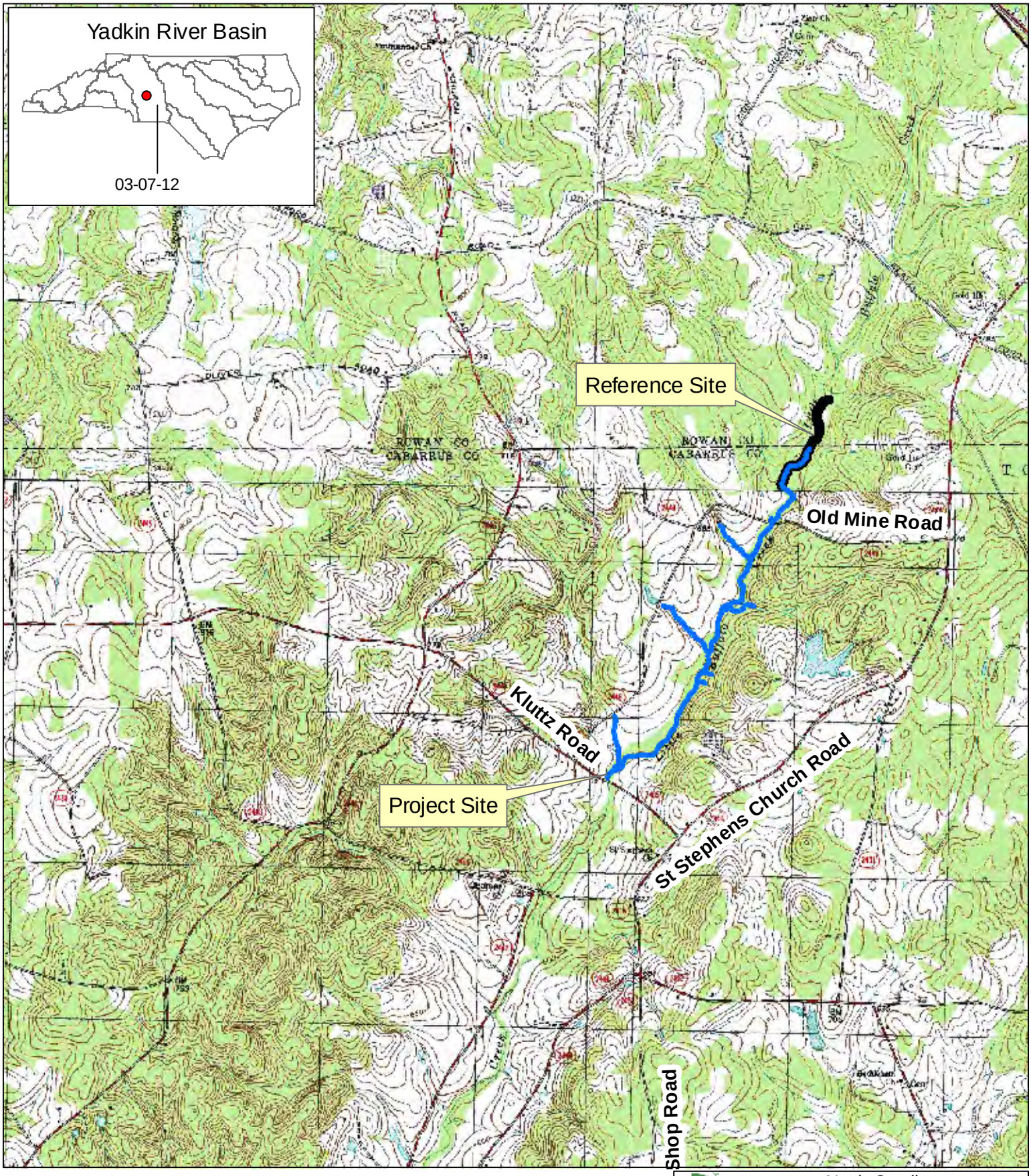
Figure 4

September 2010

Figure 5: Project Site Wetland Delineation Map

Not applicable to this project. Figure not produced.



Legend

- Project Stream Segments
- Reference Reach

N

0 0.5 1 Miles

Source: USGS Topographic Quads: Gold Hill, Rockwell, Richfield, and Mount Pleasant, NC

North Carolina Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Reference Site Vicinity Map

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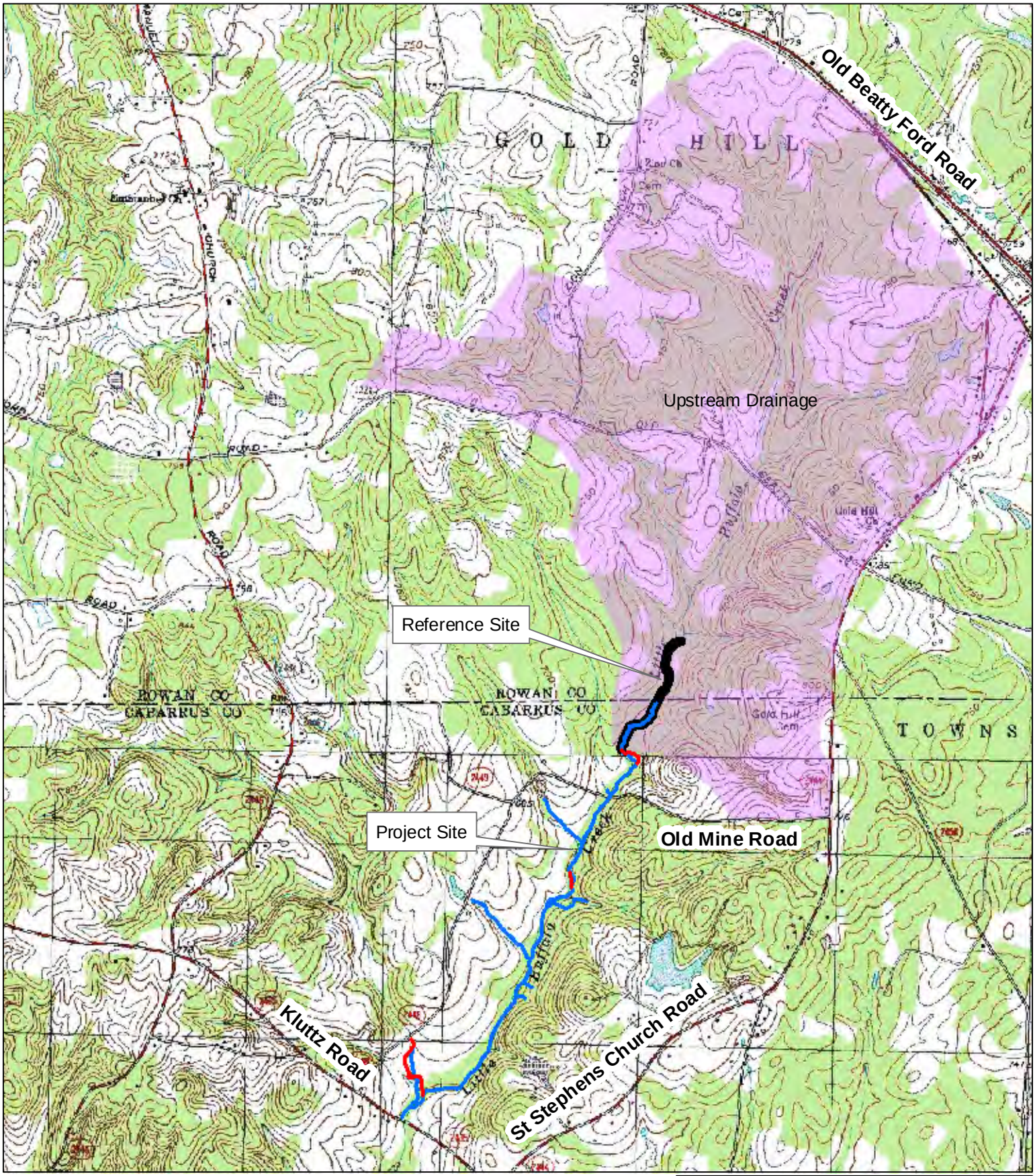
Figure 6

September 2010



Legend

- Restoration Segments
- Reference Reach
- Reference Reach Watershed
- Project Stream Segments

N

0 0.5 1 Miles

Source: USGS Topographic Quads: Gold Hill, Rockwell, Richfield, and Mount Pleasant, NC

North Carolina Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Reference Site Watershed Map

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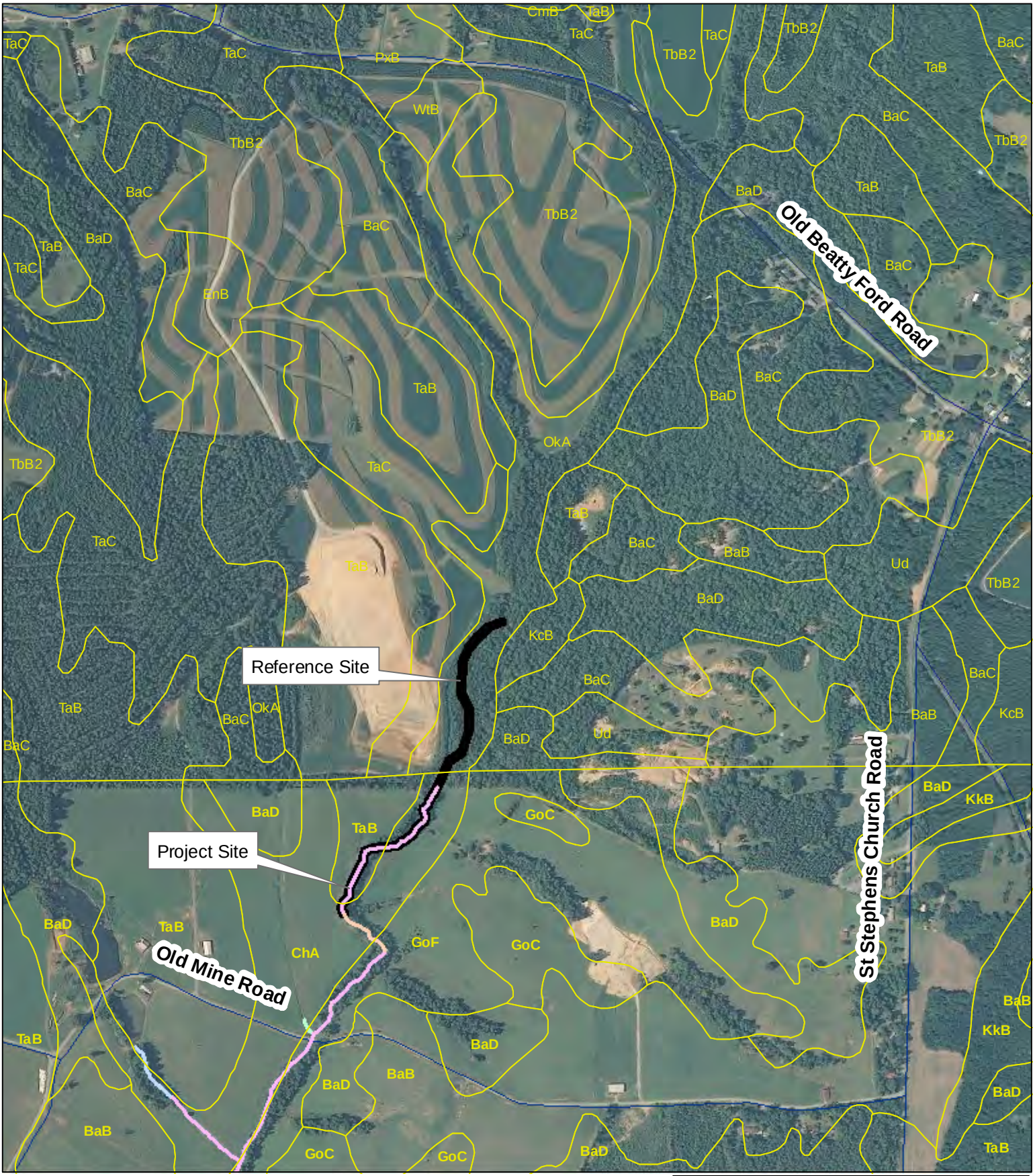
Figure 7

September 2010



Legend

- NRCS Soil

Project Stream Segments

Mitigation

- Enhancement Level I
- Enhancement Level II
- Existing
- Preservation
- Reference Reach
- Roads

N

0 250 500 1,000 1,500 2,000 2,500 Feet

Source: USDA, Aerial Photography Field Office, North Carolina, 2009

North Carolina
Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Reference Site NRCS Soil Survey Map

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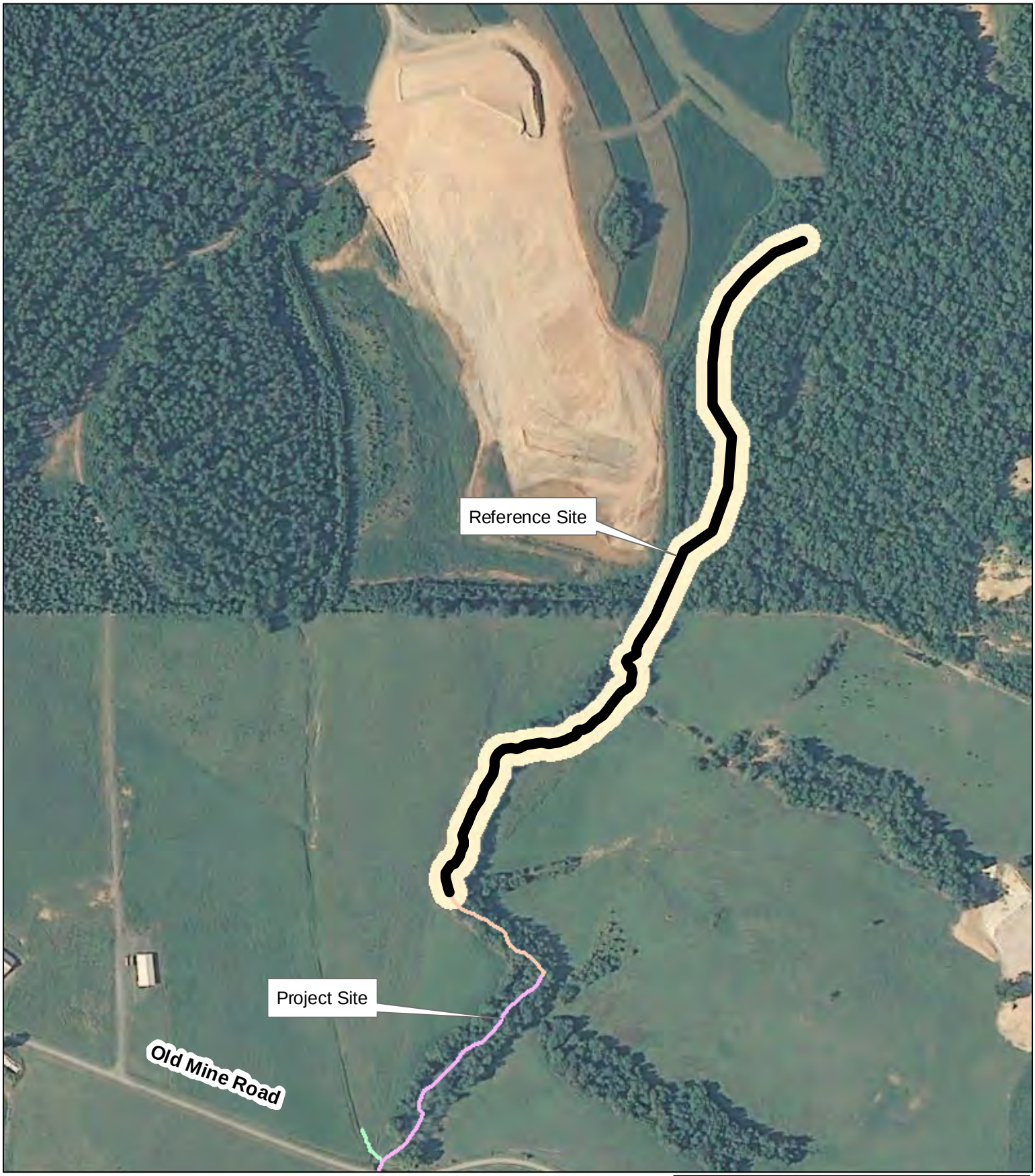
Figure 8

September 2010

Figure 9: Reference Site Wetland Determination Sample Locations with Gauge Locations

Not applicable to this project. Figure not produced



Legend

- Reference Reach

Project Stream Segments

Mitigation

- Enhancement Level I
- Enhancement Level II
- Existing
- Preservation

Reference Reach Vegetative Communities

- Piedmont/Mountain Bottomland Forest

N

0 250 500 1,000 Feet

Source: USDA, Aerial Photography Field Office, North Carolina, 2009

North Carolina
Ecosystem Enhancement Program

Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
EEP Project # 002029

Reference Site Vegetative Communities Map

THE LOUIS BERGER GROUP
1001 Wade Avenue, Suite 400
Raleigh, NC 27605

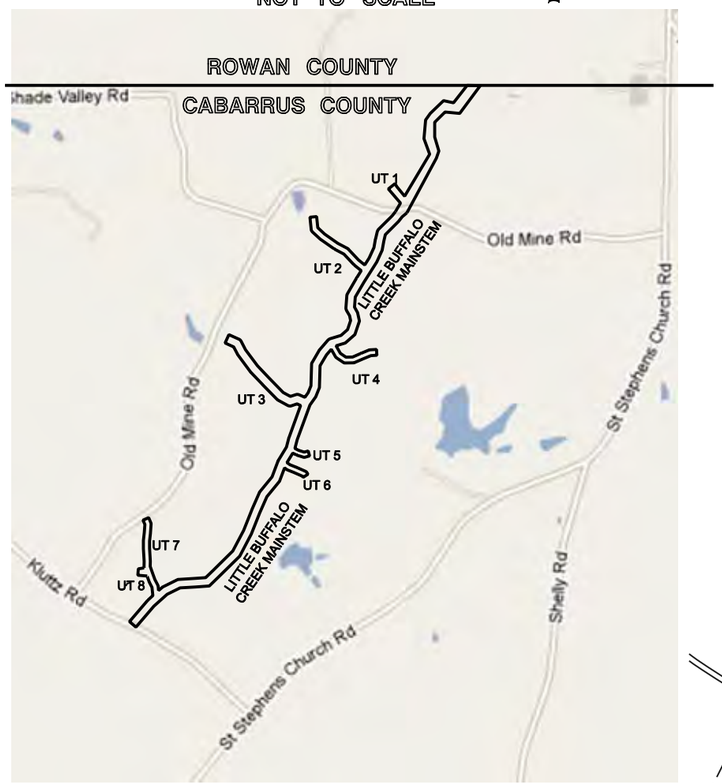
Figure 10

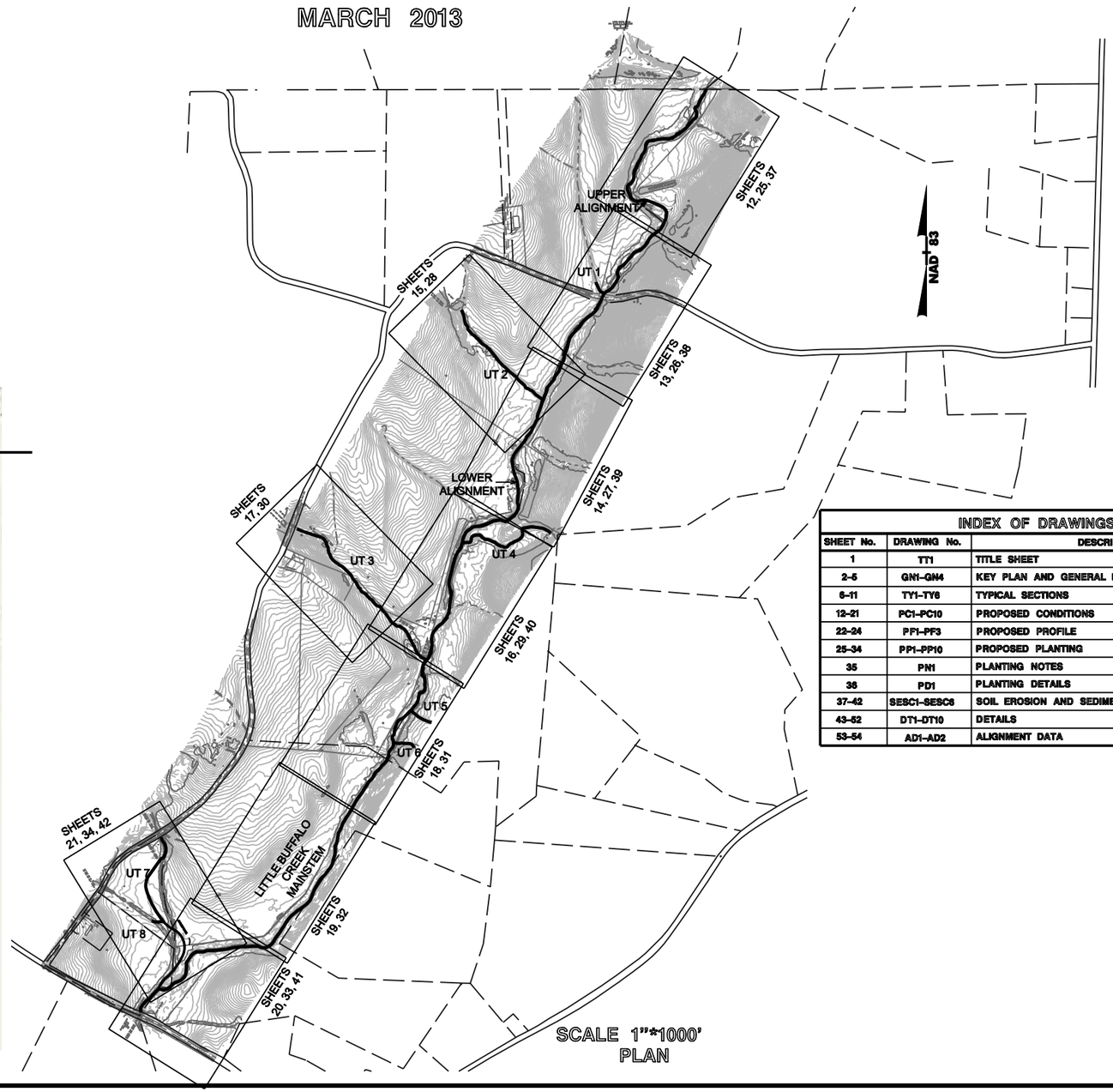
September 2010

Design Plan Sheets

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM
MARCH 2013

VICINITY MAP
NOT TO SCALE





SCALE 1"=1000'
PLAN

INDEX OF DRAWINGS

SHEET No.	DRAWING No.	DESCRIPTION
1	TT1	TITLE SHEET
2-5	GN1-GN4	KEY PLAN AND GENERAL NOTES
6-11	TY1-TY6	TYPICAL SECTIONS
12-21	PC1-PC10	PROPOSED CONDITIONS
22-24	PF1-PF3	PROPOSED PROFILE
25-34	PP1-PP10	PROPOSED PLANTING
35	PN1	PLANTING NOTES
36	PD1	PLANTING DETAILS
37-42	SESC1-SESC6	SOIL EROSION AND SEDIMENT CONTROL PLAN
43-52	DT1-DT10	DETAILS
53-54	AD1-AD2	ALIGNMENT DATA

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
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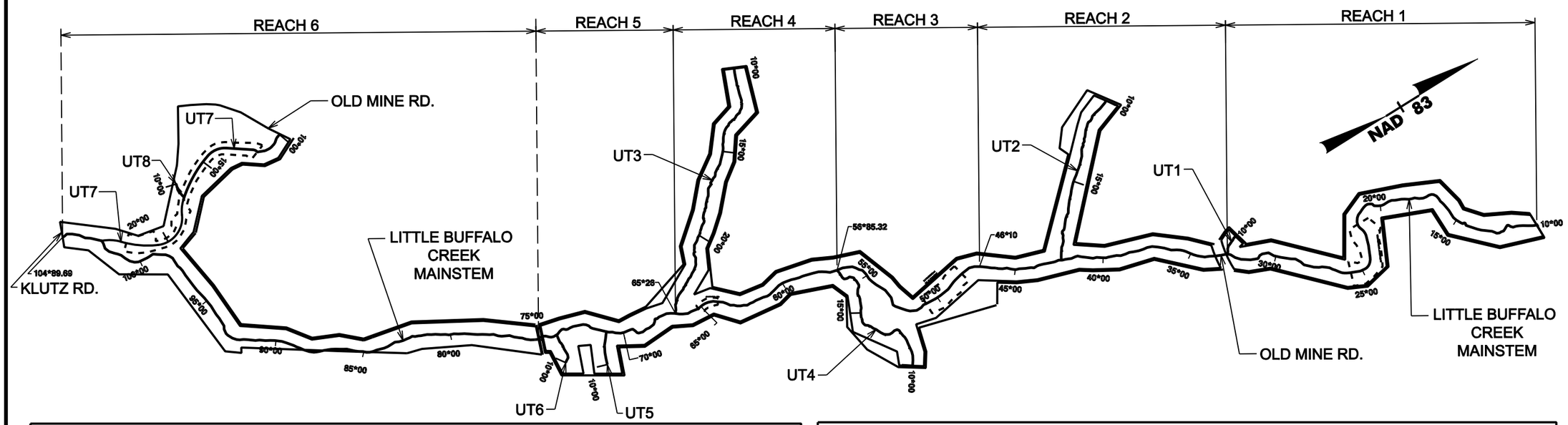
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE SHEET

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	1 OF 54
DRAWING NO.	TT1
DRAWN BY	JAD



MAINSTEM RESTORATION PLAN INDEX

ALIGNMENT	MITIGATION ACTIVITY	START STATION	END STATION
REACH 1	ENHANCEMENT LEVEL 2	10*00	21*28.92
	RESTORATION	21*28.92	25*66.91
	ENHANCEMENT LEVEL 2	25*66.91	33*00
REACH 2	ENHANCEMENT LEVEL 2	33*62.35	46*10
REACH 3	ENHANCEMENT LEVEL 2	46*10	48*10.4
	RESTORATION	48*10.40	50*76.91
	ENHANCEMENT LEVEL 2	50*76.91	56*85.32
REACH 4	ENHANCEMENT LEVEL 2	56*85.32	64*06
	ENHANCEMENT LEVEL 1	64*06	65*26
REACH 5	ENHANCEMENT LEVEL 2	65*26	74*78.37
REACH 6	PRESERVATION	75*05.63	82*47.74
	PRESERVATION	91*79.22	104*89.69

TRIBUTARY RESTORATION PLAN INDEX

ALIGNMENT	MITIGATION ACTIVITY	START STATION	END STATION
UT-1	ENHANCEMENT LEVEL 2	10*00	11*09.27
UT-2	PRESERVATION	10*00	13*34.67
UT-2	ENHANCEMENT LEVEL 2	13*34.67	19*50.70
UT-3	RESTORATION	10*00	11*97.12
UT-3	ENHANCEMENT LEVEL 2	11*97.12	14*60.22
UT-3	ENHANCEMENT LEVEL 1	14*60.22	19*74.90
UT-3	ENHANCEMENT LEVEL 2	19*74.90	24*74.90
UT-4	ENHANCEMENT LEVEL 2	10*00	14*31
UT-4	ENHANCEMENT LEVEL 1	14*31	18*28
UT-5	ENHANCEMENT LEVEL 2	10*00	11*84.46
UT-6	ENHANCEMENT LEVEL 2	10*00	11*51.33
UT-7	RESTORATION	10*00	23*74.08
UT-8	RESTORATION	10*00	11*00.60

MITIGATION ACTIVITY	GENERAL DESCRIPTION
RESTORATION	CHANNEL RE-ALIGNMENT AND CREATION. DITCH PLUG INSTALLATION. IN-STREAM STRUCTURE INSTALLATION, INCLUDING LOG VANES, ROCK CROSS VANES, STEP POOLS AND LARGE WOODY DEBRIS. STREAM BANK RE-GRADING. PLANTING.
ENHANCEMENT LEVEL I (E1)	STREAM BANK GRADING. MINOR CHANNEL REGRADING. LIMITED PIPE AND CONCRETE REMOVAL. PLANTING.
ENHANCEMENT LEVEL 2 (E2)	PLANTING.

NOTE: REFER TO PROPOSED CONDITIONS AND PLANTING PLANS FOR SPECIFIC ACTIVITIES AS PART OF THIS PROJECT. ADDITIONAL PROJECT COMPONENTS INCLUDE REMOVAL OF EXISTING FENCING, FENCE INSTALLATION, INSTALLATION OF TWO CATTLE CROSSINGS AND FLOOD GATES AS SHOWN ON THE PLANS.

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

KEY PLAN

DATE	MARCH 2013
PROJECT NO.	94147
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SHEET NO.	2 OF 54
DRAWING NO.	GN1
DRAWN BY	JAD

PLANTING LEGEND

ZONE 1 (LIVE STAKES)

ZONE 2 (BANKFULL)

ZONE 3 (ABOVE BANKFULL)

EXISTING PLAN LEGEND

PROPERTY LINE

TREE LINES / WOODS

SINGLE TREE

SHRUB

EIP EXISTING IRON PIPE

EIR EXISTING IRON ROD

POLE

CULVERT

FENCE

CONCRETE MONUMENT

SE&S LEGEND

SF TEMPORARY SILT FENCE

LIMITS OF DISTURBANCE

STAGING & STOCKPILE AREA

LIMITS OF GRADING

REINFORCED STABILIZED OUTLET

TEMPORARY CONSTRUCTION ENTRANCE

PROPOSED PLAN LEGEND

PROPOSED 4' WOVEN WIRE WITH 1 STRAND ELECTRIC

PROPOSED EASEMENT

10+00 STREAM ALIGNMENT

PROPOSED DITCH PLUG

PROPOSED LOG VANES

PROPOSED LARGE WOODY DEBRIS

PROPOSED ROCK CROSS VANE

PROPOSED LIVESTOCK CROSSING

PROPOSED LIVESTOCK WELL

SENSITIVE AREA

GENERAL NOTES

1. THE HORIZONTAL COORDINATE SYSTEM IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NAD83, FT.

2. ALL ELEVATIONS SHOWN ON THESE PLANS ARE REFERENCED TO NAVD88, FT.

3. PROPOSED CONSTRUCTED STREAM FEATURES AND STRUCTURES SHOWN ON THE PLANS ARE SHOWN IN THEIR APPROXIMATE LOCATION AND SHALL BE FIELD LOCATED AND DIMENSIONED TO INSURE PROPER CHANNEL DIMENSIONS.

4. CONSTRUCTION ACTIVITIES SHALL BEGIN UPSTREAM AND PROGRESS DOWNSTREAM, UNLESS OTHERWISE NOTED ON THESE PLANS OR AS DIRECTED BY THE ENGINEER.

5. ALL MECHANIZED EQUIPMENT OPERATED IN OR NEAR THE STREAM OR ITS TRIBUTARIES SHALL BE INSPECTED REGULARLY AND MAINTAINED TO PREVENT CONTAMINATION OF STREAM WATERS FROM FUELS, LUBRICANTS, HYDRAULIC FLUIDS OR OTHER TOXIC MATERIALS. ANY EQUIPMENT REPAIRS, MAINTENANCE OR REFUELING ACTIVITIES SHALL NOT BE DONE WHILE THE EQUIPMENT IS IN THE STREAM OR ITS TRIBUTARIES.

6. WASTE MATERIAL DESIGNATED FOR OFFSITE DISPOSAL SHALL BE DONE IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS.

7. CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRS TO ANY DAMAGE TO EXISTING UTILITIES, INCLUDING BUT NOT LIMITED TO, OVERHEAD AND UNDERGROUND UTILITIES, CURB AND GUTTER, PAVEMENT, SIDEWALKS, STORMWATER DRAINAGE SYSTEMS, SANITARY SEWER SYSTEMS, ACCESS ROADS OR FENCING. ANY REQUIRED REPAIRS TO BE MADE IN ACCORDANCE WITH ANY AND ALL APPLICABLE STATE AND/OR LOCAL MUNICIPALITY STANDARDS. THE CONTRACTOR SHALL CONSULT WITH THE "CALL BEFORE YOU DIG" TOLL FREE NUMBER 800-632-4949, AND THE NC ONE CALL CENTER AT LEAST 48 HOURS PRIOR TO BEGINNING ANY EARTHWORK ACTIVITIES.

8. CONTRACTOR IS ADVISED TO USE CAUTION AND TO FOLLOW ALL APPLICABLE REGULATIONS WITH REGARDS TO PEDESTRIAN AND BYSTANDER SAFETY.

9. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE LAND OWNER THROUGHOUT ALL PHASES OF CONSTRUCTION REGARDING THE MOVEMENT AND CONTAINMENT OF LIVESTOCK AT THE SITE. THE CONTRACTOR SHALL COORDINATE WITH THE LAND OWNER AS NECESSARY TO INSURE AT ALL TIMES THAT LIVESTOCK ARE SAFELY AND SECURELY MOVED OUT OF ALL WORK AREAS, THAT LIVESTOCK DO NOT ESCAPE FROM THE PROPERTY AS A RESULT OF CONSTRUCTION ACTIVITIES, THAT LIVESTOCK ARE NOT HARMED AS A RESULT OF CONSTRUCTION ACTIVITIES, THAT LIVESTOCK ARE EXCLUDED AT ALL TIMES FROM THE ACTIVE AND COMPLETED WORK AREAS, AND THAT CONSTRUCTION ACTIVITIES ARE NOT HINDERED, DELAYED, OR DAMAGED BY LIVESTOCK OR THE ASSOCIATED MOVEMENT OR CONTAINMENT OF LIVESTOCK.

10. AREAS DESIGNATED AS SENSITIVE AREAS MUST BE KEPT FREE OF CONSTRUCTION EQUIPMENT.

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

GENERAL NOTES

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	3 OF 54
DRAWING NO.	GN2
DRAWN BY	JAD

TYPICAL CONSTRUCTION SEQUENCE

Phase 1
LIVESTOCK MANAGEMENT, MOBILIZATION, AND ESTABLISHMENT OF EROSION CONTROL

1. Coordinate with the landowners and complete all necessary livestock movement, exclusion or containment prior to commencement of each phase of operations.
2. Identify, locate, and delineate staging areas, stockpile locations, construction entrances and access roads, temporary stream crossings required for construction access, limits of silt fence installation, and limits of tree protection fencing.
3. Install construction entrances.
4. Install stream crossings required for construction access. Stream crossings will be located at the upstream end of mainstem Reach 6 and where the existing access road crosses UT3. Locations will be shown on plan drawing.
5. Install and monitor silt fencing as shown on plan drawings. Silt fencing may be installed at other locations as directed by the Engineer. Silt fencing shall be installed and monitored at limits of all staging and stockpile areas.
6. Stockpile construction materials in designated staging areas.
7. Tree protection fencing may be installed at locations as directed by the Engineer.
8. Mark all vegetation to be transplanted.
9. Mark trees to be used as rootwads, header or footer logs, or sills. Coordinate with Engineer to ensure that selections are appropriate.
10. Install livestock water wells and livestock watering stations at locations designated on the plan drawings or as directed by the Engineer. This work may be done independent of the other steps in Phase 1, but must be completed prior to the installation of the livestock exclusion fencing.
11. Install permanent livestock exclusion fence throughout the project as shown on the plan drawings with the exception of the restoration segments or as directed by the Engineer. At the Enhancement Level 1 and Restoration segments, sequencing of installation of the fence will be at the discretion of the Contractor so as to facilitate ease of access for construction equipment and materials. In these areas, fence will be erected as temporary structures sufficient to exclude livestock until the installation of the permanent fence. All fence segments temporary and/or permanent will be securely installed prior to installation of plant materials. The Engineer will stake locations for the fenceline.

Phase 2
Restoration

1. Contractor will perform construction staking.
2. The Contractor will mark upstream and downstream end sections of new channel alignment to be left as impervious dikes in order to isolate all work from stream flow during new channel construction.
3. Remove all vegetation designated for transplant within the zone of active construction. Stockpile and maintain in accordance with project specifications.
4. Remove trees to be used as rootwads, header or footer logs, or sills, and stockpile in accordance with project specifications.
5. Perform required clearing and grubbing.
6. Segregate and stockpile topsoil and other soil material in accordance with project specifications. Soil stockpiles will be seeded, mulched, and isolated by silt fence in accordance with project specifications and other erosion controls as directed by the Engineer.
7. Construct proposed stream channel and in-stream structures as specified on the plan drawings and the project specifications or as directed by the Engineer.
8. The Engineer will mark the planting zones.
9. Perform all topsoil replacement, vegetation transplanting and installation, seeding (temporary and permanent), mulching, and installation of all erosion control matting as specified on the plans and the project specifications. Erosion control matting will be installed on top of the seeded and mulched stream banks according to the project specifications.
10. Prior to making the upstream connection to the active channel, and as needed during the course of construction, turbid water between impervious dikes will be pumped out through special stilling basins/sediment bags to be discharged downstream of the work site as shown in the typical detail and plan drawings.
11. The construction area will be ripped by a tractor drawn ripping tool to de-compact the soils prior to re-distribution of the stockpiled topsoil and installation of permanent seed.
12. Stream banks will be stabilized with permanent seed, mulch, and erosion control matting applied prior to activation of the new channel.
13. The Contractor will leave the reach of proposed channel on new alignment disconnected from the upstream end until construction of the new channel is completed and vegetation has been installed. A longer time period is more desirable, if possible, to allow establishment and growth of vegetation prior to activation of the new channel.
14. Only when construction of the new channel is completed will the connection be made to the active channel at the upstream end. The downstream impervious dike will be removed before the upstream dike. Immediately upon the removal of the upstream impervious dike from the newly constructed channel, the Contractor will construct the impervious channel plug at the upstream end of the reach of the existing channel to be abandoned. Soil material produced during construction will be hauled to the abandoned channel and used to fill it in.
15. Remove and dispose of all unused vegetation materials.
16. All excavated soil materials not utilized will be stockpiled and maintained according to the project specifications. After completion of construction, any unused excavated soil materials shall be the responsibility of the Contractor to dispose of off-site in a permitted area, as well as for providing and implementing an erosion and sedimentation control plan and permit, or any other required permit(s), for the location(s) off site where such materials are disposed.
17. All disturbed areas are to be seeded, mulched and/or matted according to the project specifications.
18. Upon the completion of work in each Work Module, the Contractor shall schedule an inspection by the Engineer. The Contractor must have written approval from the Engineer that the Work Module has been completed to satisfactory standards prior to demobilization.

NO.	REVISIONS	DRN	CHK	DATE

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

GENERAL NOTES

DATE	MARCH 2013
PROJECT NO.	94147
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SHEET NO.	4 OF 54
DRAWING NO.	GN3
DRAWN BY	JAD

TYPICAL CONSTRUCTION SEQUENCE (CONT.)

Phase 2 (continued)

Enhancement Level 1

1. Earthwork to modify and stabilize stream banks will be conducted with a stream flow diversion pump.
2. Contractor will perform construction staking.
3. Install impervious dikes at upstream and downstream ends of proposed limit of active construction to isolate work from stream flow. Pump around operation will be conducted in accordance with the typical pump around detail shown in the design plans.
4. Turbid water between impervious dikes will be pumped out through special stilling basins/sediment bags to be discharged downstream of the work site as shown in the typical detail and plan drawings.
5. The Engineer must approve the pump around operation prior to commencement of work in the reach.
6. Remove all vegetation designated for transplant within the zone of active construction. Stockpile and maintain in accordance with project specifications.
7. Perform required clearing and grubbing.
8. Segregate and stockpile topsoil and other soil material in accordance with project specifications. Soil stockpiles will be seeded, mulched, and isolated by silt fence in accordance with project specifications and other erosion controls as directed by the Engineer.
9. Perform proposed stream bank modifications as specified on the plan drawings and the project specifications or as directed by the Engineer.
10. The Engineer will mark the planting zones.
11. Perform all topsoil replacement, vegetation transplanting and installation, seeding (temporary and permanent), mulching, and installation of all erosion control matting as specified on the plans and the project specifications. Stream banks will have permanent and temporary seed, mulch, and erosion control matting applied to them as work progresses and by the end of each day. Erosion control matting will be installed on top of the seeded and mulched stream banks according to the project specifications.
12. Prior to making the upstream connection to the active channel, and as needed during the course of construction, turbid water between impervious dikes will be pumped out through special stilling basins/sediment bags to be discharged downstream of the work site as shown in the typical detail and plan drawings.
13. The construction area will be ripped by a tractor drawn ripping tool to de-compact the soils prior to re-distribution of the stockpiled topsoil and installation of permanent seed.
14. Stream banks will be stabilized with permanent seed, mulch, and erosion control matting applied to them prior to re-activation of the channel.
15. The Contractor will leave the modified reach disconnected from the upstream end until construction is completed and vegetation has been installed. A longer time period is more desirable, if possible, to allow establishment and growth of vegetation prior to re-activation of the modified channel.
16. Only when construction of the new channel is completed will the connection be made to the active channel at the upstream end. The downstream impervious dike will be removed before the upstream dike.
17. Remove and dispose of all unused vegetation materials.
18. All excavated soil materials not utilized will be stockpiled and maintained according to the project specifications. After completion of construction, any unused excavated soil materials shall be the responsibility of the Contractor to dispose of off-site in a permitted area, as well as for providing and implementing an erosion and sedimentation control plan and permit, or any other required permit(s), for the location(s) off site where such materials are disposed.

Enhancement Level 1 (continued)

19. All disturbed areas are to be seeded, mulched and/or matted according to the project specifications.
20. Upon the completion of work in each Work Module, the Contractor shall schedule an inspection by the Engineer. The Contractor must have written approval from the Engineer that the Work Module has been completed to satisfactory standards prior to demobilization.

Enhancement Level 2

1. The Engineer will mark planting zones.
2. Areas lacking existing tree canopy will be ripped by a tractor drawn ripping tool to de-compact the soils prior to installation of vegetation as shown on the design plan drawings. These areas will be marked by the Engineer.
3. Perform all vegetation transplanting and installation as specified on the plans and the project specifications.

SURVEY CONTROL POINTS

CONTROL POINT	NORTHING	EASTING	ELEVATION
600 – MONUMENT	637495.6110	1592310.8590	668.6060
601 – MONUMENT	635049.9530	1591355.3360	632.8510
602	633940.0160	1590470.3200	648.5130
603	633348.7210	1591639.1740	627.4340
604	635717.2520	1593413.0340	657.8780
605	637370.9250	1594236.7770	659.2430
606 – MONUMENT	637975.0800	1593763.8310	636.3930
607	639070.9930	1593605.3430	652.2240
608 – MONUMENT	639507.0790	1595180.5440	675.1820
609	640557.4300	1595783.8180	686.9290
610	640541.1480	1594633.4580	669.7910

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THE LOUIS BERGER GROUP, Inc.
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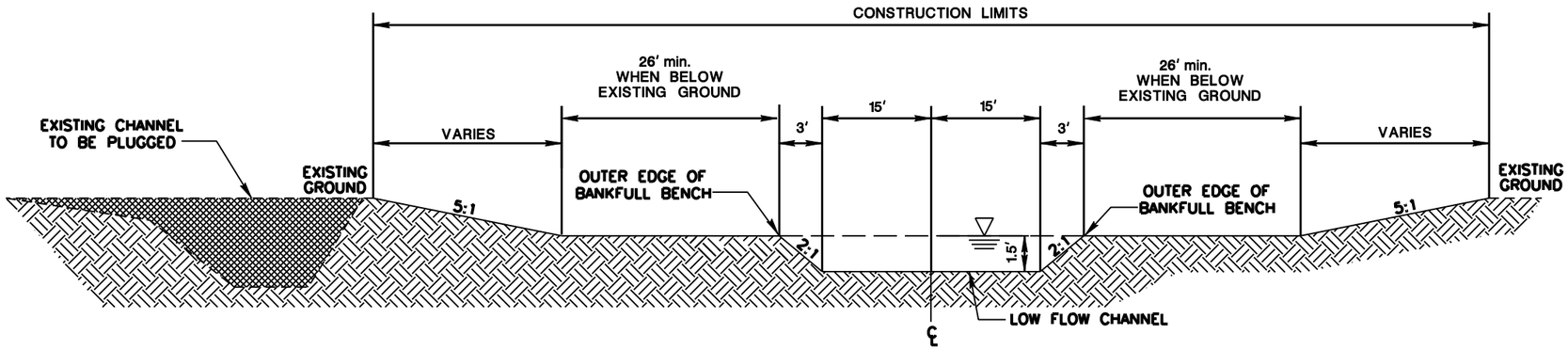
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

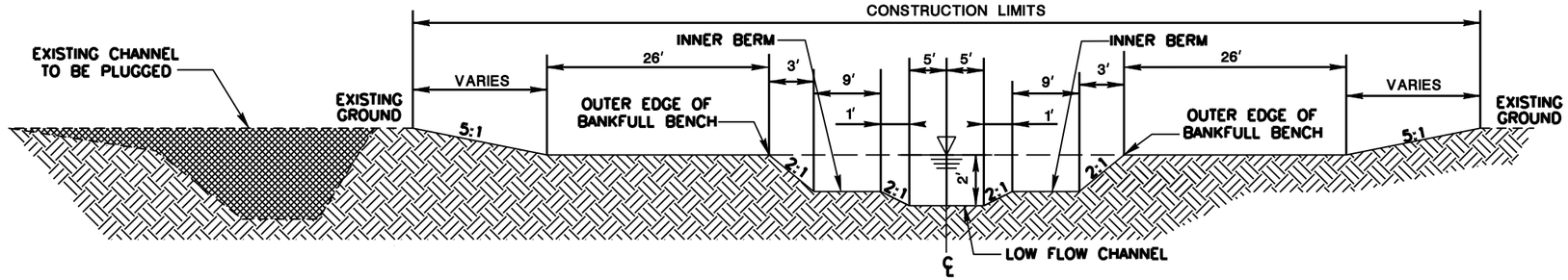
GENERAL NOTES

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	5 OF 54
DRAWING NO.	GN4
DRAWN BY	JAD



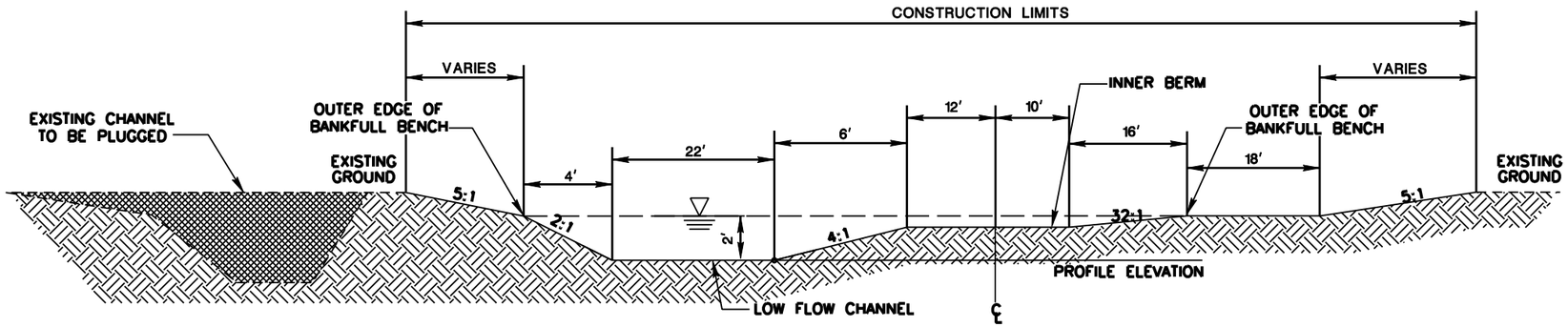
MAINSTEM UPSTREAM PROPOSED RIFFLE

ALIGNMENT STATIONS
22+23.92 TO 22+48.92
22+88.92 TO 23+23.92
23+78.92 TO 24+18.92
24+73.92 TRANSITION FROM 24+58.92 POOL
25+18.92 TO 25+58.92
N.T.S.



MAINSTEM UPSTREAM PROPOSED STRAIGHT POOL

ALIGNMENT STATIONS
23+48.92 TO 23+68.92
24+93.92 TO 25+08.92
N.T.S.



MAINSTEM UPSTREAM PROPOSED POOL CURVE "RIGHT"

ALIGNMENT STATIONS
22+68.92 TO 22+78.92
24+38.92 TO 24+58.92
N.T.S.
MIRROR TYPICAL FOR
LEFT CURVE

NO.	REVISIONS	DRN	CHK	DATE

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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
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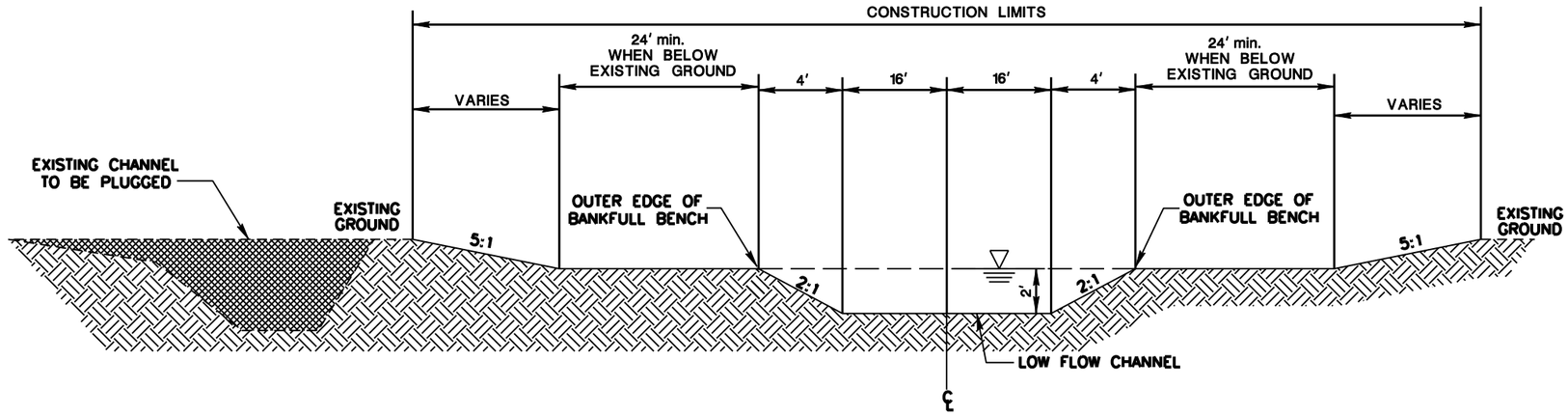
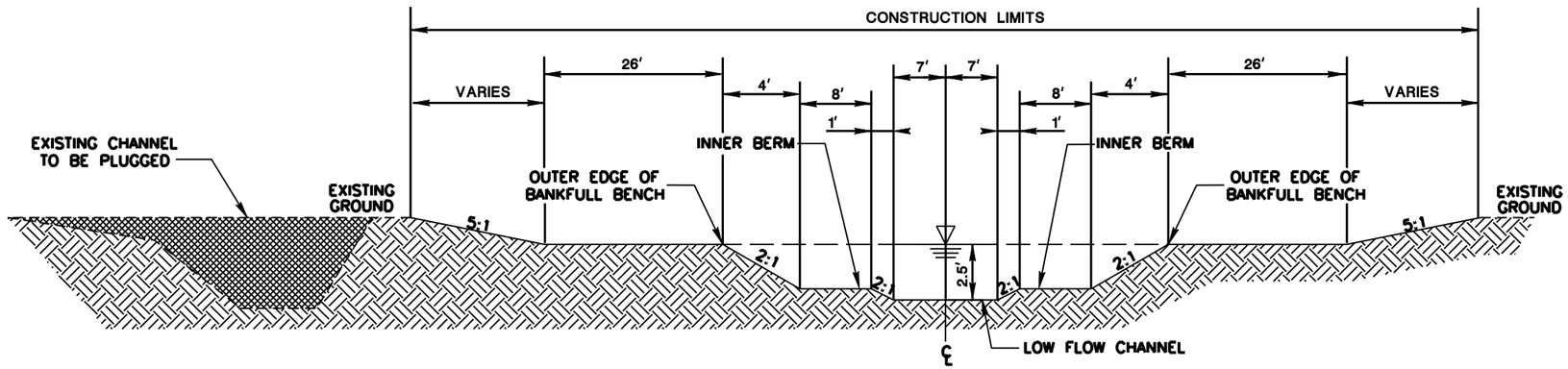
PROPOSED TYPICAL SECTIONS
RESTORATION

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	6 OF 54
DRAWING NO.	TY1
DRAWN BY	JAD



MAINSTEM DOWNSTREAM PROPOSED RIFFLE

ALIGNMENT STATIONS
48+25.34 TO 48+65.34
49+45.34 TRANSITION TO 50+10.34 POOL
50+55.34 TRANSITION FROM 50+30.34 POOL
N.T.S.



MAINSTEM DOWNSTREAM PROPOSED STRAIGHT POOL

ALIGNMENT STATIONS
48+95.34 TO 49+15.34
50+30.34 TO 50+55.34
N.T.S.

NO.	REVISIONS	DRN	CHK	DATE

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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
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PROPOSED TYPICAL SECTIONS
RESTORATION

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	7 OF 54
DRAWING NO.	TY2
DRAWN BY	JAD

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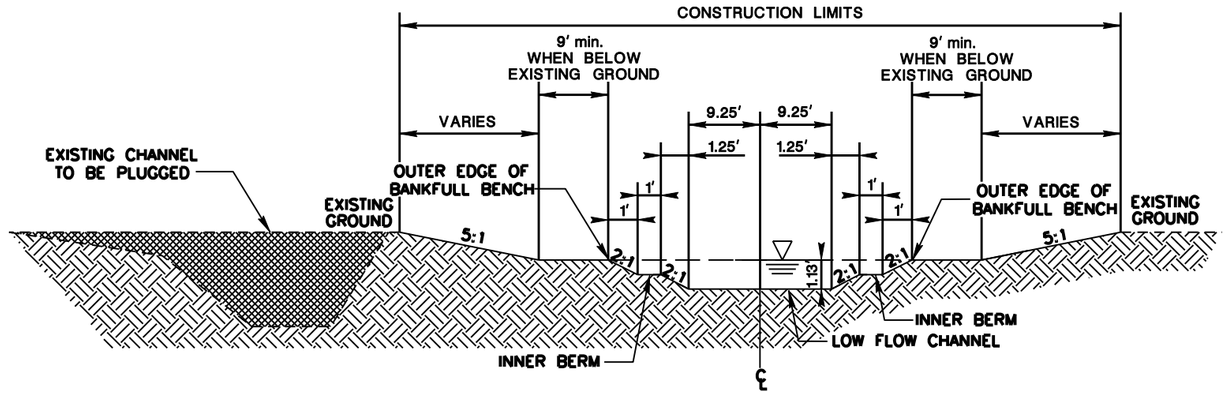
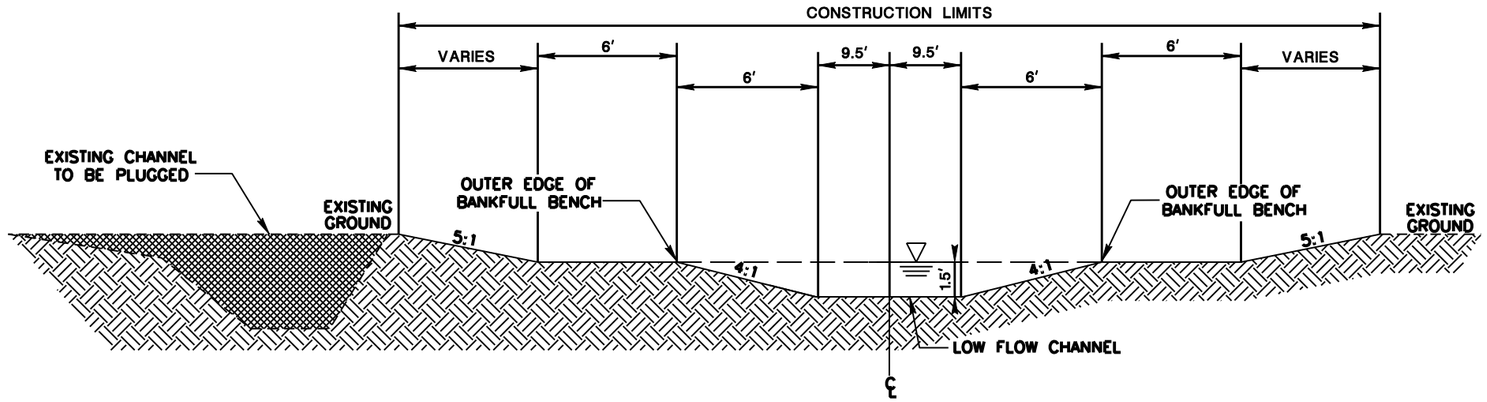


UT 7 PROPOSED RIFFLE

ALIGNMENT STATIONS
11+68.64 TO 12+05
12+40 TO 12+85
13+20 TO 13+55
14+10 TRANSITION TO 14+30 POOL CURVE
14+60 TO 15+00
15+35 TO 15+70
16+05 TO 16+40
16+75 TO 17+00
17+45 TO 17+60
18+00 TO 18+60
19+00 TO 19+35
19+90 TO 20+10
20+45 TO 20+55
N.T.S.



UT 7 PROPOSED STRAIGHT POOL

ALIGNMENT STATIONS
12+20 TO 12+30
13+00 TO 13+10
15+15 TO 15+25
15+85 TO 15+95
16+55 TO 16+65
17+75 TO 17+90
20+25 TO 20+35
N.T.S.

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

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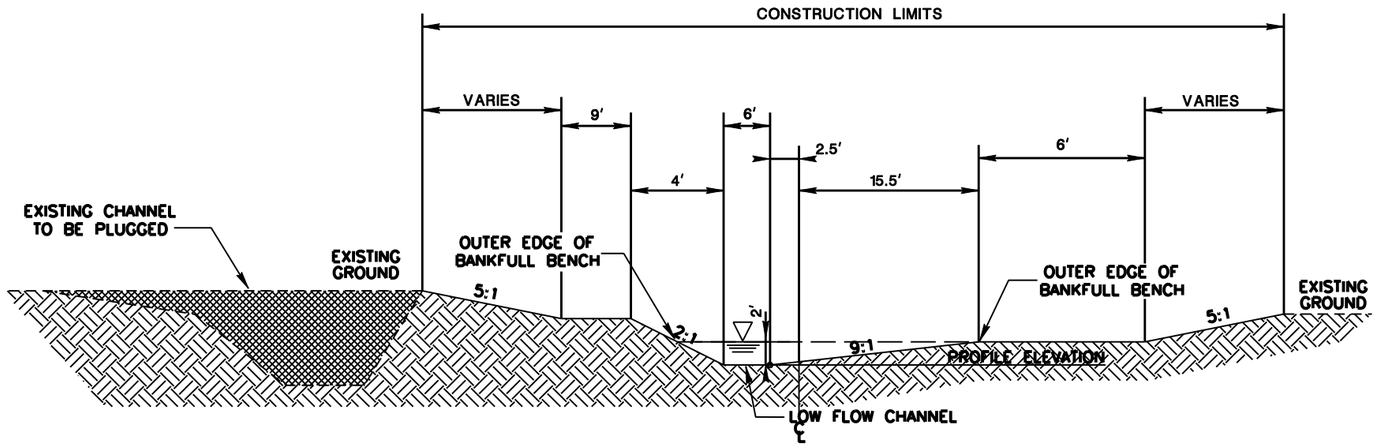
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED TYPICAL SECTIONS
RESTORATION

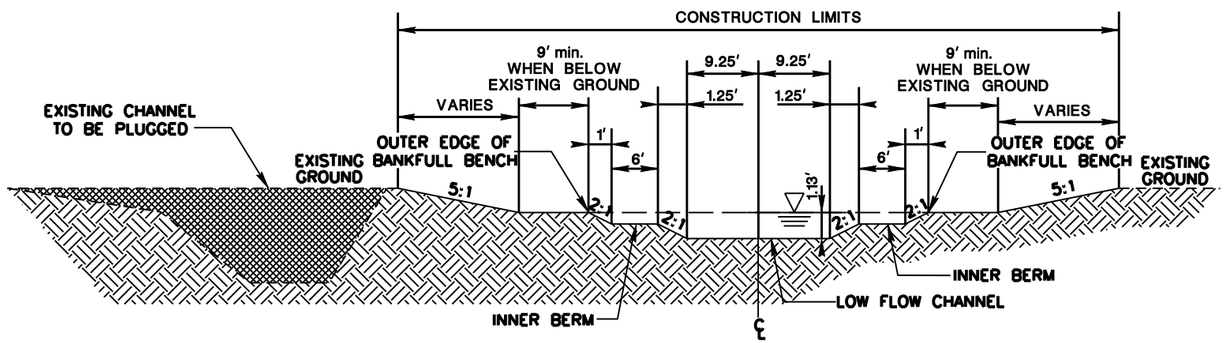
DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	8 OF 54
DRAWING NO.	TY3
DRAWN BY	JAD



UT 7 PROPOSED POOL CURVE "RIGHT"

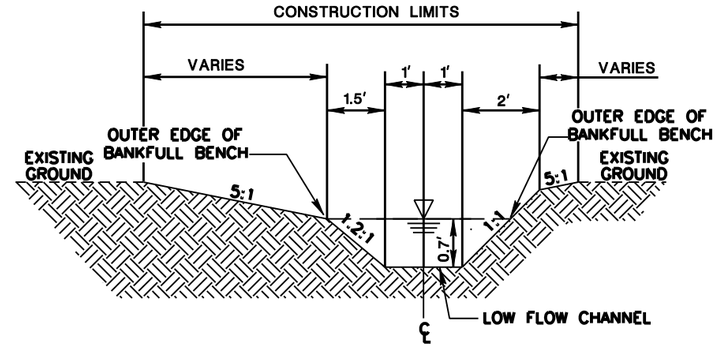
ALIGNMENT STATIONS
13+75 TO 13+95
14+30 TO 14+45
17+15 TO 17+30
18+75 TO 18+95
19+50 TO 19+70
N.T.S.

MIRROR TYPICAL FOR LEFT CURVE



UT 7 PROPOSED END RIFFLE

ALIGNMENT STATIONS
TRANSITION FROM UT-7 20+70 RIFFLE TO END RIFFLE 22+35
N.T.S.



UT TO UT 7 PROPOSED RIFFLE

ALIGNMENT STATIONS 10+00 TIE INTO UT-7
N.T.S.

NO.	REVISIONS	DRN	CHK	DATE

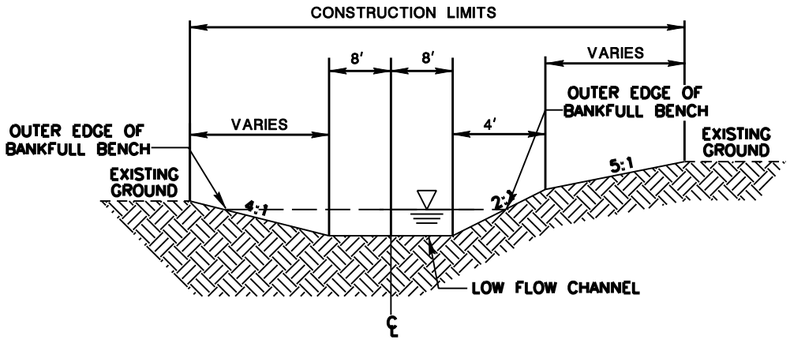
Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

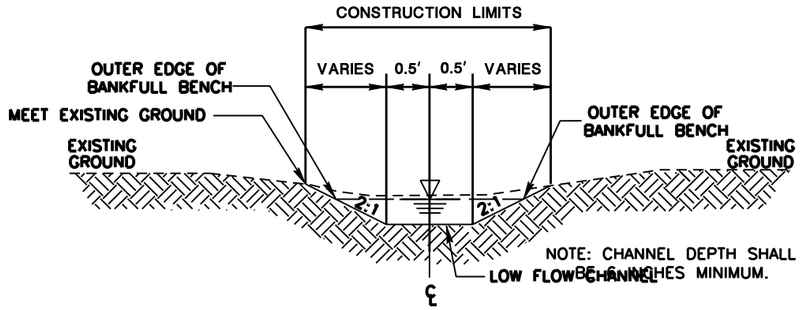
PROPOSED TYPICAL SECTIONS
RESTORATION

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	9 OF 54
DRAWING NO.	TY4
DRAWN BY	JAD



MAINSTEM CONCRETE REMOVAL RIFFLE

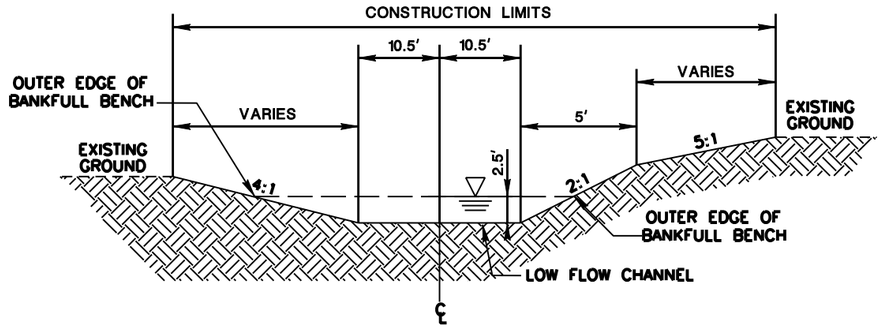
ALIGNMENT STATIONS
64+06 TO 64+21.15
64+56.15 TO 64+66.15
65+06.15 TO 65+27.87
N.T.S.



UT3 CHANNEL CREATION

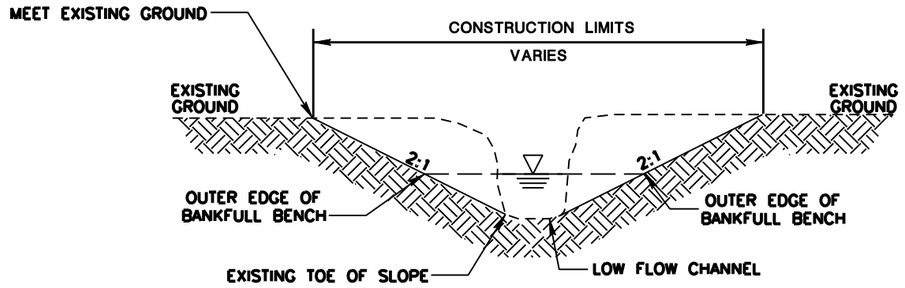
ALIGNMENT STATIONS
UT3 10+00 TO 11+97.12

N.T.S.



MAINSTEM CONCRETE REMOVAL POOL

ALIGNMENT STATIONS
64+36.15 TO 64+46.15
64+76.15 TO 64+96.15
N.T.S.



UT3 AND UT4 BANK ENHANCEMENT

ALIGNMENT STATIONS
UT3 14+60.22 TO 19+74.90
UT4 14+31 TO 18+28
N.T.S.

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED TYPICAL SECTIONS
ENHANCEMENT LEVEL I

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	10 OF 54
DRAWING NO.	TY5
DRAWN BY	JAD

TYPICAL SECTION TABLE

MAINSTEM UPSTREAM	
STATION	SECTION
22+23.92 TO 22+48.92	MAINSTEM UPSTREAM PROPOSED RIFFLE
22+48.92 TO 22+68.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED POOL CURVE "RIGHT"
22+68.92 TO 22+78.92	MAINSTEM UPSTREAM PROPOSED POOL CURVE "RIGHT"
22+78.92 TO 22+88.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED RIFFLE
22+88.92 TO 23+23.92	MAINSTEM UPSTREAM PROPOSED RIFFLE
23+23.92 TO 23+48.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED STRAIGHT POOL
23+48.92 TO 23+68.92	MAINSTEM UPSTREAM PROPOSED STRAIGHT POOL
23+68.92 TO 23+78.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED RIFFLE
23+78.92 TO 24+18.92	MAINSTEM UPSTREAM PROPOSED RIFFLE
24+18.92 TO 24+38.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED POOL CURVE "RIGHT"
24+38.92 TO 24+58.92	MAINSTEM UPSTREAM PROPOSED POOL CURVE "RIGHT"
24+58.92 TO 24+73.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED RIFFLE
24+73.92 TO 24+93.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED STRAIGHT POOL
24+93.92 TO 25+08.92	MAINSTEM UPSTREAM PROPOSED STRAIGHT POOL
25+08.92 TO 25+18.92	TRANSITION TO MAINSTEM UPSTREAM PROPOSED RIFFLE
25+18.92 TO 25+58.92	MAINSTEM UPSTREAM PROPOSED RIFFLE
MAINSTEM DOWNSTREAM	
STATION	SECTION
48+25.34 TO 48+65.34	MAINSTEM DOWNSTREAM PROPOSED RIFFLE
48+65.34 TO 48+95.34	TRANSITION TO MAINSTEM DOWNSTREAM PROPOSED STRAIGHT POOL
48+95.34 TO 49+15.34	MAINSTEM DOWNSTREAM PROPOSED STRAIGHT POOL
49+15.34 TO 49+45.34	TRANSITION TO MAINSTEM DOWNSTREAM PROPOSED RIFFLE
49+45.34 TO 50+10.34	TRANSITION TO MAINSTEM DOWNSTREAM PROPOSED STRAIGHT POOL
50+10.34 TO 50+30.34	MAINSTEM DOWNSTREAM PROPOSED STRAIGHT POOL
50+30.34 TO 50+55.34	TRANSITION TO MAINSTEM DOWNSTREAM PROPOSED RIFFLE
UT 7	
STATION	SECTION
11+68.64 TO 12+05	UT 7 PROPOSED RIFFLE
12+05 TO 12+20	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
12+20 TO 12+30	UT 7 PROPOSED STRAIGHT POOL
12+30 TO 12+40	TRANSITION TO UT 7 PROPOSED RIFFLE
12+40 TO 12+85	UT 7 PROPSED RIFFLE
12+85 TO 13+00	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
13+00 TO 13+10	UT 7 PROPOSED STRAIGHT POOL
13+10 TO 13+20	TRANSITION TO UT 7 PROPOSED RIFFLE
13+20 TO 13+55	UT 7 PROPOSED RIFFLE
13+55 TO 13+75	TRANSITION TO UT 7 PROPOSED POOL CURVE "RIGHT"
13+75 TO 13+95	UT 7 PROPOSED POOL CURVE "RIGHT"
13+95 TO 14+10	TRANSITION TO UT 7 PROPOSED RIFFLE
14+10 TO 14+30	TRANSITION TO UT 7 PROPOSED POOL CURVE "RIGHT"
14+30 TO 14+45	UT 7 PROPOSED POOL CURVE "RIGHT"
14+45 TO 14+60	TRANSITION TO UT 7 PROPOSED RIFFLE
14+60 TO 15+00	UT 7 PROPOSED RIFFLE
15+00 TO 15+15	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
15+15 TO 15+25	UT 7 PROPOSED STRAIGHT POOL
15+25 TO 15+35	TRANSITION TO UT 7 PROPOSED RIFFLE
15+35 TO 15+70	UT 7 PROPOSED RIFFLE
15+70 TO 15+85	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
15+85 TO 15+95	UT 7 PROPOSED STRAIGHT POOL
15+95 TO 16+05	TRANSITION TO UT 7 PROPOSED RIFFLE
16+05 TO 16+40	UT 7 PROPOSED RIFFLE
16+40 TO 16+55	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
16+55 TO 16+65	UT 7 PROPOSED STRAIGHT POOL
16+65 TO 16+75	TRANSITION TO UT 7 PROPOSED RIFFLE
16+75 TO 17+00	UT 7 PROPOSED RIFFLE
17+00 TO 17+15	TRANSITION TO UT 7 PROPOSED POOL CURVE "RIGHT"
17+15 TO 17+30	UT 7 PROPOSED POOL CURVE "RIGHT"
17+30 TO 17+45	TRANSITION TO UT 7 PROPOSED RIFFLE
17+45 TO 17+60	UT 7 PROPOSED RIFFLE
17+60 TO 17+75	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
17+75 TO 17+90	UT 7 PROPOSED STRAIGHT POOL
17+90 TO 18+00	TRANSITION TO UT 7 PROPOSED RIFFLE
18+00 TO 18+60	UT 7 PROPOSED RIFFLE
18+60 TO 18+75	TRANSITION TO UT 7 PROPOSED POOL CURVE "RIGHT"
18+75 TO 18+95	UT 7 PROPOSED POOL CURVE "RIGHT"
18+95 TO 19+00	TRANSITION TO UT 7 PROPOSED RIFFLE
19+00 TO 19+35	UT 7 PROPOSED RIFFLE
19+35 TO 19+50	TRANSITION TO UT 7 PROPOSED POOL CURVE "RIGHT"
19+50 TO 19+70	UT 7 PROPOSED POOL CURVE "RIGHT"
19+70 TO 19+90	TRANSITION TO UT 7 PROPOSED RIFFLE
19+90 TO 20+10	UT 7 PROPOSED RIFFLE
20+10 TO 20+25	TRANSITION TO UT 7 PROPOSED STRAIGHT POOL
20+25 TO 20+35	UT 7 PROPOSED STRAIGHT POOL
20+35 TO 20+45	TRANSITION TO UT 7 PROPOSED RIFFLE
20+45 TO 20+55	UT 7 PROPOSED RIFFLE
20+55 TO 22+35	TRANSITION TO UT 7 PROPOSED END RIFFLE
MAINSTEM CONCRETE REMOVAL	
STATION	SECTION
64+06 TO 64+21.15	MAINSTEM CONCRETE REMOVAL RIFFLE
64+21.15 TO 64+36.15	TRANSITION TO MAINSTEM CONCRETE REMOVAL POOL
64+36.15 TO 64+46.15	MAINSTEM CONCRETE REMOVAL POOL
64+46.15 TO 64+56.15	TRANSITION TO MAINSTEM CONCRETE REMOVAL RIFFLE
64+56.15 TO 64+66.15	MAINSTEM CONCRETE REMOVAL RIFFLE
64+66.15 TO 64+76.15	TRANSITION TO MAINSTEM CONCRETE REMOVAL POOL
64+76.15 TO 64+96.15	MAINSTEM CONCRETE REMOVAL POOL
64+96.15 TO 65+06.15	TRANSITION TO MAINSTEM CONCRETE REMOVAL RIFFLE
65+06.15 TO 65+27.87	MAINSTEM CONCRETE REMOVAL RIFFLE
UT3 CHANNEL CREATION	
STATION	SECTION
10+00 TO 11+97.12	UT3 CHANNEL CREATION
UT3 AND UT4 BANK ENHANCEMENT	
STATION	SECTION
14+31 TO 18+28	UT4 BANK ENHANCEMENT
14+60.22 TO 19+74.90	UT3 BANK ENHANCEMENT

STRUCTURE TABLE

STRUCTURE LOCATION TABLE			
LITTLE BUFFALO			
STRUCTURE	STATION	NORTHING	EASTING
LOG VANE	24+50	639,717.99	1,595,058.19
LOG VANE	24+90	639,678.86	1,595,066.02
LARGE WOODY DEBRIS	47+58	637,830.48	1,593,901.14
LIVESTOCK STREAM CROSSING	74+91	635,615.04	1,592,969.81
UT7			
STRUCTURE	STATION	NORTHING	EASTING
ROCK CROSS VANE	12+10	634,802.32	1,591,237.40
ROCK CROSS VANE	17+65	634,329.30	1,591,287.96
PLUGGED CHANNEL	18+40	634,282.87	1,591,357.25
PROPOSED STEP POOL START	20+55	634,090.75	1,591,415.19
PROPOSED STEP POOL END	22+35	633,945.61	1,591,312.81

NO.	REVISIONS	DRN	CHK	DATE

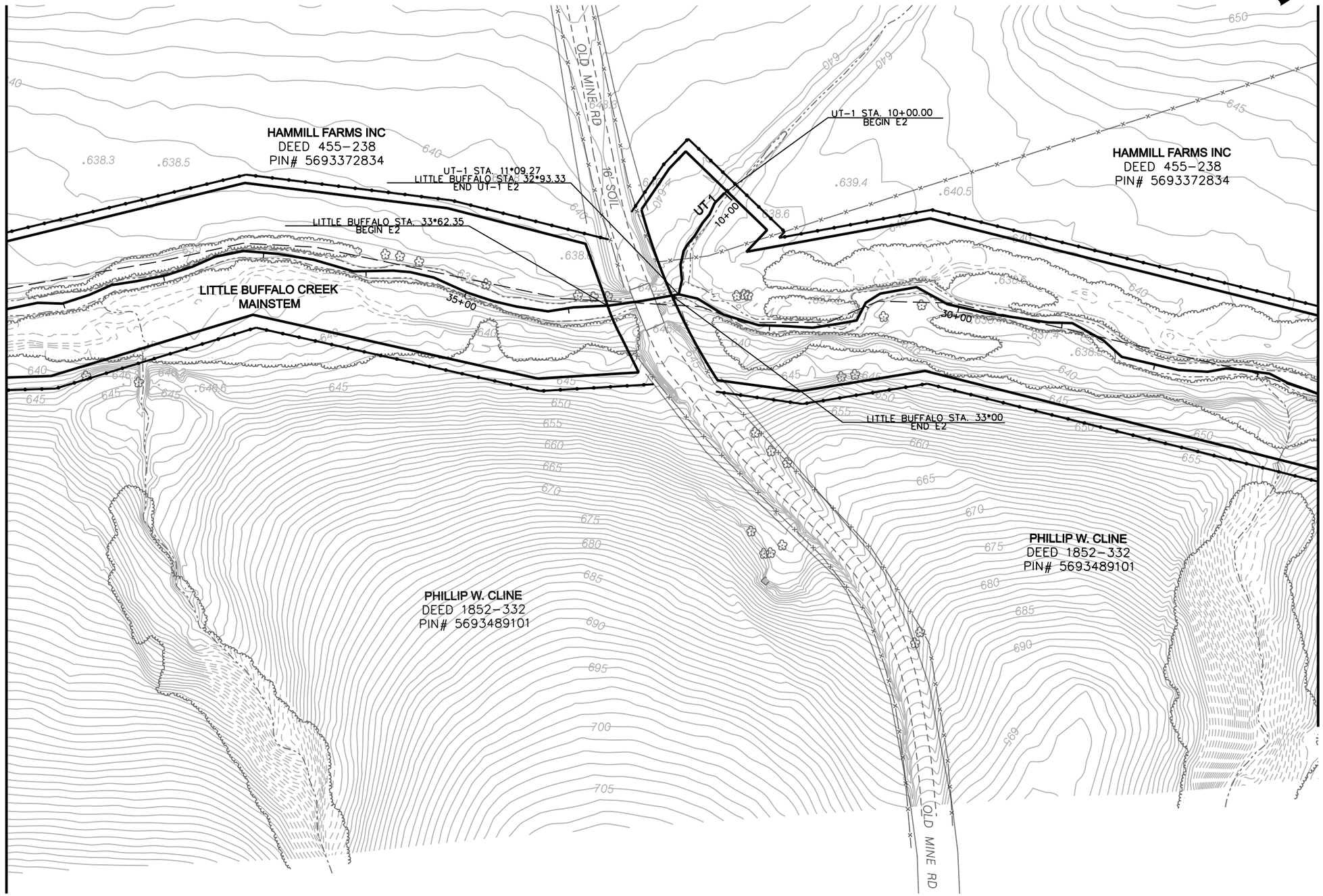
Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED TYPICAL SECTIONS
ENHANCEMENT LEVEL I

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	11 OF 54
DRAWING NO.	TY6
DRAWN BY	JAD



NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	13 OF 54
DRAWING NO.	PC2
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\13_buffalo_PLN_SHT_2.dgn Date: 4/5/2013 Time: 2:35:33 PM

NAD 83

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

LITTLE BUFFALO CREEK
MAINSTEM

20+00

15+00

10+00

LITTLE BUFFALO STA. 10+00.00
BEGIN E2

ISENHOUR BRICK
& TILE CO., INC
DEED 758-381
PARCEL# 384 001

BEGIN UPSTREAM
MAINSTEM RESTORATION
STA. 21+28.92
END E2

LIMITS OF
GRADING

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

PLUGGED
CHANNEL

PLUGGED
CHANNEL

25+00

LOG VANES
SEE DETAILS

SEE PROPOSED SHEET 13

END UPSTREAM
MAINSTEM RESTORATION
STA. 25+66.91
BEGIN E2

608-MONUMENT
675.18

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	12 OF 54
DRAWING NO.	PC1
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\12_buffalo_PLN_SHT_1.dgn Date: 4/5/2013 Time: 2:33:03 PM

SEE PROPOSED SHEET 15

SEE PROPOSED SHEET 16

SEE PROPOSED SHEET 13

NAD 83

606-MONUMENT
636.39

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

UT2

UT4

LITTLE BUFFALO STA. 46+10
BEGIN E2-REACH 3
END E2-REACH 2

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

LITTLE BUFFALO CREEK
MAINSTEM

LIMITS OF
GRADING

LARGE WOODY DEBRIS TO
HELP DIRECT PREFERENTIAL
FLOW TOWARDS THE CENTER
OF THE CHANNEL

BEGIN DOWNSTREAM
MAINSTEM RESTORATION
STA. 48+10.40
END E2

PLUGGED
CHANNEL

PLUGGED
CHANNEL

UT-2 STA. 19+50.70
LITTLE BUFFALO STA. 42+36.92
END UT-2 E2

END DOWNSTREAM
MAINSTEM RESTORATION
STA. 50+76.91
BEGIN E2

UT-4 STA. 10+00.00
BEGIN E2

40+00

45+00

50+00

10+00

NO.	REVISIONS	DRN	CHK	DATE

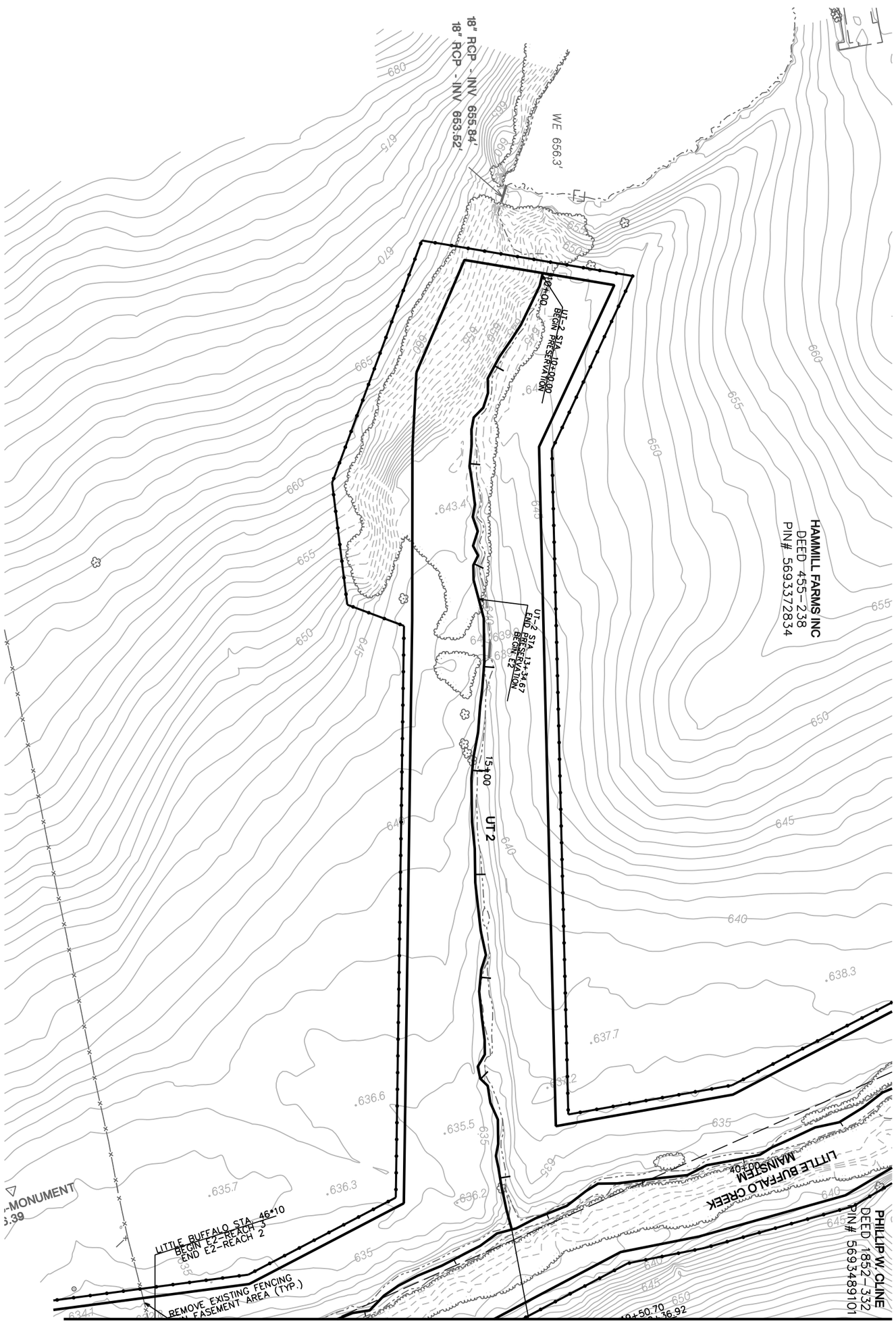
Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	14 OF 54
DRAWING NO.	PC3
DRAWN BY	JAD



SEE PROPOSED SHEET 16

NAD 83

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

Ecosystem Enhancement Program

NO.	REVISIONS	DRN	CHK	DATE

DATE: MARCH 2013
PROJECT NO.: 94147
FILENAME:
SHEET NO.: 15 OF 54
DRAWING NO.: PC4
DRAWN BY: JAD

Filename: G:\CAD\orcon\4-4-12_NC\15_buffalo_PLN_SH1_4.dgn
Date: 4/5/2013
Time: 2:37:57 PM

SEE PROPOSED SHEET 17

SEE PROPOSED SHEET 18

SEE PROPOSED SHEET 14

NAD 83

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

PHILLIP W. CLINE
DEED 1852-332
PIN#/ 5693489101

UT-4 STA. 18+28.03
LITTLE BUFFALO STA. 56+85.32
END UT-4 E1

UT-2 STA. 14+31.00
END E2
BEGIN E1

UT-3 STA. 24+74.94
LITTLE BUFFALO STA.66+52.51
END UT-3 E2

LITTLE BUFFALO STA.65+26
BEGIN E2

CONCRETE REMOVAL SECTION
STA.64+06 TO STA. 65+26
E1 AREA

CONSTRUCTION AREA

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

LITTLE BUFFALO CREEK
MAINSTEM

UT 3

UT 4

24" RCP INV - 627.58'
24" RCP INV - 627.36'

24" RCP INV IN - 622.25'
24" RCP INV - 622.25'

WE 625.6'

20+00
60+00
65+00
35+00
15+00

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

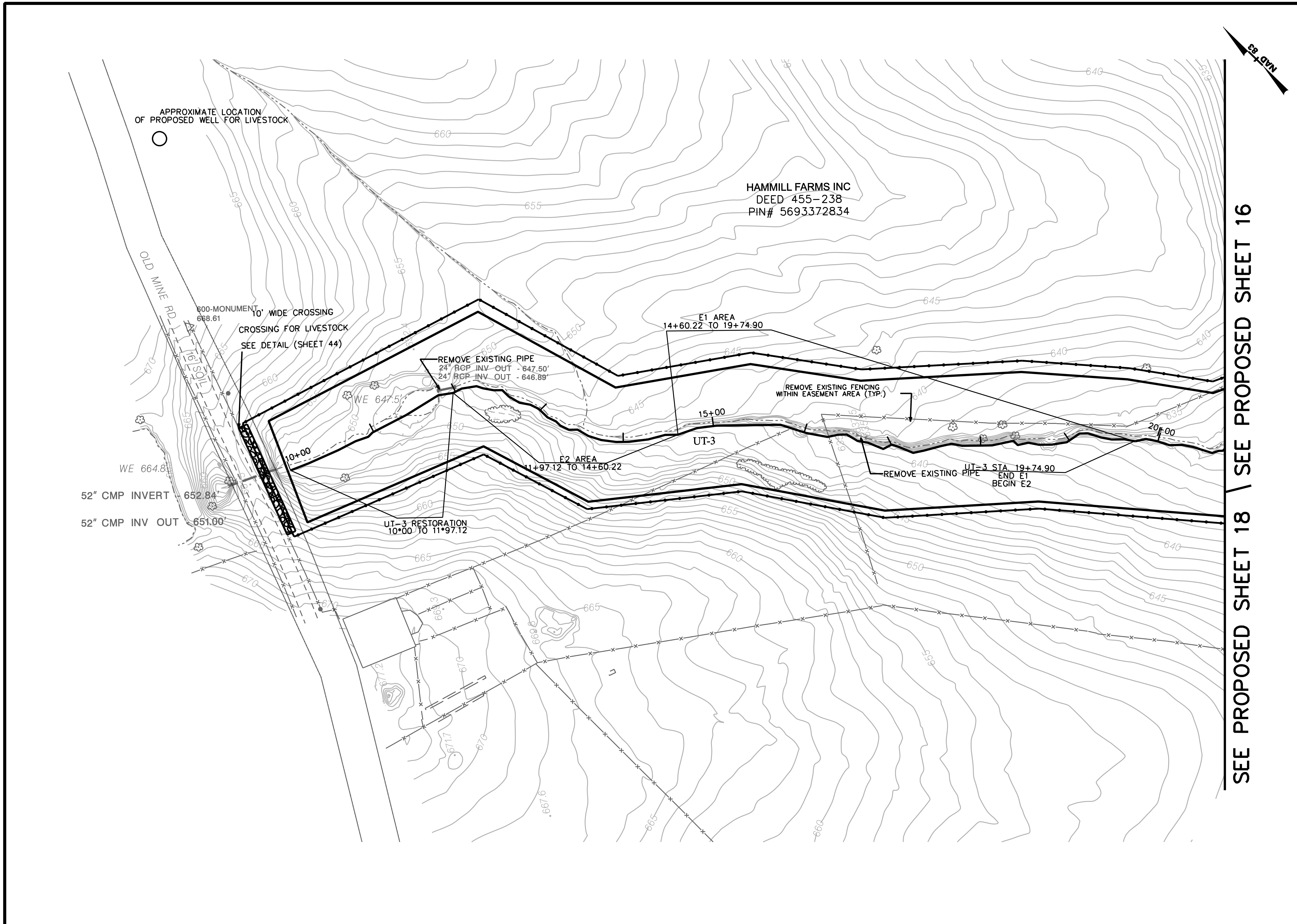
THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	16 OF 54
DRAWING NO.	PC5
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\16_buffalo_PLN_SHT_5.dgn Date: 4/5/2013 Time: 2:40:15 PM



NO.	REVISIONS	DRN	CHK	DATE

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	17 OF 54
DRAWING NO.	PC6
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\17_buffalo_PLN_SHT_6.dgn Date: 4/5/2013 Time: 2:41:06 PM

SEE PROPOSED SHEET 19

SEE PROPOSED SHEET 16

NAD 83

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

LITTLE BUFFALO STA.74+78.37
END E2

LITTLE BUFFALO STA.75+05.63
BEGIN PRESERVATION

25' WIDE CROSSING
STREAM CROSSING FOR LIVESTOCK
SEE DETAIL (SHEET 44)

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

LITTLE BUFFALO CREEK
MAINSTEM

UT-6 STA. 11+51.33
LITTLE BUFFALO STA.73+96.69
END UT-6 E2

FLOOD GATES TO BE INSTALLED
AT UPSTREAM AND DOWNSTREAM
ENDS OF CROSSING

UT-6 STA. 10+00.00
BEGIN E2

UT-5 STA. 11+84.46
LITTLE BUFFALO STA.70+95.43
END UT-5 E2

UT-5 STA. 10+00.00
BEGIN E2

UT-6

UT-5

30+00

10+00

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

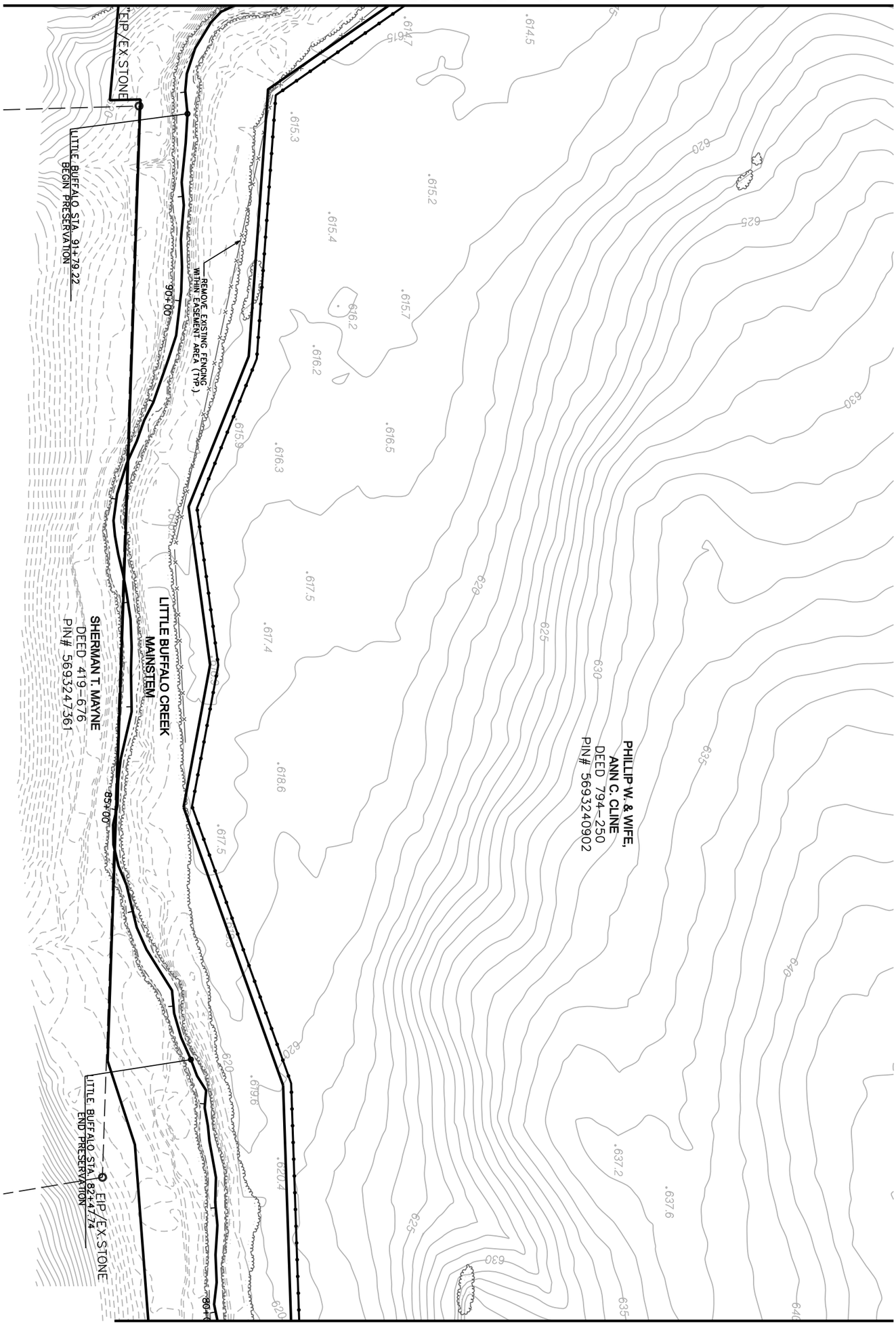
THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	18 OF 54
DRAWING NO.	PC7
DRAWN BY	JAD

SEE PROPOSED SHEET 20



SEE PROPOSED SHEET 18

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

Ecosystem Enhancement Program

NO.	REVISIONS	DRN	CHK	DATE

DATE MARCH 2013
PROJECT NO. 94147
FILENAME
SHEET NO. 19 OF 54
DRAWING NO. PC8
DRAWN BY JAD

Filename: G:\CAD\orcon\4-4-12_NC\19_buffalo_PLN_SH1_8.dgn
Date: 4/5/2013
Time: 2:43:14 PM

SEE PROPOSED SHEET 21

NAD 83

PATRICIA H. WILLIAMS
FILE 2007 #00-E-460
PIN# 5693036167

(2) 92"X 138" CMP CULVERTS
92"
138"

INVERT OUT 604.82'
INVERT OUT 604.92'

END PRESERVATION

LITTLE BUFFALO STA.102+60.71
UT-7 STA. 23+74.08
END UT-7 RESTORATION

LARRY W. & WIFE
PENNY D. HAMMILL
DEED 2755-264
PIN# 5693140046

INVERT IN 604.54'

UT4+89.69

INVERT IN 604.88'

KLUTTZ RD

16' BST

PLUGGED CHANNEL

REMOVE EXISTING FENCING WITHIN EASEMENT AREA (TYP.)

UT 7

19+00
20+00
21+00
22+00
23+00
00+00

STA BEGIN STEP POOLS 20+55 SEE DETAILS STA 22+35

LITTLE BUFFALO CREEK MAINSTEM

954.06

1/2"EIP/EX.STONE

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

EIR

SEE PROPOSED SHEET 19

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

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1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	20 OF 54
DRAWING NO.	PC9
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\20_buffalo_PLN_SHT_9.dgn
Date: 4/5/2013
Time: 2:44:06 PM

NAD '83

601-MONUMENT
632.85

OLD MINE RD

8.5' CMP INV - 616.15'
8.5' CMP INV - 615.92'

8.5' CMP INV - 613.88'
8.5' CMP INV - 613.50'

ROCK
CROSS VANE
SEE DETAILS

BEGIN UT-7 RESTORATION
STA 10+00
(SEE ALIGNMENT DATA)

PHILLIP W.
& WIFE,
ANN C. CLINE
DEED 7148-097
PIN# 5693141529

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

PLUGGED
CHANNEL

UT-8 STA:11+00.60
UT-7 STA. 17+38.79
END UT-8 RESTORATION

BEGIN STEP POOLS
STA. 20+55 TO STA. 22+35
SEE DETAILS

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

LITTLE BUFFALO CREEK
MAINSTEM

UT 7

UT 8

LIMITS OF
GRADING

BEGIN UT-8 RESTORATION
STA 10+00
(SEE ALIGNMENT DATA)

LARRY W. & WIFE
PENNY D. HAMMILL
DEED 2755-264
PIN# 5693140046

60" CMP INV IN - 617.85'
60" CMP INV OUT - 617.60'

1/2"EIR

3/8"EIR

LITTLE BUFFALO STA 102+60.71
END UT-7 STA 23+74.08
RESTORATION

SEE PROPOSED SHEET 20

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

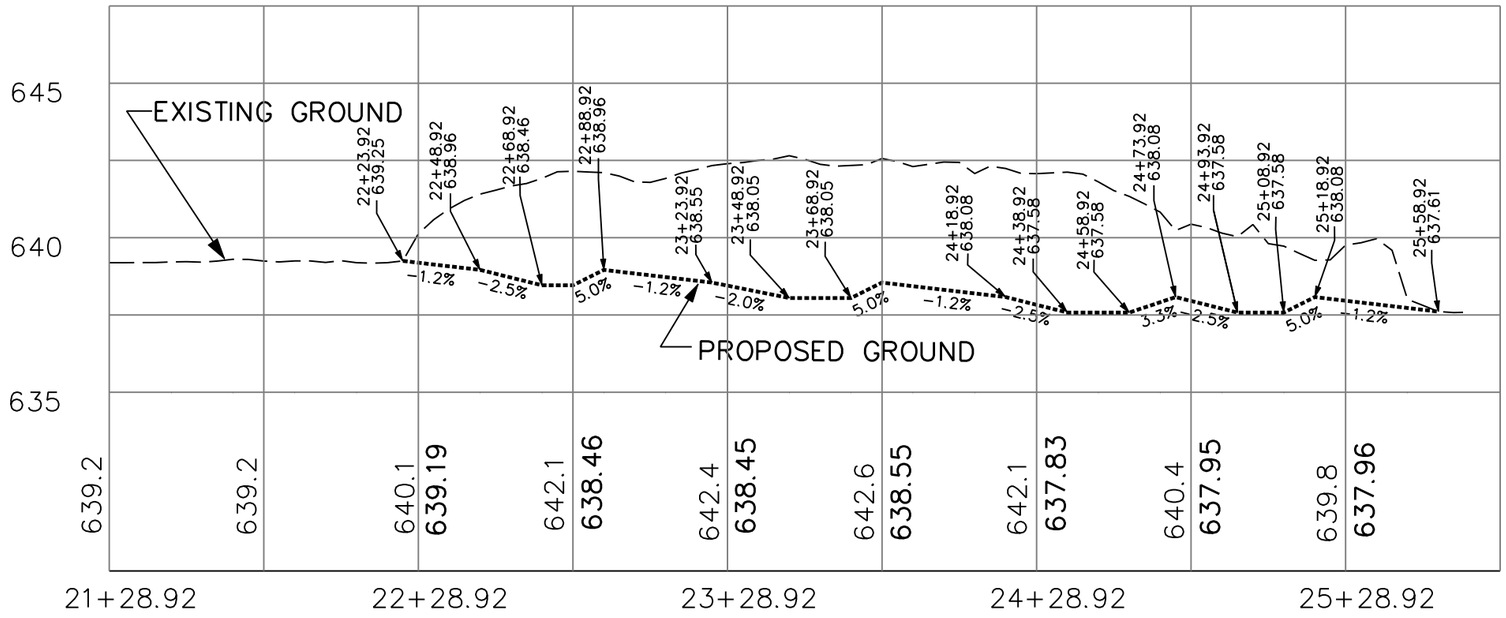
PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	21 OF 54
DRAWING NO.	PC10
DRAWN BY	JAD

Filename: C:\CAlarcon\4-4-12_NC\21_buffalo_PLN_SHT_10.dgn Date: 4/5/2013 Time: 2:44:52 PM

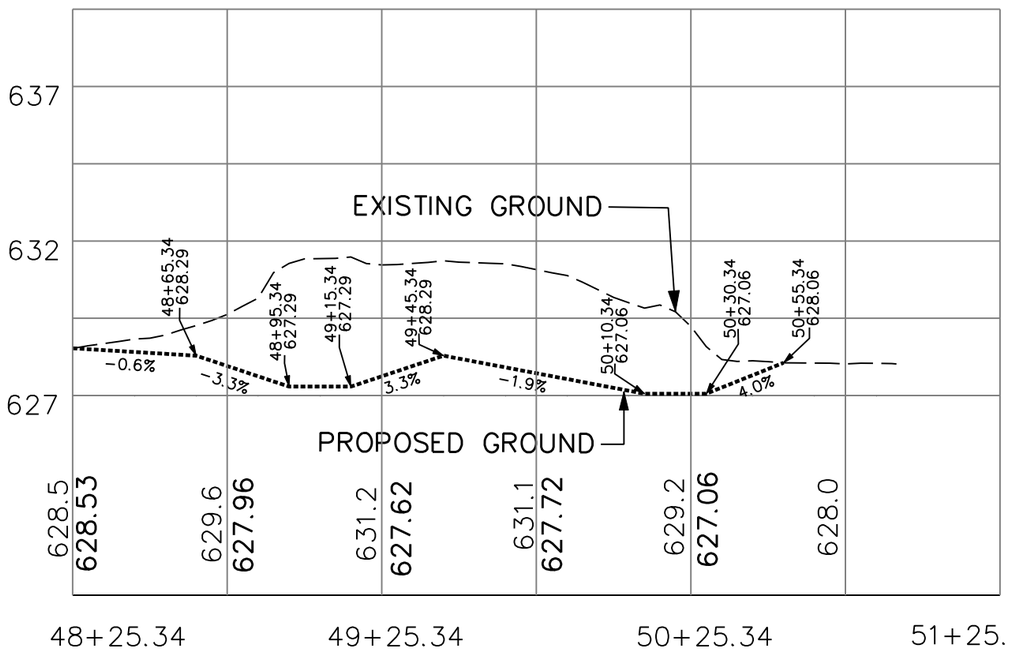
HORIZONTAL SCALE: 1" = 50' VERTICAL SCALE: 1" = 5'

UPSTREAM MAINSTEM

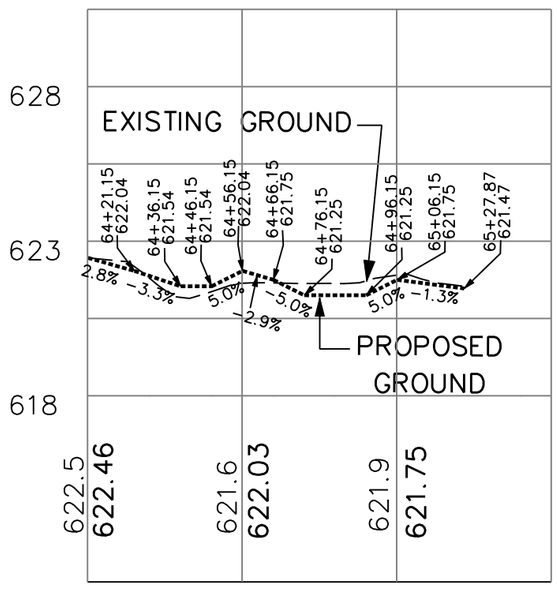


HORIZONTAL SCALE: 1" = 50' VERTICAL SCALE: 1" = 5'

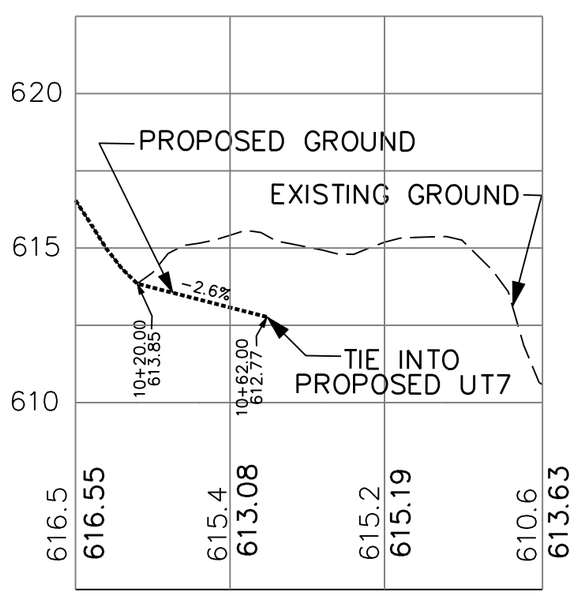
DOWNSTREAM MAINSTEM



MAINSTEMCONCRETE REMOVAL AREA



UT 8 TO UT 7



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1001 Wade Avenue
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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PROFILE

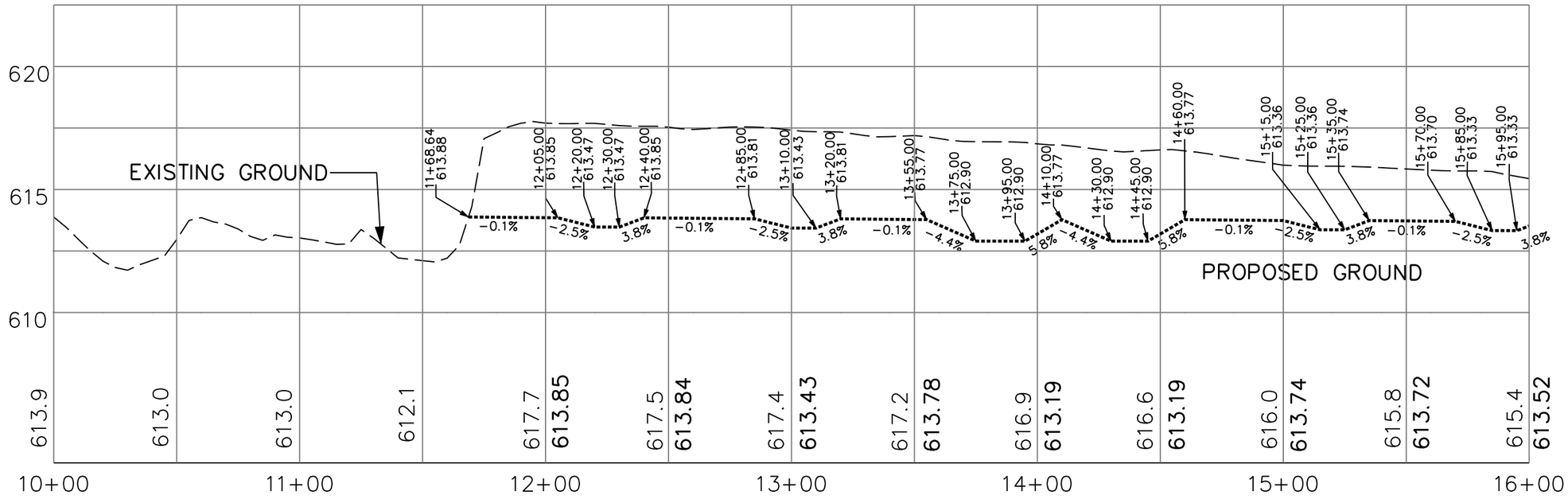
NO.	REVISIONS	DRN	CHK	DATE

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	22 OF 54
DRAWING NO.	PFI
DRAWN BY	JAD

Filename: G:*CAlarcon*4-4-12*NC*22*buffalo*PFL.dgn Date: 4/6/2013 Time: 2:48:22 PM

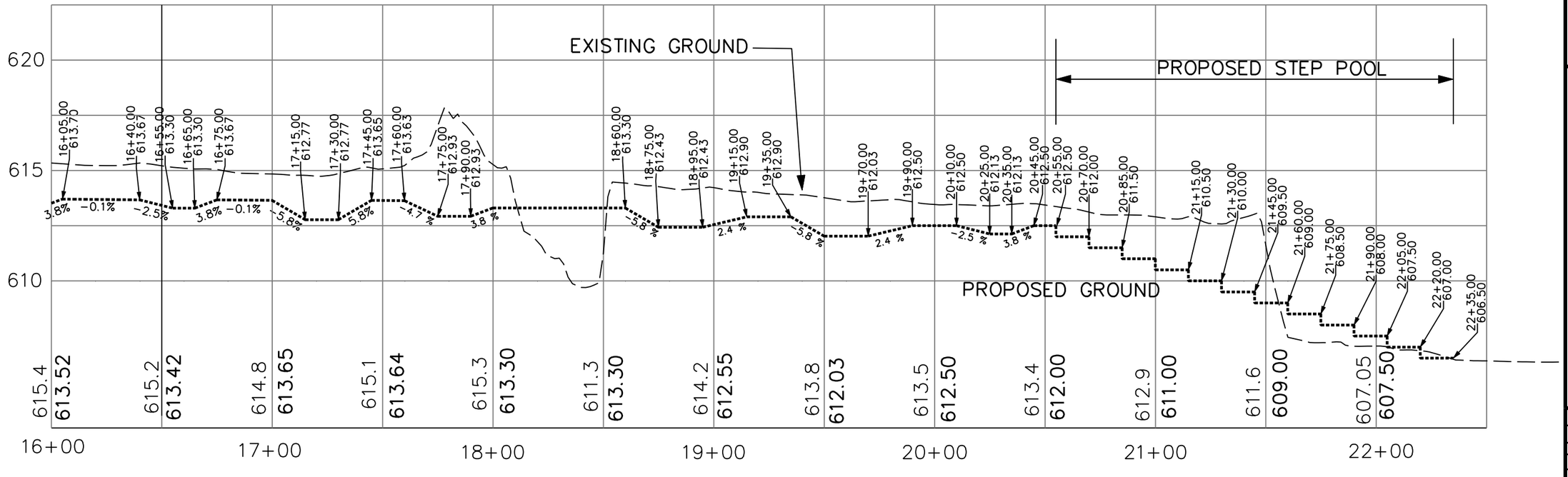
"UT 7"

HORIZONTAL SCALE: 1" = 50' VERTICAL SCALE: 1" = 5'



"UT 7"

HORIZONTAL SCALE: 1" = 50' VERTICAL SCALE: 1" = 5'



NO.	REVISIONS	DRN	CHK	DATE

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

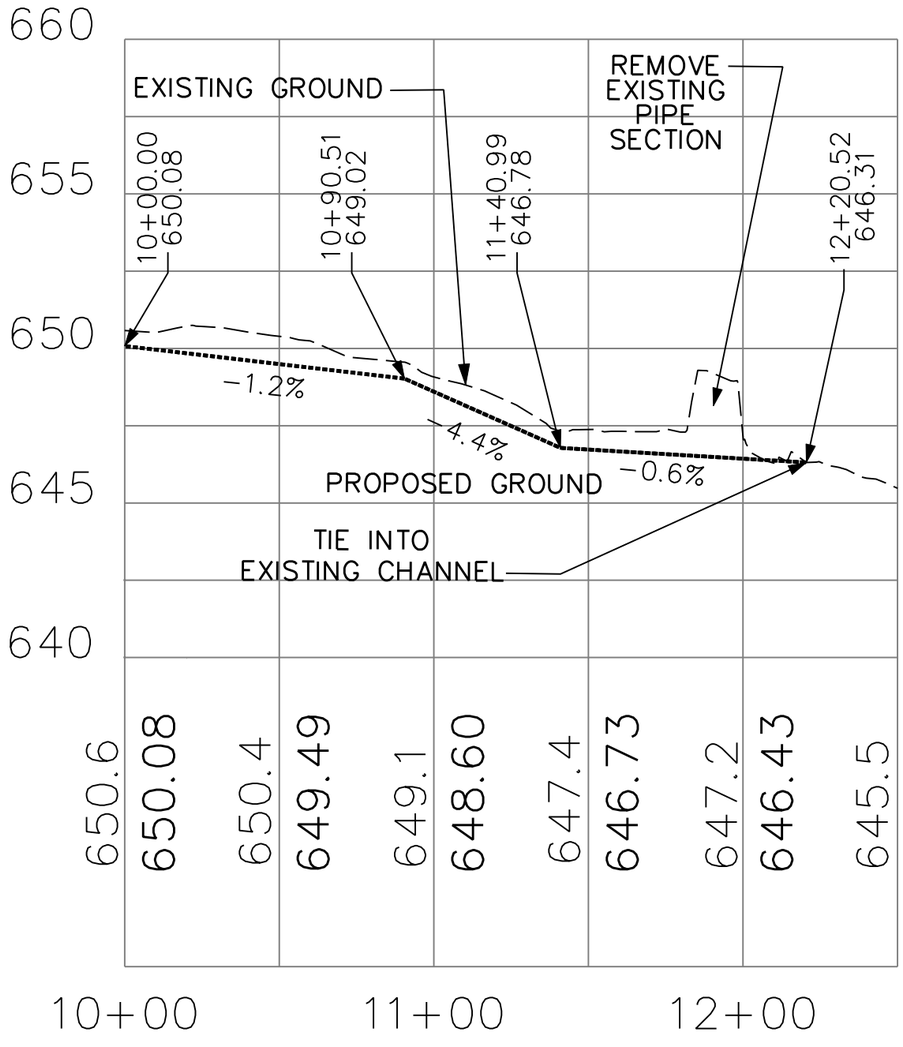
PROPOSED PROFILE

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	23 OF 54
DRAWING NO.	PF2
DRAWN BY	JAD

Filename: G:*CA\arcon*4-4-12*NC*23*buffalo*PFL.dgn Date: 4/6/2013 Time: 2:45:44 PM

HORIZONTAL SCALE: 1" = 50' VERTICAL SCALE: 1" = 5'

"UT 3"



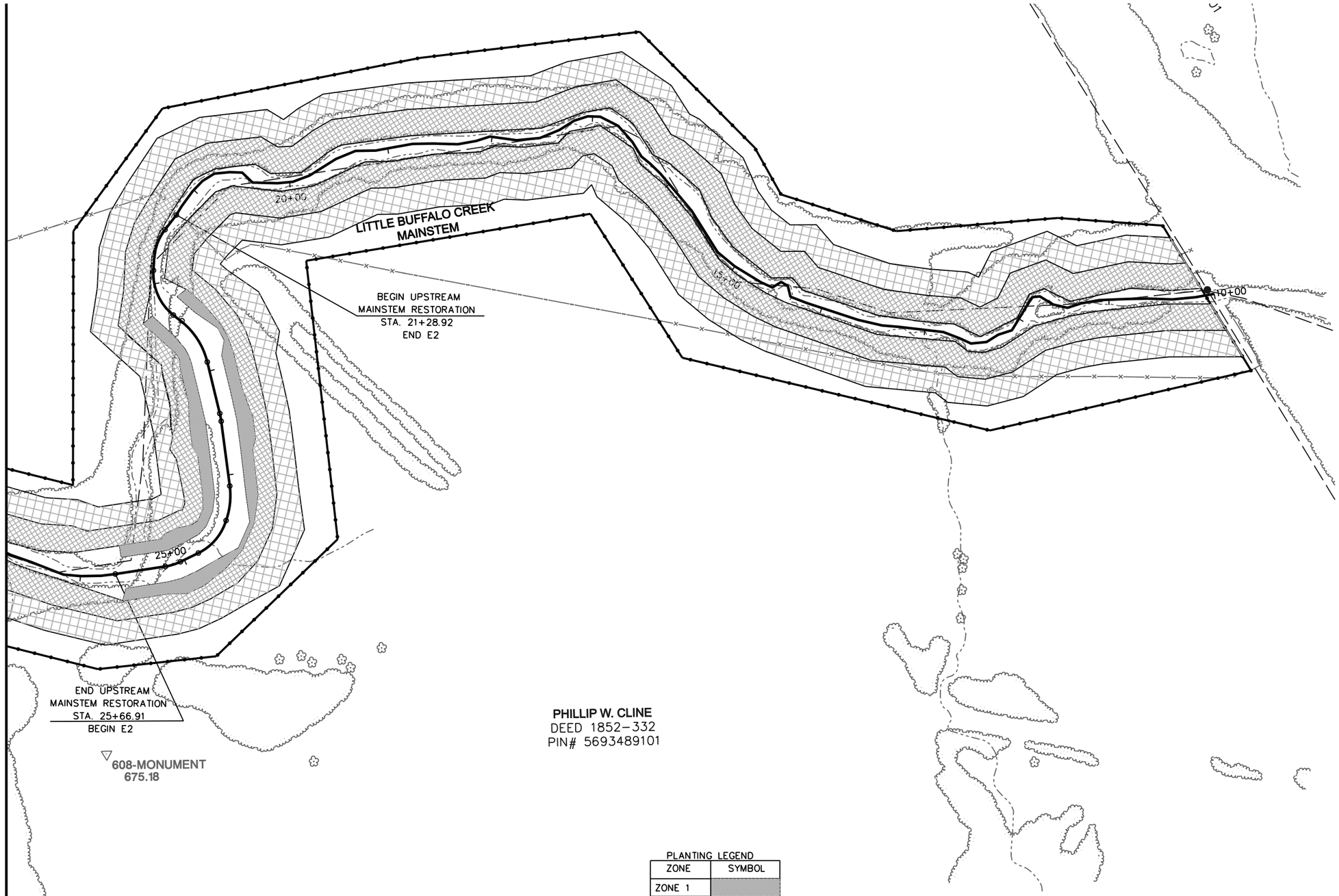
NO.	REVISIONS	DRN	CHK	DATE

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PROFILE

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	24 OF 54
DRAWING NO.	PF3
DRAWN BY	JAD



SEE PROPOSED SHEET 26

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

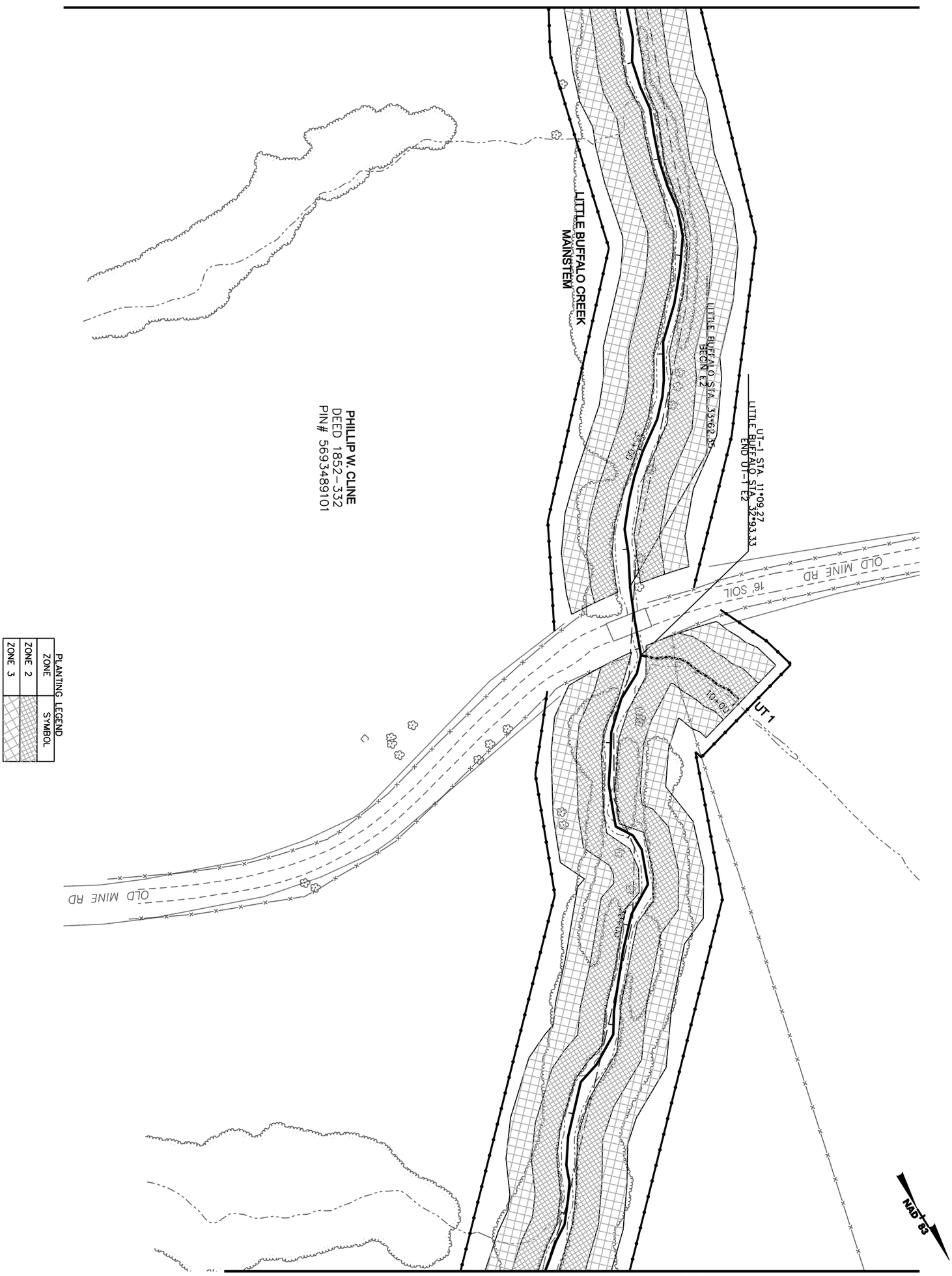
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	25 OF 54
DRAWING NO.	PP1
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\25_buffalo_PLANT_SHT_1.dgn Date: 4/5/2013 Time: 2:47:21 PM

SEE PROPOSED SHEET 27



SEE PROPOSED SHEET 25

Filename: G:\CAD\corcon\4-1-12_NC\26_buffalo_PLAN_SHT_2.dgn
Date: 4/5/2013
Time: 2:48:13 PM

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

NO.	REVISIONS	DRN	CHK	DATE

DRAWN BY: JAD
DRAWING NO.: PP2
SHEET NO.: 26 OF 54
FILENAME:
PROJECT NO.: 94147
DATE: MARCH 2013

SEE PROPOSED SHEET 28

NAD 83

606-MONUMENT
636.39

LITTLE BUFFALO STA. 46+10
BEGIN E2-REACH 3
END E2-REACH 2

UT 2

45+00

49+00

BEGIN DOWNSTREAM
MAINSTEM RESTORATION
STA. 48+10.40
END E2

LITTLE BUFFALO CREEK
MAINSTEM

50+00

UT-2 STA. 19+50.70
LITTLE BUFFALO STA. 42+36.92
END UT-2 E2

SEE PROPOSED SHEET 29

END DOWNSTREAM
MAINSTEM RESTORATION
STA. 50+76.91
BEGIN E2

UT 4

00+01

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

SEE PROPOSED SHEET 26

PLANTING LEGEND

ZONE	SYMBOL
ZONE 1	
ZONE 2	
ZONE 3	

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	27 OF 54
DRAWING NO.	PP3
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\27_buffalo_PLANT_SHT_3.dgn Date: 4/5/2013 Time: 2:49:00 PM

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

NAD 83

LITTLE BUFFALO CREEK
MAINSTEM

WE 656.3'

18" RCP - INV 655.84'
18" RCP - INV 653.52'

10+00

BEGIN PLANTING STA. 13+34

UT 2

15+00

LITTLE BUFFALO STA 46+10
BEGIN C2-REACH 2
END C2-REACH 3

MONUMENT

SEE PROPOSED SHEET 27

PLANTING LEGEND

ZONE	SYMBOL
ZONE 2	
ZONE 3	

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	28 OF 54
DRAWING NO.	PP4
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12_NC\28_buffalo_PLANT_SHT_4.dgn Date: 4/5/2013 Time: 2:49:39 PM

SEE PROPOSED SHEET 30

SEE PROPOSED SHEET 31

SEE PROPOSED SHEET 27

NAD 83

UT 3

24" RCP INV. 627.58'

24" RCP INV. 627.38'

24" RCP INV. IN 622.25'

24" RCP INV. 622.05'

WE 625.6'

65+00

60+00

55+00

LITTLE BUFFALO CREEK
MAINSTEM

UT-4 STA. 18+28.03
LITTLE BUFFALO STA. 56+85.32
END UT-4 E1

UT-2 STA. 14+31.00
END E2
BEGIN E1

15+00

UT 4

CONCRETE REMOVAL SECTION
STA.64+06 TO STA. 65+26
E1 AREA

LITTLE BUFFALO STA.65+26
BEGIN E2

UT-3 STA. 24+74.94
LITTLE BUFFALO STA.66+52.51
END UT-3 E2

PHILLIP W. CLINE
DEED 1852-332
PIN#/ 5693489101

PLANTING LEGEND

ZONE	SYMBOL
ZONE 1	
ZONE 2	
ZONE 3	

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE MARCH 2013
PROJECT NO. 94147
FILENAME
SHEET NO. 29 OF 54
DRAWING NO. PP5
DRAWN BY JAD

Filename: G:\CAlarcon\4-4-12_NC\29_buffalo_PLANT_SHT_5.dgn Date: 4/5/2013 Time: 2:52:16 PM

PLANTING LEGEND

ZONE	SYMBOL
ZONE 2	
ZONE 3	

NO.	REVISIONS	DRN	CHK	DATE

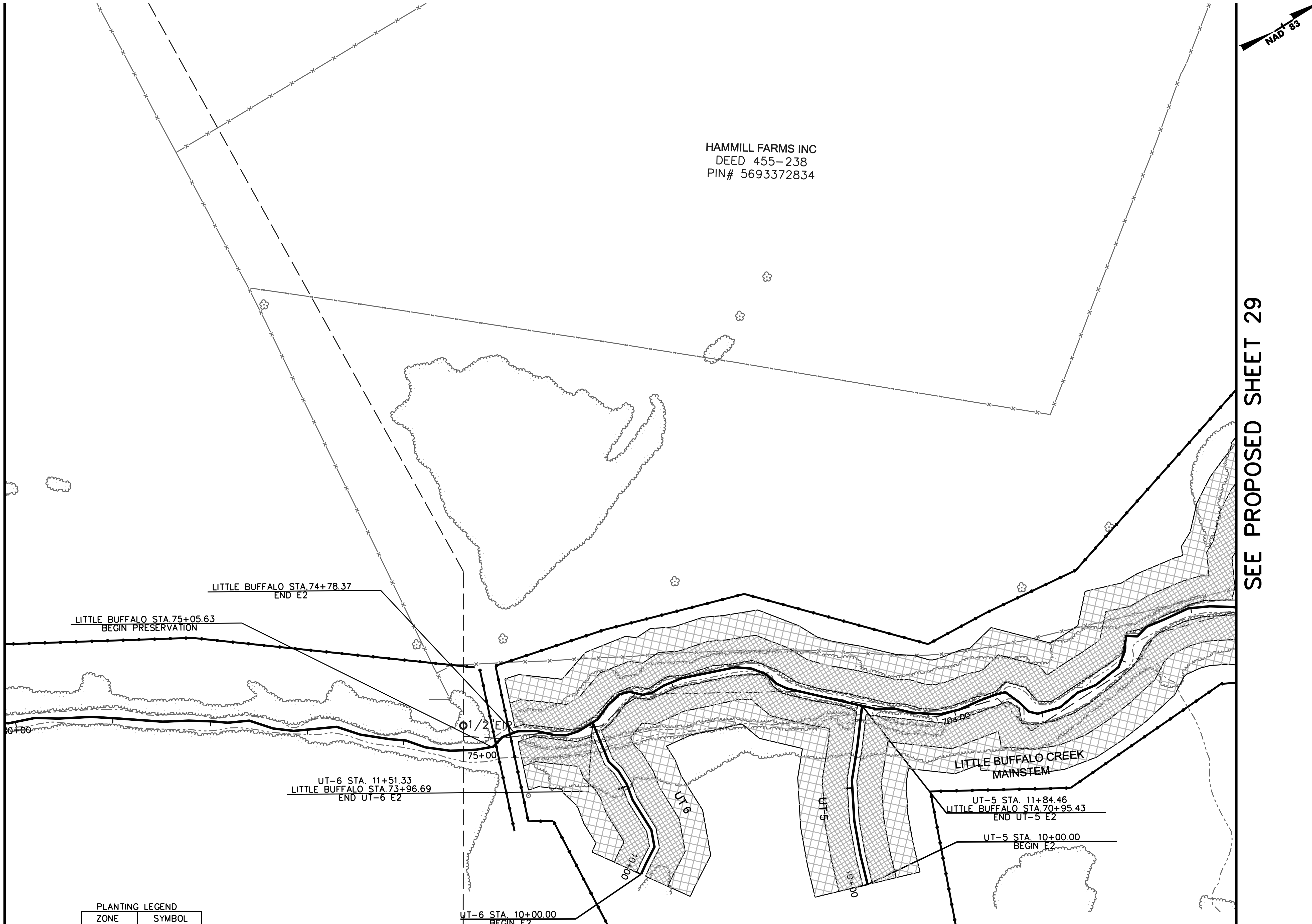
Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	30 OF 54
DRAWING NO.	PP6
DRAWN BY	JAD



NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement PROGRAM

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	31 OF 54
DRAWING NO.	PP7
DRAWN BY	JAD

SEE PROPOSED SHEET 33

SEE PROPOSED SHEET 31

NAD 83

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

90+00

LITTLE BUFFALO CREEK
MAINSTEM

85+00

80+00

"EIP/EX.STONE

LITTLE BUFFALO STA. 91+79.22
BEGIN PRESERVATION

SHERMAN T. MAYNE
DEED 419-676
PIN# 5693247361

EIP/EX.STONE

LITTLE BUFFALO STA. 82+47.74
END PRESERVATION

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	32 OF 54
DRAWING NO.	PP8
DRAWN BY	JAD

SEE PROPOSED SHEET 34

NAD 83

END PRESERVATION

LITTLE BUFFALO STA.102+60.71
UT-7 STA. 23+74.08
END UT-7 RESTORATION

PATRICIA H. WILLIAMS
FILE 2007 #00-E-460
PIN# 5693036167

(2) 92"X 138" CMP CULVERTS
92"
138"

INVERT OUT 604.82'
INVERT OUT 604.92'

INVERT IN 604.54'

104+89.69

INVERT IN 604.88'

KLUTTZ RD

16' BST

REMOVE EXISTING FENCING WITHIN EASEMENT AREA (TYP.)

UT-7

WIFE
50
02

100+00

95+00

LITTLE BUFFALO CREEK
MAINSTEM

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

EIR

1/2"EIP/EX.STONE

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

PLANTING LEGEND

ZONE	SYMBOL
ZONE 1	
ZONE 2	
ZONE 3	

SEE PROPOSED SHEET 32

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE MARCH 2013
PROJECT NO. 94147
FILENAME
SHEET NO. 33 OF 54
DRAWING NO. PP9
DRAWN BY JAD

Filename: G:\CAlarcon\4-4-12_NC\33_buffalo_PLANT_SHT_9.dgn
Date: 4/5/2013
Time: 2:55:06 PM

NAD '83

601-MONUMENT
632.85

OLD MINE RD

8.5' CMP INV - 616.15'
8.5' CMP INV - 615.92'

8.5' CMP INV - 613.88
8.5' CMP INV - 613.60

BEGIN UT-7 RESTORATION
STA 10+00
(SEE ALIGNMENT DATA)

PHILLIP W.
& WIFE,
ANN C. CLINE
DEED 7148-097
PIN# 5693141529

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

UT-8 STA.11+00.60
UT-7 STA. 17+38.79
END UT-8 RESTORATION

REMOVE EXISTING FENCING
WITHIN EASEMENT AREA (TYP.)

UT 7

UT 8

BEGIN UT-8 RESTORATION
STA 10+00
(SEE ALIGNMENT DATA)

LITTLE BUFFALO CREEK
MAINSTEM

LITTLE BUFFALO STA.102+60.71
END UT-7 STA 234+74.08

LARRY W. & WIFE
PENNY D. HAMMILL
DEED 2755-264
PIN# 5693140046

60" CMP INV IN - 617.85'
60" CMP INV OUT - 617.60'

1/2"EIR

3/8"EIR

OLD MINE RD

PLANTING LEGEND

ZONE	SYMBOL
ZONE 1	
ZONE 2	
ZONE 3	

SEE PROPOSED SHEET 33

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED PLANTING

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	34 OF 54
DRAWING NO.	PP10
DRAWN BY	JAD

Zone	Plant Community	Location	Type	Species	Common Name	Species Percent	Quantity /Acre	Acreage	Total Quantity
Zone 1	Piedmont / Mountain Bottomland Forest	Inner Berm up to Bankfull	Live Stakes	Salix nigra	Black willow	60%	1200	0.33	396
				Cornus amomum	Silky dogwood	40%	800	0.33	264
Totals						100%	2000	0.33	660

Distance between individual stems in feet. 5

Zone	Plant Community	Location	Type	Species	Common Name	Species Percent	Quantity /Acre	Acreage	Total Quantity
Zone 2	Piedmont / Mountain Bottomland Forest	Bankfull Bench	Bare Root or Tubeling	Alnus serrulata	smooth alder / hazel alder	15%	75	11.42	856
				Betula nigra	river birch	10%	50	11.42	571
				Carpinus caroliniana	ironwood	10%	50	11.42	571
				Cornus amomum	silky dogwood	5%	25	11.42	285
				Fraxinus pennsylvanica	green ash	10%	50	11.42	571
				Lindera benzoin	spicebush	10%	50	11.42	571
				Platanus occidentalis	sycamore	15%	75	11.42	856
				Salix nigra	black willow	10%	50	11.42	571
				Viburnum dentatum	arrowwood	15%	75	11.42	856
Totals						100%	500	11.42	5710

Distance between individual stems in feet. 9

Zone	Plant Community	Location	Type	Species	Common Name	Species Percent	Quantity /Acre	Acreage	Total Quantity
Zone 3	Piedmont / Mountain Bottomland Forest	Above Bankfull to 50 ft. from Top of Bank	Bare Root or Tubeling	Carpinus caroliniana	ironwood	10%	50	12.17	608
				Celtis laevigata	sugarberry	10%	50	12.17	608
				Cercis canadensis	redbud	10%	50	12.17	608
				Fraxinus pennsylvanica	green ash	5%	25	12.17	304
				Platanus occidentalis	sycamore	10%	50	12.17	608
				Liriodendron tulipifera	tulip poplar	20%	100	12.17	1217
				Quercus michauxii	swamp chestnut oak	15%	75	12.17	912
				Ulmus rubra	slippery elm	10%	50	12.17	608
				Viburnum dentatum	arrowwood	10%	50	12.17	608
Totals						100%	500	12.17	6085

Distance between individual stems in feet. 9

RIPARIAN SEED MIX:

Species	Percent Min.Purity	Percent Min. Germination	Quantity per Acre (lbs.)
Lolium multiflorum	98	90	30
Panicum virgatum var. Shelter (PLS)	95	80	4
Panicum clandestinum var. Tioga	95	75	2
Elymus virginiana	95	90	3
Wetland Seed Mix	N/A	N/A	2

NOTE: THE WETLAND SEED MIX SHALL BE COMPOSED OF AT LEAST FIVE OF THE FOLLOWING SPECIES: SOFT RUSH (JUNCUS EFFUSUS), PURPLE STEMMED ASTER (ASTER PUNICEUS), LURID SEDGE (CAREX LURIDA), FOX SEDGE (CAREX VULPINOIDEA), BONESET (EUPATORIUM PERFOLIATUM), GRASS-LEAVED GOLDENROD (EUTHAMIA GRAMINIFOLIA), GREEN BULRUSH (SCIRPUS ATROVIRENS), WOOLGRASS (SCIRPUS CYPERINUS), BLUE VERVAIN (VERBENA HASTATA) AND NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS).

SEEDING NOTES:

1. THE PROPOSED STREAM RESTORATION AND ENHANCEMENT GRADING AREAS, RIPARIAN BUFFERS AND ANY OTHER AREA OF SOIL DISTURBANCE SHALL BE SEEDED WITH THE SPECIFIED RIPRIAN SEED MIX.
2. THE SEED BED IN RIPARIAN BUFFER AREAS SHALL BE PREPARED BY HERBICDE TREATMENT OF EXISTING COOL SEASON GRASSES PER THE INVASIVE SPECIES TREATMENT NOTES, FOLLOWED BY THE REMOVAL OF SOIL COMPACTION AS DIRECTED BY THE ENGINEER, FOLLOWED BY DISCING TO A MINIMUM DEPTH OF 6 INCHES.
3. THE SEEDING PROGRAM SHALL INCLUDE THE APPLICATION AND INCORPORATION OF A SLOW RELEASE (NON-WATER SOLUBLE) FERITILIZER WITH A RATIO OF 0-10-20 AT A RATE OF 250 LBS/ACRE.
4. SEED SHALL BE EVENLY SPREAD EITHER BY HAND OR MECHANICAL MEANS AT THE SPECIFIED RATE. THE PROPOSED METHOD OF SEEDING IS SUBJECT TO APPROVAL BY THE ENGINEER. THE SEED SHALL BE APPLIED SEPARATELY FROM THE FERTILIZER.
5. IMMEDIATELY FOLLOWING SEEDING, SEED SHALL BE INCORPORATED INTO SOIL 1/4 TO 1/2 INCH USING A CHAIN OR TINE HARROW OR HAND RAKING. THE EQUIPMENT USED TO COMPLETE THIS TASK IS SUBJECT TO APPROVAL BY THE ENGINEER.

PLANTING ZONE ACREAGE SUMMARY

STREAM	ZONE 1	ZONE 2	ZONE 3
	ACRES	ACRES	ACRES
MAINSTEM	0.30	7.34	6.91
UT-1	–	0.09	0.07
UT-2	–	0.64	0.64
UT-3	–	1.63	1.65
UT-4	–	0.75	0.78
UT-5	–	0.15	0.15
UT-6	–	0.14	0.14
UT-7 AND UT-8	0.21	0.68	1.84
TOTAL	0.51	11.42	12.17

PLANTING NOTES:

1. ALL PROPOSED CHANGES TO THE PLANTING PLAN SHALL BE MADE IN WRITING TO THE LOUIS BERGER GROUP, INC. AT LEAST THREE MONTHS PRIOR TO PLANTING. ALL PROPOSED CHANGES MUST BE APPROVED IN WRITING.
2. ALL PLANT STOCK WILL BE INSPECTED ON-SITE BY THE LOUIS BERGER GROUP, INC. SITE ENGINEER OR REPRESENTATIVE PRIOR TO INSTALLATION. PLANTING STOCK NOT MEETING SPECIFICATIONS WILL NOT BE PLANTED.
3. ALL BARE ROOT PLANT MATERIAL SHALL BE INOCULATED WITH MYCORRHIZAE FUNGI EITHER AT THE NURSERY OR ON-SITE AT THE TIME OF PLANTING. THE METHOD OF INOCULATION SHALL BE APPROVED IN ADVANCE BY THE LOUIS BERGER GROUP, INC.
4. AFTER LIFTING THE PLANT STOCK AT THE NURSERY AND PRIOR TO PACKAGING, THE ENTIRE ROOT SYSTEM OF ALL BARE ROOT PLANT MATERIAL SHALL BE TREATED WITH A KAOLIN CLAY EMULSION.
5. THE INSTALLATION OF BARE ROOT TREE SAPLINGS SHALL BE WITH AN OST BAR, KBC BAR, OR HOEDAD. HOWEVER, THE USE OF HOEDADS BY AN INEXPERIENCED PLANTING CREW MAY BE PROHIBITED. SEE CONSTRUCTION DETAILS FOR ACCEPTABLE METHODS FOR INSTALLATION BARE ROOT SAPLINGS.
6. ALL PLANT MATERIAL SHALL BE ESTABLISHED IN A NATURALIZED PATTERN. NATURALIZED PLANTING SHALL RESULT IN A RELATIVELY EVEN DISTRIBUTION OF EACH SPECIES ACROSS THE PLANTING AREA AT THE SPECIFIED DENSITY. UNEVEN DISTRIBUTIONS OF SPECIES OR MONOCULTURES SHALL NOT BE ACCEPTED AS SOLELY DETERMINED BY THE ENGINEER.
7. THE ESTABLISHMENT PERIOD FOR BARE ROOT TREES AND SHRUBS IS FROM DECEMBER 15 TO MARCH 15.
8. PLANTING WILL BE SUPERVISED BY A CERTIFIED PROFESSIONAL WETLAND SCIENTIST PROVIDED BY THE LOUIS BERGER GROUP, INC.
9. HERBACEOUS COMPETITION MAY BE CONTROLLED PRIOR TO PLANTING AND THROUGHOUT THE MAINTENANCE AND MONITORING PERIOD BY ACCEPTABLE MECHANICAL AND/OR CHEMICAL METHODS.

REVISIONS | NO. | DRN | CHK | DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

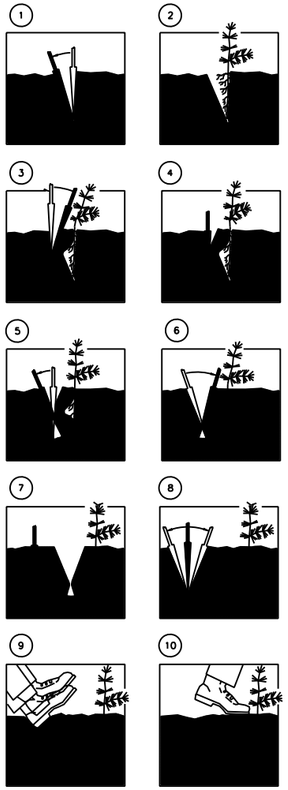
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PLANTING NOTES

DATE MARCH 2013
PROJECT NO. 94147
FILENAME
SHEET NO. 35 OF 54
DRAWING NO. PN1
DRAWN BY JAD

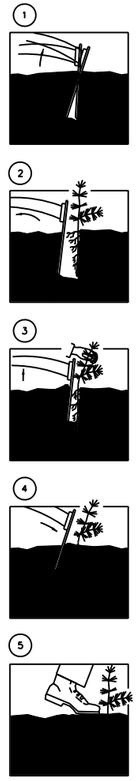
REFORESTATION

PLANTING PROCEDURE WITH KBC/OST BAR (DIBBLE BAR)

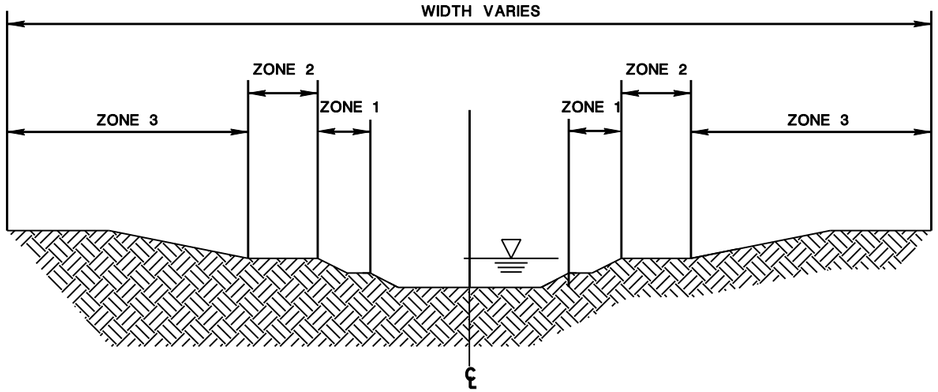


1. INSERT THE PLANTING BAR STRAIGHT DOWN INTO THE SOIL TO THE FULL DEPTH OF THE BLADE AND PULL BACK ON THE HANDLE TO OPEN THE PLANTING HOLE. (DO NOT ROCK THE PLANTING BAR BACK AND FORTH AS THIS CAUSES SOIL IN THE PLANTING HOLE TO BE COMPACTED, INHIBITING GROWTH.)
2. REMOVE THE PLANTING BAR AND PUSH THE TREE ROOTS DEEP INTO THE PLANTING HOLE. PULL THE TREE BACK UP TO THE CORRECT PLANTING DEPTH. GENTLY SHAKE THE TREE TREE TO ALLOW THE ROOT TO STRAIGHTEN OUT. DO NOT TWIST OR SPIN THE TREE OR LEAVE THE ROOTS J-ROOTED.
3. INSERT THE PLANTING BAR SEVERAL INCHES IN FRONT OF THE TREE AND PUSH THE BLADE HALFWAY INTO THE SOIL. TWIST AND PUSH THE HANDLE FORWARD TO CLOSE THE TOP OF THE SLIT TO HOLD THE TREE IN PLACE.
4. PUSH THE PLANTING BAR DOWN TO THE FULL DEPTH OF THE BLADE.
5. PULL BACK ON THE HANDLE TO CLOSE THE BOTTOM OF THE PLANTING HOLE.
6. PUSH FORWARD ON THE HANDLE TO FIRM SOIL ON TOP OF ROOTS AND TO CLIMINATE AIR POCKETS AROUND THE ROOT.
7. INSERT PLANTING BAR 2 INCHES FROM LAST HOLE.
8. PUSH FORWARD, THEN PULL BACKWARD TO FILL PREVIOUS HOLE.
9. REMOVE THE PLANTING BAR AND FIRM UP THE OPENING WITH THE HEEL.
10. FIRM THE SOIL AROUND THE TREE WITH THE FOOT. BE CAREFUL TO AVOID DAMAGING THE TREE.

PLANTING PROCEDURE WITH HOEDAD



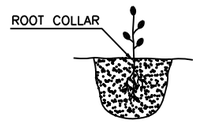
1. STRIKE BLADE ALMOST VERTICALLY, FULL DEPTH OF BLADE, INTO THE SOIL. PULL UP ON THE HANDLE TO BREAK THE SOIL LOOSE AT THE BOTTOM OF THE HOLE. CAUTION – AVOID RAISING THE HANDLE MORE THAN A FEW INCHES. OTHERWISE THE HOLE WILL FILL WITH SOIL AND THE TREE WILL BE SHALLOW ROOTED.
2. SLIDE HAND DOWN HANDLE ALMOST TO THE BLADE. PULL BACK AND DOWN ON THE HANDLE TO FORM A POCKET ON THE FAR SIDE OF THE BLADE. WITH THE OTHER HAND, IMMEDIATELY PLACE THE TREE ROOTS INTO THE POCKET TO THE FULL DEPTH OF THE HOLE.
3. HOLD TREE IN PLACE WHILE SLIDING THE HOEDAD BLADE OUT OF THE HOLE. LOOSE SOIL SHOULD FALL INTO THE HOLE, HOLDING TREE IN PLACE.
4. PULL BLADE COMPLETELY OUT OF THE HOLE AND PUSH SOIL AGAINST PLANTED TREE WITH THE TIP OF THE BLADE.
5. USE FOOT TO FIRM THE SOIL AGAINST THE TREE. DO NOT STEP ON OR BRUISE TREE WITH YOUR FOOT.



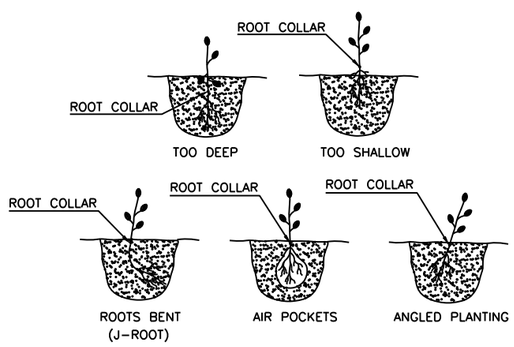
PLANTING TYPICAL

NOTE:
1) ZONE 1 APPLIES ONLY ON AREAS SHOWN ON THE PLANS.
2) PLANTING NOT TO OCCUR ON PRESERVATION AREAS.

REFORESTATION – PLANTING CRITERIA



PROPER PLANTING
N.T.S.



UNACCEPTABLE PLANTING
N.T.S.

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

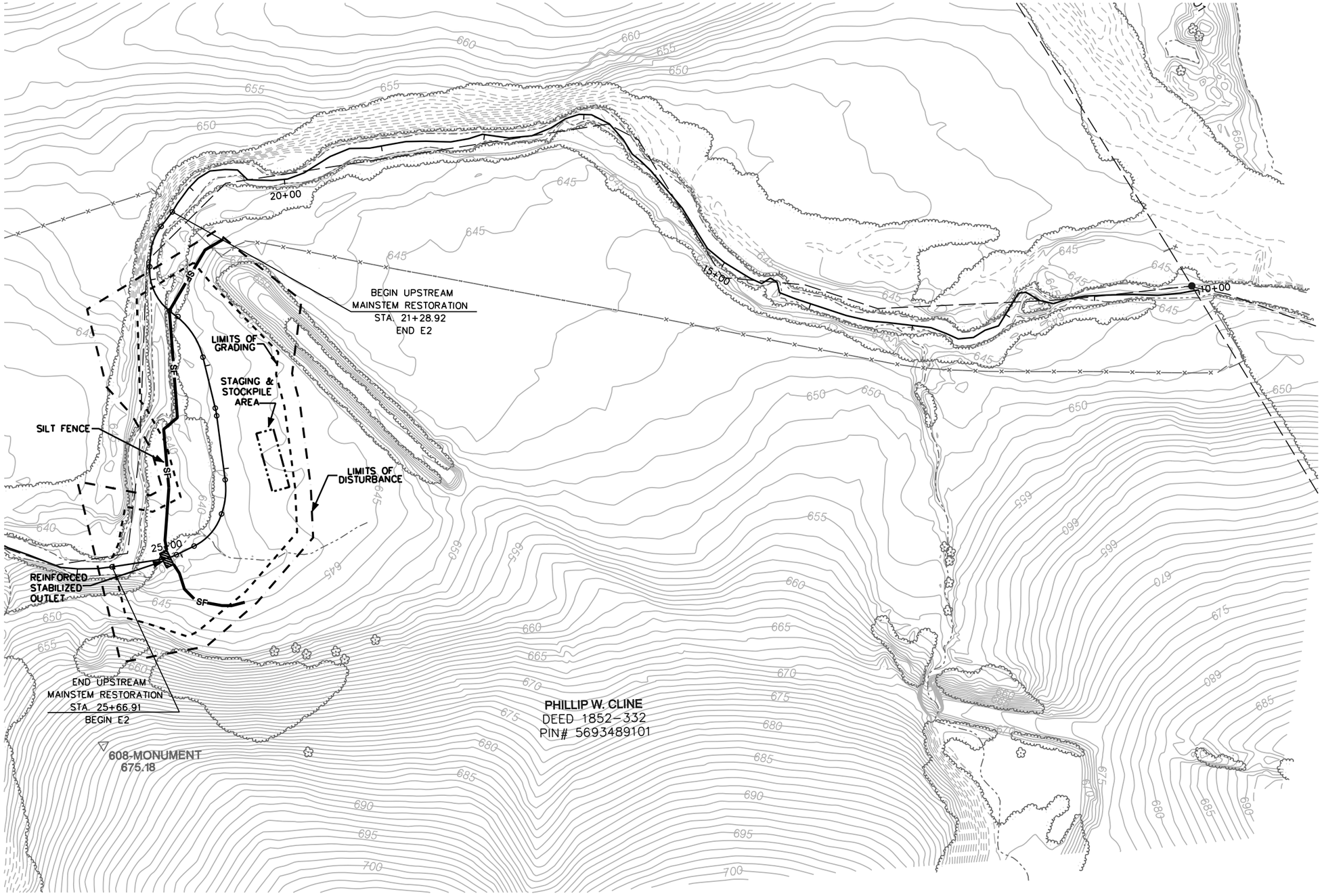
THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PLANTING DETAILS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	36 OF 54
DRAWING NO.	PD1
DRAWN BY	JAD

Filename: G:*CAlarcon*4-4-12*NC*36*buffalo*PLANT*DETAILS.dgn Date: 4/5/2013 Time: 2:56:50 PM



LIMITS OF DISTURBANCE = 1.5 AC

TOTAL LIMITS OF DISTURBANCE =6.8 AC

NO.	REVISIONS	DRN	CHK	DATE

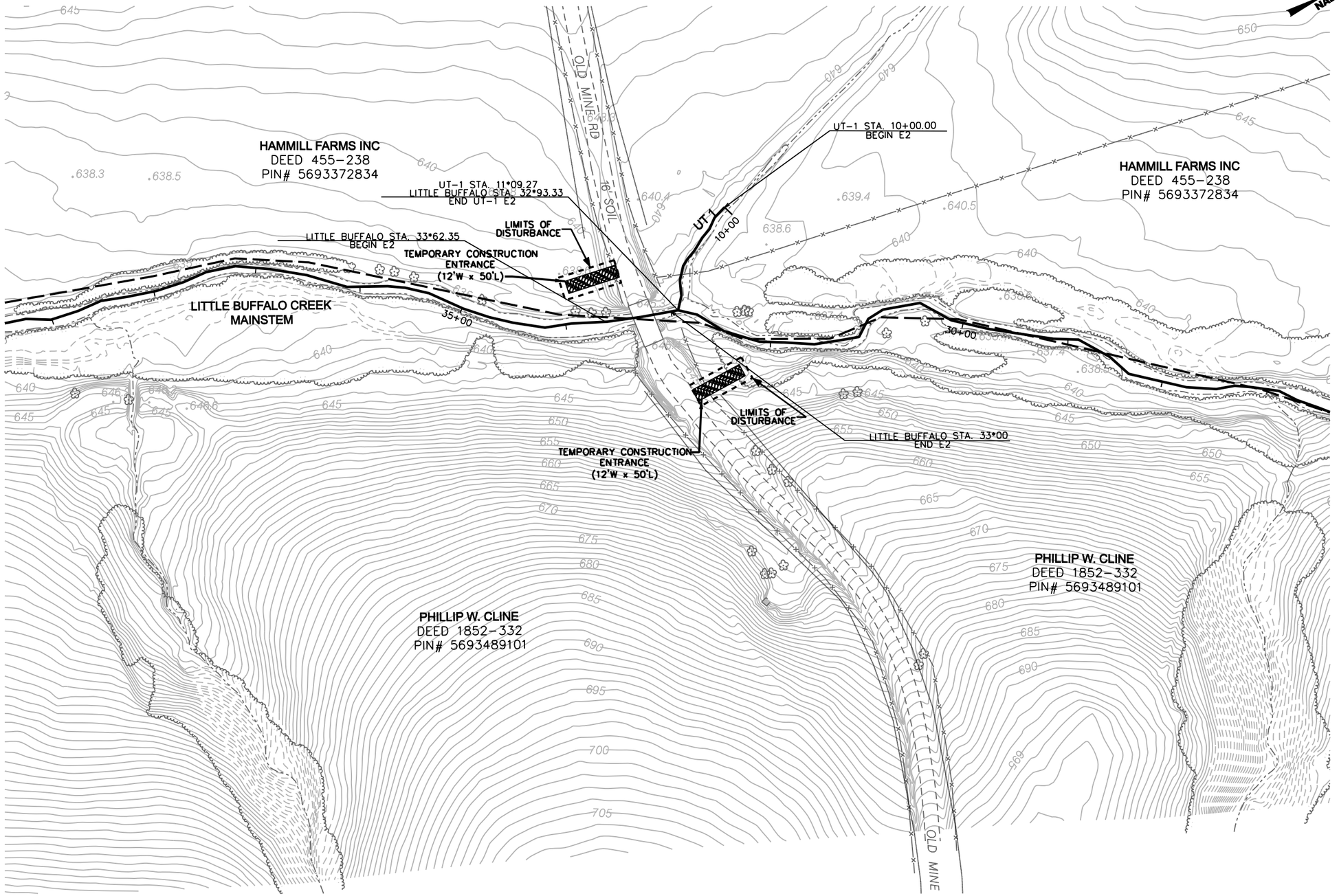
Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

SOIL EROSION & SEDIMENT CONTROL PLAN

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	37 OF 54
DRAWING NO.	SESC1
DRAWN BY	JAD



LIMITS OF DISTURBANCE = 0.1 AC

TOTAL LIMITS OF DISTURBANCE =6.8 AC

NO.	REVISIONS	DRN	CHK	DATE

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Raleigh, North Carolina 27605

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STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

SOIL EROSION & SEDIMENT CONTROL PLAN

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	38 OF 54
DRAWING NO.	SESC2
DRAWN BY	JAD

NAD 83

606-MONUMENT
636.39

STAGING AND STOCKPILE AREA

LIMITS OF DISTURBANCE

LIMITS OF GRADING

REINFORCED STABILIZED OUTLET

SF

SILT FENCE

LITTLE BUFFALO STA. 46+10
BEGIN E2-REACH 3
END E2-REACH 2

45+00

40+00

BEGIN DOWNSTREAM MAINSTEM RESTORATION
STA. 48+10.40
END E2

UT-2 STA. 19+50.70
LITTLE BUFFALO STA. 42+36.92
END UT-2 E2

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

END DOWNSTREAM MAINSTEM RESTORATION
STA. 50+76.91
BEGIN E2

10+00

LIMITS OF DISTURBANCE = 1.2 AC

TOTAL LIMITS OF DISTURBANCE =6.4 AC

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

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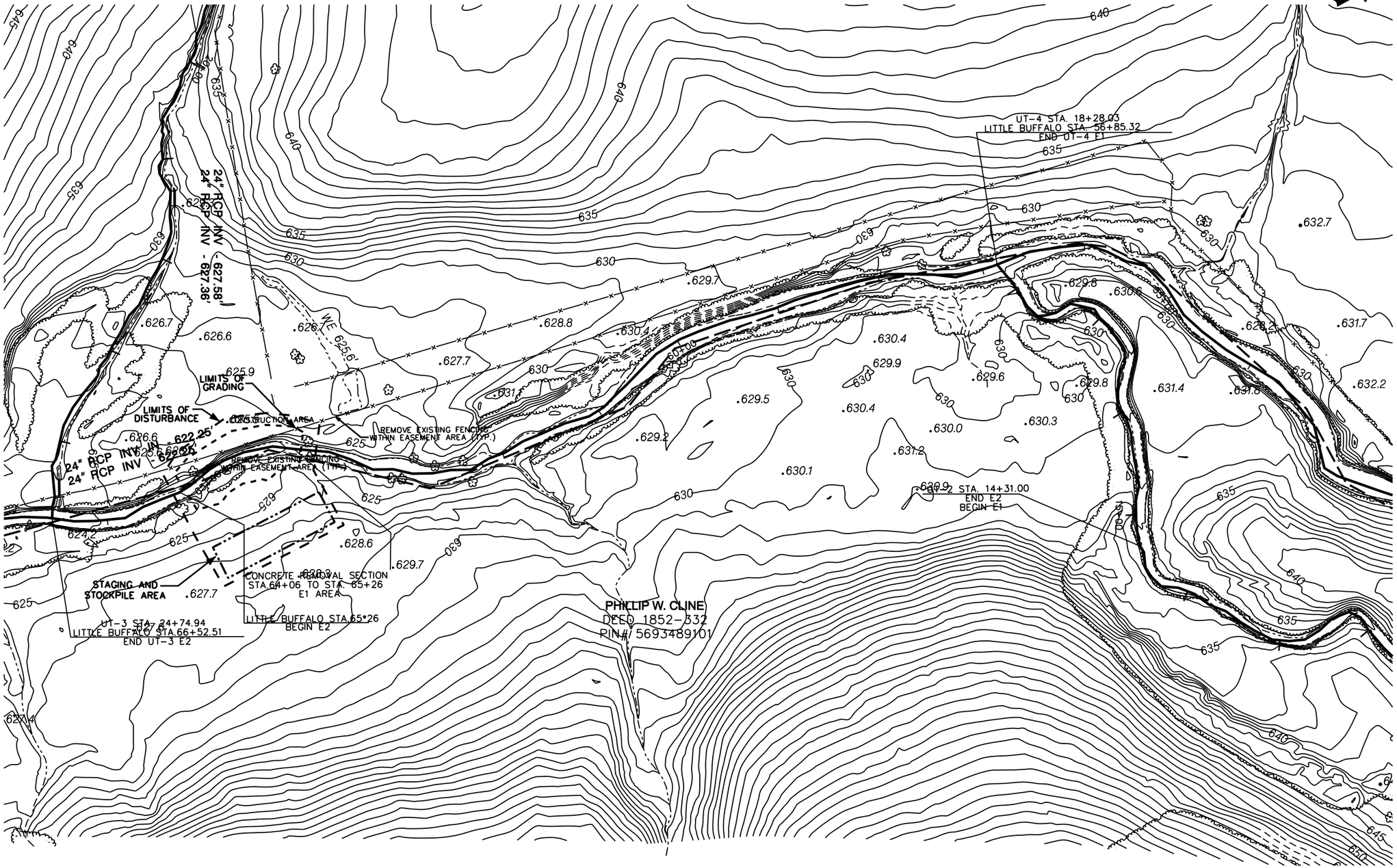
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

SOIL EROSION & SEDIMENT CONTROL PLAN

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	39 OF 54
DRAWING NO.	SESC3
DRAWN BY	JAD



LIMITS OF DISTURBANCE = 0.4 AC

TOTAL LIMITS OF DISTURBANCE =6.8 AC

0 50' 100'

SCALE 1"=100'

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

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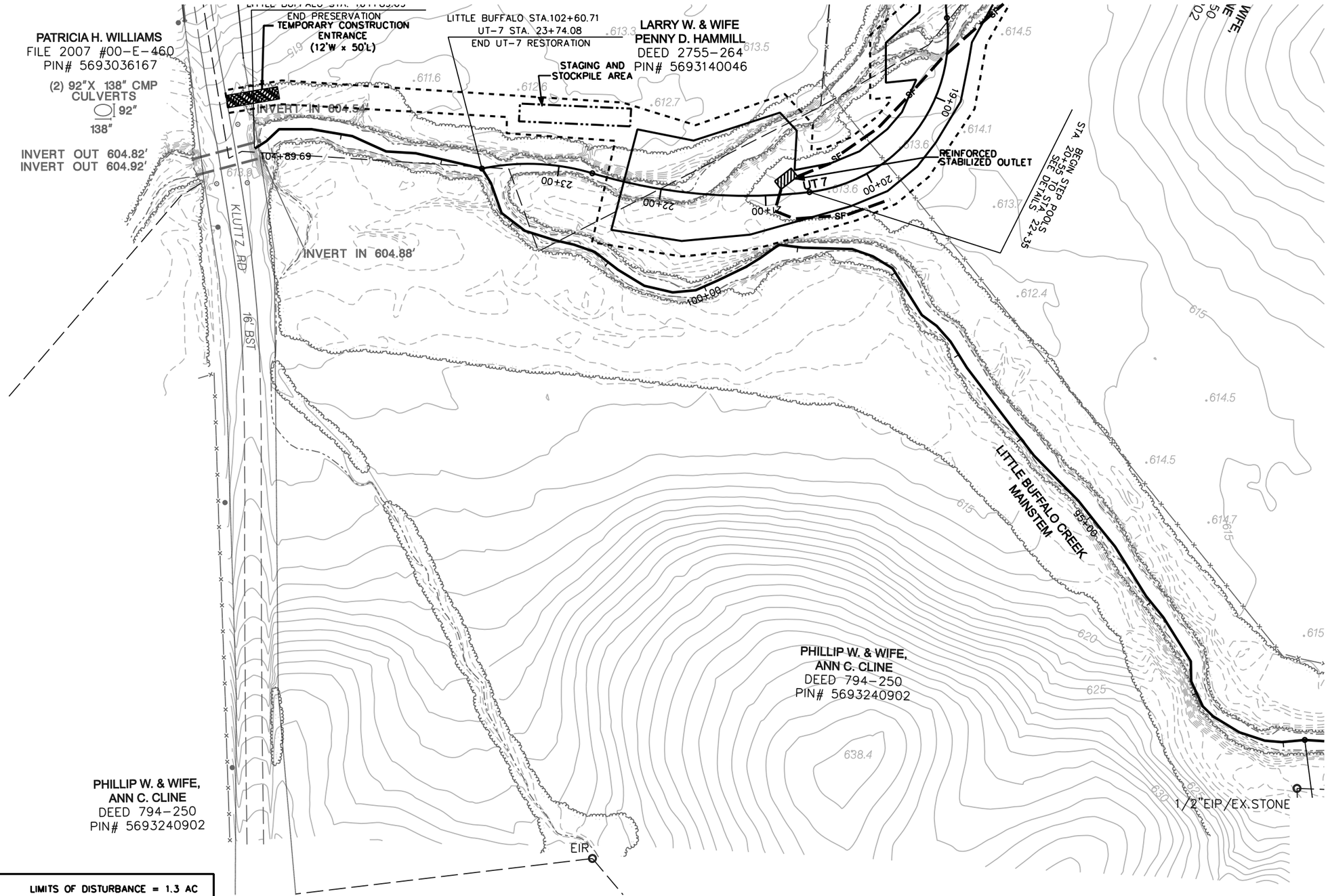
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

SOIL EROSION & SEDIMENT CONTROL PLAN

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	40 OF 54
DRAWING NO.	SESC4
DRAWN BY	JAD



NO.	REVISIONS	DRN	CHK	DATE

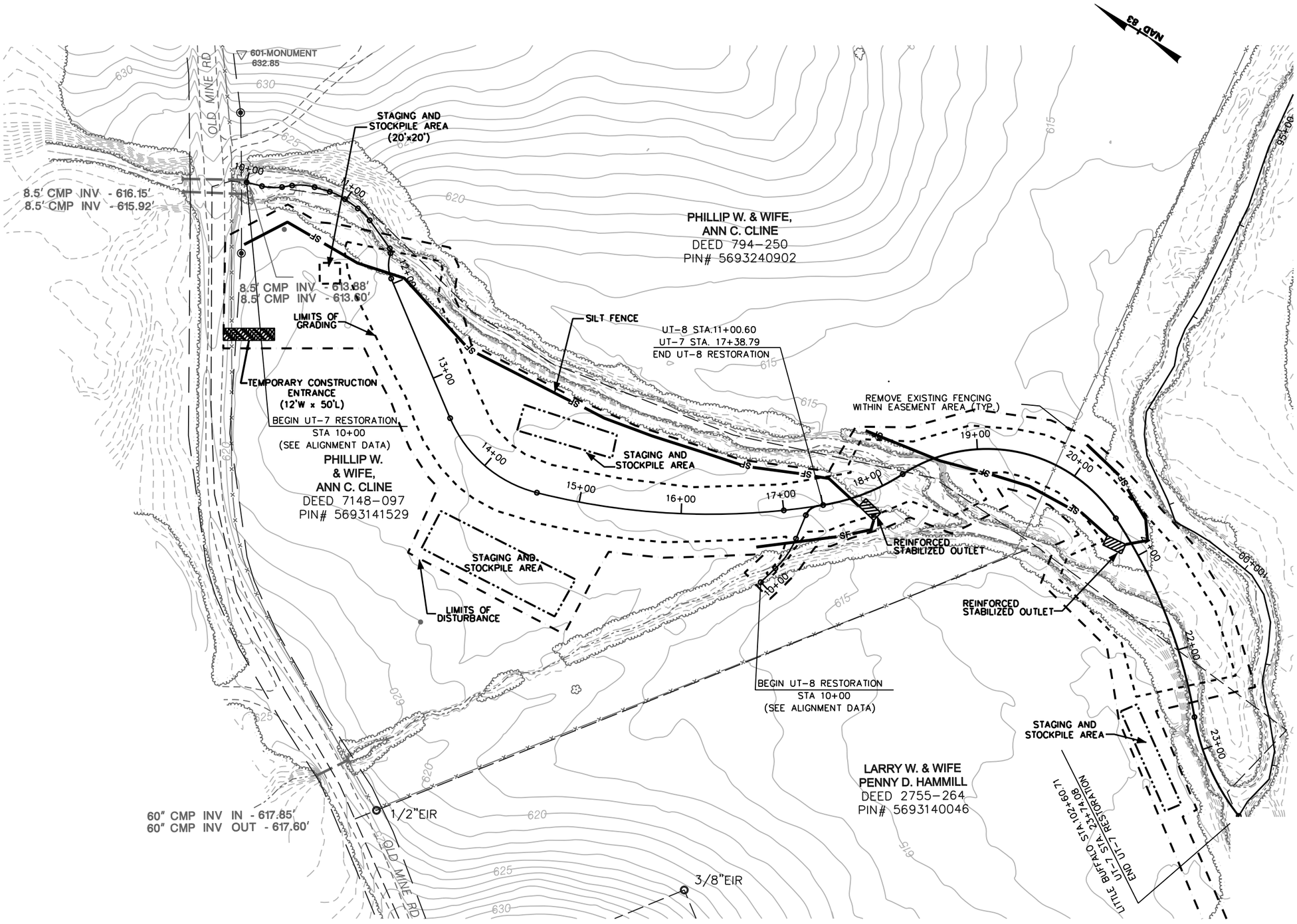
Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

PROPOSED CONDITIONS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	41 OF 54
DRAWING NO.	SESC5
DRAWN BY	JAD



LIMITS OF DISTURBANCE = 3.5 AC

TOTAL LIMITS OF DISTURBANCE = 6.8 AC

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

THE LOUIS BERGER GROUP, Inc.
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Raleigh, North Carolina 27605

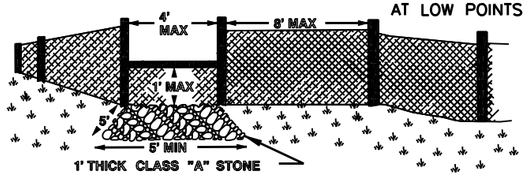
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

SOIL EROSION & SEDIMENT CONTROL PLAN

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	42 OF 54
DRAWING NO.	SESC6
DRAWN BY	JAD

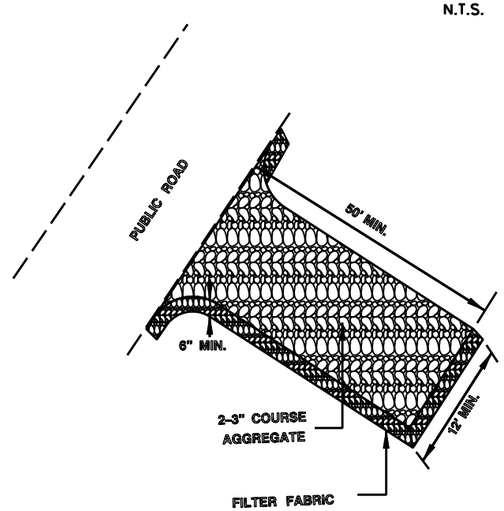
Filename: G:\CAlarcon\4-4-12_NC\42_buffalo_SE&S_SHT_6.dgn
Date: 4/5/2013
Time: 3:02:31 PM

REINFORCED STABILIZED OUTLET
N.T.S.



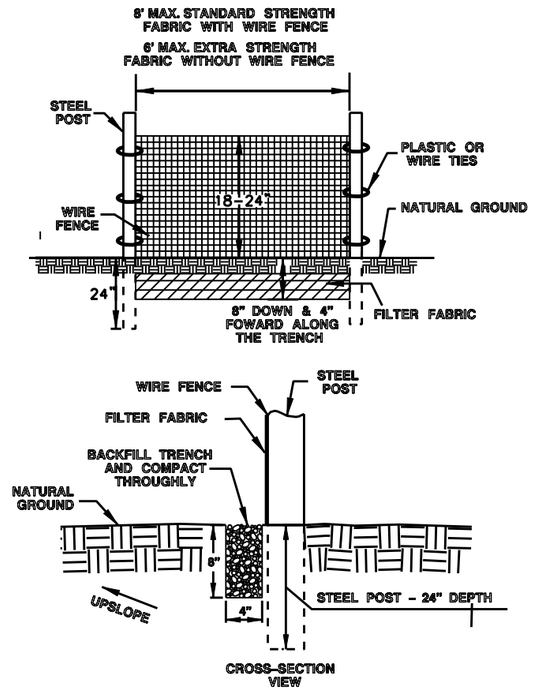
MAINTENANCE:
1. INSPECT REINFORCED STABILIZED OUTLET AT LEAST ONCE PER WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.
2. RESHAPE OUTLET PAD AS NEEDED.
3. REMOVE AND REPLACE THE STONE IF IT BECOMES CLOGGED WITH SEDIMENT.
4. TOPDRESS WITH CLEAN CLASS "A" STONE AS NEEDED.

TEMPORARY CONSTRUCTION ENTRANCE
N.T.S.



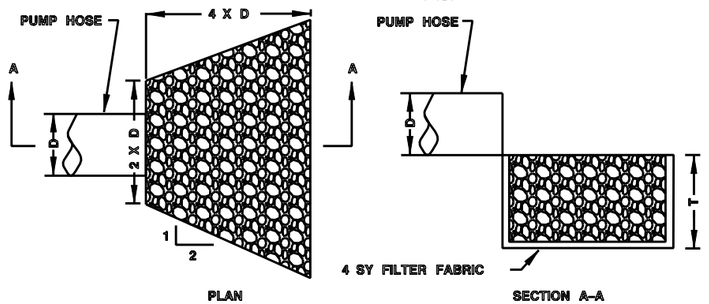
MAINTENANCE:
1. INSPECT CONSTRUCTION ENTRANCE AT LEAST ONCE PER WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATLEY.
2. RESHAPE PAD AS NEEDED FOR DRAINAGE AND RUNOFF CONTROL.
3. TOPDRESS WITH CLEAN STONE AS NEEDED.
4. IMMEDIATLEY REMOVE MUD AND SEDIMENT TRACKED OR WASHED ONTO PUBLIC ROADS.
5. REPAIR ANY BROKEN ROAD PAVEMENT IMMEDIATLEY.

TEMPORARY SILT FENCE
N.T.S.



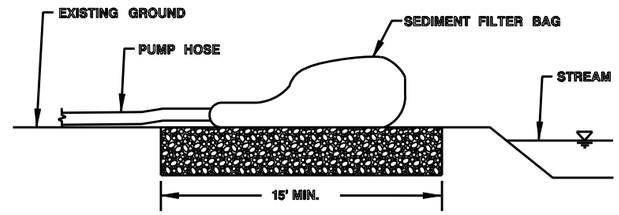
MAINTENANCE:
1. INSPECT SILT FENCE AT LEAST ONCE PER WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.
2. SHOULD THE FABRIC OF THE SILT FENCE COLLAPSE, TEAR, DECOMPOSE OR BECOME INEFFECTIVE, REPLACE IT IMMEDIATLEY.
3. REMOVE SEDIMENT DEPOSITS AS NECESSARY TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN EVENT AND TO REDUCE PRESSURE ON THE FENCE. TAKE CARE TO AVOID UNDERMINING THE FENCE DURING CLEANOUT.
4. REMOVE ALL SILT FENCE MATERIALS AND UNSTABALE SEDIMENT DEPOSITS. BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.

ENERGY DISSIPATOR FOR PUMP HOSE (IF CLEAN WATER)
N.T.S.



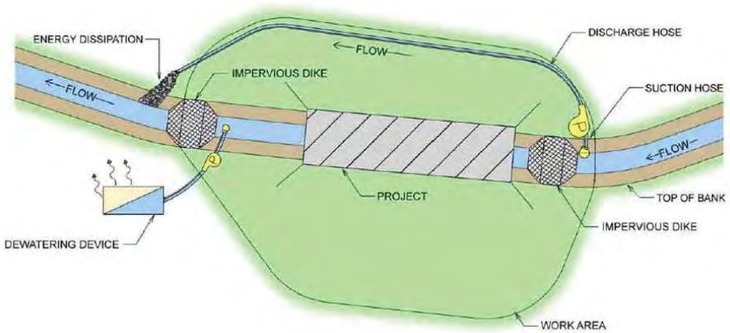
NOTES:
1. RIP RAP SHALL BE 1 TONE OF CLASS "B" RIP RAP.

SEDIMENT BAGS
N.T.S.



NOTES:
1. INSTALL SEDIMENT BAG ON A SLOPE SO INCOMING WATER FLOWS DOWNHILL THROUGH BAG WITHOUT CREATING MORE EROSION. TO INCREASE THE EFFICIENCY OF FILTRATION, PLACE THE BAG ON A GRAVEL BED IN ORDER TO MAXIMIZE WATER FLOW THROUGH THE SURFACE AREA OF THE BAG.
2. BAG IS FULL WHEN IT NO LONGER CAN EFFICIENCTLY FILTER SEDIMENT OR ALLOW WATER TO PASS AT A REASONABLE RATE. FLOW RATES WILL VARY DEPENDING ON THE SIZE OF SEDIMENT BAG, THE TYPE AND AMOUNT OF SEDIMENT DISCHARGED INTO THE BAG, THE TYPE OF GROUND, ROCK OR OTHER SUBSTANCE UNDER THE BAG AND THE DEGREE OF THE SLOPE ON WHICH THE BAG LIES. AVOID USE OF EXCESSIVE FLOW RATES OR OVERFILLING WITH SEDIMENT TO PREVENT BAG RUPTURE OR FAILURE OF THE HOSE ATTACHMENT STRAPS.
3. DISPOSE SEDIMENT BAG IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND AS DIRECTED BY THE ENGINEER. BAGS MAY NOT BE REUSED.

PUMPS
N.T.S.



NOTES:
1. ENSURE TO ANCHOR ALL PIPES AND PUMPS SECURELY.
2. PUMPS SHALL BE INSTALLED APPROVED BY ENGINEER.

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

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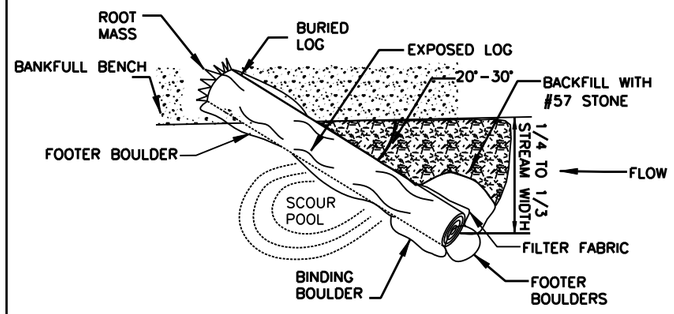
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

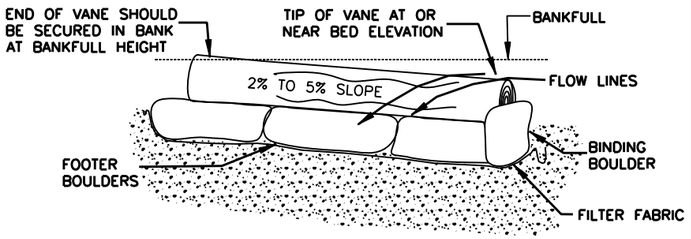
SOIL EROSION AND SEDIMENT CONTROL DETAILS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	43 OF 54
DRAWING NO.	DT1
DRAWN BY	JAD

LOG VANE N.T.S.



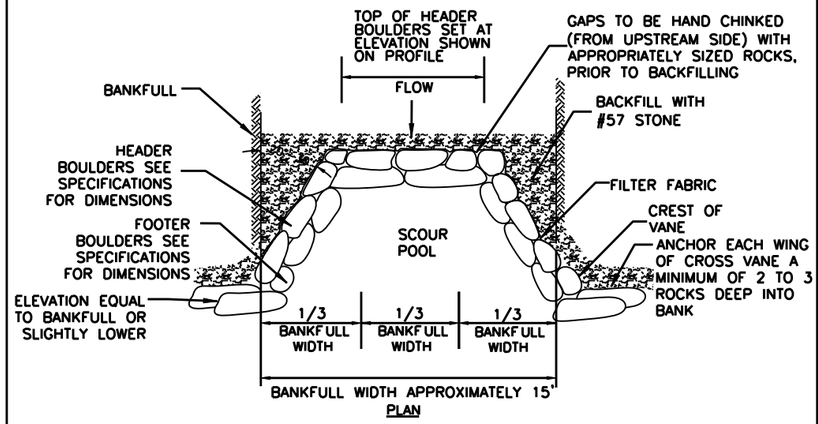
PLAN



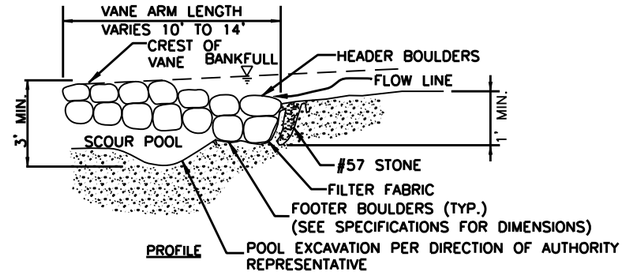
PROFILE

NOTE:
1. FILTER FABRIC SHALL BE PLACED ON THE UPSTREAM SIDE OF THE LOG VANE ¼ DIAMETER FROM THE TOP OF THE LOG
2. FILTER FABRIC SHALL BE NAILED WITH GALVANIZED ROOFING NAILS TO LOG

ROCK CROSS VANE N.T.S.



PLAN



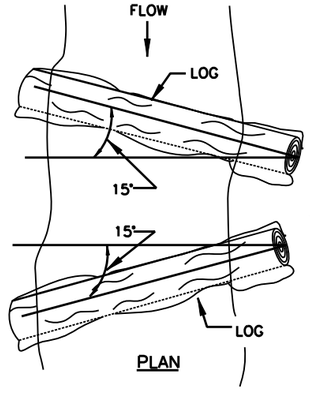
PROFILE

NOTE:
1. ALL STONES AND BOULDERS ARE TO BE STRUCTURE STONE AS DEFINED IN THE SPECIFICATIONS.
2. GAPS BETWEEN BOULDERS SHALL BE MINIMIZED BY FITTING BOULDERS TOGETHER, HAND PLUG WITH STRUCTURE STONE CLASS A AND NUMBER 57 STONE. STRUCTURE WILL BE LINED WITH FILTER FABRIC.
3. THE CONTRACTOR WILL BE REQUIRED TO FIT THE BOULDERS TIGHTLY TOGETHER.
4. SLOPE OF VANE FROM CENTERLINE TO TOP OF BANK SHALL BE 2% TO 5%, OR AS DIRECTED BY THE ENGINEER.
5. FILTER FABRIC SHALL BE PLACED ON THE UPSTREAM SIDE OF THE STRUCTURE TO PREVENT WASHOUT OF SEDIMENT THROUGH BOULDER GAPS. FILTER FABRIC SHALL EXTEND FROM THE BOTTOM OF THE FOOTER BOULDER TO THE FINISHED GRADE ELEVATION AND SHALL BE PLACED THE ENTIRE LENGTH OF THE STRUCTURE.
6. BANKFULL ELEVATIONS TO BE DETERMINED BY THE ENGINEER.

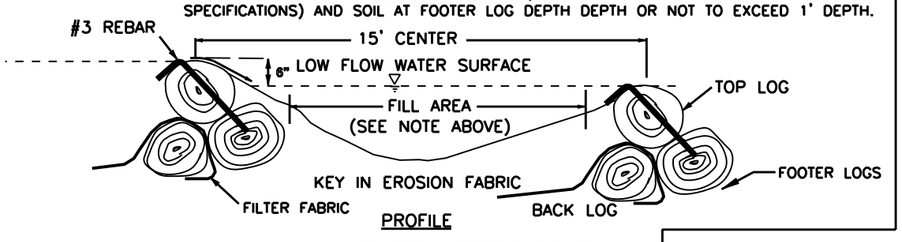
STEP POOL

N.T.S.

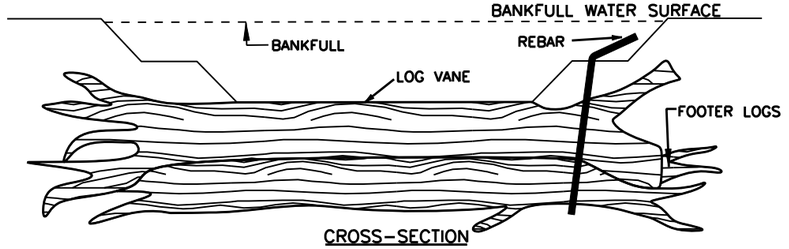
NOTE: FILL IN POOL SECTIONS OF LAST 6 STEP PODS WITH RIVER BED MATERIAL OR A MIXTURE OF CLASS "A", "B" RIPRAP STONE (AS DEFINED IN THE NCDOT 2012 STANDARD SPECIFICATIONS) AND SOIL AT FOOTER LOG DEPTH DEPTH OR NOT TO EXCEED 1' DEPTH.



PLAN



PROFILE



CROSS-SECTION

NO.	REVISIONS	DRN	CHK	DATE

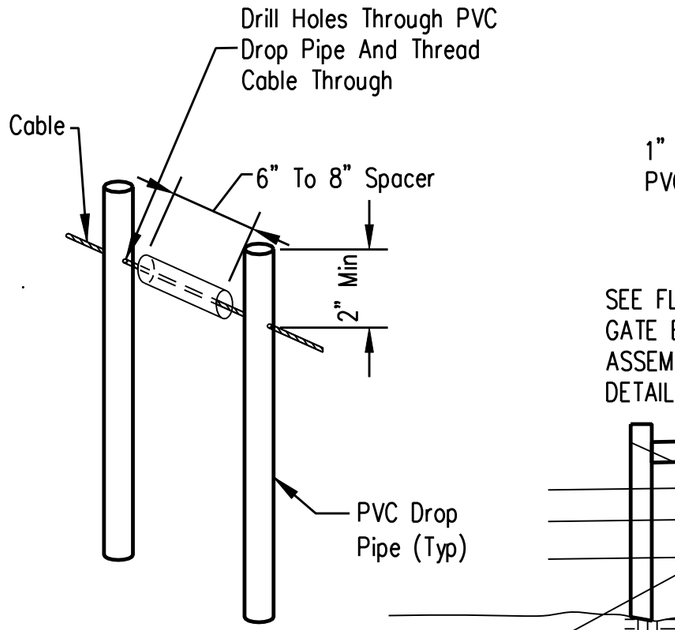
Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

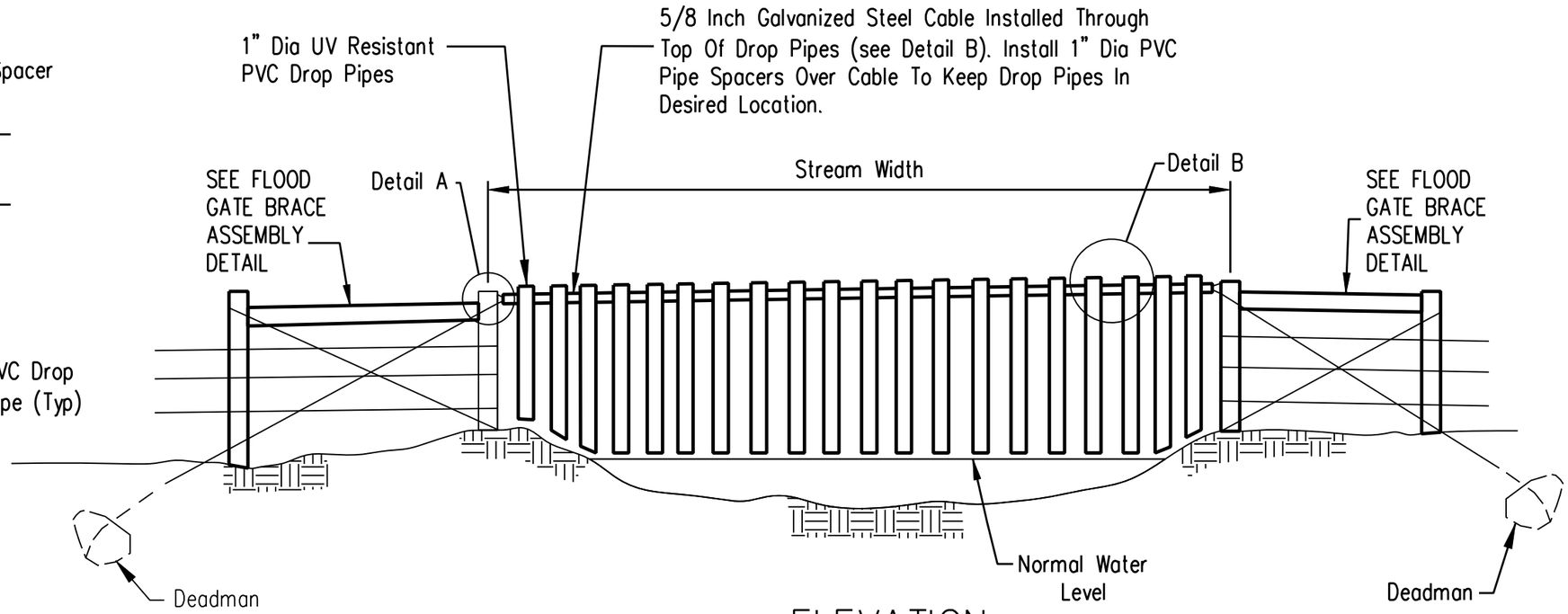
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

STREAM STRUCTURE DETAILS 1

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	44 OF 54
DRAWING NO.	DT2
DRAWN BY	JAD

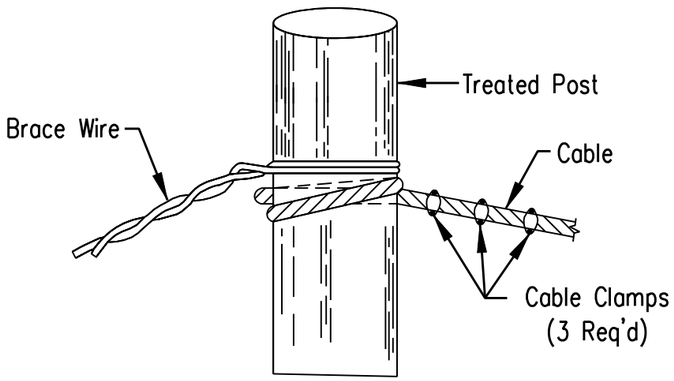


DETAIL B

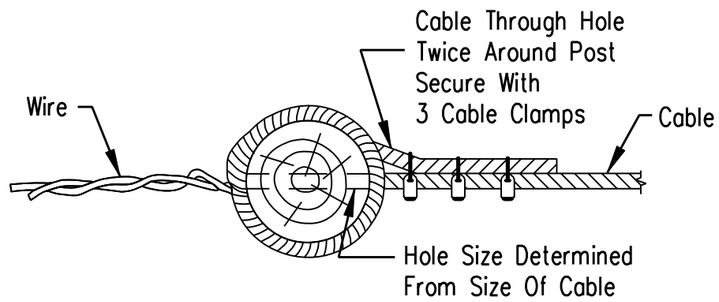


ELEVATION

NOTES:
1. The lower end of the drop pipes shall hang 2 inch to 6 inches above normal water level or natural ground, as encountered across the channel.
2. Not for use where stream width exceeds 60 feet.



DETAIL A—ELEVATION



DETAIL A—TOP VIEW

NOT TO SCALE

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement

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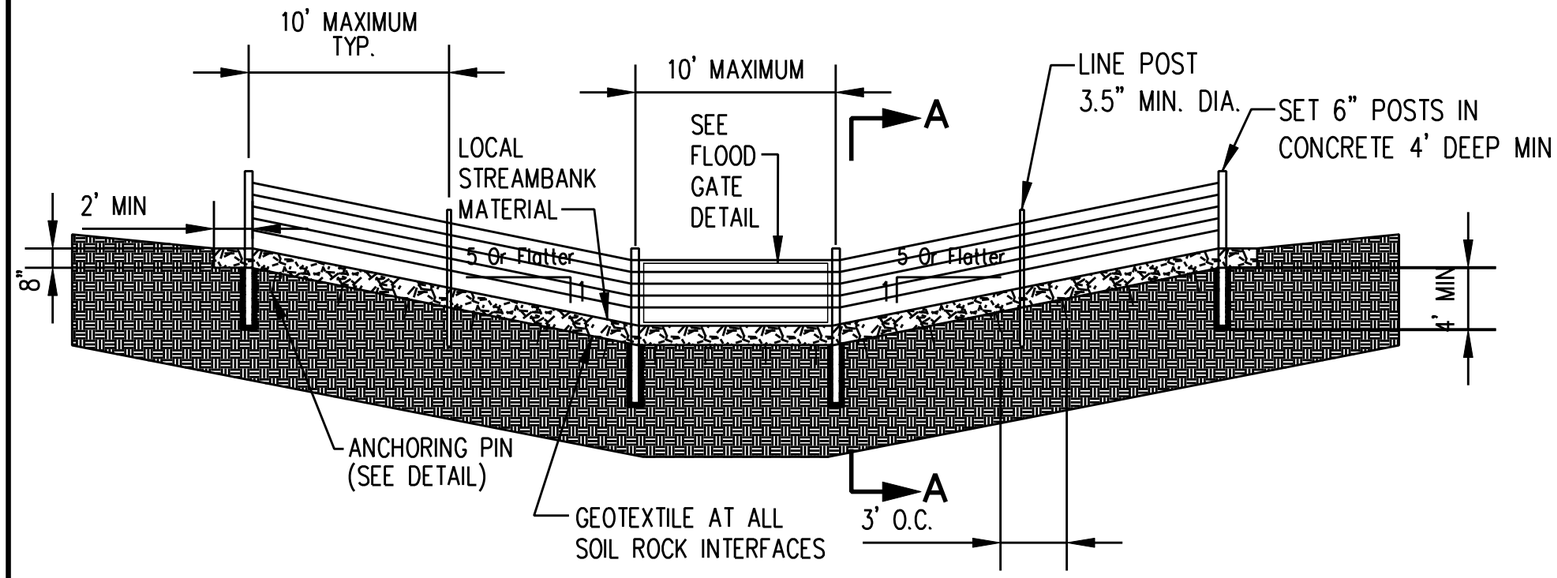
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

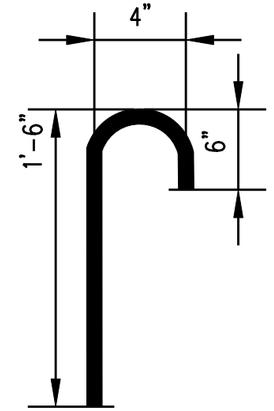
FLOOD GATE-PVC DETAILS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	46 OF 54
DRAWING NO.	DT4
DRAWN BY	JAD



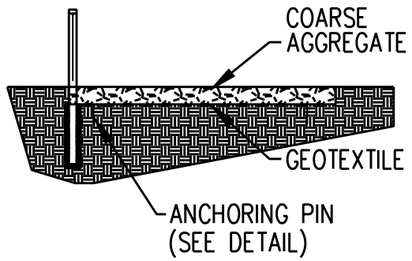
PROFILE ALONG CENTERLINE OF CROSSING

N.T.S.



ANCHORING PIN DETAIL

N.T.S.



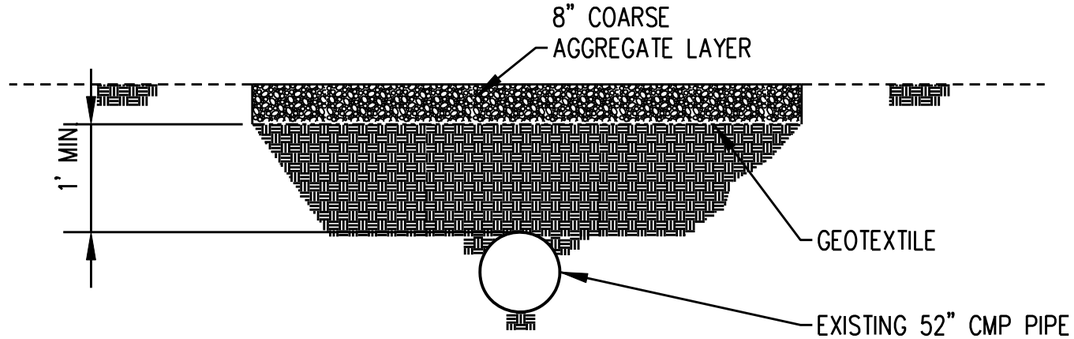
SECTION A–A

LIVE STOCK STREAM CROSSING AT MAINSTEM

N.T.S.

NOTES:

1. LIVE STOCK STREAM CROSSING TO BE INSTALLED AT MAINSTEM AT LOCATION SHOWN ON PLANS.
2. FENCING AND FLOODGATE TO BE INSTALLED AT BOTH ENDS OF STREAM CROSSING.



LIVE STOCK CROSSING AT UT3

N.T.S.

NOTES:

1. ANY DAMAGES TO THE EXISTING 52" CMP CULVERT SHALL BE REPAIRED/REPLACED AT THE CONTRACTOR'S EXPENSE.
2. ANY DAMAGES TO THE EXISTING FENCING ADJACENT TO PROPOSED LIVESTOCK CROSSING SHALL BE REPAIRED/REPLACED AT THE CONTRACTOR'S EXPENSE.

NO.	REVISIONS	DRN	CHK	DATE

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CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

LIVESTOCK CROSSING DETAILS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	47 OF 54
DRAWING NO.	DT5
DRAWN BY	JAD

Filename: G:\CAlarcon\4-4-12\NC\47\buffalo\DETAILS.dgn
Date: 4/5/2013
Time: 3:04:17 PM

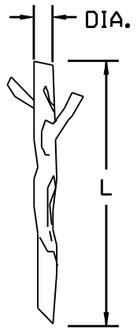
N.T.S.

LIVE STAKE INSTALLATION:

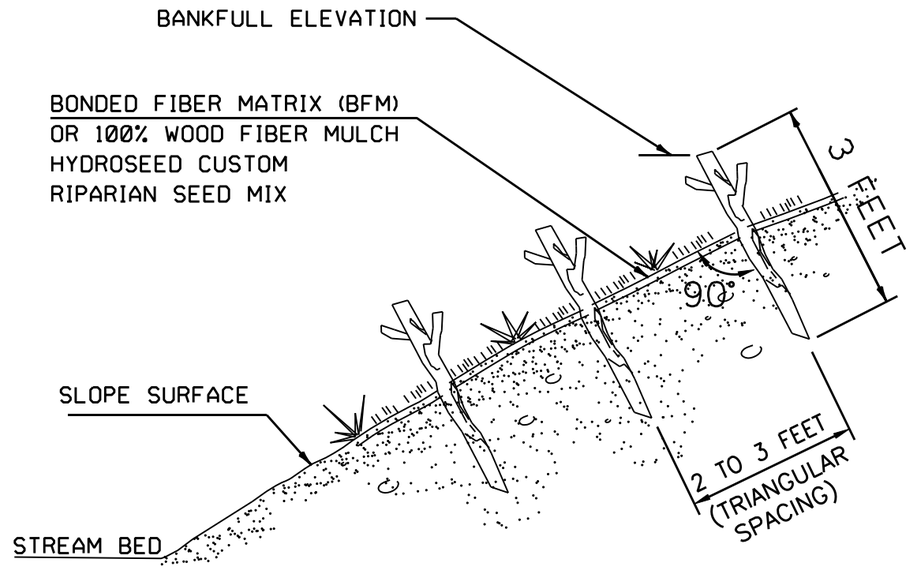
1. TAMP THE LIVE STAKE INTO THE GROUND AT RIGHT ANGLES TO THE SLOPE FACE.
2. LIVE STAKES SHALL BE INSTALLED 2-3 FEET APART USING TRIANGULAR SPACING. STAKES SHOULD BE PLACED WITH 2 TO 4 STAKES PER SQUARE YARD.
3. BUDS SHALL BE ORIENTED UP.
4. FOUR FIFTHS OF THE LENGTH OF THE LIVE STAKE SHALL BE INSTALLED INTO THE GROUND AND SOIL FIRMLY PACKED AROUND IT AFTER INSTALLATION.
5. STAKES THAT SPLIT DURING INSTALLATION SHALL BE REPLACED AT NO ADDITIONAL COST TO LBG.
6. AN IRON BAR CAN BE USED TO MAKE A PILOT HOLE IN FIRM SOIL. DRIVE THE LIVE STAKE INTO THE GROUND WITH A DEAD HAMMER (HAMMER HEAD FILLED WITH SHOT OR SAND).

ACCEPTABLE LIVE STAKE SPECIES	SCIENTIFIC NAME
BLACK WILLOW	SALIX NIGRA
SILKY DOGWOOD	CORNUS AMOMUM
ALNUS SPP.	ALDER

NOTE: REFER TO PLANTING NOTES ON SHEET 30.



N.T.S.



N.T.S.

LIVE STAKE GUIDELINES:

1. LIVE STAKE CUTTINGS SHALL BE INSTALLED WITHIN THE PLANTING ZONE I AS INDICATED ON THE PLANTING NOTES.
2. LIVE STAKE CUTTINGS SHALL BE 0.5 TO 1.5 INCHES IN DIAMETER AND A MINIMUM OF THREE FEET LONG.
3. CUTTINGS SHOULD BE UNDAMAGED, DISEASE AND INSECT FREE STOCK, AND FROM THE LIST OF ACCEPTABLE SPECIES PROVIDED ON THE PLANS.
4. MATERIALS MUST HAVE SIDE BRANCHES CLEANLY REMOVED AND BARK INTACT.
5. THE BASAL ENDS SHOULD BE CUT AT AN ANGLE FOR EASY INSERTION INTO THE SOIL. THE TOP SHOULD BE SQUARE. STAKES SHOULD BE PLANTED WITH BUTT-END INTO THE GROUND. BUDS SHOULD BE ORIENTED UP.
6. MATERIALS SHALL BE SOAKED IN WATER A MINIMUM OF 10 DAYS IMMEDIATELY AFTER PREPARATION. MATERIALS SHOULD BE INSTALLED THE SAME DAY THAT THEY ARRIVE ON SITE. THE MATERIAL MUST NOT BE ALLOWED TO DRY OUT; MATERIALS IN WATER OR IN A COOL, SHADED, WET ENVIROMENT PRIOR TO INSTALLATION.
7. PLANTS SHALL BE BOTH CUT AND INSTALLED WHEN THEY ARE DORMANT: THAT IS, PRIOR TO BUD SWELL AND LEAF EMERGENCE IN THE SPRING AND AFTER LEAVES HAVE TURNED COLOR AND FALLEN OFF IN THE FALL. THE INSTALLATION PERIOD IN THE SPRING IS BETWEEN MARCH 1 AND APRIL 15, AND IN THE FALL BETWEEN OCTOBER 30 AND NOVEMBER 30.

NO. | REVISIONS | DRN | CHK | DATE

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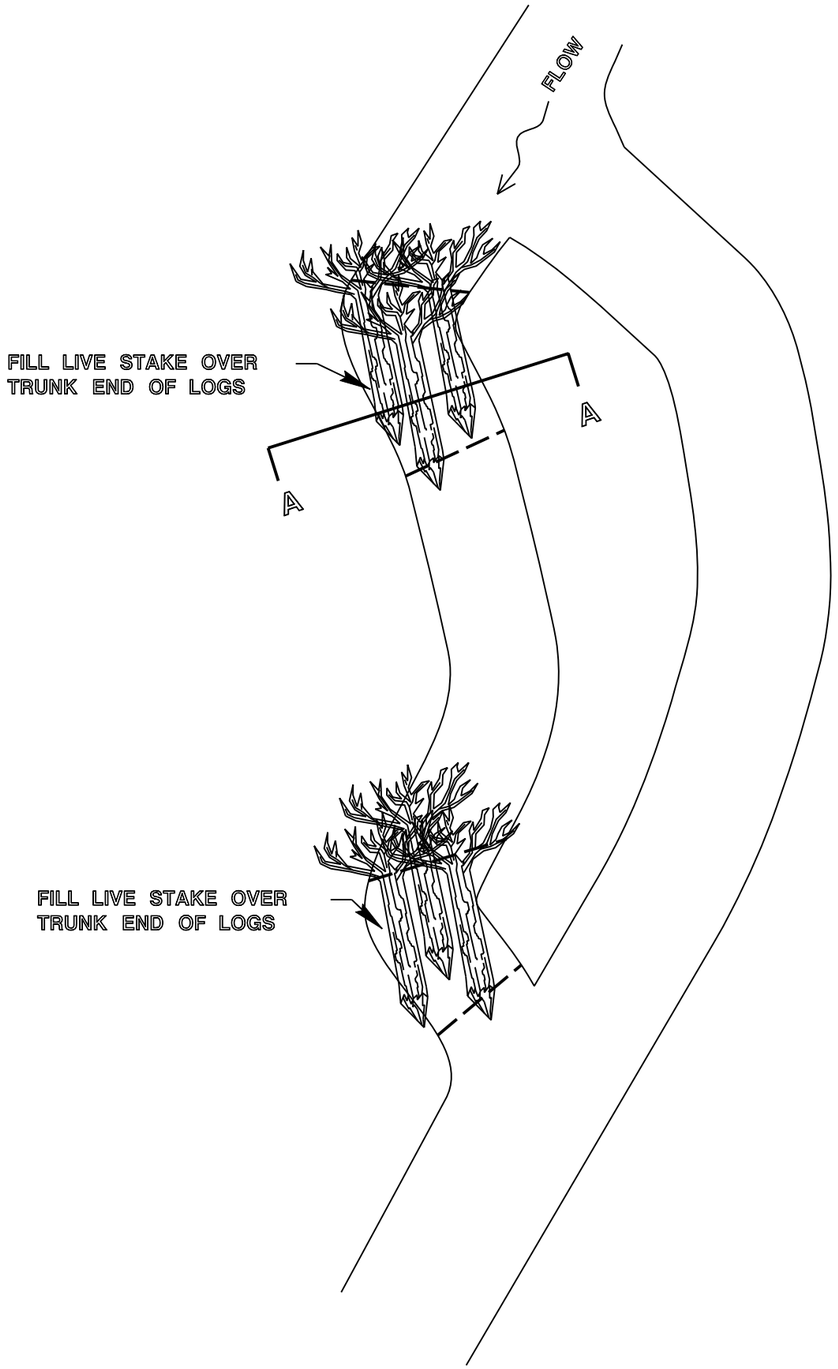
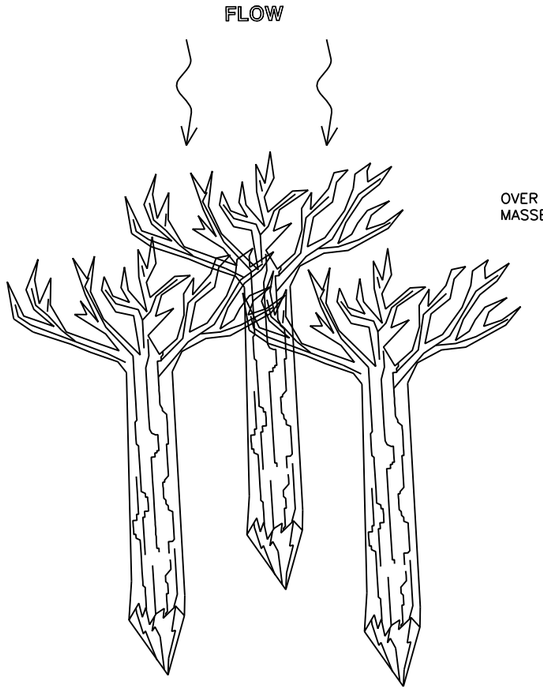
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

STREAM BANK DETAIL

DATE MARCH 2013
PROJECT NO. 94147
FILENAME
SHEET NO. 48 OF 54
DRAWING NO. DT6
DRAWN BY JAD

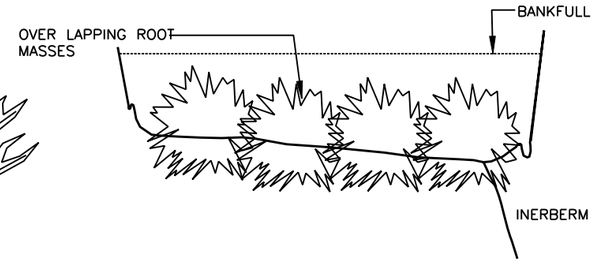


PLAN VIEW

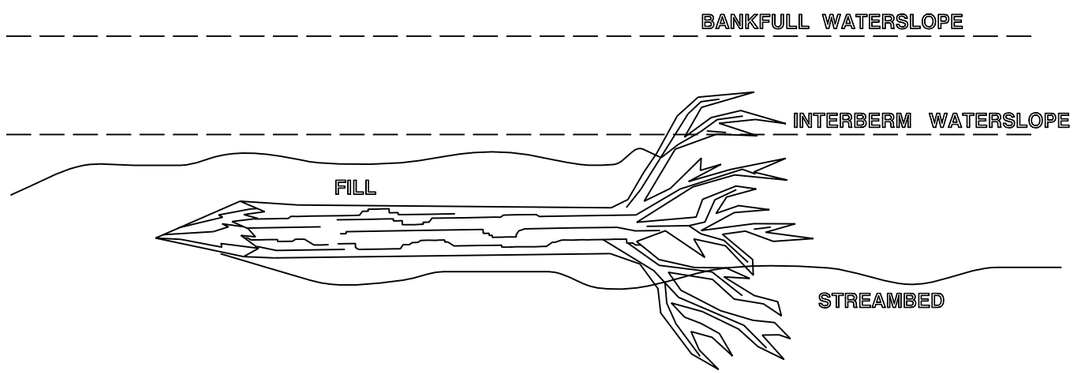


ROOT MASSES WILL BE PLACED IN A OVERLAPPING ARRANGEMENT WITH THE ROOT MASSES DIRECTED UPSTREAM

SECTION A–A



ROOT MASSES WILL BE PLACED IN A OVERLAPPING ARRANGEMENT WITH THE ROOT MASSES DIRECTED UPSTREAM



NOT TO SCALE

NO.	REVISIONS	DRN	CHK	DATE

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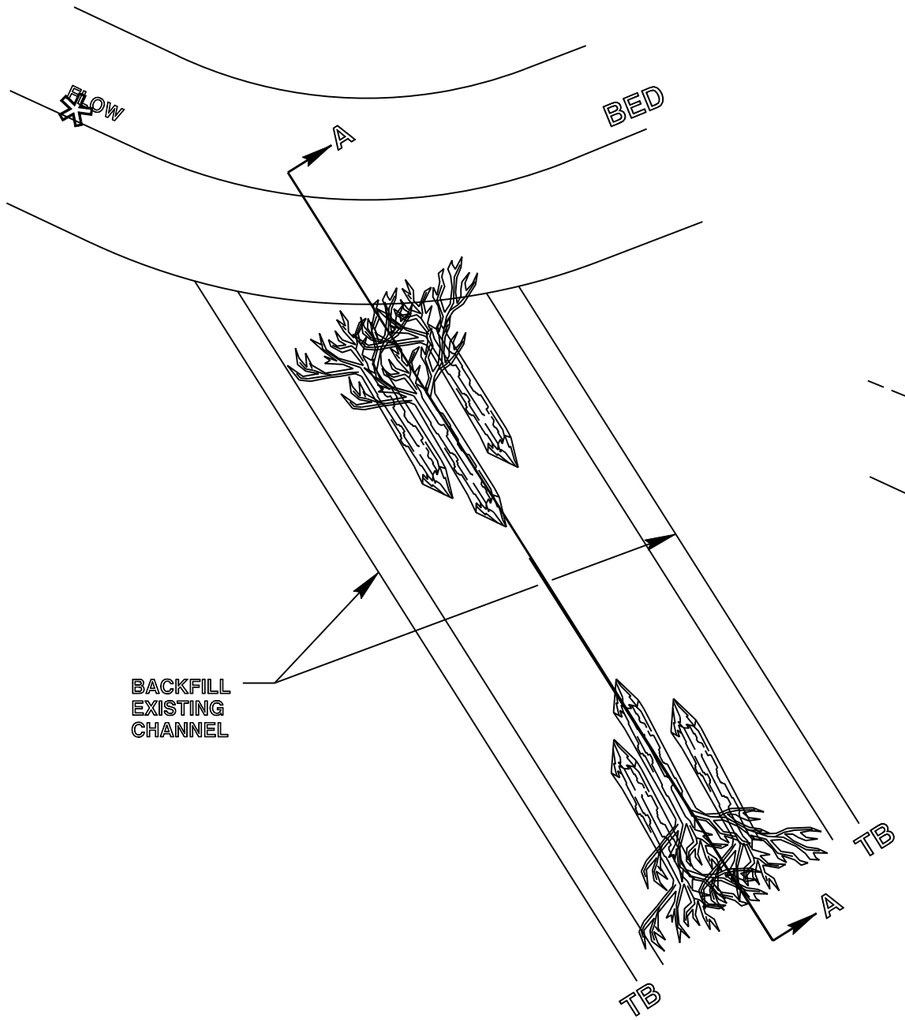
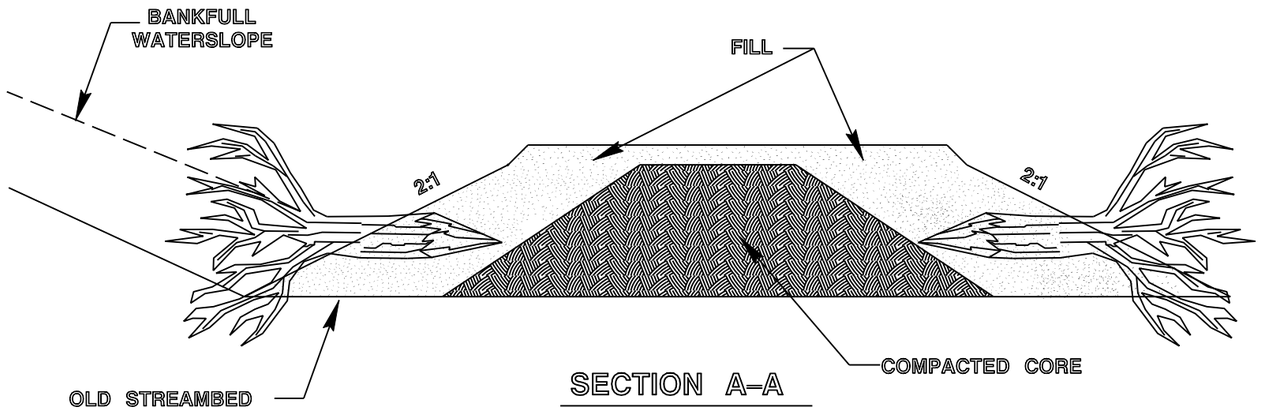
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

MAINSTREAM PLACED TREE DETAIL

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	49 OF 54
DRAWING NO.	DT7
DRAWN BY	JAD



PLAN VIEW



SECTION A–A

NOTES:

1) CORE WILL BE COMPACTED IN LIFTS OF 9 INCES OR LESS.

2) CORE MATERIAL WILL CONSIST OF SILTY OR CLAYEY MATERIAL EXCAVATED ONSITE.

3) CONTRACTOR SHALL COMPACT THE CORE TO 90% OF PROCTOR. SOIL TESTING RESPONSIBILITY OF CONTRACTOR.

4) IF EXCESS EXCAVATED ONSITE MATERIAL IS AVAILABLE AFTER DITCH PLUGS HAVE BEEN INSTALLED AT LOCATIONS SHOWN ON THE PLANS, CONTRACTOR SHALL USE EXCESS MATERIAL FOR ADDITIONAL DITCH PLUGGING WORK WITHIN ABANDONED CHANNELS AT LOCATIONS DIRECTED BY THE ENGINEER.

NOT TO SCALE

NO.	REVISIONS	DRN	CHK	DATE

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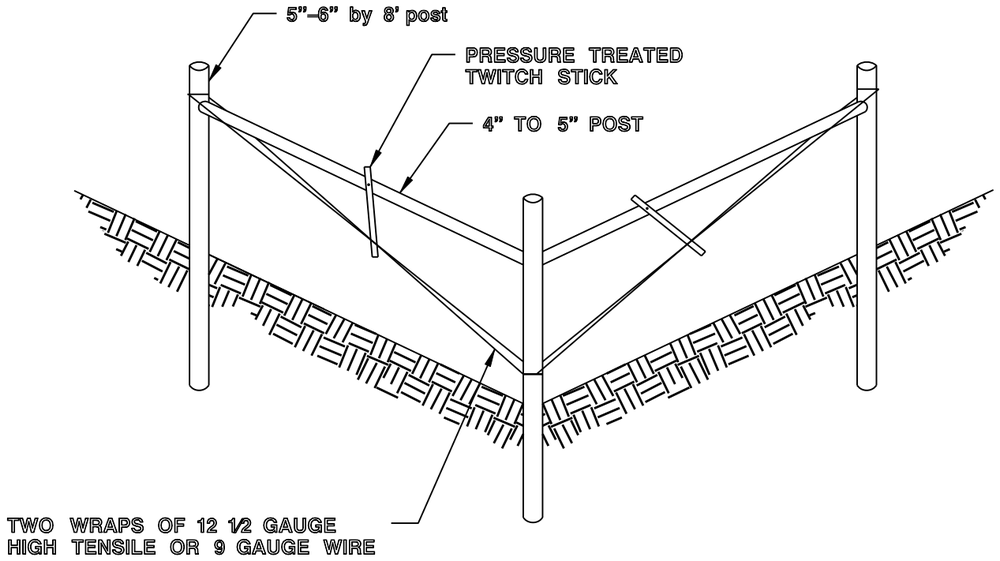
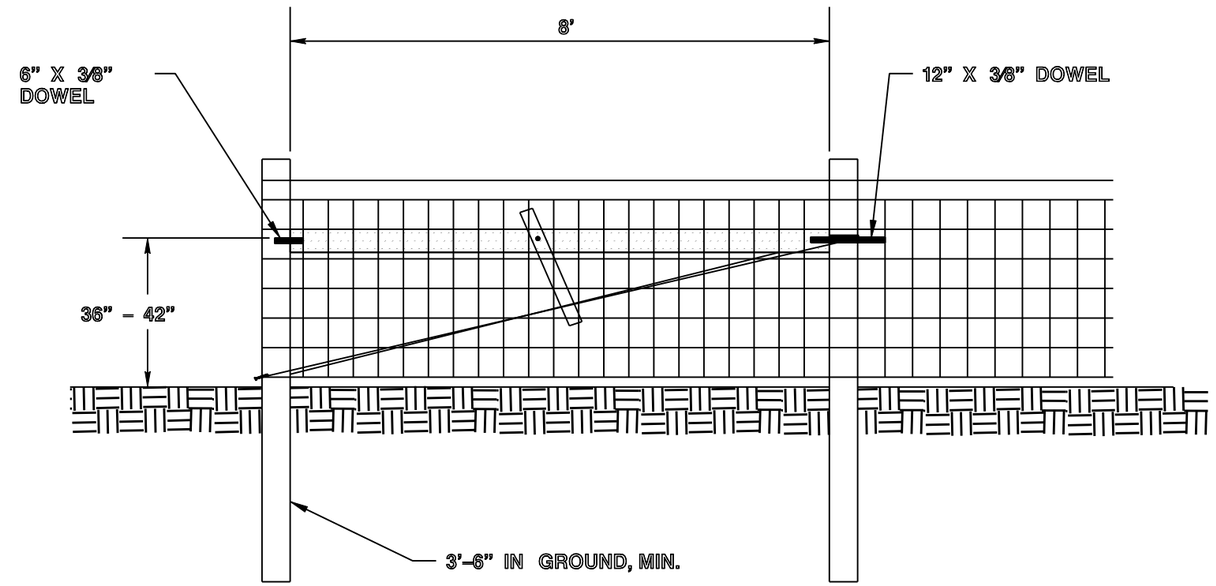
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

COMPACTED CORE
CHANNEL PLUGS

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	50 OF 54
DRAWING NO.	DT8
DRAWN BY	JAD





SINGLE–SPAN BRACE ASSEMBLY

NTS

NO.	REVISIONS	DRN	CHK	DATE

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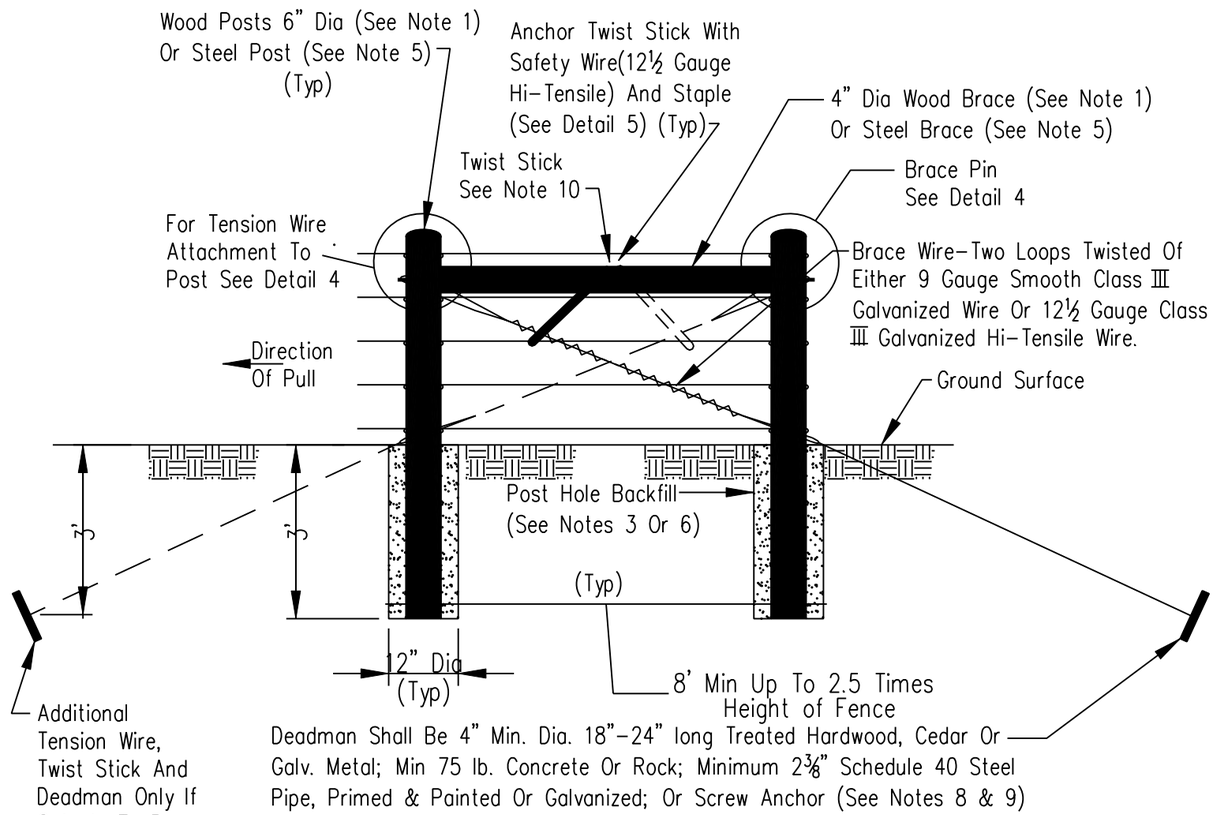
LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

CONSERVATION EASEMENT FENCE DETAIL

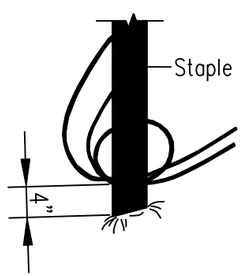
DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	51 OF 54
DRAWING NO.	DT9
DRAWN BY	JAD



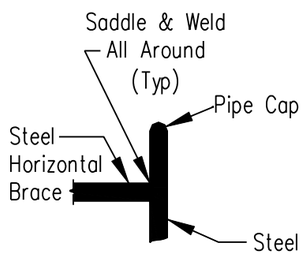
SCREW ANCHOR

NOTES:

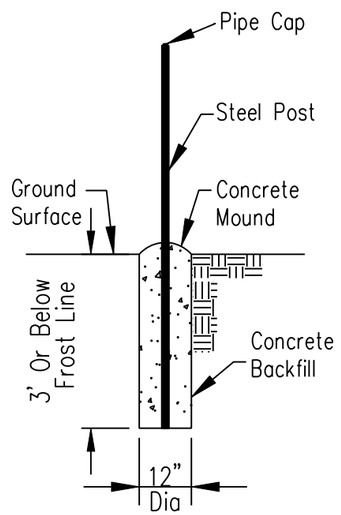
1. Wood posts and braces must be new redwood, red cedar, blueberry juniper, black locust, osage orange, pressure treated pine, treated hardwood, or steel. If using red cedar or redwood, at least one half of the diameter of the post shall be heartwood. No Landscape timbers are allowed.
2. Do not notch posts.
3. All wooden posts shall be backfilled with earth thoroughly tamped.
4. If steel pipe is used all steel pipe must be a minimum of 2⅜ inch diameter Schedule 40 steel pipe either galvanized or primed and painted. All top of steel pipe post are to be capped. Saddle and weld all connections instead of using pins. (See Detail 2).
5. If steel pipe is used, post hole must be backfilled with concrete. Mound concrete to prevent standing water around steel pipe post. (See Detail 3).
6. To prevent wire from slipping on steel post, double wrap all wire around steel post or weld chain link loops.
7. Deadman required where soil depth is restricted to <3', soil texture is loamy fine sand or coarser soil or >6' wire Hi-Tensile Fence.
8. For corrosive soils, screw anchors may be used in place of deadman, loop brace wire through eye of installed screw anchor.
9. Twist stick 18 to 24 inch long and 1 inch diameter or 2"x2" treated hardwood or 18 to 24 inch long and 1/2 inch diameter galvanized or primed and painted pipe.
10. Place horizontal brace within the top 1/3 of the posts and below the top fence wire.



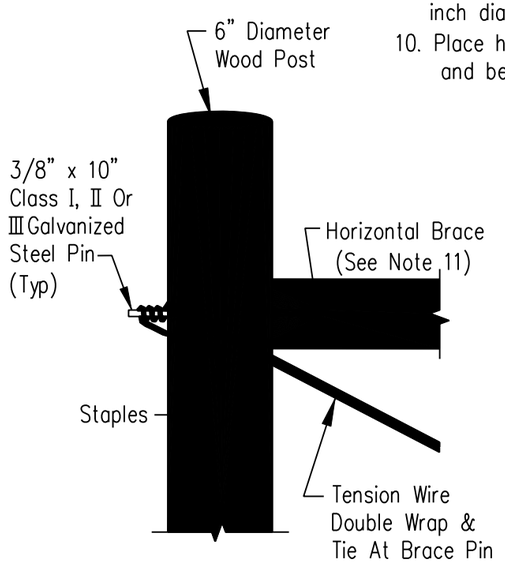
DETAIL 1



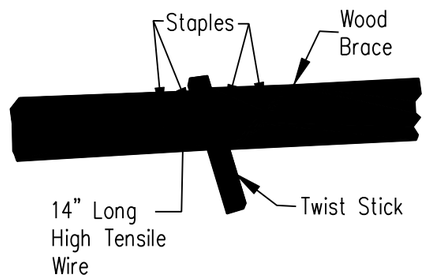
DETAIL 2



DETAIL 3



DETAIL 4



DETAIL 5

NO.	REVISIONS	DRN	CHK	DATE

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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

FLOOD GATE BRACE ASSEMBLY DETAIL

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	52 OF 54
DRAWING NO.	DT10
DRAWN BY	JAD

Filename: G:*CAlarcon*4-4-12*NC*52*buffalo*DETAILS.dgn Date: 4/5/2013 Time: 3:06:12 PM

ALIGNMENT "UPSTREAM MAINSTEM RESTORATION" DESCRIPTION
==========

POT STATION 21+28.92 N 639,836.06 E 1,594,784.57

COURSE FROM POT 21+28.92 TO PC 21+46.44 S 20° 27' 18" E DIST 17.52

CURVE DATA

P.I. STATION 21+61.75 N 639,805.30 E 1,594,796.04
DELTA = 34° 02' 43" (LT)
DEGREE = 114° 35' 30"
TANGENT = 15.31
LENGTH = 29.71
RADIUS = 50.00
LONG CHORD = 29.27
P.C. STATION 21+46.44 N 639,819.65 E 1,594,790.69
P.T. STATION 21+76.15 N 639,796.41 E 1,594,808.50
BACK = S 20° 27' 18" E
AHEAD = S 54° 30' 00" E
CHORD BEAR = S 37° 28' 39" E

COURSE FROM PT 21+76.15 TO PC 21+87.26 S 54° 30' 00" E DIST 11.11

CURVE DATA

P.I. STATION 22+13.33 N 639,774.83 E 1,594,838.77
DELTA = 55° 04' 32" (LT)
DEGREE = 114° 35' 30"
TANGENT = 26.07
LENGTH = 48.06
RADIUS = 50.00
LONG CHORD = 46.23
P.C. STATION 21+87.26 N 639,789.96 E 1,594,817.54
P.T. STATION 22+35.32 N 639,783.56 E 1,594,863.33
BACK = S 54° 30' 00" E
AHEAD = N 70° 25' 28" E
CHORD BEAR = S 82° 02' 16" E

COURSE FROM PT 22+35.32 TO PC 22+44.94 N 70° 25' 28" E DIST 9.61

CURVE DATA

P.I. STATION 22+68.99 N 639,794.84 E 1,594,895.05
DELTA = 37° 55' 34" (RT)
DEGREE = 81° 51' 04"
TANGENT = 24.05
LENGTH = 46.34
RADIUS = 70.00
LONG CHORD = 45.49
P.C. STATION 22+44.94 N 639,786.78 E 1,594,872.39
P.T. STATION 22+91.27 N 639,787.27 E 1,594,917.88
BACK = N 70° 25' 28" E
AHEAD = S 71° 38' 58" E
CHORD BEAR = N 89° 23' 15" E

COURSE FROM PT 22+91.27 TO PC 23+41.37 S 71° 38' 58" E DIST 50.10

CURVE DATA

P.I. STATION 23+45.12 N 639,770.31 E 1,594,968.99
DELTA = 6° 08' 10" (RT)
DEGREE = 81° 51' 04"
TANGENT = 3.75
LENGTH = 7.50
RADIUS = 70.00
LONG CHORD = 7.49
P.C. STATION 23+41.37 N 639,771.50 E 1,594,965.43
P.T. STATION 23+48.86 N 639,768.76 E 1,594,972.41
BACK = S 71° 38' 58" E
AHEAD = S 65° 30' 48" E
CHORD BEAR = S 68° 34' 53" E

COURSE FROM PT 23+48.86 TO PC 24+10.58 S 65° 30' 48" E DIST 61.72

CURVE DATA

P.I. STATION 24+27.48 N 639,736.17 E 1,595,043.95
DELTA = 27° 08' 45" (RT)
DEGREE = 81° 51' 04"
TANGENT = 16.90
LENGTH = 33.16
RADIUS = 70.00
LONG CHORD = 32.86
P.C. STATION 24+10.58 N 639,743.18 E 1,595,028.57
P.T. STATION 24+43.75 N 639,722.92 E 1,595,054.44
BACK = S 65° 30' 48" E
AHEAD = S 38° 22' 03" E
CHORD BEAR = S 51° 56' 25" E

COURSE FROM PT 24+43.75 TO PC 24+46.42 S 38° 22' 03" E DIST 2.68

CURVE DATA

P.I. STATION 24+66.87 N 639,704.79 E 1,595,068.80
DELTA = 44° 28' 59" (RT)
DEGREE = 114° 35' 30"
TANGENT = 20.45
LENGTH = 38.82
RADIUS = 50.00
LONG CHORD = 37.85
P.C. STATION 24+46.42 N 639,720.82 E 1,595,056.10
P.T. STATION 24+85.24 N 639,684.46 E 1,595,066.62
BACK = S 38° 22' 03" E
AHEAD = S 6° 06' 56" W
CHORD BEAR = S 16° 07' 34" E

COURSE FROM PT 24+85.24 TO PC 25+04.12 S 6° 06' 56" W DIST 18.88

CURVE DATA

P.I. STATION 24+11.70 N 639,658.16 E 1,595,063.80
DELTA = 17° 14' 43" (RT)
DEGREE = 114° 35' 30"
TANGENT = 7.58
LENGTH = 15.05
RADIUS = 50.00
LONG CHORD = 14.99
P.C. STATION 25+04.12 N 639,665.69 E 1,595,064.61
P.T. STATION 25+19.17 N 639,651.20 E 1,595,060.79
BACK = S 6° 06' 56" W
AHEAD = S 23° 21' 39" W
CHORD BEAR = S 14° 44' 18" W

COURSE FROM PT 25+19.17 TO POT 25+66.91 S 23° 21' 39" W DIST 47.74

POT STATION 25+66.91 N 639,607.37 E 1,595,041.86

==========
END ALIGNMENT "UPSTREAM MAINSTEM RESTORATION" DESCRIPTION

ALIGNMENT "DOWNSTREAM MAINSTEM RESTORATION" DESCRIPTION
==========
POT STATION 48+10.40 N 637,778.64 E 1,593,907.14

COURSE POT 48+10.40 TO PC 48+61.78 S 12° 12' 41" E DIST 51.38

CURVE DATA

P.I. STATION 48+69.91 N 637,720.48 E 1,593,919.73
DELTA = 9° 17' 24" (LT)
DEGREE = 57° 17' 45"
TANGENT = 8.12
LENGTH = 16.21
RADIUS = 100.00
LONG CHORD = 16.20
P.C. STATION 48+61.78 N 637,728.42 E 1,593,918.01
P.T. STATION 48+77.99 N 637,712.92 E 1,593,922.70
BACK = S 12° 12' 41" E
AHEAD = S 21° 30' 05" E
CHORD BEAR = S 16° 51' 23" E

COURSE FROM PT 48+77.99 TO PC 49+19.17 S 21° 30' 05" E DIST 41.17

CURVE DATA

P.I. STATION 49+25.71 N 637,668.52 E 1,593,940.19
DELTA = 14° 55' 10" (RT)
DEGREE = 114° 35' 30"
TANGENT = 6.55
LENGTH = 13.02
RADIUS = 50.00
LONG CHORD = 12.98
P.C. STATION 49+19.17 N 637,674.62 E 1,593,937.79
P.T. STATION 49+32.19 N 637,662.02 E 1,593,940.94
BACK = S 21° 30' 05" E
AHEAD = S 6° 34' 55" E
CHORD BEAR = S 14° 02' 30" E

COURSE FROM PT 49+32.19 TO PC 49+74.96 S 6° 34' 55" E DIST 42.77

CURVE DATA

P.I. STATION 49+78.89 N 637,615.63 E 1,593,946.30
DELTA = 4° 29' 58" (RT)
DEGREE = 57° 17' 45"
TANGENT = 3.93
LENGTH = 7.85
RADIUS = 100.00
LONG CHORD = 7.85
P.C. STATION 49+74.96 N 637,619.53 E 1,593,945.85
P.T. STATION 49+82.81 N 637,611.70 E 1,593,946.44
BACK = S 6° 34' 55" E
AHEAD = S 2° 04' 57" E
CHORD BEAR = S 4° 19' 56" E

COURSE FROM PT 49+82.81 TO PC 50+06.56 S 2° 04' 57" E DIST 23.75

CURVE DATA

P.I. STATION 50+12.07 N 637,582.46 E 1,593,947.50
DELTA = 6° 18' 17" (RT)
DEGREE = 57° 17' 45"
TANGENT = 5.51
LENGTH = 11.00
RADIUS = 100.00
LONG CHORD = 11.00
P.C. STATION 50+06.56 N 637,587.97 E 1,593,947.30
P.T. STATION 50+17.57 N 637,576.97 E 1,593,947.10
BACK = S 2° 04' 57" E
AHEAD = S 4° 13' 20" W
CHORD BEAR = S 1° 04' 11" W

COURSE FROM PT 50+17.57 TO POT 50+76.91 S 4° 13' 20" W DIST 59.34

POT STATION 50+76.91 N 637,517.79 E 1,593,942.73

==========
END ALIGNMENT "DOWNSTREAM MAINSTEM RESTORATION" DESCRIPTION

NO.	REVISIONS	DRN	CHK	DATE

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

ALIGNMENT DATA

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	53 OF 54
DRAWING NO.	AD1
DRAWN BY	JAD

ALIGNMENT "UT 7" DESCRIPTION
==========

POT STATION 10+00.00 N 634,983.44 E 1,591,252.65

COURSE FROM POT 10+00.00 TO PC 10+15.32 S 17° 30' 03" E DIST 15.32

CURVE DATA

P.I. STATION 10+25.31 N 634,959.31 E 1,591,260.26
DELTA = 22° 35' 15" (LT)
DEGREE = 114° 35' 30"
TANGENT = 9.99
LENGTH = 19.71
RADIUS = 50.00
LONG CHORD = 19.58
P.C. STATION 10+15.32 N 634,968.83 E 1,591,257.25
P.T. STATION 10+35.03 N 634,951.67 E 1,591,266.69
BACK = S 17° 30' 03" E
AHEAD = S 40° 05' 18" E
CHORD BEAR = S 28° 47' 40" E

COURSE FROM PT 10+35.03 TO PC 10+44.92 S 40° 05' 18" E DIST 9.88

CURVE DATA

P.I. STATION 10+56.17 N 634,935.50 E 1,591,280.30
DELTA = 25° 22' 23" (RT)
DEGREE = 114° 35' 30"
TANGENT = 11.26
LENGTH = 22.14
RADIUS = 50.00
LONG CHORD = 21.96
P.C. STATION 10+44.92 N 634,944.11 E 1,591,273.05
P.T. STATION 10+67.06 N 634,924.61 E 1,591,283.16
BACK = S 40° 05' 18" E
AHEAD = S 14° 42' 54" E
CHORD BEAR = S 27° 24' 06" E

COURSE FROM PT 10+67.06 TO PC 10+82.54 S 14° 42' 54" E DIST 15.48

CURVE DATA

P.I. STATION 10+90.87 N 634,901.58 E 1,591,289.21
DELTA = 18° 54' 56" (RT)
DEGREE = 114° 35' 30"
TANGENT = 8.33
LENGTH = 16.51
RADIUS = 50.00
LONG CHORD = 16.43
P.C. STATION 10+82.54 N 634,909.63 E 1,591,287.09
P.T. STATION 10+99.05 N 634,893.27 E 1,591,288.60
BACK = S 14° 42' 54" E
AHEAD = S 4° 12' 02" W
CHORD BEAR = S 5° 15' 26" E

COURSE FROM PT 10+99.05 TO PC 11+14.51-4 S 4° 12' 02" W DIST 15.46

CURVE DATA

P.I. STATION 11+22.77 N 634,869.61 E 1,591,286.86
DELTA = 18° 45' 16" (RT)
DEGREE = 114° 35' 30"
TANGENT = 8.26
LENGTH = 16.37
RADIUS = 50.00
LONG CHORD = 16.29
P.C. STATION 11+14.51 N 634,877.85 E 1,591,287.46
P.T. STATION 11+30.88 N 634,862.01 E 1,591,283.64
BACK = S 4° 12' 02" W
AHEAD = S 22° 57' 18" W
CHORD BEAR = S 13° 34' 40" W

COURSE FROM PT 11+30.88 TO PC 11+64.53 S 22° 57' 18" W DIST 33.65

CURVE DATA

P.I. STATION 11+67.15 N 634,828.62 E 1,591,269.49
DELTA = 50° 52' 50" (RT)
DEGREE = 1041° 44' 37"
TANGENT = 2.62
LENGTH = 4.88
RADIUS = 5.50
LONG CHORD = 4.73
P.C. STATION 11+64.53 N 634,831.03 E 1,591,270.51
P.T. STATION 11+69.41 N 634,827.89 E 1,591,266.98
BACK = S 22° 57' 18" W
AHEAD = S 73° 50' 08" W
CHORD BEAR = S 48° 23' 43" W

COURSE FROM PT 11+69.41 TO PC 11+72.76 S 73° 50' 08" W DIST 3.34

CURVE DATA

P.I. STATION 11+84.17 N 634,823.78 E 1,591,252.81
DELTA = 38° 09' 47" (LT)
DEGREE = 173° 37' 26"
TANGENT = 11.42
LENGTH = 21.98
RADIUS = 33.00
LONG CHORD = 21.58
P.C. STATION 11+72.76 N 634,826.96 E 1,591,263.77
P.T. STATION 11+94.74 N 634,814.51 E 1,591,246.15
BACK = S 73° 50' 08" W
AHEAD = S 35° 40' 21" W
CHORD BEAR = S 54° 45' 14" W

COURSE FROM PT 11+94.74 TO PC 13+42.30 S 35° 40' 21" W DIST 147.56

CURVE DATA

P.I. STATION 14+04.53 N 634,644.08 E 1,591,123.81
DELTA = 52° 55' 48" (LT)
DEGREE = 45° 50' 12"
TANGENT = 62.23
LENGTH = 115.47
RADIUS = 125.00
LONG CHORD = 111.41
P.C. STATION 13+42.30 N 634,694.63 E 1,591,160.10
P.T. STATION 14+57.78 N 634,584.65 E 1,591,142.27
BACK = S 35° 40' 21" W
AHEAD = S 17° 15' 27" E
CHORD BEAR = S 9° 12' 27" W

CURVE DATA

CURVE UT7-8
P.I. STATION 16+00.28 N 634,448.5658 E 1,591,184.5466
DELTA = 23° 27' 28" (LT)
DEGREE = 8° 20' 51"
TANGENT = 142.50
LENGTH = 281.01
RADIUS = 686.37
LONG CHORD = 279.05
P.C. STATION 14+57.78 N 634,584.6528 E 1,591,142.2708
P.T. STATION 17+38.79 N 634,340.5548 E 1,591,277.5011
BACK = S 17° 15' 27" E
AHEAD = S 40° 42' 55" E
CHORD BEAR = S 28° 59' 11" E

CURVE DATA

CURVE UT7-9
P.I. STATION 17+81.25 N 634,308.3672 E 1,591,305.2019
DELTA = 23° 58' 31" (LT)
DEGREE = 28° 38' 52"
TANGENT = 42.47
LENGTH = 83.69
RADIUS = 200.00
LONG CHORD = 83.08
P.C. STATION 17+38.79 N 634,340.5548 E 1,591,277.5011
P.T. STATION 18+22.48 N 634,290.2127 E 1,591,343.5918
BACK = S 40° 42' 55" E
AHEAD = S 64° 41' 26" E
CHORD BEAR = S 52° 42' 10" E

CURVE DATA

CURVE UT7-10
P.I. STATION 19+72.19 N 634,226.2100 E 1,591,478.9330
DELTA = 89° 53' 23" (RT)
DEGREE = 38° 11' 50"
TANGENT = 149.71
LENGTH = 235.33
RADIUS = 150.00
LONG CHORD = 211.93
P.C. STATION 18+22.48 N 634,290.2127 E 1,591,343.5918
P.T. STATION 20+57.81 N 634,090.7459 E 1,591,415.1908
BACK = S 64° 41' 26" E
AHEAD = S 25° 11' 57" W
CHORD BEAR = S 19° 44' 45" E

CURVE DATA

CURVE UT7-11
P.I. STATION 21+64.12 N 633,994.5516 E 1,591,369.9269
DELTA = 23° 29' 20" (RT)
DEGREE = 11° 12' 16"
TANGENT = 106.31
LENGTH = 209.64
RADIUS = 511.36
LONG CHORD = 208.17
P.C. STATION 20+57.81 N 634,090.7459 E 1,591,415.1908
P.T. STATION 22+67.44 N 633,924.3691 E 1,591,290.0735
BACK = S 25° 11' 57" W
AHEAD = S 48° 41' 17" W
CHORD BEAR = S 36° 56' 37" W

CURVE DATA

CURVE UT7-12
P.I. STATION 23+21.89 N 633,888.4259 E 1,591,249.18
DELTA = 28° 31' 43" (LT)
DEGREE = 26° 45' 14"
TANGENT = 54.45
LENGTH = 106.63
RADIUS = 214.16
LONG CHORD = 105.54
P.C. STATION 22+67.44 N 633,924.3691 E 1,591,290.0735
P.T. STATION 23+74.08 N 633,837.3150 E 1,591,230.4133
BACK = S 48° 41' 17" W
AHEAD = S 20° 09' 34" W
CHORD BEAR = S 34° 25' 25" W

==========
END ALIGNMENT "UT 7" DESCRIPTION

ALIGNMENT "UT 8 TO UT 7" DESCRIPTION
==========
POT STATION 10+00.00 N 634,353.20 E 1,591,181.68

COURSE FROM POT 10+00.00 TO PC 10+19.65 S 74° 48' 51" E DIST 19.65

CURVE DATA

P.I. STATION 10+37.64 N 634,343.34 E 1,591,218.00
DELTA = 23° 54' 00" (LT)
DEGREE = 67° 24' 25"
TANGENT = 17.99
LENGTH = 35.46
RADIUS = 85.00
LONG CHORD = 35.20
P.C. STATION 10+19.65 N 634,348.05 E 1,591,200.64
P.T. STATION 10+55.11 N 634,346.06 E 1,591,235.78
BACK = S 74° 48' 51" E
AHEAD = N 81° 17' 09" E
CHORD BEAR = S 86° 45' 51" E

COURSE FROM PT 10+55.11 TO PC 10+79.87 N 81° 17' 09.49" E DIST 24.76

CURVE DATA

CURVE UT8-REV-2
P.I. STATION 10+88.26 N 634,351.0862 E 1,591,268.5536
DELTA = 58° 27' 06.09" (RT)
DEGREE = 381° 58' 18.71"
TANGENT = 8.39
LENGTH = 15.30
RADIUS = 15.00
LONG CHORD = 14.65
P.C. STATION 10+79.87 N 634,349.8148 E 1,591,260.2584
P.T. STATION 10+95.17 N 634,344.6823 E 1,591,273.9773
BACK = N 81° 17' 09" E
AHEAD = S 40° 15' 44" E
CHORD BEAR = S 69° 29' 17" E

CURVE DATA

CURVE UT8-REV-3
P.I. STATION 10+97.88 N 634,342.6116 E 1,591,275.7311
DELTA = 0° 27' 11" (LT)
DEGREE = 8° 20' 51"
TANGENT = 2.71
LENGTH = 5.42
RADIUS = 686.37
LONG CHORD = 5.42
P.C. STATION 10+95.17 N 634,344.6823 E 1,591,273.9773
P.T. STATION 11+00.60 N 634,340.5548 E 1,591,277.5011

BACK = S 40° 15' 44" E
AHEAD = S 40° 42' 55" E
CHORD BEAR = S 40° 29' 20" E
==========
END ALIGNMENT "UT 8 TO UT 7" DESCRIPTION

NO.	REVISIONS	DRN	CHK	DATE

Ecosystem Enhancement Program

THE LOUIS BERGER GROUP, Inc.
1001 Wade Avenue
Raleigh, North Carolina 27605

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
ECOSYSTEM ENHANCEMENT PROGRAM

ALIGNMENT DATA

DATE	MARCH 2013
PROJECT NO.	94147
FILENAME	
SHEET NO.	54 OF 54
DRAWING NO.	AD2
DRAWN BY	JAD

Appendices

APPENDIX 1

PROJECT SITE PHOTOGRAPHS

Photo 1: Reach 1 -View looking upstream from a portion of Reference Reach. (6/18/2008)

Photo 2: Reach 1 near proposed restoration reach. View looking downstream. (6/18/2008)

Photo 3: Reach 1 near end of restoration reach at 90^{o} turn (right to left, then into the page). (3/29/2010)

Photo 4: Reach 2 downstream of Bridge, upstream of UT 2. View looking downstream. (6/18/2008)

Photo 5: Reach 3 – restored channel to be to the right. View looking downstream. (6/18/2008)

Photo 6: Reach 3 – E-2. View looking downstream. (6/18/2008)

Photo 7: Reach 4. View looking downstream. (6/18/2008)

Photo 8: Reach 4. Concrete on rt. bank to be removed and dimension, pattern, & profile restored. (8/30/2010)

Photo 9: Reach 5. View looking upstream at multi-thread channel. (7/17/2008)

Photo 10: Reach 6. Preservation Reach. (7/31/2008)

Photo 11: UT 1. View looking upstream from confluence with mainstem. (12/9/2009)

Photo 12: UT 2. View looking upstream. E-2 in pasture, Preservation from trees up to pond. (6/18/2008)

Photo 13: UT 3. View looking upstream at E-1 area. (7/27/2010)

Photo 14: UT 3. View looking upstream at E-2 area. (12/9/2009)

Photo 15: UT 4. View looking downstream at E-1 area, backpack shown for scale. (8/30/2010)

Photo 16: UT 4. View looking upstream at E-2 area. (8/30/2010)

Photo 17: UT 5. View looking upstream. (7/31/2008)

Photo 18: UT 6. View looking upstream. (7/31/2008)

Photo 19: UT 7. View looking upstream at upper limit – culverts under Old Mine Rd. (3/29/2010)

Photo 20: UT 7. View looking downstream. (3/29/2010)

APPENDIX 2

PROJECT SITE USACE ROUTINE WETLAND DELINEATION DATA FORMS

(N/A – No Wetlands are associated with this project)

APPENDIX 3

PROJECT SITE NCDWQ STREAM CLASSIFICATION FORMS

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 6/18/08	**Project:** LBC	**Latitude:**
Evaluator: JMO	**Site:** RT TRIB N of LARRY H → UT2	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 36.5	**County:** CABARRUS	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 24.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	(3)
4. Soil texture or stream substrate sorting	0	1	(2)	(3)
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	(0)	(1)	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	0	1	(2)	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		(Yes = 3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 4)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Sketch:

Notes: (use back side of this form for additional notes.)

Flow even in Drought Conditions

channel from UB

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 7/31/08	Project: LBC	Latitude:
Evaluator: RB + TS	Site: TB ⇒ UT6	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 24.75	County: CABARRUS	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 9.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 6.75)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	1	(1.5)
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	0	1	(2)	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; (FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Fish - gambozia

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 7/31/08	**Project:** LBC	**Latitude:**
Evaluator: RB + TS	**Site:** Channel from WA→UT 5	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 27.5	**County:** CABARRUS	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 5.5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	1	(0)
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	0	1	(2)	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; (OBL = 1.5)		SAV = 2.0; Other = 0	

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

'Perennial 'Trib

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 7/31/08	**Project:** L B C		**Latitude:**
Evaluator: RB + TS	**Site:** TF → UT4		**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 36.5	**County:** CABARRUS		**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 19.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	0	(0.5)	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0) ?		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 7.5)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	(1)	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Sketch:

Notes: (use back side of this form for additional notes.)

Mayflies
Water penny
Caddisfly casings

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 7/31/08	**Project:** LBC	**Latitude:**
Evaluator: RB + TS	**Site:** TE → UT 3	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 26.5	**County:** CABARRUS	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 6)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	(FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Intermittent Blue Line on USGS Topo MAP

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 6/18/08	**Project:** LBC	**Latitude:**
Evaluator: MD	**Site:** FROM WSW POND ON LOFT → UT 2	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 20	**County:** CABARRUS	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 11.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	3
2. Sinuosity	0	1	2	3
3. In-channel structure: riffle-pool sequence	0	1	2	3
4. Soil texture or stream substrate sorting	0	1	2	3
5. Active/relic floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Braided channel	0	1	2	3
8. Recent alluvial deposits	0	1	2	3
9[a] Natural levees	0	1	2	3
10. Headcuts	0	1	2	3
11. Grade controls	0	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0 (POND → 1st Order)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 4)				
14. Groundwater flow/discharge	0	1	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3
16. Leaflitter	1.5	1	0.5	0
17. Sediment on plants or debris	0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 4.5)				
20[b]. Fibrous roots in channel	3	2	1	0
21[b]. Rooted plants in channel	3	2	1	0
22. Crayfish	0	0.5	1	1.5
23. Bivalves	0	1	2	3
24. Fish	0	0.5	1	1.5
25. Amphibians FROG	0	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5
27. Filamentous algae; periphyton	0	1	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

DROUGHT CONDITIONS

USGS TOPO MAP SHOWS INT → PERENNIAL → POND WITH INTERMITTENT FLOWING POND UNTIL CONFLUENCE W/ LBC.

SOMETIMES MOWED BY FARMER

TODAY LOOKED AS THOUGH UNTOUCHED BY SURROUNDING - SEVERAL WEEKS AGO.

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 6/18/08	**Project:** LBC	**Latitude:**
Evaluator: MO	**Site:** left TRIB u/s OLD MINE → UT 1	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 21.0	**County:** CABARRUS	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0) PSR/INT.		(Yes = 3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 4)				
14. Groundwater flow/discharge	0	(1)	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	(1)	2	3
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 6)				
20[b]. Fibrous roots in channel	(3)	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Sketch:

Notes: (use back side of this form for additional notes.)

USGS TOPO MAP SHOWS Perennial Stream that becomes intermittent AS IT APPROACHES CENTER FLOODPLAIN of Little Buffalo Creek

FARMER HAS ALLOWED VEG TO GROW UNIMPEDED + SOME TREES MATURING AREA DROUGHT CONDITIONS.

APPENDIX 4

REFERENCE SITE PHOTOGRAPHS

Photo 20: Upstream of project area. View looking upstream after a large rain event. (3/31/2010)

Photo 21: Upper limits of project area. View looking upstream. (3/31/2010)

Photo 22: Middle of reference reach. View looking downstream. (3/31/2010)

Photo 23: Middle of Reference Reach. View looking upstream. (4/13/2010)

Photo 24: Downstream portion of Reference reach. View looking upstream. (4/13/2010)

Photo 25: Downstream portion of Reference reach. View looking upstream at curve. (4/13/2010)

APPENDIX 5

REFERENCE SITE USACE ROUTINE WETLAND DETERMINATION DATA FORMS

(N/A – A reference site was not necessary for this project)

APPENDIX 6

REFERENCE SITE NCDWQ STREAM CLASSIFICATION FORMS

(Little Buffalo Creek is a named, blue line stream on the USGS topographic quadrangle. The stream is perennial; therefore; a stream classification form was not completed.)

APPENDIX 7

HYDROLOGIC GAUGE DATA SUMMARY, GROUNDWATER AND RAINFALL INFORMATION

Appendix 7 Table 1: Hydrologic Gauge Data Summary – Annual Peak Flows

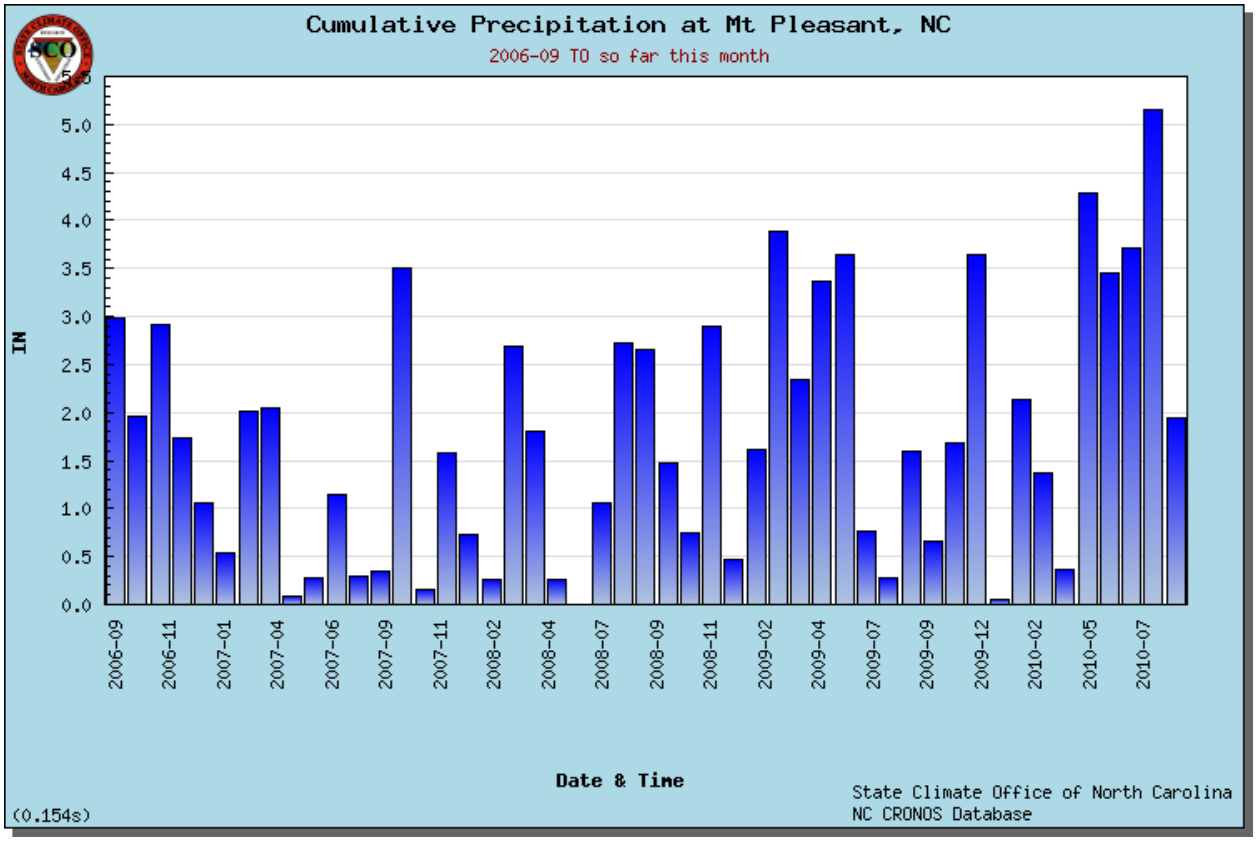
USGS 02125000 BIG BEAR CR NR RICHFIELD, NC

1955-2007

Date	**Cubic Feet per Second (CFS)**	**Date**	**Cubic Feet per Second (CFS)**
2/6/1955	4880	12/31/1981	3720
3/16/1956	4200	3/6/1983	2850
6/8/1957	7460	7/15/1984	9700
4/6/1958	4880	8/17/1985	2740
7/9/1959	9700	11/21/1985	4370
2/18/1960	4550	2/28/1987	3990
2/21/1961	4140	3/10/1988	1610
4/11/1962	5400	3/24/1989	4150
3/6/1963	3020	10/1/1989	8030
8/11/1964	4850	10/11/1990	10100
10/16/1964	8270	6/16/1992	3290
3/4/1966	5610	4/6/1993	4700
8/22/1967	11100	3/2/1994	3410
3/12/1968	3440	9/11/1995	6600
8/16/1969	3620	10/4/1995	4900
4/1/1970	1960	7/23/1997	11400
3/3/1971	4880	2/17/1998	4820
10/16/1971	4040	1/24/1999	2030

7/24/1973	6590	10/11/1999	7520
4/5/1974	1730	8/18/2001	3360
5/18/1975	6110	1/23/2002	3840
12/31/1975	1520	3/20/2003	7670
3/30/1977	5830	9/28/2004	9640
10/26/1977	8410	3/28/2005	2810
3/24/1979	6690	12/15/2005	3010
3/21/1980	3440	3/2/2007	5580
8/12/1981	7770		

Source: USGS 2010. USGS Water Resources. National Water Information System: Web Interface. Peak Streamflow for the Nation. USGS 02125000 BIG BEAR CR NR RICHFIELD, NC. Available URL: http://nwis.waterdata.usgs.gov/nwis/peak?site_no=02125000&agency_cd=USGS&format=html



Source: North Carolina State Climate Office. NC CRONOS Database – Monthly Sum of Daily Percipitation. Mount Pleasant, Cabarrus County, North Carolina. Station # 315945.
Available URL: http://www.nc-climate.ncsu.edu/cronos/

APPENDIX 8

HEC-RAS Analysis

APPENDIX A: NOAA 24-Hour Precipitation Depths

NOAA 24-HOUR PRECIPITATION DEPTHS FOR GEOMETRIC CENTROID OF

LITTLE BUFFALO CREEK WATERSHED

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

North Carolina 35.5050 N 80.3662 W 800 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2004
Extracted: Wed Mar 10 2010

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.40	0.63	0.79	1.08	1.35	1.57	1.67	2.03	2.41	2.87	3.36	3.78	4.33	4.96	6.65	8.18	10.31	12.32
2	0.47	0.75	0.94	1.30	1.63	1.90	2.02	2.44	2.91	3.47	4.04	4.53	5.17	5.89	7.85	9.62	12.08	14.37
5	0.55	0.87	1.10	1.57	2.01	2.35	2.52	3.05	3.65	4.35	5.03	5.58	6.29	7.08	9.26	11.18	13.81	16.22
10	0.60	0.96	1.21	1.75	2.28	2.69	2.90	3.52	4.23	5.04	5.81	6.41	7.19	8.02	10.38	12.39	15.14	17.66
25	0.66	1.05	1.33	1.97	2.62	3.13	3.40	4.15	5.03	5.98	6.86	7.55	8.41	9.27	11.89	13.98	16.87	19.51
50	0.70	1.11	1.40	2.12	2.87	3.45	3.78	4.64	5.67	6.73	7.69	8.45	9.38	10.26	13.07	15.21	18.18	20.91
100	0.73	1.16	1.47	2.25	3.10	3.77	4.16	5.13	6.32	7.50	8.54	9.37	10.38	11.26	14.27	16.42	19.45	22.24
200	0.76	1.21	1.52	2.37	3.32	4.08	4.55	5.63	7.00	8.29	9.41	10.32	11.40	12.27	15.48	17.64	20.71	23.55
500	0.79	1.25	1.57	2.50	3.59	4.47	5.05	6.32	7.93	9.36	10.60	11.63	12.80	13.65	17.12	19.26	22.36	25.24
1000	0.81	1.28	1.60	2.59	3.79	4.76	5.44	6.84	8.67	10.22	11.54	12.65	13.91	14.73	18.39	20.50	23.59	26.51

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

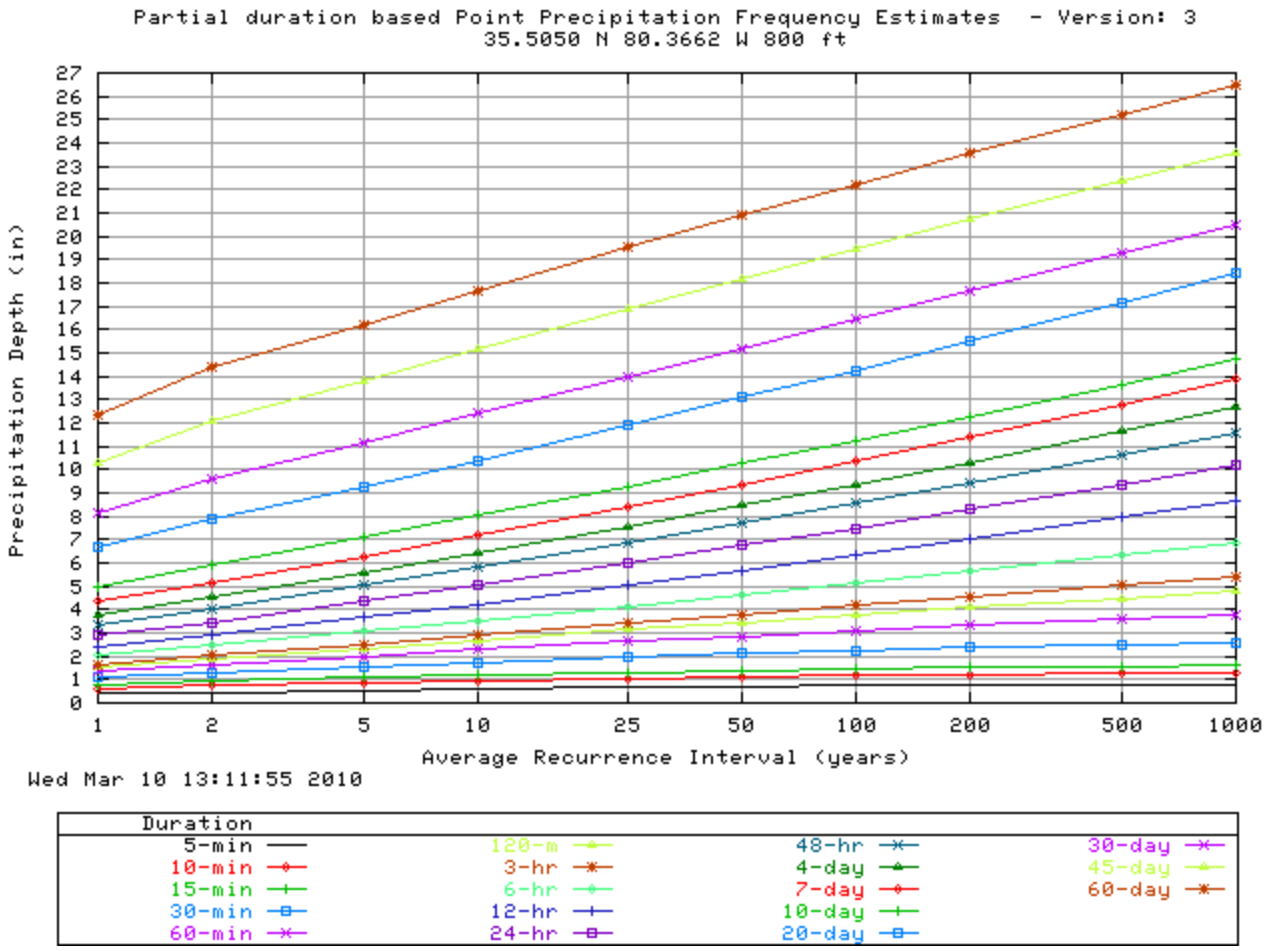
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.43	0.69	0.86	1.18	1.47	1.71	1.83	2.22	2.63	3.10	3.61	4.04	4.62	5.26	7.00	8.59	10.78	12.84
2	0.51	0.81	1.02	1.42	1.77	2.07	2.21	2.68	3.19	3.74	4.35	4.85	5.51	6.25	8.26	10.10	12.61	14.95
5	0.59	0.95	1.20	1.71	2.19	2.57	2.75	3.33	3.99	4.69	5.41	5.97	6.70	7.51	9.74	11.73	14.40	16.89
10	0.65	1.04	1.31	1.90	2.48	2.94	3.15	3.84	4.62	5.43	6.24	6.86	7.65	8.50	10.92	13.00	15.78	18.38
25	0.71	1.14	1.44	2.13	2.84	3.41	3.69	4.51	5.46	6.45	7.36	8.08	8.95	9.82	12.51	14.67	17.59	20.31
50	0.76	1.20	1.52	2.29	3.11	3.76	4.11	5.04	6.14	7.25	8.26	9.05	9.99	10.88	13.76	15.97	18.98	21.78
100	0.79	1.26	1.59	2.44	3.36	4.11	4.51	5.57	6.84	8.07	9.17	10.05	11.05	11.95	15.03	17.26	20.32	23.19
200	0.82	1.31	1.65	2.57	3.60	4.44	4.93	6.11	7.56	8.93	10.12	11.07	12.16	13.03	16.33	18.56	21.66	24.58
500	0.86	1.36	1.71	2.72	3.90	4.87	5.49	6.85	8.55	10.11	11.43	12.50	13.69	14.52	18.09	20.30	23.41	26.39
1000	0.88	1.39	1.74	2.82	4.12	5.19	5.91	7.42	9.36	11.04	12.46	13.62	14.90	15.69	19.47	21.65	24.74	27.76

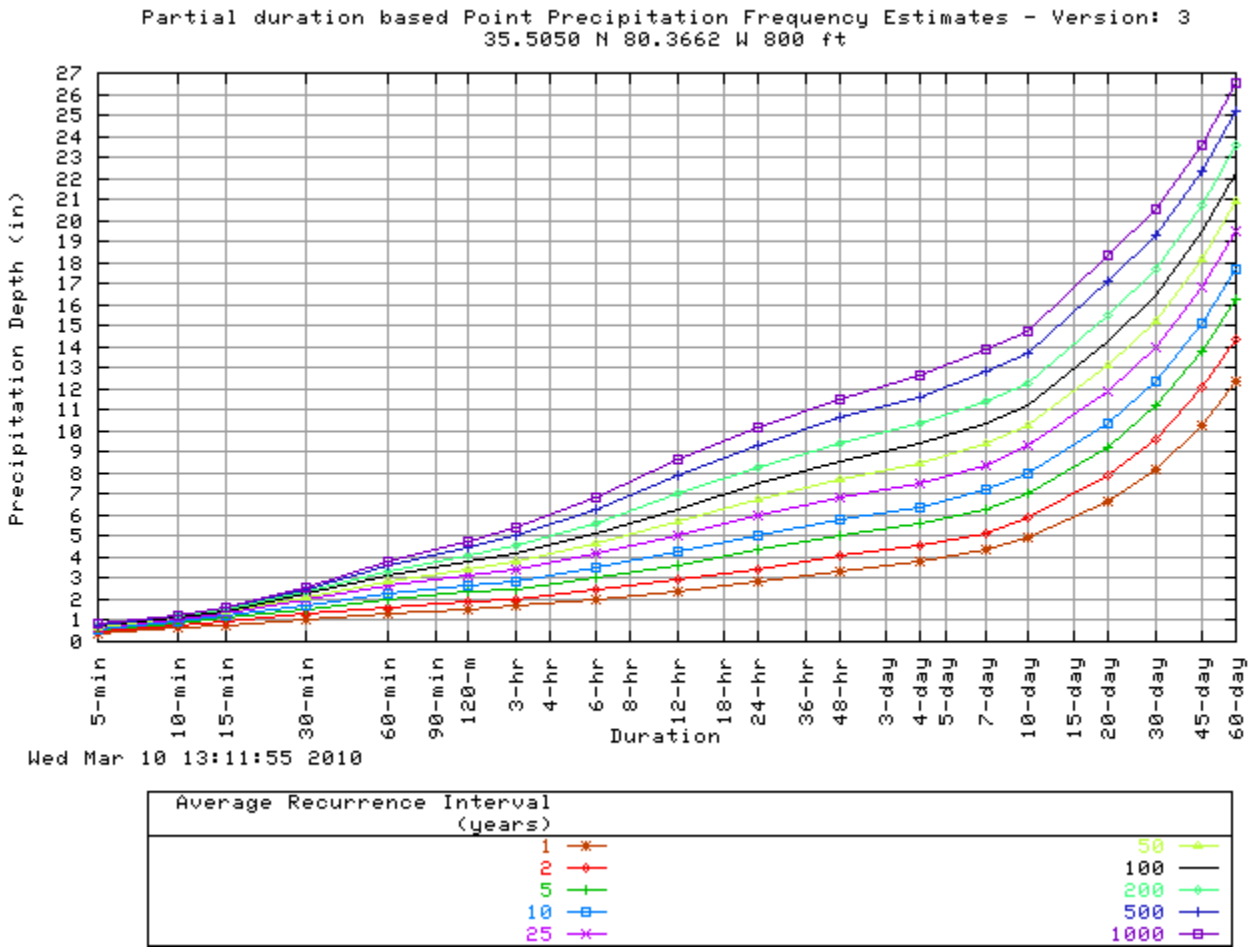
* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.36	0.58	0.73	1.00	1.25	1.44	1.53	1.86	2.22	2.67	3.12	3.52	4.07	4.68	6.31	7.79	9.88	11.84
2	0.43	0.69	0.87	1.20	1.50	1.74	1.85	2.24	2.67	3.23	3.77	4.23	4.86	5.56	7.44	9.15	11.55	13.79
5	0.50	0.80	1.01	1.44	1.85	2.15	2.31	2.79	3.35	4.04	4.68	5.21	5.91	6.67	8.78	10.63	13.19	15.57
10	0.55	0.88	1.11	1.61	2.09	2.46	2.64	3.21	3.87	4.68	5.39	5.97	6.73	7.55	9.83	11.77	14.45	16.94
25	0.60	0.96	1.21	1.80	2.39	2.84	3.08	3.76	4.55	5.53	6.35	7.00	7.85	8.70	11.23	13.26	16.07	18.69
50	0.63	1.01	1.28	1.92	2.60	3.12	3.41	4.17	5.09	6.21	7.11	7.82	8.74	9.61	12.32	14.40	17.29	20.00
100	0.66	1.05	1.33	2.04	2.80	3.38	3.73	4.59	5.63	6.90	7.87	8.64	9.63	10.52	13.41	15.52	18.46	21.25
200	0.69	1.08	1.37	2.13	2.99	3.63	4.05	4.99	6.17	7.60	8.65	9.49	10.55	11.44	14.50	16.63	19.61	22.45
500	0.71	1.12	1.41	2.24	3.21	3.94	4.44	5.52	6.88	8.54	9.69	10.64	11.79	12.67	15.97	18.09	21.09	24.00
1000	0.72	1.13	1.42	2.30	3.36	4.16	4.74	5.90	7.41	9.29	10.51	11.53	12.76	13.62	17.10	19.20	22.20	25.16

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates - Version: 3
35.5050 N 80.3662 W 800 ft
Precipitation Depth (in)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
1
2
5
10
25
50
100
200
500
1000
Average Recurrence Interval (years)
Wed Mar 10 13:11:55 2010
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
45-day
60-day



Maps -

These maps were produced using a direct map request from the
U.S. Census Bureau Mapping and Cartographic Resources
Tiger Map Server.

Please read disclaimer for more information.

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera
tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

*Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to NOAA Atlas 14 Document.*

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within: +/-30 minutes ...OR... +/-1 degree of this location (35.5050/-80.3662). Digital ASCII data can be obtained directly from **NCDC**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B: Weighted Runoff Curve Number Calculations

CURVE NUMBER INDEX

SOURCE: NRCS Runoff Curve Numbers Table 2-2a, 2-2b and 2-2c, TR-55

SCS CURVE NUMBER METHOD

LU Index	Land Cover Description	NRCS Curve Number Table Equivalent	LU Symbol	Hydrologic Soil Group (HSG)			
				A	B	C	D
1	Cultivated	Row Crops-Straight Row (SR)-Good Condition	SR-G	67	78	85	89
2	Deciduous Shrubland	Brush-brush weed grass mixture with brush the major element-Fair Condition	BR-F	35	56	70	77
3	Evergreen Shrubland	Brush-brush weed grass mixture with brush the major element-Good Condition	BR-G	30	48	65	73
4	High Intensity Developed	Residential Districts - 1 Acre (20% average impervious)	R1	51	68	79	84
5	Low Intensity Developed	Residential Districts - 2 Acre (12% average impervious)	R2	46	65	77	82
6	Managed Herbaceous Cover	Row Crops-Straight Row (SR)-Good Condition	SR-G	67	78	85	89
7	Mixed Hardwoods/Conifers	Woods-Good Condition	WO-G	30	55	70	77
8	Mixed Upland Hardwoods	Woods-Good Condition	WO-G	30	55	70	77
9	Southern Yellow Pine	Woods-Good Condition	WO-G	30	55	70	77
10	Unmanaged Herbaceous Upland	Farmsteads-building, lanes,driveways and surrounding lots	FA	59	74	82	86
11	Water Bodies	Impervious Areas	WATER	98	98	98	98

SOILS INDEX

Source: NRCS Web Soil Survey

Soil Symbol	Soil Description	HSG for SCS CN	HSG for Rational C
BaB	Badin channery silt loam, 2 to 8 percent slopes	B	
BaC	Badin channery silt loam, 8 to 15 percent slopes	B	
BaD	Badin channery silt loam, 8 to 15 percent slopes (CABARRUS); Badin channery silt loam, 15 to 30 percent slopes (ROWAN)	B	
BaF	Badin channery silt loam, 15 to 45 percent slopes	B	
CeB2	Cecil sandy clay loam, 2 to 8 percent slopes, moderately eroded	B	
ChA	Chewacla sandy loam, 0 to 2 percent slopes, frequently flooded (CABARRUS); Chewacla loam, 0 to 2 percent slopes, frequently flooded (ROWAN)	C	
CmB	Cid-Lignum complex, 1 to 6 percent slopes	C	
EnB	Enon sandy loam, 2 to 8 percent slopes (CABARRUS); Enon fine sandy loam, 2 to 8 percent slopes (ROWAN)	C	
EnC	Enon fine sandy loam, 8 to 15 percent slopes	C	
GeB2	Georgeville silty clay loam, 2 to 8 percent slopes, moderately eroded	B	
GoC	Goldston very channery silt loam, 4 to 15 percent slopes	C	
GoF	Goldston very channery silt loam, 15 to 45 percent slopes	C	
HeB	Herndon silt loam, 2 to 8 percent slopes (CABARRUS); Helena sandy loam, 1 to 6 percent slopes (ROWAN)	C	
KcB	Kirksey-Cid complex, 2 to 6 percent slopes	C	
KkB	Kirksey silt loam, 1 to 6 percent slopes	C	
LdB2	Lloyd clay loam, 2 to 8 percent slopes, moderately eroded	B	
MeB2	Mecklenburg clay loam, 2 to 8 percent slopes, moderately eroded	C	
OkA	Oakboro silt loam, 0 to 2 percent slopes, frequently flooded	C	
PaD	Pacolet sandy loam, 15 to 25 percent slopes	B	
PcE3	Pacolet-Udorthents complex, 12 to 25 percent slopes, gullied	B	
PxB	Poindexter-Rowan complex, 2 to 8 percent slopes	B	
SeB	Sedgefield fine sandy loam, 1 to 6 percent slopes	C	
TaB	Tarrus silt loam, 2 to 8 percent slopes (CABARRUS); Tarrus-Badin complex, 2 to 8 percent slopes (ROWAN)	B	
TaC	Tarrus-Badin complex, 8 to 15 percent slopes	B	
TaD	Tarrus silt loam, 8 to 15 percent slopes	B	
TbB2	Tarrus silty clay loam, 2 to 8 percent slopes, moderately eroded	B	
TbD2	Tarrus silty clay loam, 8 to 15 percent slopes, moderately eroded	B	
Ud	Udorthents, loamy	C	
UwB2	Uwharrie silty clay loam, 2 to 8 percent slopes, moderately eroded	B	
VaB	Vance sandy loam, 2 to 8 percent slopes	C	
VaC	Vance sandy loam, 8 to 15 percent slopes	C	
VnB2	Vance sandy clay loam, 2 to 8 percent slopes, moderately eroded	C	
VnC2	Vance sandy clay loam, 8 to 15 percent slopes, moderately eroded	C	
W	Water	D	
WtB	Wynott-Enon complex, 2 to 8 percent slopes	C	

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
84	SUB-1	BR-F	BaC	B	29921.8345	0.687		56	38.4670049	56
97	SUB-1	BR-F	BaC	B	4255.00148	0.098		56	5.47015801	56
101	SUB-1	BR-F	BaC	B	9842.59216	0.226		56	12.6534702	56
81	SUB-1	BR-F	CmB	C	17485.8932	0.401		70	28.099461	70
83	SUB-1	BR-F	CmB	C	13067.1532	0.300		70	20.9986392	70
82	SUB-1	BR-F	TbB2	B	44440.5156	1.020		56	57.1319759	56
87	SUB-1	BR-F	TbB2	B	8742.94191	0.201		56	11.2397784	56
95	SUB-1	BR-F	TbB2	B	43714.747	1.004		56	56.1989401	56
96	SUB-1	BR-F	TbB2	B	48202.7155	1.107		56	61.9685965	56
100	SUB-1	BR-F	TbB2	B	42615.1435	0.978		56	54.7853084	56
47	SUB-1	R1	TbB2	B	17109.6894	0.393		68	26.7093406	68
51	SUB-1	SR-G	BaC	B	247198.68	5.675		78	442.642264	78
44	SUB-1	SR-G	CeB2	B	60140.1378	1.381		78	107.688952	78
25	SUB-1	SR-G	CmB	C	513221.195	11.782		85	1001.46468	85
36	SUB-1	SR-G	CmB	C	85790.2905	1.969		85	167.405296	85
38	SUB-1	SR-G	CmB	C	303112.564	6.959		85	591.473094	85
50	SUB-1	SR-G	CmB	C	153368.91	3.521		85	299.273584	85
55	SUB-1	SR-G	CmB	C	43900.2706	1.008		85	85.6639807	85
57	SUB-1	SR-G	CmB	C	84282.0154	1.935		85	164.462151	85
30	SUB-1	SR-G	EnB	C	1146299.92	26.315		85	2236.81114	85
31	SUB-1	SR-G	EnC	C	372848.773	8.559		85	727.551554	85
27	SUB-1	SR-G	HeB	C	4496.77854	0.103		85	8.77470561	85
53	SUB-1	SR-G	LdB2	B	130718.366	3.001		78	234.0687	78
42	SUB-1	SR-G	OkA	C	66548.2149	1.528		85	129.857628	85
35	SUB-1	SR-G	TaB	B	3915.63805	0.090		78	7.01147309	78
33	SUB-1	SR-G	TaC	B	51823.8277	1.190		78	92.7974876	78
37	SUB-1	SR-G	TaC	B	366193.267	8.407		78	655.717971	78
48	SUB-1	SR-G	TaC	B	8152.72659	0.187		78	14.5985462	78
29	SUB-1	SR-G	TbB2	B	593776.166	13.631		78	1063.23556	78
32	SUB-1	SR-G	TbB2	B	91944.0322	2.111		78	164.638074	78
34	SUB-1	SR-G	TbB2	B	55714.8713	1.279		78	99.764921	78
39	SUB-1	SR-G	TbB2	B	373188.787	8.567		78	668.244385	78
46	SUB-1	SR-G	TbB2	B	152853.736	3.509		78	273.705038	78
49	SUB-1	SR-G	TbB2	B	2178689.88	50.016		78	3901.23532	78
54	SUB-1	SR-G	TbB2	B	20736.8871	0.476		78	37.132167	78
56	SUB-1	SR-G	TbB2	B	71100.4834	1.632		78	127.314915	78
52	SUB-1	SR-G	UwB2	B	237387.406	5.450		78	425.073868	78
45	SUB-1	SR-G	VaC	C	1123.32039	0.026		85	2.19197046	85
26	SUB-1	SR-G	VnB2	C	655727.518	15.053		85	1279.54176	85
41	SUB-1	SR-G	VnB2	C	711657.865	16.337		85	1388.68041	85
40	SUB-1	SR-G	VnC2	C	748446.575	17.182		85	1460.46738	85
43	SUB-1	SR-G	W	D	116908.653	2.684		89	238.862951	89
28	SUB-1	SR-G	WtB	C	232523.478	5.338		85	453.730386	85
85	SUB-1	WATER	BaC	B	36003.4029	0.827		98	80.9993913	98
86	SUB-1	WATER	W	D	33940.2072	0.779		98	76.3576746	98
19	SUB-1	WO-G	BaC	B	465766.346	10.693		55	588.08882	55
107	SUB-1	WO-G	BaC	B	150211.783	3.448		55	189.661343	55
21	SUB-1	WO-G	CeB2	B	22433.8757	0.515		55	28.3256006	55
0	SUB-1	WO-G	CmB	C	226215.265	5.193		70	363.523153	70
11	SUB-1	WO-G	CmB	C	17953.7791	0.412		70	28.8513438	70
17	SUB-1	WO-G	CmB	C	139754.4	3.208		70	224.58237	70
58	SUB-1	WO-G	CmB	C	8736.42084	0.201		70	14.0392438	70
62	SUB-1	WO-G	CmB	C	836160.347	19.196		70	1343.69202	70
74	SUB-1	WO-G	CmB	C	257569.639	5.913		70	413.908969	70
80	SUB-1	WO-G	CmB	C	26988.5045	0.620		70	43.3699568	70
5	SUB-1	WO-G	EnB	C	414584.166	9.518		70	666.227998	70
65	SUB-1	WO-G	EnB	C	8742.94191	0.201		70	14.049723	70
66	SUB-1	WO-G	EnB	C	71355.7073	1.638		70	114.667115	70
70	SUB-1	WO-G	EnB	C	8742.96061	0.201		70	14.0497531	70
6	SUB-1	WO-G	EnC	C	75463.9959	1.732		70	121.269048	70
67	SUB-1	WO-G	EnC	C	137.207843	0.003		70	0.22049011	70
2	SUB-1	WO-G	HeB	C	49374.9096	1.133		70	79.3444369	70
16	SUB-1	WO-G	OkA	C	848849.681	19.487		70	1364.08351	70
98	SUB-1	WO-G	OkA	C	7.4768979	0.000		70	0.01201522	70
106	SUB-1	WO-G	OkA	C	168934.285	3.878		70	271.473828	70
10	SUB-1	WO-G	TaB	B	148997.755	3.421		55	188.128478	55
8	SUB-1	WO-G	TaC	B	2900408.45	66.584		55	3662.13188	55
22	SUB-1	WO-G	TaC	B	68689.1737	1.577		55	86.7287546	55
61	SUB-1	WO-G	TaC	B	12603.2124	0.289		55	15.9131469	55
68	SUB-1	WO-G	TaC	B	395547.015	9.081		55	499.42805	55
71	SUB-1	WO-G	TaC	B	21903.3113	0.503		55	27.6556961	55
76	SUB-1	WO-G	TaC	B	17485.8932	0.401		55	22.078148	55
77	SUB-1	WO-G	TaC	B	86451.1214	1.985		55	109.155456	55
89	SUB-1	WO-G	TaC	B	8821.82826	0.203		55	11.138672	55
92	SUB-1	WO-G	TaC	B	126488.079	2.904		55	159.70717	55
102	SUB-1	WO-G	TaC	B	35677.3774	0.819		55	45.0471937	55
104	SUB-1	WO-G	TaC	B	1188.38692	0.027		55	1.50048853	55
4	SUB-1	WO-G	TbB2	B	25521.711	0.586		55	32.2243826	55
7	SUB-1	WO-G	TbB2	B	169166.015	3.884		55	213.593453	55
9	SUB-1	WO-G	TbB2	B	300407.435	6.896		55	379.302316	55
12	SUB-1	WO-G	TbB2	B	1186455.83	27.237		55	1498.05029	55
13	SUB-1	WO-G	TbB2	B	185221.47	4.252		55	233.865492	55
24	SUB-1	WO-G	TbB2	B	280509.564	6.440		55	354.178743	55
59	SUB-1	WO-G	TbB2	B	6.53042776	0.000		55	0.00824549	55
60	SUB-1	WO-G	TbB2	B	6143.53123	0.141		55	7.75698387	55

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
63	SUB-1	WO-G	TbB2	B	356814.981	8.191		55	450.523966	55
69	SUB-1	WO-G	TbB2	B	171195.512	3.930		55	216.155949	55
72	SUB-1	WO-G	TbB2	B	104958.75	2.410		55	132.523675	55
73	SUB-1	WO-G	TbB2	B	66035.029	1.516		55	83.3775619	55
78	SUB-1	WO-G	TbB2	B	97150.8458	2.230		55	122.665209	55
79	SUB-1	WO-G	TbB2	B	16726.2518	0.384		55	21.1190048	55
88	SUB-1	WO-G	TbB2	B	8742.95126	0.201		55	11.0390799	55
94	SUB-1	WO-G	TbB2	B	33703.1477	0.774		55	42.5544794	55
99	SUB-1	WO-G	TbB2	B	177.997336	0.004		55	0.22474411	55
103	SUB-1	WO-G	TbB2	B	97849.2698	2.246		55	123.547058	55
105	SUB-1	WO-G	TbB2	B	132564.003	3.043		55	167.378791	55
108	SUB-1	WO-G	TbB2	B	27950.0604	0.642		55	35.2904804	55
23	SUB-1	WO-G	VaC	C	35804.9865	0.822		70	57.5378572	70
93	SUB-1	WO-G	VaC	C	163.424489	0.004		70	0.2626197	70
1	SUB-1	WO-G	VnB2	C	9237.39354	0.212		70	14.8442963	70
15	SUB-1	WO-G	VnB2	C	521852.072	11.980		70	838.605258	70
75	SUB-1	WO-G	VnB2	C	101979.437	2.341		70	163.878802	70
91	SUB-1	WO-G	VnB2	C	391839.842	8.995		70	629.67835	70
14	SUB-1	WO-G	VnC2	C	460182.487	10.564		70	739.503537	70
64	SUB-1	WO-G	VnC2	C	21034.0477	0.483		70	33.8012704	70
90	SUB-1	WO-G	VnC2	C	7275.53918	0.167		70	11.6916378	70
18	SUB-1	WO-G	W	D	3206.13191	0.074		77	5.66740489	77
20	SUB-1	WO-G	W	D	68591.2582	1.575		77	121.247174	77
3	SUB-1	WO-G	WtB	C	9949.33984	0.228		70	15.988379	70
	SUB-1 Total					**522.355**	**0.816**		**36552.3024**	**70**
728	SUB-10	BR-F	BaB	B	115896.567	2.661		56	148.994668	56
908	SUB-10	BR-F	BaB	B	199164.931	4.572		56	256.043071	56
647	SUB-10	BR-F	BaC	B	1695.78085	0.039		56	2.1800672	56
666	SUB-10	BR-F	BaC	B	7881.7376	0.181		56	10.1326287	56
671	SUB-10	BR-F	BaC	B	3155.87538	0.072		56	4.05714006	56
673	SUB-10	BR-F	BaC	B	49565.123	1.138		56	63.7200847	56
676	SUB-10	BR-F	BaC	B	3494.37363	0.080		56	4.4923077	56
713	SUB-10	BR-F	BaC	B	9675.94615	0.222		56	12.4392329	56
646	SUB-10	BR-F	BaD	B	39137.4908	0.898		56	50.3144969	56
651	SUB-10	BR-F	BaD	B	4180.45729	0.096		56	5.37432526	56
654	SUB-10	BR-F	BaD	B	8642.74787	0.198		56	11.1109706	56
675	SUB-10	BR-F	BaD	B	5248.58698	0.120		56	6.74749475	56
899	SUB-10	BR-F	BaD	B	26228.8444	0.602		56	33.7193592	56
905	SUB-10	BR-F	BaD	B	6559.26248	0.151		56	8.43247702	56
910	SUB-10	BR-F	BaD	B	235.571893	0.005		56	0.30284725	56
919	SUB-10	BR-F	BaD	B	25230.8696	0.579		56	32.4363797	56
930	SUB-10	BR-F	BaD	B	7.16654475	0.000		56	0.00921319	56
911	SUB-10	BR-F	ChA	C	14596.3257	0.335		70	23.4559871	70
929	SUB-10	BR-F	ChA	C	8735.78472	0.201		70	14.0382215	70
645	SUB-10	BR-F	EnB	C	175424.264	4.027		70	281.903087	70
650	SUB-10	BR-F	EnB	C	4075.59012	0.094		70	6.54938724	70
665	SUB-10	BR-F	EnB	C	861.223016	0.020		70	1.3839672	70
670	SUB-10	BR-F	EnB	C	7748.45965	0.178		70	12.451611	70
672	SUB-10	BR-F	EnB	C	20378.4777	0.468		70	32.7477833	70
711	SUB-10	BR-F	EnB	C	78140.2047	1.794		70	125.569659	70
644	SUB-10	BR-F	EnC	C	76814.8191	1.763		70	123.439792	70
652	SUB-10	BR-F	EnC	C	26715.7577	0.613		70	42.9316583	70
655	SUB-10	BR-F	EnC	C	100.194046	0.002		70	0.16100972	70
707	SUB-10	BR-F	EnC	C	8742.94191	0.201		70	14.049723	70
712	SUB-10	BR-F	EnC	C	130757.621	3.002		70	210.124736	70
904	SUB-10	BR-F	GeB2	B	72127.3082	1.656		56	92.7256488	56
918	SUB-10	BR-F	GeB2	B	184599.942	4.238		56	237.318566	56
923	SUB-10	BR-F	GeB2	B	8742.94191	0.201		56	11.2397784	56
925	SUB-10	BR-F	GeB2	B	8742.96061	0.201		56	11.2398024	56
782	SUB-10	BR-F	PcE3	B	110428.616	2.535		56	141.965164	56
780	SUB-10	BR-F	TbB2	B	29938.6587	0.687		56	38.4886337	56
827	SUB-10	BR-F	TbB2	B	6148.73797	0.141		56	7.90471364	56
912	SUB-10	BR-F	TbB2	B	82727.1406	1.899		56	106.352614	56
781	SUB-10	BR-F	TbD2	B	121921.225	2.799		56	156.739867	56
828	SUB-10	BR-F	TbD2	B	28823.0858	0.662		56	37.0544721	56
909	SUB-10	BR-F	TbD2	B	245339.009	5.632		56	315.403684	56
636	SUB-10	R2	EnB	C	11461.9237	0.263		77	20.2609762	77
641	SUB-10	R2	EnB	C	159.89308	0.004		77	0.28263928	77
635	SUB-10	R2	VaB	C	11959.3204	0.275		77	21.1402128	77
640	SUB-10	R2	VaB	C	537.586213	0.012		77	0.95027866	77
681	SUB-10	SR-G	BaB	B	280256.298	6.434		78	501.836347	78
685	SUB-10	SR-G	BaB	B	267648.42	6.144		78	479.260256	78
692	SUB-10	SR-G	BaB	B	344270.47	7.903		78	616.462273	78
729	SUB-10	SR-G	BaB	B	4616.0539	0.106		78	8.26566126	78
731	SUB-10	SR-G	BaB	B	104531.859	2.400		78	187.17826	78
734	SUB-10	SR-G	BaB	B	817974.556	18.778		78	1464.69273	78
838	SUB-10	SR-G	BaB	B	357256.998	8.201		78	639.716388	78
840	SUB-10	SR-G	BaB	B	307117.536	7.050		78	549.934981	78
849	SUB-10	SR-G	BaB	B	667821.353	15.331		78	1195.82336	78
881	SUB-10	SR-G	BaB	B	90597.1526	2.080		78	162.226306	78
680	SUB-10	SR-G	BaC	B	176574.535	4.054		78	316.180297	78
684	SUB-10	SR-G	BaC	B	335363.266	7.699		78	600.512736	78
686	SUB-10	SR-G	BaC	B	81698.2125	1.876		78	146.291565	78
691	SUB-10	SR-G	BaC	B	122151.107	2.804		78	218.727878	78
694	SUB-10	SR-G	BaC	B	68613.4154	1.575		78	122.861488	78

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
730	SUB-10	SR-G	BaC	B	28752.0853	0.660		78	51.4844502	78
736	SUB-10	SR-G	BaD	B	370572.188	8.507		78	663.559015	78
836	SUB-10	SR-G	BaD	B	217096.484	4.984		78	388.74026	78
841	SUB-10	SR-G	BaD	B	720871.457	16.549		78	1290.81666	78
851	SUB-10	SR-G	BaD	B	222656.965	5.112		78	398.697045	78
895	SUB-10	SR-G	BaD	B	43512.2038	0.999		78	77.9144145	78
900	SUB-10	SR-G	BaD	B	8742.96061	0.201		78	15.6554391	78
931	SUB-10	SR-G	BaD	B	1908.3297	0.044		78	3.4171193	78
933	SUB-10	SR-G	BaD	B	7428.39314	0.171		78	13.3015304	78
937	SUB-10	SR-G	BaD	B	81989.0601	1.882		78	146.812367	78
747	SUB-10	SR-G	BaF	B	17463.7567	0.401		78	31.2711897	78
830	SUB-10	SR-G	BaF	B	13273.1696	0.305		78	23.7673835	78
860	SUB-10	SR-G	BaF	B	53792.4016	1.235		78	96.3224821	78
839	SUB-10	SR-G	ChA	C	166983.406	3.833		85	325.839979	85
932	SUB-10	SR-G	ChA	C	34378.0335	0.789		85	67.0829395	85
936	SUB-10	SR-G	ChA	C	170.921464	0.004		85	0.33352444	85
605	SUB-10	SR-G	EnB	C	3112.90924	0.071		85	6.07431785	85
606	SUB-10	SR-G	EnB	C	86.5850581	0.002		85	0.16895615	85
607	SUB-10	SR-G	EnB	C	1323063.3	30.373		85	2581.73509	85
609	SUB-10	SR-G	EnB	C	130255.739	2.990		85	254.172126	85
630	SUB-10	SR-G	EnB	C	730187.981	16.763		85	1424.83881	85
631	SUB-10	SR-G	EnB	C	11899.936	0.273		85	23.2207199	85
648	SUB-10	SR-G	EnB	C	7184.90242	0.165		85	14.0201264	85
653	SUB-10	SR-G	EnB	C	1201.85677	0.028		85	2.34522097	85
678	SUB-10	SR-G	EnB	C	646991.872	14.853		85	1262.49562	85
679	SUB-10	SR-G	EnB	C	119198.526	2.736		85	232.595838	85
689	SUB-10	SR-G	EnB	C	327200.137	7.511		85	638.475932	85
829	SUB-10	SR-G	EnB	C	57975.7291	1.331		85	113.129866	85
832	SUB-10	SR-G	EnB	C	307850.675	7.067		85	600.718718	85
834	SUB-10	SR-G	EnB	C	911689.991	20.930		85	1779.0094	85
604	SUB-10	SR-G	EnC	C	9821.29942	0.225		85	19.1646109	85
610	SUB-10	SR-G	EnC	C	219571.762	5.041		85	428.457294	85
629	SUB-10	SR-G	EnC	C	54388.0729	1.249		85	106.12916	85
634	SUB-10	SR-G	EnC	C	240508.683	5.521		85	469.312168	85
682	SUB-10	SR-G	EnC	C	118698.221	2.725		85	231.619578	85
690	SUB-10	SR-G	EnC	C	74801.5569	1.717		85	145.962634	85
693	SUB-10	SR-G	EnC	C	94631.5633	2.172		85	184.65755	85
833	SUB-10	SR-G	GeB2	B	595275.148	13.666		78	1065.91969	78
934	SUB-10	SR-G	GeB2	B	41671.7367	0.957		78	74.6188122	78
940	SUB-10	SR-G	GeB2	B	7240.21934	0.166		78	12.9645801	78
746	SUB-10	SR-G	KkB	C	218999.751	5.028		85	427.341112	85
845	SUB-10	SR-G	KkB	C	445368.808	10.224		85	869.062183	85
883	SUB-10	SR-G	KkB	C	796.901757	0.018		85	1.5550195	85
896	SUB-10	SR-G	KkB	C	26431.4063	0.607		85	51.5764356	85
608	SUB-10	SR-G	MeB2	C	50536.6367	1.160		85	98.6137309	85
632	SUB-10	SR-G	MeB2	C	467178.061	10.725		85	911.619266	85
649	SUB-10	SR-G	MeB2	C	9875.92299	0.227		85	19.2711996	85
612	SUB-10	SR-G	TaB	B	128434.037	2.948		78	229.978303	78
683	SUB-10	SR-G	TaB	B	6823.00383	0.157		78	12.2175	78
687	SUB-10	SR-G	TaB	B	175328.572	4.025		78	313.949234	78
732	SUB-10	SR-G	TaB	B	29924.9398	0.687		78	53.5846029	78
741	SUB-10	SR-G	TaB	B	90010.368	2.066		78	161.17559	78
743	SUB-10	SR-G	TaB	B	9763.05677	0.224		78	17.4820576	78
745	SUB-10	SR-G	TaB	B	454432.43	10.432		78	813.721982	78
789	SUB-10	SR-G	TaB	B	6604.2808	0.152		78	11.8258472	78
818	SUB-10	SR-G	TaB	B	17485.8932	0.401		78	31.310828	78
835	SUB-10	SR-G	TaB	B	166715.638	3.827		78	298.526625	78
837	SUB-10	SR-G	TaB	B	525028.586	12.053		78	940.133832	78
844	SUB-10	SR-G	TaB	B	392519.474	9.011		78	702.858562	78
846	SUB-10	SR-G	TaB	B	334474.577	7.678		78	598.921419	78
847	SUB-10	SR-G	TaB	B	38766.7055	0.890		78	69.4169657	78
859	SUB-10	SR-G	TaB	B	71814.3971	1.649		78	128.593273	78
935	SUB-10	SR-G	TaB	B	1299.93775	0.030		78	2.32771222	78
613	SUB-10	SR-G	TaC	B	30372.8834	0.697		78	54.3867059	78
614	SUB-10	SR-G	TaC	B	34889.4737	0.801		78	62.4742641	78
688	SUB-10	SR-G	TaC	B	46057.1971	1.057		78	82.471565	78
733	SUB-10	SR-G	TaC	B	53203.3992	1.221		78	95.2677947	78
742	SUB-10	SR-G	TaC	B	13700.3583	0.315		78	24.532322	78
735	SUB-10	SR-G	TaD	B	171962.781	3.948		78	307.922335	78
848	SUB-10	SR-G	TaD	B	381520.922	8.759		78	683.164186	78
861	SUB-10	SR-G	TaD	B	14280.4122	0.328		78	25.5709861	78
868	SUB-10	SR-G	TaD	B	8742.94191	0.201		78	15.6554056	78
611	SUB-10	SR-G	TbB2	B	141902.141	3.258		78	254.094743	78
737	SUB-10	SR-G	TbB2	B	525949.477	12.074		78	941.78281	78
740	SUB-10	SR-G	TbB2	B	504.423106	0.012		78	0.90323697	78
842	SUB-10	SR-G	TbB2	B	537685.225	12.344		78	962.797236	78
852	SUB-10	SR-G	TbB2	B	767226.711	17.613		78	1373.82193	78
885	SUB-10	SR-G	TbB2	B	663359.034	15.229		78	1187.83298	78
915	SUB-10	SR-G	TbB2	B	8695.062	0.200		78	15.5696702	78
917	SUB-10	SR-G	TbB2	B	6687.19802	0.154		78	11.9743215	78
738	SUB-10	SR-G	TbD2	B	23277.4805	0.534		78	41.6814389	78
744	SUB-10	SR-G	TbD2	B	74971.9377	1.721		78	134.247271	78
831	SUB-10	SR-G	TbD2	B	273106.899	6.270		78	489.034391	78
843	SUB-10	SR-G	TbD2	B	88447.4949	2.030		78	158.377057	78
850	SUB-10	SR-G	TbD2	B	981464.626	22.531		78	1757.44354	78

LITTLE BUFFALO CREEK
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ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
882	SUB-10	SR-G	TbD2	B	110584.235	2.539		78	198.015848	78
884	SUB-10	SR-G	TbD2	B	70158.4714	1.611		78	125.628117	78
914	SUB-10	SR-G	TbD2	B	47.8892668	0.001		78	0.08575213	78
916	SUB-10	SR-G	TbD2	B	2055.7439	0.047		78	3.68108411	78
603	SUB-10	SR-G	VaB	C	169084.972	3.882		85	329.940831	85
628	SUB-10	SR-G	VaB	C	58058.5267	1.333		85	113.291432	85
633	SUB-10	SR-G	W	D	186.696069	0.004		89	0.38144973	89
663	SUB-10	WO-G	BaB	B	121923.705	2.799		55	153.944072	55
717	SUB-10	WO-G	BaB	B	15038.0366	0.345		55	18.98742	55
794	SUB-10	WO-G	BaB	B	406097.004	9.323		55	512.748742	55
801	SUB-10	WO-G	BaB	B	64278.8416	1.476		55	81.1601535	55
814	SUB-10	WO-G	BaB	B	28628.9983	0.657		55	36.1477251	55
819	SUB-10	WO-G	BaB	B	8742.95126	0.201		55	11.0390799	55
853	SUB-10	WO-G	BaB	B	43655.5228	1.002		55	55.1206097	55
856	SUB-10	WO-G	BaB	B	26286.4009	0.603		55	33.1899001	55
867	SUB-10	WO-G	BaB	B	12954.0672	0.297		55	16.3561454	55
926	SUB-10	WO-G	BaB	B	65779.6308	1.510		55	83.0550894	55
626	SUB-10	WO-G	BaC	B	48.5050034	0.001		55	0.06124369	55
662	SUB-10	WO-G	BaC	B	951901.953	21.853		55	1201.89641	55
677	SUB-10	WO-G	BaC	B	8742.95126	0.201		55	11.0390799	55
699	SUB-10	WO-G	BaC	B	62082.244	1.425		55	78.3866717	55
703	SUB-10	WO-G	BaC	B	185142.162	4.250		55	233.765356	55
715	SUB-10	WO-G	BaC	B	47763.1634	1.096		55	60.3070245	55
716	SUB-10	WO-G	BaC	B	202840.549	4.657		55	256.111804	55
763	SUB-10	WO-G	BaC	B	1012.56461	0.023		55	1.27849068	55
767	SUB-10	WO-G	BaC	B	50710.3058	1.164		55	64.0281638	55
624	SUB-10	WO-G	BaD	B	243135.488	5.582		55	306.989252	55
660	SUB-10	WO-G	BaD	B	230247.855	5.286		55	290.716988	55
784	SUB-10	WO-G	BaD	B	89251.6623	2.049		55	112.691493	55
799	SUB-10	WO-G	BaD	B	700131.667	16.073		55	884.00463	55
803	SUB-10	WO-G	BaD	B	743963.398	17.079		55	939.347724	55
816	SUB-10	WO-G	BaD	B	248220.595	5.698		55	313.409843	55
854	SUB-10	WO-G	BaD	B	186693.938	4.286		55	235.724669	55
866	SUB-10	WO-G	BaD	B	4531.84471	0.104		55	5.72202615	55
886	SUB-10	WO-G	BaD	B	1943.38029	0.045		55	2.45376299	55
889	SUB-10	WO-G	BaD	B	171808.814	3.944		55	216.93032	55
901	SUB-10	WO-G	BaD	B	8742.94191	0.201		55	11.0390681	55
907	SUB-10	WO-G	BaD	B	3668.45312	0.084		55	4.63188525	55
927	SUB-10	WO-G	BaD	B	460797.077	10.578		55	581.814491	55
938	SUB-10	WO-G	BaD	B	6054.88448	0.139		55	7.64505616	55
788	SUB-10	WO-G	BaF	B	82492.2946	1.894		55	104.156938	55
793	SUB-10	WO-G	BaF	B	395081.859	9.070		55	498.840731	55
811	SUB-10	WO-G	BaF	B	788284.677	18.097		55	995.308936	55
862	SUB-10	WO-G	BaF	B	99632.4777	2.287		55	125.798583	55
802	SUB-10	WO-G	ChA	C	870465.932	19.983		70	1398.82037	70
939	SUB-10	WO-G	ChA	C	2514.97422	0.058		70	4.04151045	70
616	SUB-10	WO-G	EnB	C	298455.821	6.852		70	479.612201	70
621	SUB-10	WO-G	EnB	C	261943.311	6.013		70	420.937369	70
623	SUB-10	WO-G	EnB	C	353114.98	8.106		70	567.448315	70
638	SUB-10	WO-G	EnB	C	220254.846	5.056		70	353.944886	70
639	SUB-10	WO-G	EnB	C	2942.47802	0.068		70	4.72850003	70
642	SUB-10	WO-G	EnB	C	8742.96061	0.201		70	14.0497531	70
643	SUB-10	WO-G	EnB	C	8742.95126	0.201		70	14.049738	70
657	SUB-10	WO-G	EnB	C	162751.675	3.736		70	261.538505	70
658	SUB-10	WO-G	EnB	C	23723.8079	0.545		70	38.1236582	70
659	SUB-10	WO-G	EnB	C	24009.6506	0.551		70	38.5830014	70
667	SUB-10	WO-G	EnB	C	48814.4733	1.121		70	78.4438276	70
668	SUB-10	WO-G	EnB	C	56448.156	1.296		70	90.7109945	70
674	SUB-10	WO-G	EnB	C	14712.6514	0.338		70	23.64292	70
695	SUB-10	WO-G	EnB	C	702575.346	16.129		70	1129.02374	70
696	SUB-10	WO-G	EnB	C	175.694147	0.004		70	0.28233678	70
702	SUB-10	WO-G	EnB	C	215387.947	4.945		70	346.123882	70
710	SUB-10	WO-G	EnB	C	498.119469	0.011		70	0.80046747	70
721	SUB-10	WO-G	EnB	C	5100.38764	0.117		70	8.19621521	70
792	SUB-10	WO-G	EnB	C	94189.0857	2.162		70	151.359871	70
796	SUB-10	WO-G	EnB	C	2261.46804	0.052		70	3.63413138	70
798	SUB-10	WO-G	EnB	C	18538.1654	0.426		70	29.7904403	70
810	SUB-10	WO-G	EnB	C	32.5605853	0.001		70	0.05232417	70
877	SUB-10	WO-G	EnB	C	173.677016	0.004		70	0.2790953	70
618	SUB-10	WO-G	EnC	C	109097.22	2.505		70	175.316928	70
620	SUB-10	WO-G	EnC	C	488337.294	11.211		70	784.747718	70
627	SUB-10	WO-G	EnC	C	33558.9623	0.770		70	53.9285436	70
637	SUB-10	WO-G	EnC	C	222669.341	5.112		70	357.824929	70
656	SUB-10	WO-G	EnC	C	5623.94876	0.129		70	9.03756689	70
661	SUB-10	WO-G	EnC	C	278032.12	6.383		70	446.791745	70
669	SUB-10	WO-G	EnC	C	375599.69	8.623		70	603.580769	70
698	SUB-10	WO-G	EnC	C	391577.339	8.989		70	629.256513	70
700	SUB-10	WO-G	EnC	C	318446.973	7.311		70	511.73756	70
709	SUB-10	WO-G	EnC	C	32061.0709	0.736		70	51.5214637	70
714	SUB-10	WO-G	EnC	C	13437.5048	0.308		70	21.5937864	70
797	SUB-10	WO-G	GeB2	B	79301.2565	1.821		55	100.127849	55
888	SUB-10	WO-G	GeB2	B	12118.1327	0.278		55	15.3006726	55
906	SUB-10	WO-G	GeB2	B	13817.4588	0.317		55	17.4462863	55
913	SUB-10	WO-G	GeB2	B	8742.95126	0.201		55	11.0390799	55
920	SUB-10	WO-G	GeB2	B	8742.95126	0.201		55	11.0390799	55

LITTLE BUFFALO CREEK
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ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
921	SUB-10	WO-G	GeB2	B	8742.95126	0.201		55	11.0390799	55
922	SUB-10	WO-G	GeB2	B	8742.95126	0.201		55	11.0390799	55
924	SUB-10	WO-G	GeB2	B	8742.95126	0.201		55	11.0390799	55
757	SUB-10	WO-G	KkB	C	68870.9069	1.581		70	110.674093	70
787	SUB-10	WO-G	KkB	C	240479.99	5.521		70	386.446265	70
809	SUB-10	WO-G	KkB	C	1491193.92	34.233		70	2396.31713	70
825	SUB-10	WO-G	KkB	C	52333.0929	1.201		70	84.0981749	70
855	SUB-10	WO-G	KkB	C	31881.5489	0.732		70	51.2329757	70
887	SUB-10	WO-G	KkB	C	6799.58033	0.156		70	10.926782	70
890	SUB-10	WO-G	KkB	C	5.6083755	0.000		70	0.00901254	70
894	SUB-10	WO-G	KkB	C	8742.94191	0.201		70	14.049723	70
617	SUB-10	WO-G	MeB2	C	110528.713	2.537		70	177.617307	70
622	SUB-10	WO-G	MeB2	C	4339.04666	0.100		70	6.97275633	70
705	SUB-10	WO-G	PaD	B	83835.7355	1.925		55	105.853201	55
727	SUB-10	WO-G	PaD	B	3745.94523	0.086		55	4.72972883	55
761	SUB-10	WO-G	PaD	B	1026.88058	0.024		55	1.29656639	55
764	SUB-10	WO-G	PaD	B	12283.0783	0.282		55	15.5089373	55
769	SUB-10	WO-G	PaD	B	15812.7202	0.363		55	19.9655558	55
765	SUB-10	WO-G	PcE3	B	54925.3397	1.261		55	69.3501765	55
772	SUB-10	WO-G	PcE3	B	72955.2783	1.675		55	92.1152504	55
776	SUB-10	WO-G	PcE3	B	140513.002	3.226		55	177.415406	55
806	SUB-10	WO-G	PcE3	B	2970.02206	0.068		55	3.75002785	55
822	SUB-10	WO-G	PcE3	B	77018.6093	1.768		55	97.2457188	55
704	SUB-10	WO-G	TaB	B	5045.5745	0.116		55	6.37067487	55
739	SUB-10	WO-G	TaB	B	25780.5643	0.592		55	32.5512175	55
751	SUB-10	WO-G	TaB	B	58880.5736	1.352		55	74.3441586	55
754	SUB-10	WO-G	TaB	B	17108.8017	0.393		55	21.6020224	55
756	SUB-10	WO-G	TaB	B	1364.67903	0.031		55	1.72307959	55
768	SUB-10	WO-G	TaB	B	4344.06017	0.100		55	5.48492445	55
800	SUB-10	WO-G	TaB	B	140460.582	3.225		55	177.34922	55
808	SUB-10	WO-G	TaB	B	504666.994	11.586		55	637.2058	55
812	SUB-10	WO-G	TaB	B	306618.947	7.039		55	387.145135	55
857	SUB-10	WO-G	TaB	B	99644.4536	2.288		55	125.813704	55
863	SUB-10	WO-G	TaB	B	179874.239	4.129		55	227.113938	55
872	SUB-10	WO-G	TaB	B	6557.59848	0.151		55	8.27979606	55
874	SUB-10	WO-G	TaB	B	3943.20961	0.091		55	4.97880002	55
876	SUB-10	WO-G	TaB	B	31421.7104	0.721		55	39.6738768	55
891	SUB-10	WO-G	TaB	B	10153.2176	0.233		55	12.8197191	55
897	SUB-10	WO-G	TaB	B	5304.14491	0.122		55	6.69715267	55
664	SUB-10	WO-G	TaC	B	11636.5192	0.267		55	14.6925747	55
701	SUB-10	WO-G	TaC	B	447914.581	10.283		55	565.548714	55
706	SUB-10	WO-G	TaC	B	23616.0433	0.542		55	29.8182365	55
718	SUB-10	WO-G	TaC	B	695.196428	0.016		55	0.87777327	55
720	SUB-10	WO-G	TaC	B	19176.6459	0.440		55	24.2129368	55
723	SUB-10	WO-G	TaC	B	5781.64422	0.133		55	7.30005583	55
725	SUB-10	WO-G	TaC	B	8742.96061	0.201		55	11.0390917	55
749	SUB-10	WO-G	TaC	B	8064.49191	0.185		55	10.1824393	55
783	SUB-10	WO-G	TaD	B	46232.6772	1.061		55	58.3745924	55
813	SUB-10	WO-G	TaD	B	861337.675	19.774		55	1087.54757	55
826	SUB-10	WO-G	TaD	B	501.974361	0.012		55	0.63380601	55
858	SUB-10	WO-G	TaD	B	44390.5738	1.019		55	56.0487043	55
864	SUB-10	WO-G	TaD	B	35239.5192	0.809		55	44.4943424	55
865	SUB-10	WO-G	TaD	B	8742.94191	0.201		55	11.0390681	55
873	SUB-10	WO-G	TaD	B	2185.36213	0.050		55	2.75929562	55
875	SUB-10	WO-G	TaD	B	4799.74165	0.110		55	6.06027986	55
878	SUB-10	WO-G	TaD	B	15878.0673	0.365		55	20.0480647	55
879	SUB-10	WO-G	TaD	B	8742.95126	0.201		55	11.0390799	55
880	SUB-10	WO-G	TaD	B	8742.94191	0.201		55	11.0390681	55
697	SUB-10	WO-G	TbB2	B	715440.082	16.424		55	903.333437	55
708	SUB-10	WO-G	TbB2	B	89842.1461	2.062		55	113.437053	55
719	SUB-10	WO-G	TbB2	B	10694.7715	0.246		55	13.5034993	55
722	SUB-10	WO-G	TbB2	B	31160.1848	0.715		55	39.3436676	55
724	SUB-10	WO-G	TbB2	B	8742.95126	0.201		55	11.0390799	55
726	SUB-10	WO-G	TbB2	B	7319.34264	0.168		55	9.24159425	55
748	SUB-10	WO-G	TbB2	B	45043.6038	1.034		55	56.8732372	55
750	SUB-10	WO-G	TbB2	B	32651.1188	0.750		55	41.2261602	55
752	SUB-10	WO-G	TbB2	B	18297.3248	0.420		55	23.1026828	55
753	SUB-10	WO-G	TbB2	B	188800.801	4.334		55	238.38485	55
758	SUB-10	WO-G	TbB2	B	11287.3572	0.259		55	14.2517136	55
759	SUB-10	WO-G	TbB2	B	7622.15394	0.175		55	9.62393174	55
760	SUB-10	WO-G	TbB2	B	4003.67309	0.092		55	5.05514279	55
762	SUB-10	WO-G	TbB2	B	1193.10581	0.027		55	1.50644673	55
766	SUB-10	WO-G	TbB2	B	92956.0497	2.134		55	117.36875	55
770	SUB-10	WO-G	TbB2	B	1357.40327	0.031		55	1.71389302	55
773	SUB-10	WO-G	TbB2	B	1217.62856	0.028		55	1.53740979	55
774	SUB-10	WO-G	TbB2	B	16268.2646	0.373		55	20.5407382	55
777	SUB-10	WO-G	TbB2	B	239062.736	5.488		55	301.846889	55
779	SUB-10	WO-G	TbB2	B	43714.747	1.004		55	55.1953876	55
785	SUB-10	WO-G	TbB2	B	109318.287	2.510		55	138.02814	55
790	SUB-10	WO-G	TbB2	B	25236.1416	0.579		55	31.8638151	55
804	SUB-10	WO-G	TbB2	B	86758.043	1.992		55	109.542984	55
817	SUB-10	WO-G	TbB2	B	911447.8	20.924		55	1150.81793	55
820	SUB-10	WO-G	TbB2	B	21592.8475	0.496		55	27.2636963	55
823	SUB-10	WO-G	TbB2	B	41373.6066	0.950		55	52.2394023	55
871	SUB-10	WO-G	TbB2	B	349940.686	8.034		55	441.8443	55

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
893	SUB-10	WO-G	TbB2	B	367.070846	0.008		55	0.46347329	55
903	SUB-10	WO-G	TbB2	B	31767.5284	0.729		55	40.1105156	55
928	SUB-10	WO-G	TbB2	B	351740.965	8.075		55	444.11738	55
755	SUB-10	WO-G	TbD2	B	193192.705	4.435		55	243.930184	55
771	SUB-10	WO-G	TbD2	B	95625.2477	2.195		55	120.738949	55
775	SUB-10	WO-G	TbD2	B	21556.0298	0.495		55	27.2172093	55
778	SUB-10	WO-G	TbD2	B	1043.98151	0.024		55	1.31815847	55
786	SUB-10	WO-G	TbD2	B	9259.89125	0.213		55	11.6917819	55
791	SUB-10	WO-G	TbD2	B	18478.6241	0.424		55	23.3315961	55
795	SUB-10	WO-G	TbD2	B	798019.601	18.320		55	1007.60051	55
805	SUB-10	WO-G	TbD2	B	161848.167	3.716		55	204.353747	55
807	SUB-10	WO-G	TbD2	B	64503.9642	1.481		55	81.4443993	55
815	SUB-10	WO-G	TbD2	B	960966.544	22.061		55	1213.3416	55
821	SUB-10	WO-G	TbD2	B	74518.2486	1.711		55	94.0886978	55
824	SUB-10	WO-G	TbD2	B	196038.056	4.500		55	247.522799	55
869	SUB-10	WO-G	TbD2	B	12786.6751	0.294		55	16.1447918	55
870	SUB-10	WO-G	TbD2	B	432881.223	9.938		55	546.567201	55
892	SUB-10	WO-G	TbD2	B	8375.88042	0.192		55	10.5756066	55
898	SUB-10	WO-G	TbD2	B	8742.95126	0.201		55	11.0390799	55
902	SUB-10	WO-G	TbD2	B	3204.28602	0.074		55	4.04581568	55
615	SUB-10	WO-G	VaB	C	3296.26288	0.076		70	5.29702483	70
619	SUB-10	WO-G	VaB	C	96300.8221	2.211		70	154.753387	70
625	SUB-10	WO-G	W	D	33759.6152	0.775		77	59.6760874	77
	SUB-10 Total					**1094.511**	**1.710**		**75336.3224**	**69**
1058	SUB-10A	SR-G	BaB	B	253237.713	5.814		78	453.45596	78
1057	SUB-10A	SR-G	BaD	B	216223.019	4.964		78	387.176205	78
1059	SUB-10A	SR-G	BaF	B	311450.776	7.150		78	557.694228	78
1063	SUB-10A	SR-G	ChA	C	507886.511	11.659		85	991.054947	85
1062	SUB-10A	SR-G	TaB	B	568662.907	13.055		78	1018.26691	78
1061	SUB-10A	SR-G	TaD	B	203983.32	4.683		78	365.259389	78
1060	SUB-10A	SR-G	TbB2	B	406340.808	9.328		78	727.607507	78
1065	SUB-10A	SR-G	TbB2	B	1106431.16	25.400		78	1981.21283	78
1064	SUB-10A	SR-G	TbD2	B	1204616.47	27.654		78	2157.02674	78
1066	SUB-10A	WO-G	BaD	B	13595.4158	0.312		55	17.165929	55
1068	SUB-10A	WO-G	BaD	B	346017.31	7.943		55	436.890543	55
1072	SUB-10A	WO-G	BaD	B	722.183064	0.017		55	0.9118473	55
1073	SUB-10A	WO-G	BaF	B	30807.0271	0.707		55	38.8977615	55
1055	SUB-10A	WO-G	ChA	C	1246.24475	0.029		70	2.00268899	70
1069	SUB-10A	WO-G	ChA	C	28502.9494	0.654		70	45.8036378	70
1076	SUB-10A	WO-G	ChA	C	66881.4454	1.535		70	107.47707	70
1078	SUB-10A	WO-G	ChA	C	173.083213	0.004		70	0.27814107	70
1075	SUB-10A	WO-G	TaB	B	168581.166	3.870		55	212.855008	55
1074	SUB-10A	WO-G	TaD	B	182563.019	4.191		55	230.508863	55
1056	SUB-10A	WO-G	TbB2	B	1739.28255	0.040		55	2.19606382	55
1067	SUB-10A	WO-G	TbB2	B	26096.8038	0.599		55	32.9505099	55
1071	SUB-10A	WO-G	TbB2	B	88073.2785	2.022		55	111.203635	55
1070	SUB-10A	WO-G	TbD2	B	782.878639	0.018		55	0.98848313	55
1077	SUB-10A	WO-G	TbD2	B	52.9553931	0.001		55	0.06686287	55
	SUB-10A Total					**131.650**	**0.206**		**9878.95176**	**75**
941	SUB-11	SR-G	BaB	B	305610.132	7.016		78	547.235773	78
943	SUB-11	SR-G	BaD	B	108069.447	2.481		78	193.512784	78
942	SUB-11	SR-G	BaF	B	15672.3452	0.360		78	28.0634281	78
946	SUB-11	SR-G	ChA	C	220635.928	5.065		85	430.533836	85
944	SUB-11	SR-G	TaB	B	44987.726	1.033		78	80.5565342	78
945	SUB-11	SR-G	TaB	B	194211.141	4.458		78	347.760996	78
949	SUB-11	WO-G	BaB	B	103621.801	2.379		55	130.835607	55
952	SUB-11	WO-G	BaB	B	8394.18813	0.193		55	10.5987224	55
948	SUB-11	WO-G	BaD	B	1477.80579	0.034		55	1.86591641	55
951	SUB-11	WO-G	BaD	B	100158.187	2.299		55	126.462357	55
954	SUB-11	WO-G	BaD	B	107959.284	2.478		55	136.312228	55
947	SUB-11	WO-G	BaF	B	5940.00563	0.136		55	7.50000711	55
950	SUB-11	WO-G	BaF	B	20638.962	0.474		55	26.0592955	55
953	SUB-11	WO-G	BaF	B	17054.7232	0.392		55	21.5337414	55
955	SUB-11	WO-G	TaB	B	23964.9179	0.550		55	30.2587347	55
	SUB-11 Total					**29.348**	**0.046**		**2119.08996**	**72**
1054	SUB-11A	SR-G	ChA	C	110976.073	2.548		85	216.551107	85
1053	SUB-11A	SR-G	TaB	B	252239.809	5.791		78	451.669079	78
	SUB-11A Total					**8.338**	**0.013**		**668.220186**	**80**
141	SUB-2	FA	BaC	B	17766.9552	0.408		74	30.1826144	74
157	SUB-2	FA	BaC	B	17917.5907	0.411		74	30.438515	74
139	SUB-2	FA	CmB	C	35831.6496	0.823		82	67.4516821	82
121	SUB-2	FA	TaC	B	25890.1724	0.594		74	43.9823866	74
120	SUB-2	FA	TbB2	B	101151.257	2.322		74	171.836387	74
140	SUB-2	FA	TbB2	B	158556.28	3.640		74	269.356398	74
149	SUB-2	FA	TbB2	B	24.7981233	0.001		74	0.04212721	74
158	SUB-2	FA	TbB2	B	112845.045	2.591		74	191.701867	74
160	SUB-2	FA	TbB2	B	1460.83525	0.034		74	2.48167604	74
159	SUB-2	FA	Ud	C	6771.45296	0.155		82	12.7469959	82
113	SUB-2	SR-G	BaC	B	159626.962	3.665		78	285.833403	78
154	SUB-2	SR-G	BaC	B	11147.8466	0.256		78	19.9617088	78
161	SUB-2	SR-G	BaC	B	22030.2827	0.506		78	39.4481646	78
164	SUB-2	SR-G	BaC	B	69881.154	1.604		78	125.131543	78
110	SUB-2	SR-G	CmB	C	615344.371	14.126		85	1200.74085	85
116	SUB-2	SR-G	CmB	C	3387.22578	0.078		85	6.60960034	85
117	SUB-2	SR-G	LdB2	B	184280.474	4.230		78	329.978809	78

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
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ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
114	SUB-2	SR-G	TaC	B	191814.039	4.403		78	343.468666	78
111	SUB-2	SR-G	TbB2	B	416714.36	9.566		78	746.182739	78
112	SUB-2	SR-G	TbB2	B	707317.586	16.238		78	1266.54664	78
118	SUB-2	SR-G	TbB2	B	400756.018	9.200		78	717.607195	78
155	SUB-2	SR-G	TbB2	B	174457.9	4.005		78	312.390179	78
162	SUB-2	SR-G	TbB2	B	401160.098	9.209		78	718.330754	78
167	SUB-2	SR-G	TbB2	B	415.915412	0.010		78	0.74475211	78
168	SUB-2	SR-G	TbB2	B	6224.98464	0.143		78	11.1466667	78
119	SUB-2	SR-G	Ud	C	8005.1771	0.184		85	15.6207542	85
156	SUB-2	SR-G	Ud	C	50453.9565	1.158		85	98.4523944	85
163	SUB-2	SR-G	Ud	C	5762.56281	0.132		85	11.2446703	85
115	SUB-2	SR-G	UwB2	B	72979.8171	1.675		78	130.680113	78
126	SUB-2	WO-G	BaC	B	3046116.79	69.929		55	3846.10706	55
137	SUB-2	WO-G	BaC	B	19024.128	0.437		55	24.0203636	55
138	SUB-2	WO-G	BaC	B	282327.604	6.481		55	356.474247	55
142	SUB-2	WO-G	BaC	B	110426.771	2.535		55	139.427742	55
146	SUB-2	WO-G	BaC	B	196461.526	4.510		55	248.057482	55
153	SUB-2	WO-G	BaC	B	7070.7247	0.162		55	8.9276827	55
136	SUB-2	WO-G	BaD	B	309692.072	7.110		55	391.025343	55
148	SUB-2	WO-G	BaD	B	10904.4593	0.250		55	13.7682567	55
122	SUB-2	WO-G	CmB	C	238167.233	5.468		70	382.729714	70
129	SUB-2	WO-G	CmB	C	242053.981	5.557		70	388.975635	70
150	SUB-2	WO-G	CmB	C	38812.2709	0.891		70	62.3704996	70
130	SUB-2	WO-G	LdB2	B	6029.46143	0.138		55	7.61295634	55
143	SUB-2	WO-G	LdB2	B	20717.507	0.476		55	26.1584684	55
147	SUB-2	WO-G	LdB2	B	8676.10842	0.199		55	10.9546824	55
124	SUB-2	WO-G	OkA	C	15204.9027	0.349		70	24.4339575	70
145	SUB-2	WO-G	OkA	C	66447.7534	1.525		70	106.780136	70
132	SUB-2	WO-G	TaB	B	520025.649	11.938		55	656.598041	55
135	SUB-2	WO-G	TaB	B	358881.71	8.239		55	453.133472	55
127	SUB-2	WO-G	TaC	B	20301.1026	0.466		55	25.6327053	55
109	SUB-2	WO-G	TbB2	B	22094.7216	0.507		55	27.8973757	55
123	SUB-2	WO-G	TbB2	B	142553.872	3.273		55	179.992263	55
125	SUB-2	WO-G	TbB2	B	26387.3857	0.606		55	33.3174062	55
131	SUB-2	WO-G	TbB2	B	312196.715	7.167		55	394.187772	55
133	SUB-2	WO-G	TbB2	B	794597.469	18.241		55	1003.27963	55
144	SUB-2	WO-G	TbB2	B	107252.246	2.462		55	135.419502	55
151	SUB-2	WO-G	TbB2	B	118560.871	2.722		55	149.698069	55
152	SUB-2	WO-G	TbB2	B	1672.21721	0.038		55	2.11138537	55
165	SUB-2	WO-G	TbB2	B	73270.0195	1.682		55	92.5126509	55
134	SUB-2	WO-G	Ud	C	481625.49	11.057		70	773.96199	70
166	SUB-2	WO-G	Ud	C	1291.4144	0.030		70	2.07527567	70
128	SUB-2	WO-G	UwB2	B	1768.04683	0.041		55	2.23238236	55
	SUB-2 Total					**265.854**	**0.415**		**17170.2144**	**65**
424	SUB-3	SR-G	BaC	B	44008.1682	1.010		78	78.802505	78
422	SUB-3	SR-G	TbB2	B	3370.38369	0.077		78	6.03512231	78
423	SUB-3	SR-G	TbB2	B	121692	2.794		78	217.905785	78
425	SUB-3	SR-G	TbB2	B	2517.97598	0.058		78	4.50877241	78
426	SUB-3	SR-G	TbB2	B	8742.94191	0.201		78	15.6554056	78
417	SUB-3	WO-G	BaB	B	113569.345	2.607		55	143.395638	55
412	SUB-3	WO-G	BaC	B	1287348.95	29.553		55	1625.4406	55
416	SUB-3	WO-G	BaC	B	69627.5205	1.598		55	87.913536	55
420	SUB-3	WO-G	BaC	B	22666.7546	0.520		55	28.6196396	55
411	SUB-3	WO-G	BaD	B	68879.865	1.581		55	86.9695265	55
413	SUB-3	WO-G	BaD	B	913891.079	20.980		55	1153.90288	55
419	SUB-3	WO-G	BaD	B	290.156076	0.007		55	0.36635868	55
421	SUB-3	WO-G	BaD	B	82248.6512	1.888		55	103.849307	55
409	SUB-3	WO-G	OkA	C	224006.899	5.142		70	359.974355	70
418	SUB-3	WO-G	OkA	C	952.887042	0.022		70	1.53126935	70
415	SUB-3	WO-G	TaB	B	55388.8368	1.272		55	69.9354	55
410	SUB-3	WO-G	TbB2	B	544213.3	12.493		55	687.138005	55
414	SUB-3	WO-G	Ud	C	277724.441	6.376		70	446.297311	70
	SUB-3 Total					**88.180**	**0.138**		**5118.24141**	**58**
965	SUB-3A	SR-G	CeB2	B	83186.2451	1.910		78	148.956086	78
971	SUB-3A	SR-G	CmB	C	127789.08	2.934		85	249.358856	85
964	SUB-3A	SR-G	OkA	C	79292.6245	1.820		85	154.726196	85
970	SUB-3A	SR-G	TaB	B	38703.2543	0.889		78	69.3033479	78
966	SUB-3A	SR-G	TaC	B	631326.746	14.493		78	1130.47489	78
993	SUB-3A	SR-G	TaC	B	786.347221	0.018		78	1.40805976	78
968	SUB-3A	SR-G	TbB2	B	143764.464	3.300		78	257.429481	78
969	SUB-3A	SR-G	TbB2	B	393362.741	9.030		78	704.368544	78
994	SUB-3A	SR-G	TbB2	B	51575.1939	1.184		78	92.3522755	78
995	SUB-3A	SR-G	TbB2	B	30765.0814	0.706		78	55.0889888	78
967	SUB-3A	SR-G	VaC	C	43397.2613	0.996		85	84.6824428	85
963	SUB-3A	SR-G	VnB2	C	382454.744	8.780		85	746.295989	85
962	SUB-3A	WO-G	CmB	C	130079.834	2.986		70	209.035546	70
972	SUB-3A	WO-G	OkA	C	342854.278	7.871		70	550.959584	70
982	SUB-3A	WO-G	OkA	C	9401.21278	0.216		70	15.1075504	70
961	SUB-3A	WO-G	TaB	B	273694.249	6.283		55	345.573547	55
985	SUB-3A	WO-G	TaB	B	7851.99188	0.180		55	9.91413116	55
991	SUB-3A	WO-G	TaB	B	342.46761	0.008		55	0.4324086	55
957	SUB-3A	WO-G	TaC	B	490465.311	11.260		55	619.274383	55
973	SUB-3A	WO-G	TaC	B	307338.405	7.056		55	388.053541	55
976	SUB-3A	WO-G	TaC	B	11784.7567	0.271		55	14.8797433	55
979	SUB-3A	WO-G	TaC	B	8742.94191	0.201		55	11.0390681	55

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980	SUB-3A	WO-G	TaC	B	40853.7862	0.938		55	51.5830634	55
984	SUB-3A	WO-G	TaC	B	890.968733	0.020		55	1.12496052	55
986	SUB-3A	WO-G	TaC	B	7775.63448	0.179		55	9.8177203	55
988	SUB-3A	WO-G	TaC	B	8664.24962	0.199		55	10.9397091	55
990	SUB-3A	WO-G	TaC	B	17143.4443	0.394		55	21.645763	55
992	SUB-3A	WO-G	TaC	B	26228.8444	0.602		55	33.1172278	55
959	SUB-3A	WO-G	TbB2	B	39676.3814	0.911		55	50.0964411	55
960	SUB-3A	WO-G	TbB2	B	79667.6054	1.829		55	100.590411	55
974	SUB-3A	WO-G	TbB2	B	1776.14386	0.041		55	2.24260589	55
975	SUB-3A	WO-G	TbB2	B	275451.533	6.323		55	347.79234	55
977	SUB-3A	WO-G	TbB2	B	73262.3964	1.682		55	92.5030257	55
978	SUB-3A	WO-G	TbB2	B	7510.34018	0.172		55	9.48275275	55
981	SUB-3A	WO-G	TbB2	B	29089.8146	0.668		55	36.7295638	55
983	SUB-3A	WO-G	TbB2	B	1803.20164	0.041		55	2.27676975	55
987	SUB-3A	WO-G	TbB2	B	18453.2287	0.424		55	23.2995311	55
989	SUB-3A	WO-G	TbB2	B	78.6922973	0.002		55	0.09935896	55
958	SUB-3A	WO-G	VaC	C	383155.901	8.796		70	615.723441	70
956	SUB-3A	WO-G	VnB2	C	238254.983	5.470		70	382.870726	70
	SUB-3A Total					**111.081**	**0.174**		**7650.65007**	**69**
223	SUB-4	R2	PxB	B	11375.4127	0.261		65	16.9743303	65
224	SUB-4	R2	PxB	B	43714.7657	1.004		65	65.2309405	65
222	SUB-4	R2	TaC	B	54897.1906	1.260		65	81.9172954	65
221	SUB-4	R2	TbB2	B	47385.7725	1.088		65	70.7087974	65
193	SUB-4	SR-G	BaC	B	274438.236	6.300		78	491.418329	78
237	SUB-4	SR-G	BaC	B	7374.69933	0.169		78	13.2053845	78
244	SUB-4	SR-G	BaC	B	17485.8932	0.401		78	31.310828	78
251	SUB-4	SR-G	BaC	B	199296.846	4.575		78	356.867631	78
172	SUB-4	SR-G	CeB2	B	449934.038	10.329		78	805.667011	78
178	SUB-4	SR-G	CeB2	B	603873.547	13.863		78	1081.31627	78
194	SUB-4	SR-G	CmB	C	75.4566111	0.002		85	0.14724086	85
173	SUB-4	SR-G	EnB	C	173212.333	3.976		85	337.994682	85
183	SUB-4	SR-G	EnB	C	273740.549	6.284		85	534.158555	85
189	SUB-4	SR-G	EnB	C	97107.066	2.229		85	189.488076	85
234	SUB-4	SR-G	EnB	C	611.474076	0.014		85	1.19318862	85
181	SUB-4	SR-G	EnC	C	258166.212	5.927		85	503.767861	85
187	SUB-4	SR-G	HeB	C	75640.505	1.736		85	147.5997	85
177	SUB-4	SR-G	MeB2	C	275019.442	6.314		85	536.654099	85
176	SUB-4	SR-G	OkA	C	94065.7879	2.159		85	183.553535	85
255	SUB-4	SR-G	OkA	C	1899.49831	0.044		85	3.70655087	85
261	SUB-4	SR-G	OkA	C	8742.94191	0.201		85	17.0603779	85
190	SUB-4	SR-G	PxB	B	360931.451	8.286		78	646.295987	78
174	SUB-4	SR-G	SeB	C	449908.513	10.328		85	877.920652	85
195	SUB-4	SR-G	SeB	C	72468.0705	1.664		85	141.409228	85
252	SUB-4	SR-G	TaB	B	269713.547	6.192		78	482.958142	78
179	SUB-4	SR-G	TaC	B	162838.789	3.738		78	291.584609	78
188	SUB-4	SR-G	TaC	B	483624.871	11.102		78	865.994949	78
219	SUB-4	SR-G	TaC	B	1880.87675	0.043		78	3.36796111	78
240	SUB-4	SR-G	TaC	B	7445.33029	0.171		78	13.3318586	78
242	SUB-4	SR-G	TaC	B	2440.00395	0.056		78	4.36915307	78
247	SUB-4	SR-G	TaC	B	3725.95663	0.086		78	6.67182317	78
253	SUB-4	SR-G	TaC	B	5008.87918	0.115		78	8.96906741	78
256	SUB-4	SR-G	TaC	B	29072.54	0.667		78	52.0582672	78
258	SUB-4	SR-G	TaC	B	6259.79452	0.144		78	11.2089985	78
186	SUB-4	SR-G	TbB2	B	483190.642	11.093		78	865.217404	78
191	SUB-4	SR-G	TbB2	B	240129.352	5.513		78	429.983688	78
218	SUB-4	SR-G	TbB2	B	8742.95126	0.201		78	15.6554224	78
220	SUB-4	SR-G	TbB2	B	226331.004	5.196		78	405.275903	78
231	SUB-4	SR-G	TbB2	B	8742.95126	0.201		78	15.6554224	78
232	SUB-4	SR-G	TbB2	B	1301.2291	0.030		78	2.33002455	78
233	SUB-4	SR-G	TbB2	B	195960.262	4.499		78	350.89303	78
235	SUB-4	SR-G	TbB2	B	30556.9976	0.701		78	54.7163869	78
236	SUB-4	SR-G	TbB2	B	1368.24259	0.031		78	2.45002116	78
238	SUB-4	SR-G	TbB2	B	96.1758388	0.002		78	0.17221569	78
239	SUB-4	SR-G	TbB2	B	96172.4639	2.208		78	172.209646	78
241	SUB-4	SR-G	TbB2	B	1297.62097	0.030		78	2.32356373	78
243	SUB-4	SR-G	TbB2	B	6302.94732	0.145		78	11.2862693	78
248	SUB-4	SR-G	TbB2	B	5017.00398	0.115		78	8.98361594	78
249	SUB-4	SR-G	TbB2	B	17485.9119	0.401		78	31.3108615	78
250	SUB-4	SR-G	TbB2	B	82629.4652	1.897		78	147.959098	78
254	SUB-4	SR-G	TbB2	B	3734.06273	0.086		78	6.68633822	78
257	SUB-4	SR-G	TbB2	B	113121.906	2.597		78	202.559886	78
259	SUB-4	SR-G	TbB2	B	2483.15674	0.057		78	4.44642392	78
182	SUB-4	SR-G	VaB	C	315874.848	7.251		85	616.37654	85
175	SUB-4	SR-G	VnB2	C	842508.194	19.341		85	1644.01277	85
196	SUB-4	SR-G	VnB2	C	80294.9235	1.843		85	156.682013	85
184	SUB-4	SR-G	VnC2	C	238434.816	5.474		85	465.265366	85
180	SUB-4	SR-G	W	D	46338.5803	1.064		89	94.677081	89
185	SUB-4	SR-G	W	D	87419.4791	2.007		89	178.611883	89
192	SUB-4	SR-G	WtB	C	187166.884	4.297		85	365.224635	85
211	SUB-4	WO-G	BaC	B	314292.284	7.215		55	396.833692	55
230	SUB-4	WO-G	BaC	B	143392.919	3.292		55	181.051665	55
262	SUB-4	WO-G	BaC	B	5669.16027	0.130		55	7.15803064	55
198	SUB-4	WO-G	CeB2	B	15627.8227	0.359		55	19.7320993	55
204	SUB-4	WO-G	EnB	C	62541.9669	1.436		70	100.50362	70
209	SUB-4	WO-G	EnB	C	205708.714	4.722		70	330.569558	70

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
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ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
215	SUB-4	WO-G	EnB	C	78733.5143	1.807		70	126.523095	70
202	SUB-4	WO-G	EnC	C	338681.262	7.775		70	544.253634	70
214	SUB-4	WO-G	EnC	C	174812.072	4.013		70	280.919308	70
207	SUB-4	WO-G	HeB	C	86504.4121	1.986		70	139.010763	70
200	SUB-4	WO-G	MeB2	C	42411.1415	0.974		70	68.1538086	70
199	SUB-4	WO-G	OkA	C	411066.047	9.437		70	660.574455	70
170	SUB-4	WO-G	PxB	B	36966.258	0.849		55	46.6745682	55
217	SUB-4	WO-G	PxB	B	17277.1517	0.397		55	21.8145855	55
228	SUB-4	WO-G	PxB	B	5.53776102	0.000		55	0.00699212	55
212	SUB-4	WO-G	TaB	B	67004.9791	1.538		55	84.6022464	55
263	SUB-4	WO-G	TaB	B	11816.7329	0.271		55	14.9201173	55
201	SUB-4	WO-G	TaC	B	226466.269	5.199		55	285.942259	55
208	SUB-4	WO-G	TaC	B	486873.981	11.177		55	614.739875	55
213	SUB-4	WO-G	TaC	B	4940.82286	0.113		55	6.2384127	55
225	SUB-4	WO-G	TaC	B	135512.312	3.111		55	171.101404	55
227	SUB-4	WO-G	TaC	B	144410.262	3.315		55	182.336189	55
245	SUB-4	WO-G	TaC	B	8727.78028	0.200		55	11.0199246	55
169	SUB-4	WO-G	TbB2	B	52923.204	1.215		55	66.8222272	55
206	SUB-4	WO-G	TbB2	B	228778.83	5.252		55	288.862159	55
210	SUB-4	WO-G	TbB2	B	572660.119	13.146		55	723.055706	55
216	SUB-4	WO-G	TbB2	B	132585.631	3.044		55	167.4061	55
226	SUB-4	WO-G	TbB2	B	49715.4601	1.141		55	62.7720456	55
229	SUB-4	WO-G	TbB2	B	44423.4204	1.020		55	56.0901772	55
246	SUB-4	WO-G	TbB2	B	15.1709826	0.000		55	0.01915528	55
260	SUB-4	WO-G	TbB2	B	8742.94191	0.201		55	11.0390681	55
197	SUB-4	WO-G	VaB	C	10865.3457	0.249		70	17.4603811	70
203	SUB-4	WO-G	VaB	C	31893.5175	0.732		70	51.2522091	70
205	SUB-4	WO-G	W	D	2830.60664	0.065		77	5.00359759	77
171	SUB-4	WO-G	WtB	C	10930.8072	0.251		70	17.5655763	70
	SUB-4 Total					**282.642**	**0.442**		**20889.0756**	**74**
286	SUB-5	BR-F	BaB	B	57215.6013	1.313		56	73.5554103	56
285	SUB-5	BR-F	BaC	B	7866.75679	0.181		56	10.1133696	56
287	SUB-5	BR-F	BaC	B	38558.9577	0.885		56	49.5707445	56
284	SUB-5	BR-F	BaD	B	876.20382	0.020		56	1.12643283	56
281	SUB-5	SR-G	BaB	B	184687.103	4.240		78	330.706933	78
283	SUB-5	SR-G	BaB	B	10274.1048	0.236		78	18.3971573	78
288	SUB-5	SR-G	BaB	B	173932.069	3.993		78	311.448608	78
301	SUB-5	SR-G	BaB	B	8742.96061	0.201		78	15.6554391	78
309	SUB-5	SR-G	BaB	B	1366249.2	31.365		78	2446.45173	78
317	SUB-5	SR-G	BaB	B	179139.097	4.112		78	320.772488	78
282	SUB-5	SR-G	BaC	B	117183.845	2.690		78	209.833332	78
289	SUB-5	SR-G	BaD	B	143176.441	3.287		78	256.376546	78
308	SUB-5	SR-G	BaD	B	1292.00049	0.030		78	2.31349949	78
310	SUB-5	SR-G	BaD	B	447802.653	10.280		78	801.85048	78
313	SUB-5	SR-G	BaD	B	280114.142	6.431		78	501.581797	78
314	SUB-5	SR-G	BaD	B	415.510562	0.010		78	0.74402718	78
318	SUB-5	SR-G	BaD	B	3073.35221	0.071		78	5.50324776	78
299	SUB-5	SR-G	ChA	C	1414.34529	0.032		85	2.75985651	85
291	SUB-5	SR-G	GoC	C	527.612879	0.012		85	1.02954763	85
312	SUB-5	SR-G	GoC	C	256296.528	5.884		85	500.119487	85
290	SUB-5	SR-G	GoF	C	271136.372	6.224		85	529.076942	85
311	SUB-5	SR-G	GoF	C	610300.126	14.011		85	1190.89786	85
300	SUB-5	SR-G	TaB	B	7132.74394	0.164		78	12.772131	78
268	SUB-5	WO-G	BaB	B	98204.8157	2.254		55	123.995979	55
271	SUB-5	WO-G	BaB	B	314167.01	7.212		55	396.675518	55
275	SUB-5	WO-G	BaB	B	16643.2038	0.382		55	21.0141462	55
292	SUB-5	WO-G	BaB	B	251420.588	5.772		55	317.450237	55
303	SUB-5	WO-G	BaB	B	38214.0386	0.877		55	48.2500487	55
319	SUB-5	WO-G	BaB	B	896.101277	0.021		55	1.13144101	55
321	SUB-5	WO-G	BaB	B	156209.309	3.586		55	197.233976	55
322	SUB-5	WO-G	BaB	B	40.2701197	0.001		55	0.05084611	55
267	SUB-5	WO-G	BaC	B	197851.142	4.542		55	249.812047	55
272	SUB-5	WO-G	BaC	B	736620.566	16.910		55	930.076472	55
280	SUB-5	WO-G	BaC	B	92838.76	2.131		55	117.220657	55
269	SUB-5	WO-G	BaD	B	731085.921	16.783		55	923.088284	55
274	SUB-5	WO-G	BaD	B	225361.439	5.174		55	284.547271	55
276	SUB-5	WO-G	BaD	B	38063.268	0.874		55	48.0596818	55
279	SUB-5	WO-G	BaD	B	64534.3627	1.482		55	81.4827812	55
293	SUB-5	WO-G	BaD	B	232127.403	5.329		55	293.090155	55
302	SUB-5	WO-G	BaD	B	5073.85477	0.116		55	6.40638228	55
307	SUB-5	WO-G	BaD	B	10509.913	0.241		55	13.2700921	55
320	SUB-5	WO-G	BaD	B	231.675155	0.005		55	0.29251914	55
278	SUB-5	WO-G	ChA	C	5155.02261	0.118		70	8.28401246	70
295	SUB-5	WO-G	ChA	C	269278.005	6.182		70	432.724067	70
305	SUB-5	WO-G	ChA	C	1495.1219	0.034		70	2.40262931	70
297	SUB-5	WO-G	GoC	C	95199.9711	2.185		70	152.984343	70
298	SUB-5	WO-G	GoC	C	195320.515	4.484		70	313.875942	70
306	SUB-5	WO-G	GoC	C	50365.565	1.156		70	80.9363992	70
316	SUB-5	WO-G	GoC	C	169.916279	0.004		70	0.27305187	70
277	SUB-5	WO-G	GoF	C	23823.2935	0.547		70	38.2835294	70
294	SUB-5	WO-G	GoF	C	767205.888	17.613		70	1232.88366	70
304	SUB-5	WO-G	GoF	C	195614.801	4.491		70	314.348853	70
315	SUB-5	WO-G	GoF	C	17315.9956	0.398		70	27.8264392	70
270	SUB-5	WO-G	KcB	C	180988.823	4.155		70	290.845216	70
264	SUB-5	WO-G	OkA	C	281998.622	6.474		70	453.165829	70

LITTLE BUFFALO CREEK
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ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
266	SUB-5	WO-G	TaB	B	187648.893	4.308		55	236.93042	55
296	SUB-5	WO-G	TaB	B	26710.2815	0.613		55	33.7251029	55
265	SUB-5	WO-G	Ud	C	96378.1807	2.213		70	154.877701	70
273	SUB-5	WO-G	Ud	C	254053.798	5.832		70	408.259088	70
	SUB-5 Total					**230.170**	**0.360**		**15828.4319**	**69**
1009	SUB-5A	SR-G	BaC	B	1700.42869	0.039		78	3.04484476	78
1025	SUB-5A	SR-G	ChA	C	896.633773	0.021		85	1.74962972	85
1030	SUB-5A	SR-G	ChA	C	70142.7605	1.610		85	136.871778	85
1033	SUB-5A	SR-G	ChA	C	96942.5963	2.225		85	189.167142	85
1001	SUB-5A	SR-G	EnB	C	11330.0658	0.260		85	22.1087142	85
1005	SUB-5A	SR-G	EnB	C	104631.006	2.402		85	204.169778	85
1012	SUB-5A	SR-G	EnB	C	5560.39965	0.128		85	10.850183	85
1032	SUB-5A	SR-G	GoF	C	11873.4409	0.273		85	23.1690192	85
1022	SUB-5A	SR-G	OkA	C	6775.04543	0.156		85	13.2203595	85
1003	SUB-5A	SR-G	TaB	B	109341.928	2.510		78	195.791331	78
1007	SUB-5A	SR-G	TaB	B	27473.0916	0.631		78	49.1942412	78
1010	SUB-5A	SR-G	TaB	B	245748.043	5.642		78	440.044705	78
1020	SUB-5A	SR-G	TaB	B	315109.029	7.234		78	564.244818	78
1024	SUB-5A	SR-G	TaB	B	27592.2036	0.633		78	49.4075271	78
1026	SUB-5A	SR-G	TaB	B	5429.61256	0.125		78	9.72244673	78
1029	SUB-5A	SR-G	TaB	B	263.939339	0.006		78	0.47261865	78
1031	SUB-5A	SR-G	TaB	B	229578.419	5.270		78	411.090833	78
1002	SUB-5A	SR-G	TaC	B	121916.453	2.799		78	218.307699	78
1006	SUB-5A	SR-G	TaC	B	3517.35884	0.081		78	6.29830095	78
1011	SUB-5A	SR-G	TaC	B	98234.5204	2.255		78	175.902034	78
1013	SUB-5A	SR-G	TaC	B	3182.54227	0.073		78	5.69876715	78
1019	SUB-5A	SR-G	TaC	B	13614.772	0.313		78	24.3790684	78
1023	SUB-5A	SR-G	TaC	B	36937.8276	0.848		78	66.1421156	78
1004	SUB-5A	SR-G	TbB2	B	29365.4674	0.674		78	52.5827929	78
1008	SUB-5A	SR-G	TbB2	B	20687.0318	0.475		78	37.0428945	78
1000	SUB-5A	WO-G	ChA	C	2950.52247	0.068		70	4.74142729	70
1027	SUB-5A	WO-G	ChA	C	37382.4615	0.858		70	60.0728261	70
1035	SUB-5A	WO-G	ChA	C	11955.893	0.274		70	19.2128676	70
1015	SUB-5A	WO-G	EnB	C	151.501629	0.003		70	0.24345992	70
1034	SUB-5A	WO-G	GoF	C	34365.6647	0.789		70	55.2248974	70
996	SUB-5A	WO-G	OkA	C	396326.7	9.098		70	636.888637	70
997	SUB-5A	WO-G	TaB	B	87087.6292	1.999		55	109.959128	55
999	SUB-5A	WO-G	TaB	B	344987.043	7.920		55	435.589701	55
1016	SUB-5A	WO-G	TaB	B	4288.3542	0.098		55	5.41458864	55
1018	SUB-5A	WO-G	TaB	B	5540.97009	0.127		55	6.99617436	55
1021	SUB-5A	WO-G	TaB	B	8742.95126	0.201		55	11.0390799	55
1028	SUB-5A	WO-G	TaB	B	5816.21948	0.134		55	7.34371146	55
998	SUB-5A	WO-G	TaC	B	797612.449	18.311		55	1007.08643	55
1017	SUB-5A	WO-G	TaC	B	77390.0395	1.777		55	97.7146963	55
1014	SUB-5A	WO-G	TbB2	B	58.656577	0.001		55	0.07406133	55
	SUB-5A Total					**78.340**	**0.122**		**5368.27532**	**69**
373	SUB-6	BR-F	BaC	B	2192.69416	0.050		56	2.81889056	56
374	SUB-6	BR-F	BaD	B	127156.206	2.919		56	163.46987	56
370	SUB-6	BR-F	EnB	C	133522.729	3.065		70	214.568206	70
376	SUB-6	BR-F	TaB	B	22326.123	0.513		56	28.7020865	56
371	SUB-6	BR-F	TaC	B	1415.16326	0.032		56	1.81930997	56
375	SUB-6	BR-F	TaC	B	25376.6963	0.583		56	32.623852	56
372	SUB-6	BR-F	TbB2	B	26974.9959	0.619		56	34.6785989	56
351	SUB-6	SR-G	BaC	B	165681.111	3.804		78	296.674166	78
358	SUB-6	SR-G	BaC	B	253996.33	5.831		78	454.814366	78
364	SUB-6	SR-G	BaC	B	125610.328	2.884		78	224.922075	78
389	SUB-6	SR-G	BaC	B	18378.0131	0.422		78	32.9082879	78
391	SUB-6	SR-G	BaC	B	9008.84086	0.207		78	16.1315332	78
396	SUB-6	SR-G	BaC	B	1009.04876	0.023		78	1.80683661	78
328	SUB-6	SR-G	BaD	B	2656.55571	0.061		78	4.75691795	78
352	SUB-6	SR-G	BaD	B	75049.8829	1.723		78	134.386843	78
359	SUB-6	SR-G	BaD	B	171803.633	3.944		78	307.63736	78
365	SUB-6	SR-G	BaD	B	23349.5831	0.536		78	41.8105483	78
393	SUB-6	SR-G	BaD	B	6.73385362	0.000		78	0.01205786	78
399	SUB-6	SR-G	BaD	B	186457.208	4.280		78	333.876543	78
392	SUB-6	SR-G	ChA	C	239.520932	0.005		85	0.46738474	85
397	SUB-6	SR-G	ChA	C	465425.315	10.685		85	908.199076	85
405	SUB-6	SR-G	ChA	C	214659.717	4.928		85	418.872266	85
324	SUB-6	SR-G	EnB	C	47317.2784	1.086		85	92.3316957	85
327	SUB-6	SR-G	EnB	C	3.787056	0.000		85	0.0073898	85
361	SUB-6	SR-G	EnB	C	64914.1673	1.490		85	126.669059	85
367	SUB-6	SR-G	EnB	C	86823.0468	1.993		85	169.420546	85
404	SUB-6	SR-G	GoF	C	1688.00071	0.039		85	3.29384896	85
329	SUB-6	SR-G	MeB2	C	345977.683	7.943		85	675.11715	85
388	SUB-6	SR-G	OkA	C	4460.51682	0.102		85	8.70394696	85
362	SUB-6	SR-G	TaB	B	75458.7594	1.732		78	135.118991	78
368	SUB-6	SR-G	TaB	B	30697.2766	0.705		78	54.9675751	78
379	SUB-6	SR-G	TaB	B	99680.8293	2.288		78	178.491843	78
385	SUB-6	SR-G	TaB	B	4593.58165	0.105		78	8.22542168	78
387	SUB-6	SR-G	TaB	B	217445.375	4.992		78	389.364997	78
390	SUB-6	SR-G	TaB	B	75864.3763	1.742		78	135.845302	78
394	SUB-6	SR-G	TaB	B	1064.25419	0.024		78	1.90568932	78
395	SUB-6	SR-G	TaB	B	1155.63545	0.027		78	2.06931967	78
398	SUB-6	SR-G	TaB	B	2446.97377	0.056		78	4.38163348	78
400	SUB-6	SR-G	TaB	B	376570.165	8.645		78	674.299193	78

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
406	SUB-6	SR-G	TaB	B	164774.787	3.783		78	295.051271	78
326	SUB-6	SR-G	TaC	B	273608.246	6.281		78	489.932122	78
330	SUB-6	SR-G	TaC	B	142128.011	3.263		78	254.499192	78
350	SUB-6	SR-G	TaC	B	14321.2402	0.329		78	25.644094	78
360	SUB-6	SR-G	TaC	B	50205.5524	1.153		78	89.8997495	78
366	SUB-6	SR-G	TaC	B	49526.024	1.137		78	88.682963	78
377	SUB-6	SR-G	TaC	B	1493.67218	0.034		78	2.67461961	78
384	SUB-6	SR-G	TaC	B	4149.36962	0.095		78	7.43000069	78
386	SUB-6	SR-G	TaC	B	4524.23271	0.104		78	8.10124315	78
325	SUB-6	SR-G	TbB2	B	33665.8442	0.773		78	60.2831922	78
349	SUB-6	SR-G	TbB2	B	146228.376	3.357		78	261.841444	78
357	SUB-6	SR-G	TbB2	B	83970.6364	1.928		78	150.360644	78
363	SUB-6	SR-G	TbB2	B	109300.705	2.509		78	195.717515	78
369	SUB-6	SR-G	TbB2	B	4414.80745	0.101		78	7.9053026	78
378	SUB-6	SR-G	TbB2	B	175661.62	4.033		78	314.545601	78
323	SUB-6	SR-G	VaB	C	270688.104	6.214		85	528.202223	85
336	SUB-6	WO-G	BaC	B	8982.16808	0.206		55	11.3411213	55
342	SUB-6	WO-G	BaC	B	10509.538	0.241		55	13.2696187	55
347	SUB-6	WO-G	BaC	B	170099.756	3.905		55	214.772419	55
354	SUB-6	WO-G	BaC	B	144367.353	3.314		55	182.282012	55
401	SUB-6	WO-G	BaC	B	1354.94385	0.031		55	1.71078769	55
337	SUB-6	WO-G	BaD	B	1367360.82	31.390		55	1726.46568	55
348	SUB-6	WO-G	BaD	B	16.8435963	0.000		55	0.02126717	55
355	SUB-6	WO-G	BaD	B	4084.85255	0.094		55	5.15764211	55
403	SUB-6	WO-G	BaD	B	21753.8884	0.499		55	27.4670308	55
402	SUB-6	WO-G	ChA	C	73.8942154	0.002		70	0.11874644	70
408	SUB-6	WO-G	ChA	C	3228.27238	0.074		70	5.18776553	70
332	SUB-6	WO-G	EnB	C	1718.72437	0.039		70	2.76195377	70
335	SUB-6	WO-G	EnB	C	187800.641	4.311		70	301.791664	70
356	SUB-6	WO-G	EnB	C	34995.6538	0.803		70	56.2372766	70
407	SUB-6	WO-G	GoF	C	2685.36872	0.062		70	4.31533081	70
338	SUB-6	WO-G	MeB2	C	50757.406	1.165		70	81.5660795	70
346	SUB-6	WO-G	OkA	C	112261.3	2.577		70	180.401537	70
340	SUB-6	WO-G	TaB	B	390492.734	8.964		55	493.046381	55
344	SUB-6	WO-G	TaB	B	807897.748	18.547		55	1020.07291	55
345	SUB-6	WO-G	TaB	B	218197.521	5.009		55	275.50192	55
381	SUB-6	WO-G	TaB	B	333999.482	7.668		55	421.716518	55
383	SUB-6	WO-G	TaB	B	98948.1462	2.272		55	124.934528	55
334	SUB-6	WO-G	TaC	B	68694.2678	1.577		55	86.7351866	55
339	SUB-6	WO-G	TaC	B	1848402.32	42.433		55	2333.84132	55
343	SUB-6	WO-G	TaC	B	835.52787	0.019		55	1.05495943	55
380	SUB-6	WO-G	TaC	B	595557.203	13.672		55	751.966166	55
382	SUB-6	WO-G	TaC	B	189569.236	4.352		55	239.355096	55
333	SUB-6	WO-G	TbB2	B	62844.396	1.443		55	79.3489849	55
341	SUB-6	WO-G	TbB2	B	310921.57	7.138		55	392.57774	55
353	SUB-6	WO-G	TbB2	B	103467.576	2.375		55	130.640878	55
331	SUB-6	WO-G	VaB	C	101191.327	2.323		70	162.612326	70
	SUB-6 Total					**281.685**	**0.440**		**18425.2147**	**65**
434	SUB-7	SR-G	BaB	B	14311.7216	0.329		78	25.6270497	78
435	SUB-7	SR-G	BaD	B	708.814007	0.016		78	1.26922618	78
428	SUB-7	SR-G	ChA	C	5150.07887	0.118		85	10.0495111	85
427	SUB-7	SR-G	GoF	C	32200.2265	0.739		85	62.8333161	85
430	SUB-7	WO-G	BaB	B	3813.96258	0.088		55	4.81560932	55
436	SUB-7	WO-G	BaB	B	20.9035086	0.000		55	0.02639332	55
438	SUB-7	WO-G	BaB	B	32924.7569	0.756		55	41.5716628	55
441	SUB-7	WO-G	BaB	B	333839.902	7.664		55	421.515027	55
444	SUB-7	WO-G	BaB	B	13441.2382	0.309		55	16.9712604	55
450	SUB-7	WO-G	BaB	B	54070.8616	1.241		55	68.2712899	55
453	SUB-7	WO-G	BaB	B	1522.79899	0.035		55	1.922726	55
454	SUB-7	WO-G	BaB	B	0.36427923	0.000		55	0.00045995	55
457	SUB-7	WO-G	BaB	B	5654.45375	0.130		55	7.1394618	55
433	SUB-7	WO-G	BaD	B	96613.5839	2.218		55	121.986848	55
437	SUB-7	WO-G	BaD	B	8722.04776	0.200		55	11.0126866	55
439	SUB-7	WO-G	BaD	B	1150.94684	0.026		55	1.45321571	55
442	SUB-7	WO-G	BaD	B	49608.1222	1.139		55	62.6365179	55
446	SUB-7	WO-G	BaD	B	4629.18612	0.106		55	5.84493197	55
448	SUB-7	WO-G	BaD	B	8728.73906	0.200		55	11.0211352	55
451	SUB-7	WO-G	BaD	B	22868.2438	0.525		55	28.8740452	55
432	SUB-7	WO-G	ChA	C	359.676447	0.008		70	0.57799245	70
429	SUB-7	WO-G	GoC	C	8747.74583	0.201		70	14.0574428	70
440	SUB-7	WO-G	GoC	C	43319.5258	0.994		70	69.613563	70
443	SUB-7	WO-G	GoC	C	122492.763	2.812		70	196.843283	70
447	SUB-7	WO-G	GoC	C	14.2122086	0.000		70	0.02283872	70
449	SUB-7	WO-G	GoC	C	25406.3642	0.583		70	40.8274906	70
452	SUB-7	WO-G	GoC	C	23500.6521	0.540		70	37.7650516	70
455	SUB-7	WO-G	GoC	C	17611.542	0.404		70	28.301376	70
456	SUB-7	WO-G	GoC	C	3088.48816	0.071		70	4.96313525	70
458	SUB-7	WO-G	GoC	C	1970.96102	0.045		70	3.16729274	70
459	SUB-7	WO-G	GoC	C	4113.45677	0.094		70	6.61023815	70
460	SUB-7	WO-G	GoC	C	6821.47847	0.157		70	10.9619718	70
461	SUB-7	WO-G	GoC	C	3535.62629	0.081		70	5.68167678	70
462	SUB-7	WO-G	GoC	C	36.055854	0.001		70	0.057941	70
431	SUB-7	WO-G	GoF	C	130597.163	2.998		70	209.866882	70
445	SUB-7	WO-G	GoF	C	5892.7769	0.135		70	9.46956803	70
	SUB-7 Total					**24.965**	**0.039**		**1543.63012**	**62**

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
1037	SUB-7A	SR-G	ChA	C	232386.129	5.335		85	453.462372	85
1036	SUB-7A	SR-G	GoF	C	7927.69275	0.182		85	15.4695566	85
1038	SUB-7A	SR-G	TaB	B	135914.776	3.120		78	243.373566	78
1040	SUB-7A	WO-G	ChA	C	1362.4181	0.031		70	2.18937711	70
1039	SUB-7A	WO-G	GoF	C	1682.03237	0.039		70	2.7029905	70
	SUB-7A Total					**8.707**	**0.014**		**717.197862**	**82**
512	SUB-8	BR-F	BaB	B	3061.67786	0.070		56	3.93604133	56
515	SUB-8	BR-F	BaB	B	150115.801	3.446		56	192.986337	56
473	SUB-8	BR-F	BaC	B	115115.333	2.643		56	147.990328	56
478	SUB-8	BR-F	BaC	B	33603.1148	0.771		56	43.1995967	56
504	SUB-8	BR-F	BaC	B	7563.79948	0.174		56	9.72389281	56
511	SUB-8	BR-F	BaC	B	6919.73811	0.159		56	8.8958984	56
514	SUB-8	BR-F	BaD	B	346644.259	7.958		56	445.640002	56
525	SUB-8	BR-F	BaD	B	8742.94191	0.201		56	11.2397784	56
471	SUB-8	BR-F	EnB	C	294248.488	6.755		70	472.851106	70
477	SUB-8	BR-F	EnB	C	10111.6321	0.232		70	16.2491793	70
481	SUB-8	BR-F	EnB	C	32810.4119	0.753		70	52.725639	70
513	SUB-8	BR-F	TaB	B	8101.2726	0.186		56	10.4148592	56
516	SUB-8	BR-F	TaB	B	26161.1631	0.601		56	33.6323493	56
472	SUB-8	BR-F	TbB2	B	7753.39604	0.178		56	9.96763495	56
496	SUB-8	SR-G	BaB	B	430196.185	9.876		78	770.323747	78
519	SUB-8	SR-G	BaB	B	6085.87054	0.140		78	10.8975643	78
521	SUB-8	SR-G	BaB	B	86874.2719	1.994		78	155.559991	78
530	SUB-8	SR-G	BaB	B	64466.6892	1.480		78	115.43622	78
532	SUB-8	SR-G	BaB	B	253899.556	5.829		78	454.641079	78
476	SUB-8	SR-G	BaC	B	37883.2628	0.870		78	67.8350436	78
494	SUB-8	SR-G	BaC	B	124485.943	2.858		78	222.908713	78
506	SUB-8	SR-G	BaD	B	69139.4077	1.587		78	123.803347	78
520	SUB-8	SR-G	BaD	B	97592.4254	2.240		78	174.752277	78
529	SUB-8	SR-G	BaD	B	226921.427	5.209		78	406.333134	78
527	SUB-8	SR-G	ChA	C	256880.733	5.897		85	501.259465	85
493	SUB-8	SR-G	EnB	C	394385.087	9.054		85	769.576042	85
526	SUB-8	SR-G	GoF	C	19.9132533	0.000		85	0.03885736	85
495	SUB-8	SR-G	TaB	B	222258.555	5.102		78	397.983639	78
502	SUB-8	SR-G	TaB	B	10806.8649	0.248		78	19.3511355	78
503	SUB-8	SR-G	TaB	B	444.931089	0.010		78	0.79670856	78
505	SUB-8	SR-G	TaB	B	433813.508	9.959		78	776.801047	78
522	SUB-8	SR-G	TaB	B	84267.0604	1.935		78	150.891431	78
528	SUB-8	SR-G	TaB	B	478865.795	10.993		78	857.473186	78
531	SUB-8	SR-G	TaB	B	579573.322	13.305		78	1037.80347	78
475	SUB-8	SR-G	TbB2	B	388225.082	8.912		78	695.16888	78
468	SUB-8	WO-G	BaB	B	72581.2535	1.666		55	91.6429969	55
518	SUB-8	WO-G	BaB	B	111.621521	0.003		55	0.14093626	55
465	SUB-8	WO-G	BaC	B	1702753.75	39.090		55	2149.94161	55
480	SUB-8	WO-G	BaC	B	33.2856273	0.001		55	0.04202731	55
484	SUB-8	WO-G	BaC	B	10570.6036	0.243		55	13.3467217	55
486	SUB-8	WO-G	BaC	B	8742.95126	0.201		55	11.0390799	55
487	SUB-8	WO-G	BaC	B	8742.94191	0.201		55	11.0390681	55
489	SUB-8	WO-G	BaC	B	130342.435	2.992		55	164.573782	55
491	SUB-8	WO-G	BaC	B	18854.3442	0.433		55	23.8059902	55
498	SUB-8	WO-G	BaC	B	19660.9142	0.451		55	24.8243867	55
508	SUB-8	WO-G	BaC	B	668.276124	0.015		55	0.84378298	55
517	SUB-8	WO-G	BaC	B	4358.12353	0.100		55	5.50268122	55
470	SUB-8	WO-G	BaD	B	108.653081	0.002		55	0.13718823	55
510	SUB-8	WO-G	BaD	B	5520.03571	0.127		55	6.96974205	55
524	SUB-8	WO-G	BaD	B	87135.9198	2.000		55	110.020101	55
535	SUB-8	WO-G	BaD	B	68900.6525	1.582		55	86.9957733	55
533	SUB-8	WO-G	ChA	C	49203.8769	1.130		70	79.0695911	70
463	SUB-8	WO-G	EnB	C	71458.4659	1.640		70	114.832245	70
474	SUB-8	WO-G	EnB	C	78626.2662	1.805		70	126.350749	70
479	SUB-8	WO-G	EnB	C	17452.6076	0.401		70	28.0459717	70
482	SUB-8	WO-G	EnB	C	8742.95126	0.201		70	14.049738	70
485	SUB-8	WO-G	EnB	C	11516.2024	0.264		70	18.5062941	70
466	SUB-8	WO-G	TaB	B	212794.032	4.885		55	268.679333	55
467	SUB-8	WO-G	TaB	B	32002.0561	0.735		55	40.4066365	55
469	SUB-8	WO-G	TaB	B	429.375503	0.010		55	0.54214079	55
500	SUB-8	WO-G	TaB	B	527178.257	12.102		55	665.629113	55
501	SUB-8	WO-G	TaB	B	1152.95734	0.026		55	1.45575422	55
507	SUB-8	WO-G	TaB	B	15923.2819	0.366		55	20.1051539	55
509	SUB-8	WO-G	TaB	B	43191.5676	0.992		55	54.5348075	55
523	SUB-8	WO-G	TaB	B	293.583482	0.007		55	0.37068621	55
534	SUB-8	WO-G	TaB	B	56754.5146	1.303		55	71.6597406	55
499	SUB-8	WO-G	TaC	B	12490.4858	0.287		55	15.7708154	55
464	SUB-8	WO-G	TbB2	B	447164.191	10.265		55	564.601251	55
483	SUB-8	WO-G	TbB2	B	6915.30827	0.159		55	8.73144983	55
488	SUB-8	WO-G	TbB2	B	35773.6295	0.821		55	45.1687241	55
490	SUB-8	WO-G	TbB2	B	33603.3727	0.771		55	42.4285009	55
492	SUB-8	WO-G	TbB2	B	8742.95126	0.201		55	11.0390799	55
497	SUB-8	WO-G	TbB2	B	6567.9302	0.151		55	8.29284116	55
	SUB-8 Total					**209.254**	**0.327**		**14070.2241**	**67**
582	SUB-9	BR-F	BaB	B	146698.574	3.368		56	188.593208	56
584	SUB-9	BR-F	BaB	B	258772.715	5.941		56	332.673831	56
587	SUB-9	BR-F	BaB	B	17485.9119	0.401		56	22.4795929	56
581	SUB-9	BR-F	BaD	B	71875.2078	1.650		56	92.4015527	56
583	SUB-9	BR-F	BaD	B	3515.82253	0.081		56	4.51988204	56

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
589	SUB-9	BR-G	BaB	B	164991.327	3.788		48	181.808625	48
588	SUB-9	BR-G	BaD	B	6582.15326	0.151		48	7.25306145	48
537	SUB-9	SR-G	BaB	B	448851.048	10.304		78	803.727772	78
538	SUB-9	SR-G	BaB	B	366280.515	8.409		78	655.8742	78
554	SUB-9	SR-G	BaB	B	382262.829	8.776		78	684.49267	78
557	SUB-9	SR-G	BaB	B	158366.326	3.636		78	283.576065	78
558	SUB-9	SR-G	BaB	B	62661.5482	1.439		78	112.203874	78
591	SUB-9	SR-G	BaB	B	89493.1528	2.054		78	160.249447	78
601	SUB-9	SR-G	BaB	B	148704.259	3.414		78	266.274843	78
536	SUB-9	SR-G	BaD	B	590245.565	13.550		78	1056.91355	78
553	SUB-9	SR-G	BaD	B	95212.0978	2.186		78	170.489982	78
556	SUB-9	SR-G	BaD	B	18523.6647	0.425		78	33.1690965	78
590	SUB-9	SR-G	BaD	B	253670.696	5.823		78	454.231274	78
600	SUB-9	SR-G	BaD	B	8069.52202	0.185		78	14.4495573	78
543	SUB-9	SR-G	ChA	C	5112.90019	0.117		85	9.97696318	85
542	SUB-9	SR-G	GoF	C	22503.4164	0.517		85	43.9116252	85
541	SUB-9	SR-G	TaB	B	1261072.59	28.950		78	2258.11897	78
555	SUB-9	SR-G	TaB	B	116789.661	2.681		78	209.127493	78
602	SUB-9	SR-G	TaB	B	206889.939	4.750		78	370.464079	78
539	SUB-9	SR-G	W	D	5.4874182	0.000		89	0.01121167	89
540	SUB-9	SR-G	W	D	7287.77146	0.167		89	14.8900748	89
592	SUB-9	SR-G	W	D	2893.66831	0.066		89	5.91222405	89
593	SUB-9	SR-G	W	D	3660.53341	0.084		89	7.47905128	89
595	SUB-9	WATER	BaB	B	3808.44378	0.087		98	8.5681242	98
596	SUB-9	WATER	BaB	B	14062.307	0.323		98	31.6369624	98
594	SUB-9	WATER	BaD	B	147140.084	3.378		98	331.031409	98
599	SUB-9	WATER	TaB	B	109074.294	2.504		98	245.392123	98
597	SUB-9	WATER	W	D	223230.797	5.125		98	502.218048	98
598	SUB-9	WATER	W	D	27261.1963	0.626		98	61.3314334	98
547	SUB-9	WO-G	BaB	B	1648821.63	37.852		55	2081.84549	55
548	SUB-9	WO-G	BaB	B	18745.8152	0.430		55	23.6689585	55
550	SUB-9	WO-G	BaB	B	150914.869	3.465		55	190.549078	55
561	SUB-9	WO-G	BaB	B	53422.3137	1.226		55	67.4524163	55
566	SUB-9	WO-G	BaB	B	38592.6846	0.886		55	48.7281372	55
545	SUB-9	WO-G	BaD	B	2355918.33	54.084		55	2974.64436	55
559	SUB-9	WO-G	BaD	B	27207.3724	0.625		55	34.3527429	55
564	SUB-9	WO-G	BaD	B	338.394449	0.008		55	0.42726572	55
552	SUB-9	WO-G	ChA	C	19672.6987	0.452		70	31.6136114	70
546	SUB-9	WO-G	GoC	C	134016.025	3.077		70	215.360922	70
560	SUB-9	WO-G	GoC	C	26854.9672	0.617		70	43.155365	70
562	SUB-9	WO-G	GoC	C	851.322389	0.020		70	1.3680571	70
563	SUB-9	WO-G	GoC	C	27434.2471	0.630		70	44.0862557	70
565	SUB-9	WO-G	GoC	C	151135.13	3.470		70	242.870962	70
568	SUB-9	WO-G	GoC	C	22665.1316	0.520		70	36.4223878	70
570	SUB-9	WO-G	GoC	C	1811.65844	0.042		70	2.91129685	70
571	SUB-9	WO-G	GoC	C	5207.33432	0.120		70	8.36807627	70
572	SUB-9	WO-G	GoC	C	43678.7005	1.003		70	70.1907491	70
573	SUB-9	WO-G	GoC	C	8633.46273	0.198		70	13.8737923	70
574	SUB-9	WO-G	GoC	C	8742.95126	0.201		70	14.049738	70
575	SUB-9	WO-G	GoC	C	8742.94191	0.201		70	14.049723	70
576	SUB-9	WO-G	GoC	C	4424.48342	0.102		70	7.11005141	70
578	SUB-9	WO-G	GoC	C	8187.47209	0.188		70	13.1570947	70
585	SUB-9	WO-G	GoC	C	2433.66605	0.056		70	3.91084994	70
551	SUB-9	WO-G	GoF	C	1010453.55	23.197		70	1623.77751	70
567	SUB-9	WO-G	GoF	C	37209.8803	0.854		70	59.7954917	70
569	SUB-9	WO-G	GoF	C	75187.0775	1.726		70	120.824046	70
577	SUB-9	WO-G	GoF	C	1148.49198	0.026		70	1.84560236	70
579	SUB-9	WO-G	GoF	C	29607.479	0.680		70	47.5785934	70
580	SUB-9	WO-G	GoF	C	8742.96061	0.201		70	14.0497531	70
586	SUB-9	WO-G	GoF	C	6309.27587	0.145		70	10.1388731	70
544	SUB-9	WO-G	TaB	B	127933.325	2.937		55	161.531976	55
549	SUB-9	WO-G	W	D	6061.82539	0.139		77	10.7153479	77
	SUB-9 Total					**264.329**	**0.413**		**17859.8764**	**68**
1088	SUB-9A	SR-G	ChA	C	12590.9734	0.289		85	24.569163	85
1087	SUB-9A	SR-G	GoF	C	23396.3788	0.537		85	45.6540908	85
1091	SUB-9A	WO-G	ChA	C	58848.4545	1.351		70	94.5682235	70
1089	SUB-9A	WO-G	GoC	C	105975.064	2.433		70	170.29969	70
1092	SUB-9A	WO-G	GoC	C	24180.3363	0.555		70	38.8572898	70
1094	SUB-9A	WO-G	GoC	C	27947.4864	0.642		70	44.9110204	70
1095	SUB-9A	WO-G	GoC	C	85117.3796	1.954		70	136.781831	70
1097	SUB-9A	WO-G	GoC	C	6771.99959	0.155		70	10.8824603	70
1098	SUB-9A	WO-G	GoC	C	4629.4945	0.106		70	7.43949988	70
1099	SUB-9A	WO-G	GoC	C	109.814354	0.003		70	0.17646935	70
1100	SUB-9A	WO-G	GoC	C	8742.94191	0.201		70	14.049723	70
1101	SUB-9A	WO-G	GoC	C	109.479185	0.003		70	0.17593074	70
1102	SUB-9A	WO-G	GoC	C	8742.96061	0.201		70	14.0497531	70
1103	SUB-9A	WO-G	GoC	C	11912.9365	0.273		70	19.1438373	70
1104	SUB-9A	WO-G	GoC	C	5919.79589	0.136		70	9.51298697	70
1090	SUB-9A	WO-G	GoF	C	242531.688	5.568		70	389.743301	70
1093	SUB-9A	WO-G	GoF	C	21708.6365	0.498		70	34.8853204	70
1096	SUB-9A	WO-G	GoF	C	506.729712	0.012		70	0.81430394	70
	SUB-9A Total					**14.916**	**0.023**		**1056.51489**	**71**
1083	SUB-9B	SR-G	BaB	B	565221.945	12.976		78	1012.10541	78
1081	SUB-9B	SR-G	BaD	B	8894.70532	0.204		78	15.9271583	78
1080	SUB-9B	SR-G	ChA	C	492471.24	11.306		85	960.974641	85

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
1079	SUB-9B	SR-G	GoF	C	9499.48507	0.218		85	18.5366444	85
1082	SUB-9B	SR-G	TaB	B	882220.266	20.253		78	1579.73326	78
1085	SUB-9B	WO-G	ChA	C	22651.664	0.520		70	36.4007456	70
1086	SUB-9B	WO-G	ChA	C	7764.8305	0.178		70	12.4779186	70
1084	SUB-9B	WO-G	GoF	C	1802.5066	0.041		70	2.89659003	70
	SUB-9B Total					**45.696**	**0.071**		**3639.05237**	**80**
1041	SUB-9C	SR-G	BaB	B	582002.553	13.361		78	1042.15333	78
1046	SUB-9C	SR-G	BaB	B	9866.33101	0.226		78	17.6669839	78
1042	SUB-9C	SR-G	BaD	B	420270.823	9.648		78	752.55106	78
1047	SUB-9C	SR-G	BaD	B	11156.9978	0.256		78	19.9780953	78
1045	SUB-9C	SR-G	ChA	C	42373.407	0.973		85	82.6845638	85
1043	SUB-9C	SR-G	GeB2	B	530552.425	12.180		78	950.025004	78
1048	SUB-9C	SR-G	TaB	B	965055.253	22.155		78	1728.06037	78
1044	SUB-9C	SR-G	W	D	36504.3018	0.838		89	74.5840877	89
1050	SUB-9C	WO-G	BaD	B	6544.47565	0.150		55	8.26322683	55
1052	SUB-9C	WO-G	ChA	C	9641.90557	0.221		70	15.4943386	70
1049	SUB-9C	WO-G	GeB2	B	1199.10052	0.028		55	1.51401581	55
1051	SUB-9C	WO-G	TaB	B	8001.47267	0.184		55	10.1028695	55
	SUB-9C Total					**60.220**	**0.094**		**4703.07795**	**78**
1109	SUB-9D	SR-G	BaD	B	1244.26118	0.029		78	2.22801588	78
1115	SUB-9D	SR-G	BaD	B	12922.3796	0.297		78	23.1392472	78
1107	SUB-9D	SR-G	BaF	B	1030.13818	0.024		78	1.84460005	78
1108	SUB-9D	SR-G	ChA	C	298448.878	6.851		85	582.372697	85
1114	SUB-9D	SR-G	ChA	C	175995.632	4.040		85	343.42582	85
1118	SUB-9D	SR-G	ChA	C	34971.8051	0.803		85	68.2415847	85
1121	SUB-9D	SR-G	ChA	C	8742.94191	0.201		85	17.0603779	85
1105	SUB-9D	SR-G	GeB2	B	1622382.44	37.245		78	2905.09253	78
1112	SUB-9D	SR-G	GeB2	B	699129.143	16.050		78	1251.88414	78
1116	SUB-9D	SR-G	GeB2	B	8742.95126	0.201		78	15.6554224	78
1117	SUB-9D	SR-G	GeB2	B	1502.74127	0.034		78	2.69085903	78
1106	SUB-9D	SR-G	TaB	B	220700.165	5.067		78	395.193133	78
1113	SUB-9D	SR-G	TaB	B	9657.943	0.222		78	17.2938373	78
1122	SUB-9D	WO-G	BaF	B	1171.07645	0.027		55	1.47863188	55
1125	SUB-9D	WO-G	BaF	B	1459.75287	0.034		55	1.84312231	55
1111	SUB-9D	WO-G	ChA	C	137431.341	3.155		70	220.849263	70
1119	SUB-9D	WO-G	ChA	C	3270.0211	0.075		70	5.25485484	70
1120	SUB-9D	WO-G	ChA	C	6412.86118	0.147		70	10.3053325	70
1123	SUB-9D	WO-G	ChA	C	36441.5014	0.837		70	58.5607232	70
1124	SUB-9D	WO-G	ChA	C	719.853593	0.017		70	1.15678952	70
1126	SUB-9D	WO-G	ChA	C	1453.89506	0.033		70	2.33637865	70
1110	SUB-9D	WO-G	GeB2	B	2202.18078	0.051		55	2.78053129	55
	SUB-9D Total					**75.437**	**0.118**		**5930.68789**	**79**
1128	SUB-9E	SR-G	BaB	B	1622492.84	37.247		78	2905.29021	78
1179	SUB-9E	SR-G	BaB	B	63.2360074	0.001		78	0.11323252	78
1127	SUB-9E	SR-G	BaD	B	162612.541	3.733		78	291.179481	78
1130	SUB-9E	SR-G	BaD	B	436316.069	10.016		78	781.282216	78
1132	SUB-9E	SR-G	BaD	B	688359.84	15.803		78	1232.60026	78
1131	SUB-9E	SR-G	BaF	B	36984.0399	0.849		78	66.2248648	78
1136	SUB-9E	SR-G	ChA	C	222244.84	5.102		85	433.673355	85
1146	SUB-9E	SR-G	ChA	C	88.5913	0.002		85	0.17287099	85
1135	SUB-9E	SR-G	GoF	C	889816.921	20.427		85	1736.32778	85
1129	SUB-9E	SR-G	TaB	B	287569.426	6.602		78	514.931479	78
1134	SUB-9E	SR-G	TaB	B	256859.631	5.897		78	459.941487	78
1180	SUB-9E	SR-G	TaB	B	2200.65126	0.051		78	3.9405601	78
1133	SUB-9E	SR-G	W	D	6141.91403	0.141		89	12.5489061	89
1175	SUB-9E	WATER	BaB	B	2221.96561	0.051		98	4.99891253	98
1176	SUB-9E	WATER	BaD	B	100322.08	2.303		98	225.701649	98
1178	SUB-9E	WATER	GoF	C	11016.4441	0.253		98	24.7844701	98
1177	SUB-9E	WATER	W	D	52555.5753	1.207		98	118.237979	98
1143	SUB-9E	WO-G	BaB	B	151135.268	3.470		55	190.827359	55
1161	SUB-9E	WO-G	BaB	B	150397.296	3.453		55	189.895576	55
1183	SUB-9E	WO-G	BaB	B	4224.33252	0.097		55	5.33375318	55
1187	SUB-9E	WO-G	BaB	B	31823.108	0.731		55	40.1806919	55
1139	SUB-9E	WO-G	BaD	B	75351.876	1.730		55	95.1412576	55
1142	SUB-9E	WO-G	BaD	B	2678.3048	0.061		55	3.38169798	55
1144	SUB-9E	WO-G	BaD	B	55077.1411	1.264		55	69.5418448	55
1147	SUB-9E	WO-G	BaD	B	235669.669	5.410		55	297.562714	55
1150	SUB-9E	WO-G	BaD	B	99269.0339	2.279		55	125.339689	55
1153	SUB-9E	WO-G	BaD	B	8858.12917	0.203		55	11.1845065	55
1155	SUB-9E	WO-G	BaD	B	8742.94191	0.201		55	11.0390681	55
1163	SUB-9E	WO-G	BaD	B	187544.251	4.305		55	236.798297	55
1189	SUB-9E	WO-G	BaD	B	18417.2932	0.423		55	23.2541581	55
1192	SUB-9E	WO-G	BaD	B	1007.81513	0.023		55	1.27249385	55
1158	SUB-9E	WO-G	BaF	B	103.959874	0.002		55	0.13126247	55
1162	SUB-9E	WO-G	BaF	B	328901.87	7.551		55	415.280139	55
1167	SUB-9E	WO-G	BaF	B	3503.27952	0.080		55	4.42333273	55
1170	SUB-9E	WO-G	BaF	B	27536.3064	0.632		55	34.7680637	55
1173	SUB-9E	WO-G	BaF	B	35919.0037	0.825		55	45.3522774	55
1181	SUB-9E	WO-G	BaF	B	23925.0883	0.549		55	30.2084449	55
1184	SUB-9E	WO-G	BaF	B	4148.83668	0.095		55	5.23843015	55
1188	SUB-9E	WO-G	BaF	B	21313.3515	0.489		55	26.9107973	55
1191	SUB-9E	WO-G	BaF	B	7735.14548	0.178		55	9.76659783	55
1138	SUB-9E	WO-G	ChA	C	4827.60824	0.111		70	7.75786447	70
1141	SUB-9E	WO-G	ChA	C	182157.539	4.182		70	292.723318	70
1152	SUB-9E	WO-G	ChA	C	1233.28372	0.028		70	1.9818609	70

LITTLE BUFFALO CREEK
WEIGHTED RUNOFF CURVE NUMBER CALCULATIONS
EXISTING CONDITIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	Area (Sq.Miles)	CN	CN*A	Weighted CN
1157	SUB-9E	WO-G	ChA	C	3606.42148	0.083		70	5.79544314	70
1160	SUB-9E	WO-G	ChA	C	17932.7671	0.412		70	28.817578	70
1166	SUB-9E	WO-G	ChA	C	8291.84581	0.190		70	13.3248211	70
1168	SUB-9E	WO-G	ChA	C	10712.6113	0.246		70	17.21494	70
1169	SUB-9E	WO-G	ChA	C	2330.09008	0.053		70	3.74440555	70
1172	SUB-9E	WO-G	ChA	C	9700.1882	0.223		70	15.5879976	70
1174	SUB-9E	WO-G	ChA	C	7075.88971	0.162		70	11.3708053	70
1186	SUB-9E	WO-G	ChA	C	204.432405	0.005		70	0.32851856	70
1137	SUB-9E	WO-G	GoF	C	0.08897791	0.000		70	0.00014299	70
1140	SUB-9E	WO-G	GoF	C	433516.628	9.952		70	696.652065	70
1145	SUB-9E	WO-G	GoF	C	219513.898	5.039		70	352.754197	70
1149	SUB-9E	WO-G	GoF	C	182110.475	4.181		70	292.647687	70
1151	SUB-9E	WO-G	GoF	C	48127.8351	1.105		70	77.3404146	70
1154	SUB-9E	WO-G	GoF	C	8627.78271	0.198		70	13.8646646	70
1156	SUB-9E	WO-G	GoF	C	13879.4904	0.319		70	22.3040479	70
1159	SUB-9E	WO-G	GoF	C	16935.0781	0.389		70	27.2143128	70
1165	SUB-9E	WO-G	GoF	C	35944.8008	0.825		70	57.7625358	70
1164	SUB-9E	WO-G	TaB	B	15910.0117	0.365		55	20.0883987	55
1171	SUB-9E	WO-G	TaB	B	3837.49823	0.088		55	4.84532605	55
1182	SUB-9E	WO-G	TaB	B	2303.76545	0.053		55	2.90879477	55
1185	SUB-9E	WO-G	TaB	B	1476.04361	0.034		55	1.86369142	55
1190	SUB-9E	WO-G	TaB	B	966.10688	0.022		55	1.21983192	55
1148	SUB-9E	WO-G	W	D	1881.50739	0.043		77	3.32589689	77
	SUB-9E Total					**172.044**	**0.269**		**12658.2217**	**74**
	Grand Total					**3999.723**	**6.250**		**277183.473**	

APPENDIX C: Watershed Lag Time and Time of Concentration Calculations

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-1**			
total contour length, C (Ft) =	98189.52			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	22753794.72			
Average watershed slope, Y (%) =	8.63			
watershed hydraulic length, l (Ft)=	8297.60			
Weighted CN (Dimensionless) =	70.00			
Time of Concentration, T_c (Hours)	1.31			
Time of Concentration, T_c (Minutes)	78.44			
Watershed Lag Time, T_L (Minutes)	**47.07**	**($0.6*T_c$)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-2**			
total contour length, C (Ft) =	66281.62			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	11580583.53			
Average watershed slope, Y (%) =	11.45			
watershed hydraulic length, l (Ft)=	6099.48			
Weighted CN (Dimensionless) =	65.00			
Time of Concentration, Tc (Hours)	1.01			
Time of Concentration, Tc (Minutes)	60.78			
Watershed Lag Time, TL (Minutes)	**36.47**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-3**			
total contour length, C (Ft) =	28930.78			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	3841129.13			
Average watershed slope, Y (%) =	15.06			
watershed hydraulic length, l (Ft)=	3509.25			
Weighted CN (Dimensionless) =	58.00			
Time of Concentration, Tc (Hours)	0.68			
Time of Concentration, Tc (Minutes)	40.71			
Watershed Lag Time, TL (Minutes)	**24.42**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-3A**			
total contour length, C (Ft) =	20427.58			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	4838696.36			
Average watershed slope, Y (%) =	8.44			
watershed hydraulic length, l (Ft)=	6161.76			
Weighted CN (Dimensionless) =	69.00			
Time of Concentration, Tc (Hours)	1.07			
Time of Concentration, Tc (Minutes)	64.21			
Watershed Lag Time, TL (Minutes)	**38.53**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-4**			
total contour length, C (Ft) =	56620.45			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	12311878.99			
Average watershed slope, Y (%) =	9.20			
watershed hydraulic length, l (Ft)=	6258.00			
Weighted CN (Dimensionless) =	74.00			
Time of Concentration, Tc (Hours)	0.90			
Time of Concentration, Tc (Minutes)	54.29			
Watershed Lag Time, TL (Minutes)	**32.57**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-5**			
total contour length, C (Ft) =	76290.6806			
contour interval, I (Ft)	20			
Drainage area, A (Sq.Ft) =	10026217.06			
Average watershed slope, Y (%) =	15.22			
watershed hydraulic length, l (Ft)=	7191.86			
Weighted CN (Dimensionless) =	69			
Time of Concentration, Tc (Hours)	0.90			
Time of Concentration, Tc (Minutes)	54.12			
Watershed Lag Time, TL (Minutes)	**32.47**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-5A**			
total contour length, C (Ft) =	11603.90			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	3412497.50			
Average watershed slope, Y (%) =	6.80			
watershed hydraulic length, l (Ft)=	6829.54			
Weighted CN (Dimensionless) =	69.00			
Time of Concentration, Tc (Hours)	1.29			
Time of Concentration, Tc (Minutes)	77.68			
Watershed Lag Time, TL (Minutes)	**46.61**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-6**			
total contour length, C (Ft) =	59797.37			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	12270184.78			
Average watershed slope, Y (%) =	9.75			
watershed hydraulic length, l (Ft)=	8637.78			
Weighted CN (Dimensionless) =	65.00			
Time of Concentration, Tc (Hours)	1.45			
Time of Concentration, Tc (Minutes)	87.00			
Watershed Lag Time, TL (Minutes)	**52.20**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-7**			
total contour length, C (Ft) =	6466.06			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	1087484.57			
Average watershed slope, Y (%) =	11.89			
watershed hydraulic length, l (Ft)=	2052.77			
Weighted CN (Dimensionless) =	62.00			
Time of Concentration, Tc (Hours)	0.45			
Time of Concentration, Tc (Minutes)	26.95			
Watershed Lag Time, TL (Minutes)	**16.17**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-7A**			
total contour length, C (Ft) =	1210.57			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	379273.05			
Average watershed slope, Y (%) =	6.38			
watershed hydraulic length, l (Ft)=	1442.02			
Weighted CN (Dimensionless) =	82.00			
Time of Concentration, Tc (Hours)	0.26			
Time of Concentration, Tc (Minutes)	15.81			
Watershed Lag Time, TL (Minutes)	**9.49**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-8**			
total contour length, C (Ft) =	35909.77			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	9115103.55			
Average watershed slope, Y (%) =	7.88			
watershed hydraulic length, l (Ft)=	7098.37			
Weighted CN (Dimensionless) =	67.00			
Time of Concentration, Tc (Hours)	1.31			
Time of Concentration, Tc (Minutes)	78.49			
Watershed Lag Time, TL (Minutes)	**47.10**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-9**			
total contour length, C (Ft) =	59663.16			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	11514139.70			
Average watershed slope, Y (%) =	10.36			
watershed hydraulic length, l (Ft)=	6399.65			
Weighted CN (Dimensionless) =	68.00			
Time of Concentration, Tc (Hours)	1.02			
Time of Concentration, Tc (Minutes)	61.35			
Watershed Lag Time, TL (Minutes)	**36.81**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-9A**			
total contour length, C (Ft) =	3789.05			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	649740.40			
Average watershed slope, Y (%) =	11.66			
watershed hydraulic length, l (Ft)=	2374.57			
Weighted CN (Dimensionless) =	71.00			
Time of Concentration, Tc (Hours)	0.40			
Time of Concentration, Tc (Minutes)	24.14			
Watershed Lag Time, TL (Minutes)	**14.48**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-9B**			
total contour length, C (Ft) =	4407.92			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	1990520.39			
Average watershed slope, Y (%) =	4.43			
watershed hydraulic length, l (Ft)=	2750.50			
Weighted CN (Dimensionless) =	80.00			
Time of Concentration, Tc (Hours)	0.57			
Time of Concentration, Tc (Minutes)	33.92			
Watershed Lag Time, TL (Minutes)	**20.35**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-9C**			
total contour length, C (Ft) =	6788.04			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	2623135.26			
Average watershed slope, Y (%) =	5.18			
watershed hydraulic length, l (Ft)=	3871.68			
Weighted CN (Dimensionless) =	78.00			
Time of Concentration, Tc (Hours)	0.73			
Time of Concentration, Tc (Minutes)	43.86			
Watershed Lag Time, TL (Minutes)	**26.32**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-9D**			
total contour length, C (Ft) =	8497.13			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	3286019.25			
Average watershed slope, Y (%) =	5.17			
watershed hydraulic length, l (Ft)=	5317.00			
Weighted CN (Dimensionless) =	79.00			
Time of Concentration, Tc (Hours)	0.91			
Time of Concentration, Tc (Minutes)	54.86			
Watershed Lag Time, TL (Minutes)	**32.92**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-9E**			
total contour length, C (Ft) =	40222.61			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	7494223.71			
Average watershed slope, Y (%) =	10.73			
watershed hydraulic length, l (Ft)=	5247.63			
Weighted CN (Dimensionless) =	74.00			
Time of Concentration, Tc (Hours)	0.73			
Time of Concentration, Tc (Minutes)	43.65			
Watershed Lag Time, TL (Minutes)	**26.19**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-10**			
total contour length, C (Ft) =	243977.39			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	53435661.84			
Average watershed slope, Y (%) =	9.13			
watershed hydraulic length, l (Ft)=	13559.06			
Weighted CN (Dimensionless) =	69.00			
Time of Concentration, Tc (Hours)	1.93			
Time of Concentration, Tc (Minutes)	116.04			
Watershed Lag Time, TL (Minutes)	**69.62**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-10A**			
total contour length, C (Ft) =	30689.94			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	5734662.48			
Average watershed slope, Y (%) =	10.70			
watershed hydraulic length, l (Ft)=	5952.11			
Weighted CN (Dimensionless) =	75.00			
Time of Concentration, Tc (Hours)	0.78			
Time of Concentration, Tc (Minutes)	46.99			
Watershed Lag Time, TL (Minutes)	**28.19**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-11**			
total contour length, C (Ft) =	5420.67			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	1278396.60			
Average watershed slope, Y (%) =	8.48			
watershed hydraulic length, l (Ft)=	2438.02			
Weighted CN (Dimensionless) =	72.00			
Time of Concentration, Tc (Hours)	0.47			
Time of Concentration, Tc (Minutes)	28.13			
Watershed Lag Time, TL (Minutes)	**16.88**	**(0.6*Tc)**		

WATERSHED LAG TIME CALCULATIONS				
SUB-AREA NUMBER	**SUB-11A**			
total contour length, C (Ft) =	1164.45			
contour interval, I (Ft)	20.00			
Drainage area, A (Sq.Ft) =	363215.87			
Average watershed slope, Y (%) =	6.41			
watershed hydraulic length, l (Ft)=	1149.13			
Weighted CN (Dimensionless) =	80.00			
Time of Concentration, Tc (Hours)	0.23			
Time of Concentration, Tc (Minutes)	14.02			
Watershed Lag Time, TL (Minutes)	**8.41**	**(0.6*Tc)**		

APPENDIX D: Hydrologic Reach Routing Calculations

HYDROLOGIC REACH LENGTH CALCULATIONS							
Reach Location	**POI-1 to POI-2**	**POI-2 to POI-3**	**POI-3 to POI-4**	**POI-4 to POI-5**	**POI-5 to POI-6**	**POI-6 to POI-7**	**POI-7 to POI-8**
Reach Length (Ft)	2504.46	4568.61	912.18	1496.37	962.03	3588.25	232.22
Upstream Invert Elevation (Ft)	671.00	658.60	633.53	629.59	623.98	620.50	605.33
Downstream Invert Elevation (Ft)	658.60	633.53	629.59	623.98	620.50	605.33	605.30
Reach Slope (Ft/Ft)	0.0050	0.0055	0.0043	0.0037	0.0036	0.0042	0.0001

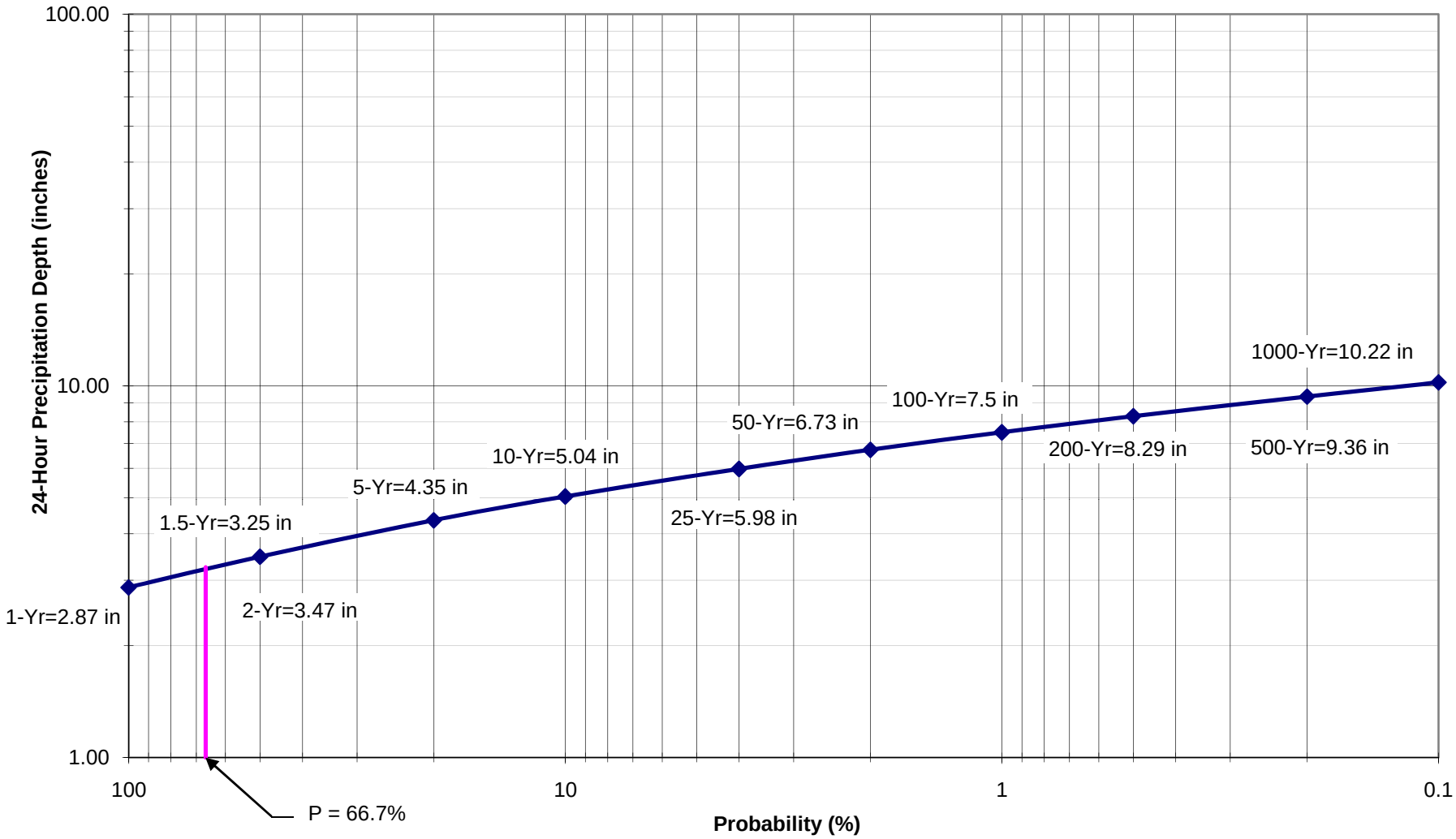
APPENDIX E: 1.5 Year 24-Hour Precipitation Depth Calculations

1.5 Year 24 Hour Precipitation Depth Calculations

Selected Precipitation Values by Recurrence Intervals (from NOAA)		
Frequency	**Probability (%)**	**24-Hr Precipitation Depths (inches)**
1 -Year	100	2.87
2 -Year	50	3.47
5 -Year	20	4.35
10 -Year	10	5.04
25 -Year	4	5.98
50 -Year	2	6.73
100 -Year	1	7.50
200 -Year	0.5	8.29
500 -Year	0.2	9.36
1000 -Year	0.1	10.22

24-Hr Precipitation Depth Estimate (See Attached Logarithmic Plot)		
Frequency	**Probability (%)**	**24-Hr Precipitation Depths (inches)**
1.5 -Year	66.7	1.00
1.5 -Year	66.7	3.25

1.5 Year 24-Hour Precipitation Depth Estimate



APPENDIX F: HEC-HMS Peak Flows Summary

LITTLE BUFFALO CREEK - EXISTING CONDITIONS FLOW SUMMARY - 1.5 YEAR			
CONTRIBUTING HYDROLOGIC ELEMENT	**DRAINAGE AREA (MI^2)**	**PEAK DISCHARGE (CFS)**	**VOLUME (IN)**
SUB-1	0.816	181.30	0.86
SUB-2	0.415	71.30	0.62
POI-1	1.231	248.90	0.78
POI-1 TO POI-2	1.231	247.80	0.78
SUB-4	0.442	171.80	1.07
SUB-3A	0.174	38.90	0.81
SUB-3	0.138	12.80	0.36
POI-2	1.985	425.40	0.82
POI-2 TO POI-3	1.985	422.20	0.82
SUB-6	0.440	58.50	0.62
SUB-5	0.360	96.90	0.81
SUB-5A	0.122	25.20	0.81
POI-3	2.907	568.30	0.79
POI-3 TO POI-4	2.907	567.20	0.79
SUB-8	0.327	56.50	0.71
SUB-7	0.039	8.50	0.50
SUB-7A	0.014	18.00	1.58
POI-4	3.287	626.70	0.78
POI-4 TO POI-5	3.287	624.00	0.78
SUB-9	0.413	93.20	0.76
SUB-9B	0.071	54.40	1.44
SUB-9A	0.023	12.70	0.91
POI-5	3.794	705.70	0.79
POI-5 TO POI-6	3.794	703.70	0.79
SUB-9C	0.094	54.30	1.31
POI-6	3.888	722.70	0.80
POI-6 TO POI-7	3.888	717.30	0.80
SUB-10	1.710	262.20	0.81
SUB-9E	0.269	122.30	1.07
SUB-10A	0.206	94.80	1.13
SUB-9D	0.118	61.50	1.37
POI-7	6.191	1068.50	0.84
POI-7 TO POI-8	6.191	1062.40	0.84
SUB-11	0.046	24.70	0.96
SUB-11A	0.013	15.90	1.44
POI-8	6.250	1067.10	0.84

LITTLE BUFFALO CREEK - EXISTING CONDITIONS FLOW SUMMARY - 2 YEAR			
CONTRIBUTING HYDROLOGIC ELEMENT	**DRAINAGE AREA (MI^2)**	**PEAK DISCHARGE (CFS)**	**VOLUME (IN)**
SUB-1	0.816	214.70	0.99
SUB-2	0.415	87.80	0.74
POI-1	1.231	297.80	0.90
POI-1 TO POI-2	1.231	296.50	0.90
SUB-4	0.442	198.70	1.22
SUB-3A	0.174	46.40	0.94
SUB-3	0.138	17.40	0.44
POI-2	1.985	507.10	0.94
POI-2 TO POI-3	1.985	503.30	0.94
SUB-6	0.440	71.80	0.74
SUB-5	0.360	115.60	0.94
SUB-5A	0.122	30.00	0.94
POI-3	2.907	680.70	0.91
POI-3 TO POI-4	2.907	679.30	0.91
SUB-8	0.327	68.30	0.83
SUB-7	0.039	10.90	0.60
SUB-7A	0.014	20.10	1.76
POI-4	3.287	751.30	0.90
POI-4 TO POI-5	3.287	748.20	0.90
SUB-9	0.413	112.00	0.88
SUB-9B	0.071	61.20	1.61
SUB-9A	0.023	14.80	1.04
POI-5	3.794	847.20	0.92
POI-5 TO POI-6	3.794	844.70	0.92
SUB-9C	0.094	61.60	1.47
POI-6	3.888	866.90	0.93
POI-6 TO POI-7	3.888	860.50	0.93
SUB-10	1.710	311.80	0.94
SUB-9E	0.269	141.40	1.22
SUB-10A	0.206	109.00	1.28
SUB-9D	0.118	69.50	1.54
POI-7	6.191	1276.10	0.97
POI-7 TO POI-8	6.191	1269.10	0.97
SUB-11	0.046	28.80	1.10
SUB-11A	0.013	17.80	1.61
POI-8	6.250	1274.50	0.97

LITTLE BUFFALO CREEK - EXISTING CONDITIONS FLOW SUMMARY - 5 YEAR			
CONTRIBUTING HYDROLOGIC ELEMENT	**DRAINAGE AREA (MI^2)**	**PEAK DISCHARGE (CFS)**	**VOLUME (IN)**
SUB-1	0.816	362.00	1.57
SUB-2	0.415	164.70	1.24
POI-1	1.231	517.20	1.46
POI-1 TO POI-2	1.231	515.00	1.46
SUB-4	0.442	314.10	1.86
SUB-3A	0.174	79.70	1.50
SUB-3	0.138	41.80	0.83
POI-2	1.985	872.80	1.51
POI-2 TO POI-3	1.985	866.50	1.51
SUB-6	0.440	133.90	1.24
SUB-5	0.360	198.70	1.50
SUB-5A	0.122	51.60	1.50
POI-3	2.907	1190.00	1.46
POI-3 TO POI-4	2.907	1187.30	1.46
SUB-8	0.327	122.00	1.37
SUB-7	0.039	22.20	1.05
SUB-7A	0.014	28.50	2.50
POI-4	3.287	1316.60	1.45
POI-4 TO POI-5	3.287	1311.10	1.45
SUB-9	0.413	196.40	1.43
SUB-9B	0.071	89.60	2.33
SUB-9A	0.023	24.30	1.64
POI-5	3.794	1493.00	1.47
POI-5 TO POI-6	3.794	1488.30	1.47
SUB-9C	0.094	92.40	2.17
POI-6	3.888	1525.60	1.49
POI-6 TO POI-7	3.888	1513.40	1.48
SUB-10	1.710	534.10	1.50
SUB-9E	0.269	223.00	1.86
SUB-10A	0.206	169.80	1.93
SUB-9D	0.118	103.20	2.25
POI-7	6.191	2216.10	1.53
POI-7 TO POI-8	6.191	2204.00	1.53
SUB-11	0.046	46.50	1.71
SUB-11A	0.013	25.90	2.33
POI-8	6.250	2212.60	1.54

LITTLE BUFFALO CREEK - EXISTING CONDITIONS FLOW SUMMARY - 100 YEAR			
CONTRIBUTING HYDROLOGIC ELEMENT	**DRAINAGE AREA (MI^2)**	**PEAK DISCHARGE (CFS)**	**VOLUME (IN)**
SUB-1	0.816	989.30	4.04
SUB-2	0.415	517.40	3.49
POI-1	1.231	1476.10	3.85
POI-1 TO POI-2	1.231	1470.10	3.85
SUB-4	0.442	781.10	4.48
SUB-3A	0.174	223.30	3.93
SUB-3	0.138	173.70	2.76
POI-2	1.985	2461.60	3.92
POI-2 TO POI-3	1.985	2445.90	3.92
SUB-6	0.440	420.90	3.49
SUB-5	0.360	555.00	3.93
SUB-5A	0.122	144.60	3.93
POI-3	2.907	3435.20	3.86
POI-3 TO POI-4	2.907	3428.30	3.86
SUB-8	0.327	361.20	3.71
SUB-7	0.039	75.80	3.17
SUB-7A	0.014	59.90	5.39
POI-4	3.287	3813.60	3.84
POI-4 TO POI-5	3.287	3798.30	3.84
SUB-9	0.413	564.40	3.82
SUB-9B	0.071	197.30	5.16
SUB-9A	0.023	63.30	4.15
POI-5	3.794	4356.40	3.86
POI-5 TO POI-6	3.794	4342.90	3.86
SUB-9C	0.094	211.80	4.93
POI-6	3.888	4445.00	3.89
POI-6 TO POI-7	3.888	4412.50	3.89
SUB-10	1.710	1498.70	3.93
SUB-9E	0.269	553.20	4.48
SUB-10A	0.206	412.90	4.59
SUB-9D	0.118	232.70	5.04
POI-7	6.191	6341.10	3.97
POI-7 TO POI-8	6.191	6310.30	3.97
SUB-11	0.046	119.10	4.26
SUB-11A	0.013	56.00	5.16
POI-8	6.250	6333.00	3.97

APPENDIX G: Peak Flows for HEC-RAS Hydraulic Analysis

LITTLE BUFFALO CREEK - HEC-RAS LOADING POINTS SUMMARY							
River Reach Name	Reach Number	River Station Number	100-Year Discharge (CFS)	5-Year Discharge (CFS)	2-Year Discharge (CFS)	1.5-Year Discharge (CFS)	HEC-HMS CONTRIBUTING HYDROLOGIC ELEMENTS
LBC Main Stream	1	6	3161.20	1123.10	652.70	547.50	POI-2 + SUB-5 + SUB-5A
LBC Main Stream	1	2.5	3570.90	1240.70	711.70	594.80	POI-3 + SUB-7A + SUB-7
LBC Main Stream	2	3	4074.20	1430.50	827.30	693.80	POI-4 + SUB-9A + SUB-9B
LBC Main Stream	4	2	4356.40	1493.00	847.20	705.70	POI-5
LBC Main Stream	3	5	5230.90	1851.80	1077.80	906.50	POI-6 + SUB-9D + SUB-9E
LBC Main Stream	5	2 (4*)	6333.00	2212.60	1274.50	1067.10	POI-8
LBC Trib 1	1	2	361.20	122.00	68.30	56.50	SUB-8
LBC Trib 2	1	6	211.80	92.40	61.60	54.30	SUB-9C
LBC Trib 3	1	3	564.40	196.40	112.00	93.20	SUB-9
LBC Trib 4	1	4	1498.70	534.10	311.80	262.20	SUB-10
LBC Trib 5	1	5	412.90	169.80	109.00	94.80	SUB-10A
LBC Trib 6	1	1 (4*)	1911.60	703.90	420.80	357.00	SUB-10 + SUB-10A

* The proposed condition river station name for the cross-section.

APPENDIX H: HEC-RAS Computed Water Surface Elevations and Flow Velocities Summary

HEC-RAS Computed Water Surface Elevation and Velocity Summary for Work Area 1

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
Main-Reach 1 River Station 4.9 (Cross-section Upstream of Realigned Channel of proposed project reach)						
100-Year Storm	647.96	648.1	0.14	3.96	3.99	0.03
5-Year Storm	645.2	644.87	-0.33	3.73	4.53	0.8
2-Year Storm	643.94	643.6	-0.34	3.69	4.53	0.84
1.5-Year Storm	643.6	643.28	-0.32	3.58	4.46	0.88
Main-Reach 1 River Station 4.8 (Cross-section Upstream of Realigned Channel of proposed project reach)						
100-Year Storm	646.62	645.92	-0.7	10.76	14.6	3.84
5-Year Storm	644.81	644.13	-0.68	6.01	8.42	2.41
2-Year Storm	643.67	643.02	-0.65	5.07	7.24	2.17
1.5-Year Storm	643.34	642.71	-0.63	4.74	6.97	2.23
Main-Reach 1 River Station 4.7 (Cross-section Upstream of Realigned Channel of proposed project reach)						
100-Year Storm	646.86	646.8	-0.06	5.83	5.65	-0.18
5-Year Storm	644.78	644.1	-0.68	5.2	6.89	1.69
2-Year Storm	643.56	642.96	-0.6	4.84	5.5	0.66
1.5-Year Storm	643.25	642.65	-0.6	4.47	5.18	0.71
Main-Reach 1 River Station 4.6 (Cross-section 11+16 of proposed project reach)						
100-Year Storm	646.5	646.55	0.05	7.15	5.85	-1.3
5-Year Storm	643.55	643.92	0.37	9.14	4.91	-4.23
2-Year Storm	642.62	642.78	0.16	7.52	3.96	-3.56
1.5-Year Storm	642.33	642.46	0.13	7.16	3.72	-3.44
Main-Reach 1 River Station 4 (Cross-section 11+73 of proposed project reach)						
100-Year Storm	646.48	646.48	0	6.19	5.32	-0.87
5-Year Storm	643.81	643.86	0.05	6.09	4.17	-1.92
2-Year Storm	642.71	642.7	-0.01	5.39	3.45	-1.94
1.5-Year Storm	642.42	642.37	-0.05	4.99	3.27	-1.72
Main-Reach 1 River Station 3.8 (Cross-section 13+41 of proposed project reach)						
100-Year Storm	646.43	646.36	-0.07	4.2	3.85	-0.35
5-Year Storm	643.81	643.76	-0.05	3.49	2.7	-0.79
2-Year Storm	642.65	642.58	-0.07	3.23	2.24	-0.99
1.5-Year Storm	642.32	642.25	-0.07	3.19	2.12	-1.07
Main-Reach 1 River Station 3.7 (Cross-section 13+90 of proposed project reach)						
100-Year Storm	645.68	646.29	0.61	8.41	8.6	0.19
5-Year Storm	643	643.7	0.7	6.91	7.23	0.32
2-Year Storm	642.12	642.53	0.41	5.15	5.33	0.18
1.5-Year Storm	641.85	642.2	0.35	4.71	4.86	0.15
Main-Reach 1 River Station 3.6 (Cross-section 14+40 of proposed project reach)						
100-Year Storm	646.35	645.66	-0.69	4.45	4.23	-0.22
5-Year Storm	643.75	643.01	-0.74	3.46	3.05	-0.41
2-Year Storm	642.6	642.13	-0.47	3.06	2.51	-0.55
1.5-Year Storm	642.27	641.86	-0.41	2.93	2.36	-0.57
Main-Reach 1 River Station 3 (Downstream of Realigned Channel of proposed project reach)						
100-Year Storm	645.21	645.21	0	2.41	2.41	0
5-Year Storm	641.47	641.47	0	3	3	0
2-Year Storm	639.87	639.87	0	3.64	3.64	0
1.5-Year Storm	639.49	639.49	0	3.65	3.65	0

HEC-RAS Computed Water Surface Elevation and Velocity Summary for Work Area 2

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
Main-Reach 2 River Station 3 (Cross-section Upstream of Realigned Channel of proposed project reach)						
100-Year Storm	638.06	638.06	0	8.12	8.11	-0.01
5-Year Storm	636.24	636.24	0	5.65	5.66	0.01
2-Year Storm	635.36	635.34	-0.02	4.55	4.57	0.02
1.5-Year Storm	635.1	635.08	-0.02	4.21	4.24	0.03
Main-Reach 2 River Station 2 (Cross-section 10+05 of proposed project reach)						
100-Year Storm	635.76	635.38	-0.38	7.01	9.22	2.21
5-Year Storm	634.31	633.75	-0.56	5.26	5.6	0.34
2-Year Storm	633.64	632.94	-0.7	4.38	3.92	-0.46
1.5-Year Storm	633.42	632.66	-0.76	4.09	3.57	-0.52
Main-Reach 2 River Station 1.5 (Cross-section 11+08 of proposed project reach)						
100-Year Storm	635.32	634.97	-0.35	8.02	8.88	0.86
5-Year Storm	633.93	633.51	-0.42	6.13	5.35	-0.78
2-Year Storm	633.27	632.78	-0.49	5.13	3.86	-1.27
1.5-Year Storm	633.03	632.51	-0.52	4.93	3.47	-1.46
Main-Reach 2 River Station 1.3 (Cross-section 12+60 of proposed project reach)						
100-Year Storm	634.54	634.51	-0.03	8.45	7.32	-1.13
5-Year Storm	633.09	633.15	0.06	7.74	5.07	-2.67
2-Year Storm	632.4	632.49	0.09	7.07	3.93	-3.14
1.5-Year Storm	632.18	632.25	0.07	6.63	3.62	-3.01
Main-Reach 2 River Station 1 (Downstream of Realigned Channel of proposed project reach)						
100-Year Storm	634.43	634.42	-0.01	5.55	5.56	0.01
5-Year Storm	633.12	633.11	-0.01	3.81	3.82	0.01
2-Year Storm	632.42	632.41	-0.01	3.52	3.54	0.02
1.5-Year Storm	632.15	632.14	-0.01	3.63	3.66	0.03

HEC-RAS Computed Water Surface Elevation and Velocity Summary for Work Area 3

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
LBC 4 River Station 3 (Cross-section Upstream of Realigned Channel of proposed project reach)						
100-Year Storm	624.82	624.82	0	4.32	4.32	0
5-Year Storm	621.89	621.89	0	2.83	2.83	0
2-Year Storm	620.06	620.06	0	2.83	2.83	0
1.5-Year Storm	619.59	619.59	0	2.85	2.85	0
LBC 4 River Station 2.9 (Cross-section 10+03 of proposed project reach)						
100-Year Storm	619.86	619.86	0	6.47	6.47	0
5-Year Storm	618.32	618.35	0.03	5.31	5.25	-0.06
2-Year Storm	617.9	617.88	-0.02	3.52	3.55	0.03
1.5-Year Storm	617.65	617.69	0.04	3.23	3.18	-0.05
LBC 4 River Station 2 (Cross-section 10+59 of proposed project reach)						
100-Year Storm	619.22	619.19	-0.03	3.84	3.06	-0.78
5-Year Storm	618.36	618.38	0.02	3.06	2.52	-0.54
2-Year Storm	617.81	617.75	-0.06	3.32	3.34	0.02
1.5-Year Storm	617.46	617.5	0.04	3.72	3.57	-0.15
LBC 4River Station 1.8 (Cross-section 12+52 of proposed project reach)						
100-Year Storm	618.37	618.48	0.11	7.34	5.97	-1.37
5-Year Storm	617.77	617.08	-0.69	5.36	5.82	0.46
2-Year Storm	616.76	616.54	-0.22	6.18	4.28	-1.9
1.5-Year Storm	616.49	616.38	-0.11	5.75	3.89	-1.86
LBC 4 River Station 1.7 (Cross-section 14+20 of proposed project reach)						
100-Year Storm	617.74	617.7	-0.04	6.72	5.51	-1.21
5-Year Storm	616.6	616.67	0.07	6.85	3.38	-3.47
2-Year Storm	615.78	616.2	0.42	6.47	2.49	-3.98
1.5-Year Storm	615.47	616.05	0.58	6.22	2.24	-3.98
LBC 4 River Station 1.5 (Cross-section 16+37 of proposed project reach)						
100-Year Storm	617.13	617.21	0.08	4.97	4.19	-0.78
5-Year Storm	615.67	616.33	0.66	5.49	2.34	-3.15
2-Year Storm	614.98	615.94	0.96	4.87	1.7	-3.17
1.5-Year Storm	614.5	615.81	1.31	5.03	1.53	-3.5
LBC 4 River Station 1.3 (Cross-section 17+12 of proposed project reach)						
100-Year Storm	617.03	616.6	-0.43	4.77	7.91	3.14
5-Year Storm	615.2	615.83	0.63	5.9	6.16	0.26
2-Year Storm	614.87	615.42	0.55	4.12	5.69	1.57
1.5-Year Storm	614.34	615.34	1	4.28	5.29	1.01
LBC 6 River Station 3 (Cross-section 18+78 of proposed project reach)						
100-Year Storm	616.91	616.64	-0.27	3.74	2.37	-1.37
5-Year Storm	614.97	614.72	-0.25	4.2	7.32	3.12
2-Year Storm	614.76	614.55	-0.21	2.85	5.81	2.96
1.5-Year Storm	614.14	614.48	0.34	3.21	5.6	2.39
LBC 6 River Station 2 (Cross-section 19+47 of proposed project reach)						
100-Year Storm	616.91	616.63	-0.28	2.71	1.64	-1.07
5-Year Storm	614.94	614.78	-0.16	3.2	2.23	-0.97
2-Year Storm	614.75	614.27	-0.48	2.18	1.07	-1.11
1.5-Year Storm	614.09	613.65	-0.44	2.67	0.84	-1.83
LBC 6 River Station 1.5 (Cross-section 20+00 of proposed project reach)						
100-Year Storm	616.94	616.62	-0.32	1.52	1.17	-0.35
5-Year Storm	614.96	614.67	-0.29	2.44	2.13	-0.31
2-Year Storm	614.75	614.18	-0.57	1.91	1.03	-0.88
1.5-Year Storm	613.97	613.42	-0.55	3.53	0.79	-2.74
LBC 6 River Station 1 (Cross-section 21+56 of proposed project reach)						
100-Year Storm	616.9	616.61	-0.29	1.99	0.94	-1.05
5-Year Storm	614.92	614.67	-0.25	1.96	0.8	-1.16
2-Year Storm	614.73	614.23	-0.5	1.33	0.59	-0.74
1.5-Year Storm	614.01	613.57	-0.44	1.7	0.63	-1.07

HEC-RAS Computed Water Surface Elevation and Velocity Summary for Work Area 4

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
Main-Reach 4 River Station 1.2 (Cross-section 25 ft. Upstream of Restored Channel of proposed project reach)						
100-Year Storm	630.35	629.6	-0.75	4.64	6.24	1.6
5-Year Storm	628.51	627.73	-0.78	3.33	5.02	1.69
2-Year Storm	627.74	626.95	-0.79	2.89	5.23	2.34
1.5-Year Storm	627.44	626.62	-0.82	2.98	5.62	2.64
Main-Reach 4 River Station 1.1						
100-Year Storm	630.24	629.43	-0.81	6.05	6.33	0.28
5-Year Storm	628.39	627.29	-1.1	4.54	6.37	1.83
2-Year Storm	627.61	626.55	-1.06	4.08	5.7	1.62
1.5-Year Storm	627.29	626.34	-0.95	4.14	5.25	1.11
Main-Reach 4 River Station 1						
100-Year Storm	629.19	629.43	0.24	11.53	5.49	-6.04
5-Year Storm	627.72	627.38	-0.34	8.09	4.42	-3.67
2-Year Storm	626.8	626.67	-0.13	7.83	3.62	-4.21
1.5-Year Storm	626.41	626.42	0.01	7.92	3.44	-4.48
Main-Reach 4 River Station 0.9						
100-Year Storm	629.26	629.29	0.03	7	5.11	-1.89
5-Year Storm	627.05	627.2	0.15	7.45	4.31	-3.14
2-Year Storm	626.32	626.54	0.22	6.87	3.36	-3.51
1.5-Year Storm	626.06	626.3	0.24	6.81	3.14	-3.67
Main-Reach 4 River Station 0.5						
100-Year Storm	629.17	629.21	0.04	6.18	5.01	-1.17
5-Year Storm	626.87	627.01	0.14	6.36	4.99	-1.37
2-Year Storm	626.17	626.33	0.16	5.57	4.31	-1.26
1.5-Year Storm	625.93	626.07	0.14	5.34	4.22	-1.12
Main-Reach 4 River Station 0.1 (Cross-section 21 ft. Downstream of Restored Channel of proposed project reach)						
100-Year Storm	629.17	629.17	0	5.06	5.06	0
5-Year Storm	626.79	626.78	-0.01	6.03	6	-0.03
2-Year Storm	626.01	626.01	0	5.8	5.75	-0.05
1.5-Year Storm	625.8	625.81	0.01	5.41	5.37	-0.04

HEC-RAS Computed Water Surface Elevation and Velocity Summary for Wooden Bridge on Old Mine Road

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
Main-Reach 1 River Station 2.5 (Upstream Bounding Cross-section)						
100-Year Storm	645.04	645.04	0	4.69	4.69	0
5-Year Storm	640.93	640.93	0	6.05	6.05	0
2-Year Storm	639.34	639.34	0	5.49	5.49	0
1.5-Year Storm	638.98	638.98	0	5.27	5.27	0
Main-Reach 1 River Station 2 (Downstream Bounding Cross-section)						
100-Year Storm	642.7	642.7	0	7.74	7.74	0
5-Year Storm	639.82	639.82	0	6.25	6.25	0
2-Year Storm	638.48	638.48	0	5.34	5.34	0
1.5-Year Storm	638.09	638.1	0.01	5.02	5.01	-0.01

HEC-RAS Computed Water Surface Elevation for Two 8.5' CMP Culverts along Old Mine Road (Upstream of Work Area 3)

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
LBC Trib 4 River Station 3 (Upstream Bounding Cross-section)						
100-Year Storm	624.82	624.82	0	4.32	4.32	0
5-Year Storm	621.89	621.89	0	2.83	2.83	0
2-Year Storm	620.06	620.06	0	2.83	2.83	0
1.5-Year Storm	619.59	619.59	0	2.85	2.85	0
LBC Trib 4 River Station 2.9 (Downstream Bounding Cross-section)						
100-Year Storm	619.86	619.86	0	6.47	6.47	0
5-Year Storm	618.32	618.35	0.03	5.31	5.25	-0.06
2-Year Storm	617.9	617.88	-0.02	3.52	3.55	0.03
1.5-Year Storm	617.65	617.69	0.04	3.23	3.18	-0.05

HEC-RAS Computed Water Surface Elevation for 72"x108" CMP Culvert along Old Mine Road (Upstream of Work Area 3)

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
LBC Trib 5 River Station 4 (Upstream Bounding Cross-section)						
100-Year Storm	624.68	624.68	0	3.22	3.22	0
5-Year Storm	622.31	622.31	0	4.68	4.68	0
2-Year Storm	621.29	621.29	0	4.47	4.47	0
1.5-Year Storm	621.06	621.06	0	4.31	4.31	0
LBC Trib 5 River Station 3 (Downstream Bounding Cross-section)						
100-Year Storm	622.49	622.49	0	10.96	10.96	0
5-Year Storm	620.8	620.8	0	8.24	8.24	0
2-Year Storm	620.69	620.69	0	5.57	5.57	0
1.5-Year Storm	620.57	620.57	0	5.15	5.15	0

HEC-RAS Computed Water Surface Elevation for two 92"x138" CMP Culverts along Kluttz Road Downstream of Project Site

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
Main-Reach 5 River Station 1.9 (Upstream Bounding Cross-section)						
100-Year Storm	615.67	615.67	0	4.7	4.7	0
5-Year Storm	614.01	614.01	0	2.5	2.5	0
2-Year Storm	613.51	613.51	0	5.06	5.06	0
1.5-Year Storm	612.85	612.85	0	4.57	4.57	0
Main-Reach 5 River Station 1 (Downstream Bounding Cross-section)						
100-Year Storm	613.01	613.01	0	7.87	7.87	0
5-Year Storm	609.34	609.34	0	9.75	9.75	0
2-Year Storm	607.79	607.79	0	8.26	8.26	0
1.5-Year Storm	607.38	607.38	0	7.81	7.81	0

HEC-RAS Computed Water Surface Elevation and Velocity Summary Upstream and Downstream of Overall Project Site

Existing and Proposed Conditions

Storm Frequency	Existing Condition Water Surface Elevation	Proposed Condition Water Surface Elevation	Difference in Water Surface Elevation (Proposed minus Existing)	Existing Condition Velocity	Proposed Condition Velocity	Velocity Difference (Proposed minus Existing)
	(ft, NAVD 1988)	(ft, NAVD 1988)	(ft)	ft/sec	ft/sec	ft/sec
Main-Reach 1 River Station 6 (Most Upstream Cross-section of Overall Project Site						
100-Year Storm	651.12	651.13	0.01	6.39	6.38	-0.01
5-Year Storm	648.66	648.66	0	5.08	5.09	0.01
2-Year Storm	647.67	647.67	0	4.18	4.18	0
1.5-Year Storm	647.38	647.38	0	3.99	3.99	0
Main-Reach 5 River Station 1 (Most Downstream Cross-section of Overall Project Site						
100-Year Storm	613.01	613.01	0	7.87	7.87	0
5-Year Storm	609.34	609.34	0	9.75	9.75	0
2-Year Storm	607.79	607.79	0	8.26	8.26	0
1.5-Year Storm	607.38	607.38	0	7.81	7.81	0

APPENDIX I: Maps and Exhibits

DRAINAGE AREA BOUNDARIES

FLOW PATH FOR WATERSHED HYDRAULIC FLOW LENGTH

SURVEYED CONTOURS PROVIDED BY GEODATA CORP (MAY 26, 2010)

1–FOOT CONTOURS GENERATED FROM 1/9 ARC–SECOND DIGITAL ELEVATION MODEL (DEM) DATA

0 550 1100 1650

SCALE IN FEET
1" = 550'

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

LITTLE BUFFALO CREEK STREAM MITIGATION SITE

YADKIN RIVER BASIN, NORTH CAROLINA

DRAINAGE AREA PLAN

THE LOUIS BERGER GROUP, INC.
412 MOUNT KEMBLE AVENUE
MORRISTOWN, NEW JERSEY 07962

DRAWN BY: EB	CHECKED BY: AC	APPROVED BY: AF
SCALE: AS SHOWN	DATE: AUGUST 10	SHEET NO.:

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LEGEND

HEC-RAS CROSS SECTION LOCATION

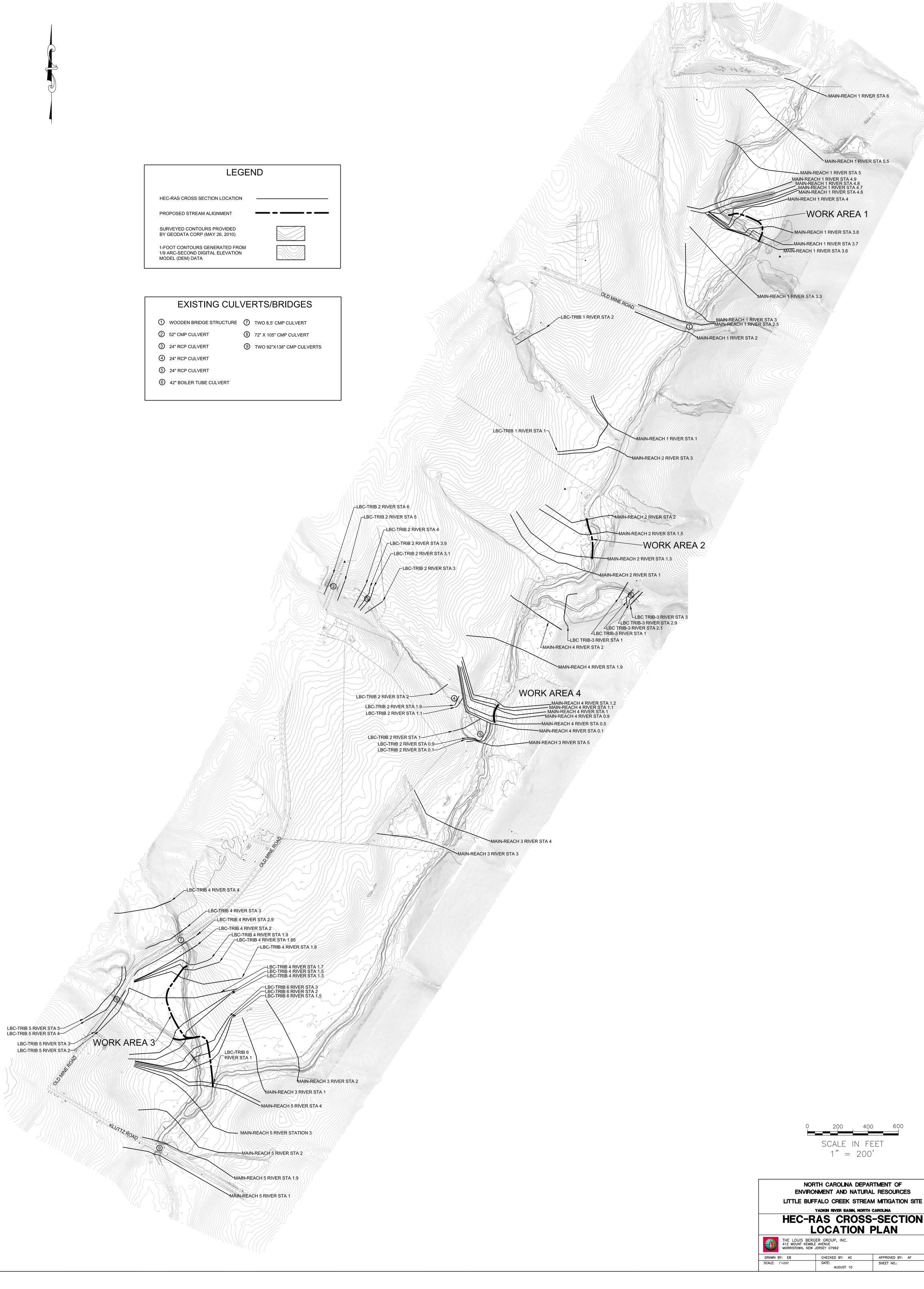
PROPOSED STREAM ALIGNMENT

SURVEYED CONTOURS PROVIDED BY GEODATA CORP (MAY 26, 2010)

1-FOOT CONTOURS GENERATED FROM 1/9 ARC-SECOND DIGITAL ELEVATION MODEL (DEM) DATA

EXISTING CULVERTS/BRIDGES

1. WOODEN BRIDGE STRUCTURE
2. 52" CMP CULVERT
3. 24" RCP CULVERT
4. 24" RCP CULVERT
5. 24" RCP CULVERT
6. 42" BOILER TUBE CULVERT
7. TWO 8.5' CMP CULVERT
8. 72" X 105" CMP CULVERT
9. TWO 92"X138" CMP CULVERTS



0 200 400 600

SCALE IN FEET
1" = 200'

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

LITTLE BUFFALO CREEK STREAM MITIGATION SITE

YADKIN RIVER BASIN, NORTH CAROLINA

HEC-RAS CROSS-SECTION LOCATION PLAN

THE LOUIS BERGER GROUP, INC.
412 MOUNT KEMBLE AVENUE
MORRISTOWN, NEW JERSEY 07962

DRAWN BY: EB	CHECKED BY: AC	APPROVED BY: AF
SCALE: 1"=200'	DATE: AUGUST 10	SHEET NO.:

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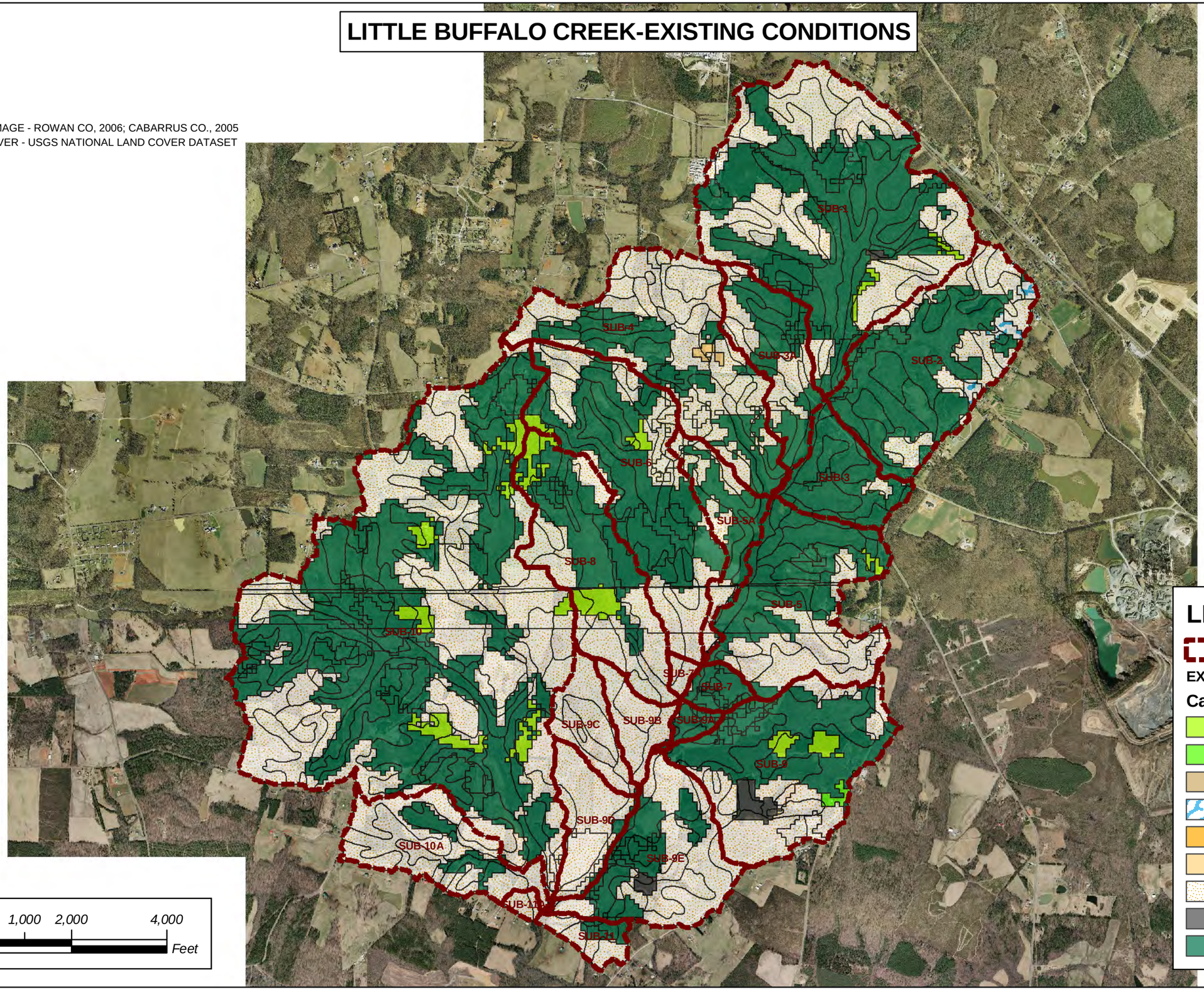
LITTLE BUFFALO CREEK-EXISTING CONDITIONS

SOURCE:
AERIAL IMAGE - ROWAN CO, 2006; CABARRUS CO., 2005
LAND COVER - USGS NATIONAL LAND COVER DATASET



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LEGEND

EXISTING DRAINAGE AREAS

EXISTING LANDUSE

Categories

- BR-F
- BR-G
- DIRT
- FA
- R1
- R2
- SR-G
- WATER
- WO-G

0 1,000 2,000 4,000 Feet

Map Document: (V:\Operations\121\1008 - Little Buffalo Creek\Deliverables\Calculations\H&H\HYDRO\RCN-PRE.mxd)
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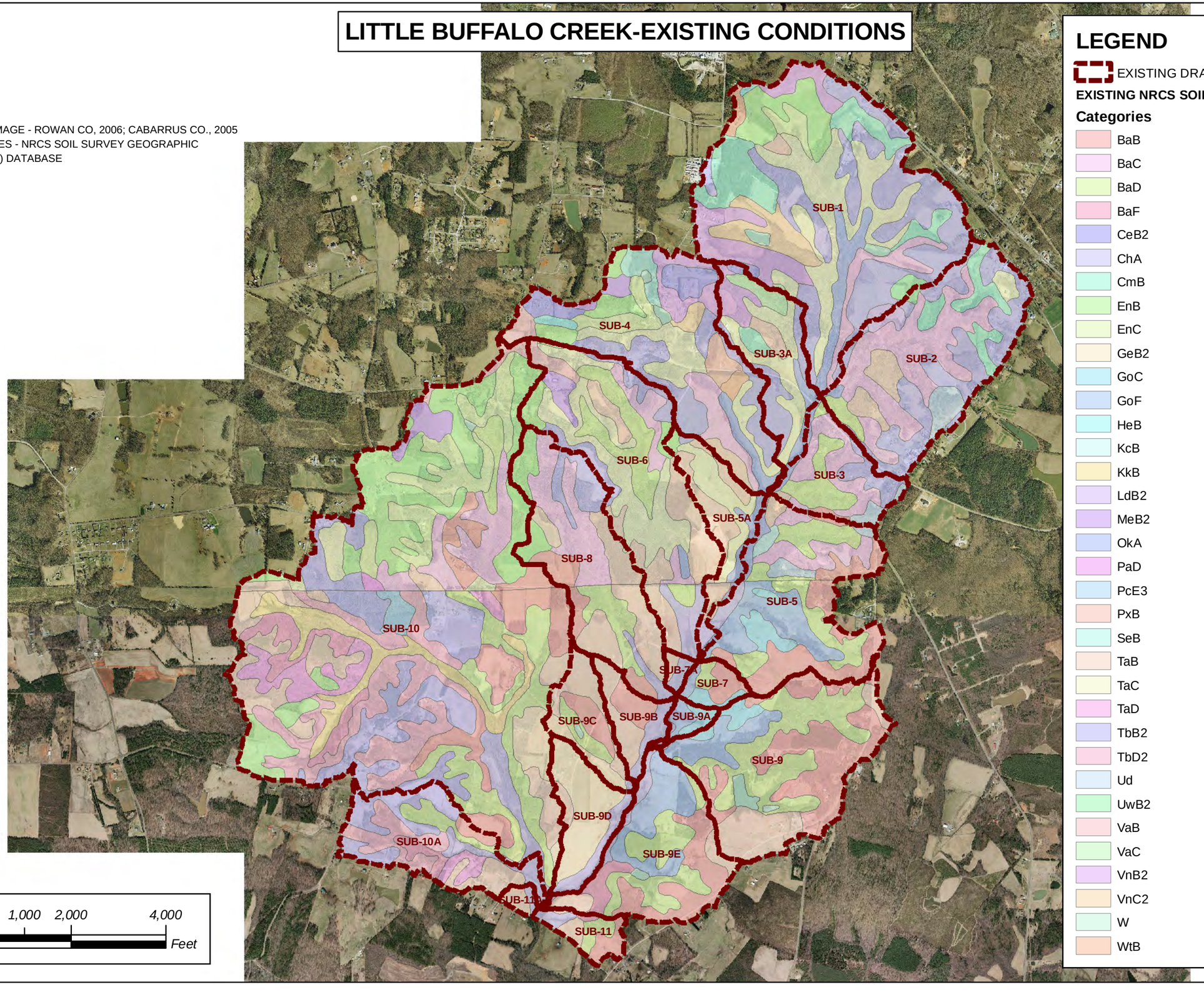
LITTLE BUFFALO CREEK-EXISTING CONDITIONS

SOURCE:
AERIAL IMAGE - ROWAN CO, 2006; CABARRUS CO., 2005
SOIL TYPES - NRCS SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE



LEGEND

EXISTING DRAINAGE AREAS

EXISTING NRCS SOIL TYPES

Categories

- BaB
- BaC
- BaD
- BaF
- CeB2
- ChA
- CmB
- EnB
- EnC
- GeB2
- GoC
- GoF
- HeB
- KcB
- KkB
- LdB2
- MeB2
- OkA
- PaD
- PcE3
- PxB
- SeB
- TaB
- TaC
- TaD
- TbB2
- TbD2
- Ud
- UwB2
- VaB
- VaC
- VnB2
- VnC2
- W
- WtB

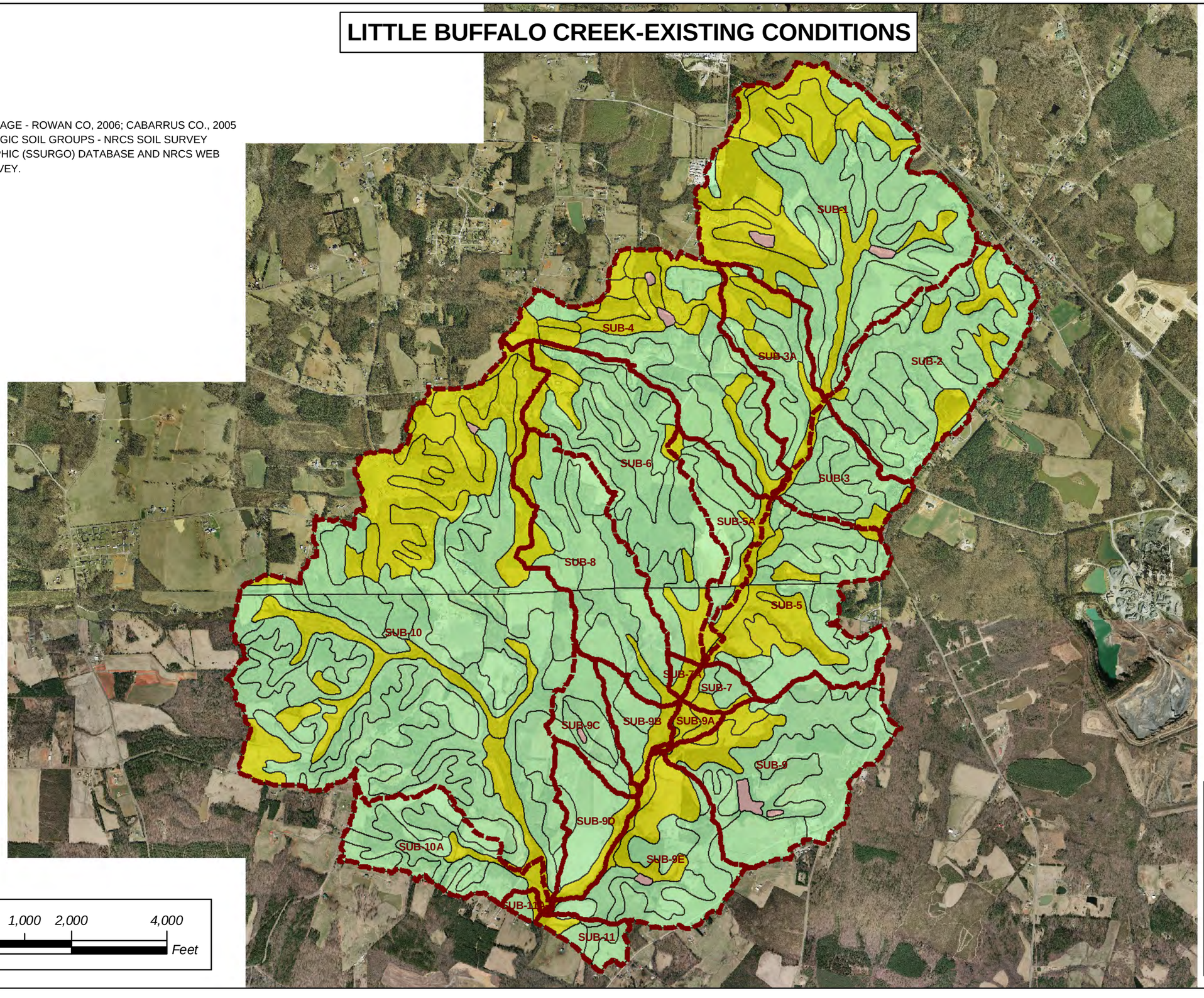
N
W E
S

0 1,000 2,000 4,000 Feet

Map Document: (V:\Operations\1211\008 - Little Buffalo Creek\Deliverables\Calculations\H&H\HYDRO\RCN-PRE.mxd)
3/18/2010 -- 3:31:06 PM

LITTLE BUFFALO CREEK-EXISTING CONDITIONS

SOURCE:
AERIAL IMAGE - ROWAN CO, 2006; CABARRUS CO., 2005
HYDROLOGIC SOIL GROUPS - NRCS SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE AND NRCS WEB SOIL SURVEY.



LEGEND

EXISTING DRAINAGE AREAS

HYDROLOGIC SOIL GROUPS

Categories

- B
- C
- D

Map Document: (V:\Operations\121\008 - Little Buffalo Creek\Deliverables\Calculations\H&H\HYDRO\RCN-PRE.mxd)
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LITTLE BUFFALO CREEK-DRAINAGE AREA AND ZONING OVERLAY MAP

N
W E
S

ROWAN

CABARRUS

SUB-1
SUB-2
SUB-3
SUB-3A
SUB-4
SUB-5
SUB-5A
SUB-6
SUB-7
SUB-7A
SUB-8
SUB-9
SUB-9A
SUB-10
SUB-11
SUB-11A

0 1,000 2,000 4,000
Feet

LEGEND

COUNTY BOUNDARIES

County Name

- CABARRUS
- ROWAN
- DRAINAGE AREAS NEW

CABARRUS CO. ZONING

ZONING CODE

- AO
- GI
- OI

ROWAN CO. ZONING

ZONING CODE

- CBI
- IND
- NB
- RA

Map Document: (V:\Operations\121\1008 - Little Buffalo Creek\Deliverables\Calculations\H&H\HYDRO\RCN-PRE.mxd)
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Residential Zoning Districts

AO- AGRICULTURAL/OPEN SPACE

Due to physical characteristics such as soil type, topography, etc., this district should remain agrarian.To a lesser degree, these are also those lands which are conducive to providing recreationally oriented open space. These land areas should remain the farmland and undeveloped forested land of the County.
Public utilities will not be planned for these areas.

CR- COUNTRYSIDE RESIDENTIAL

Comprised of land having a strong rural, pastoral feel. Natural environmental elements such as tree lines, small ponds, rock formations, and manmade elements such as pasture fencing are to be retained, if at all possible. Development only includes standard single family detached dwelling.

LDR- LOW DENSITY RESIDENTIAL

Intended to promote development with a low density feel. This district allows conventional, open space and amenity subdivisions. These zones are located where public utilities either are available or are envisioned available within the next two to five years.

MDR- MEDIUM DENSITY RESIDENTIAL

Intended to permit development with a moderately high density community character. This district allows open space and amenity subdivisions. These zones are located where public utilities either are available or are envisioned available within the next ten years. These districts are located adjacent to municipalities.

HDR- HIGH DENSITY RESIDENTIAL

Intended to allow for a wide range of residential uses and will be the primary location for multifamily development. This district allows amenity and open space subdivisions. This district is typically located near muncipal boundary lines and are adjacent to mixed use areas. Both water and sewer are available and transportation networks are capable of supporting high density development.

Non-Residential Zoning Districts

OI- OFFICE/INSTITUTIONAL

Intended to accomodate relatively low intensity office and institutional uses at an intensity complementary to residential land use. Where appropriate, this district can serve as a transition between residential land use and higher intensity non-residential land use.

LC- LIMITED COMMERCIAL

Intended to accomodate relatively small scale commercial and office development at an intensity complementary to residential land use.

GC- GENERAL COMMERCIAL

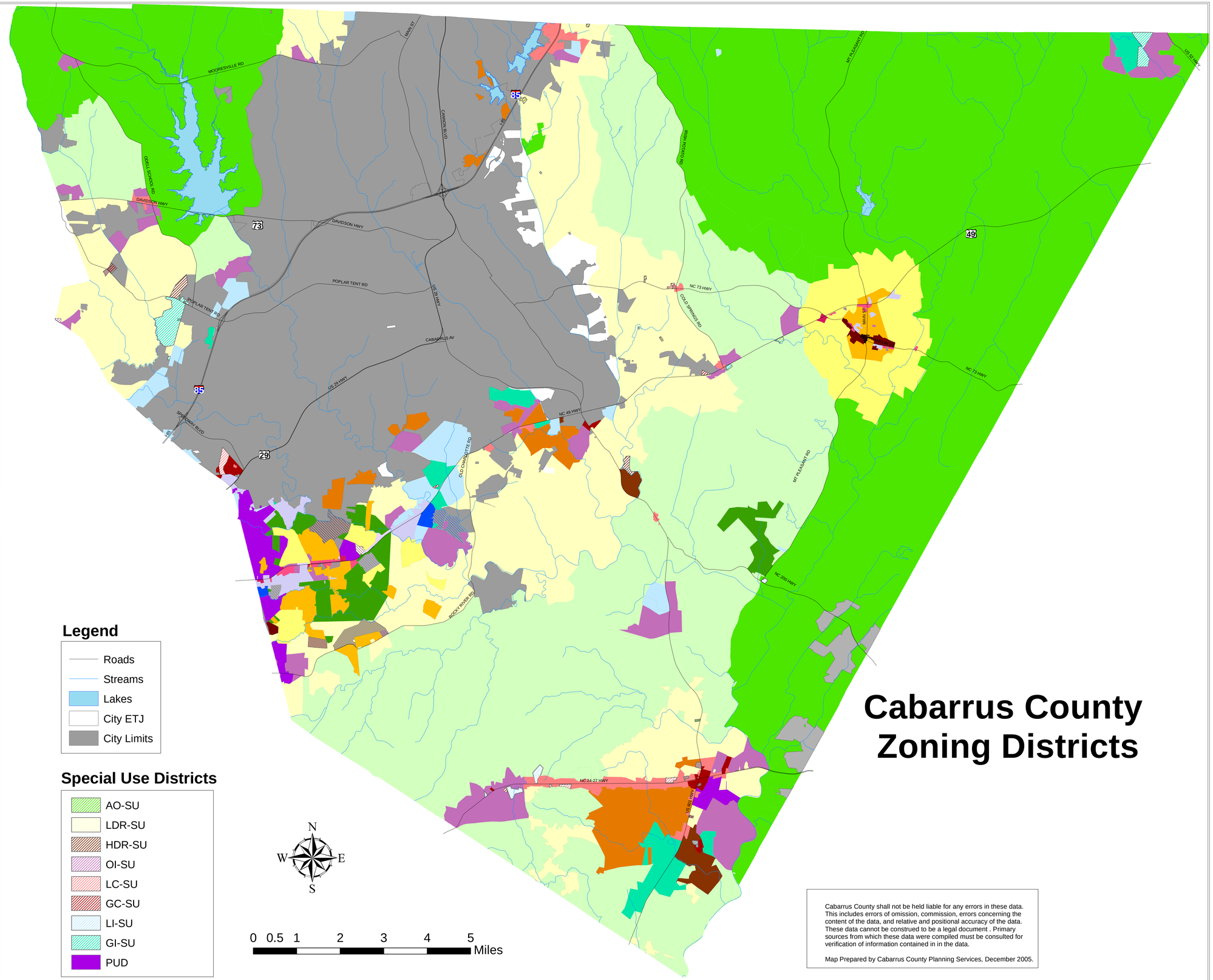
Provides location for large scale commercial activities. The zone will accomodate a wide variety of office, retail, and lodging land uses. It may border the other less intense commercial zone or either of the two industrial zones. It may border a high intensity residential zone, but must have the proper buffers.

LI- LIGHT INDUSTRIAL

Provides for both large and small scale industrial and office development. The primary distinguishing feature is that it is geared towards indoor industrial activities which do not generate high levels of noise, soot, odors, or orther potential nuisances/pollutants for impacting adjoining properties. It is located within the county where proper infrastructure is provided.

GI- GENERAL INDUSTRIAL

While this zone permits both large and small scale industrial/office development, its primary purpose is to provide a clocation for large scale development. It is designed to permit a wide variety of industrial uses which may occur both indoors and outdoors, including land uses which are permitted in no other zoning district between of their potential to create nuisances for adjoining properties.



Legend

- Roads
- Streams
- Lakes
- City ETJ
- City Limits

Special Use Districts

- AO-SU
- LDR-SU
- HDR-SU
- OI-SU
- LC-SU
- GC-SU
- LI-SU
- GI-SU
- PUD

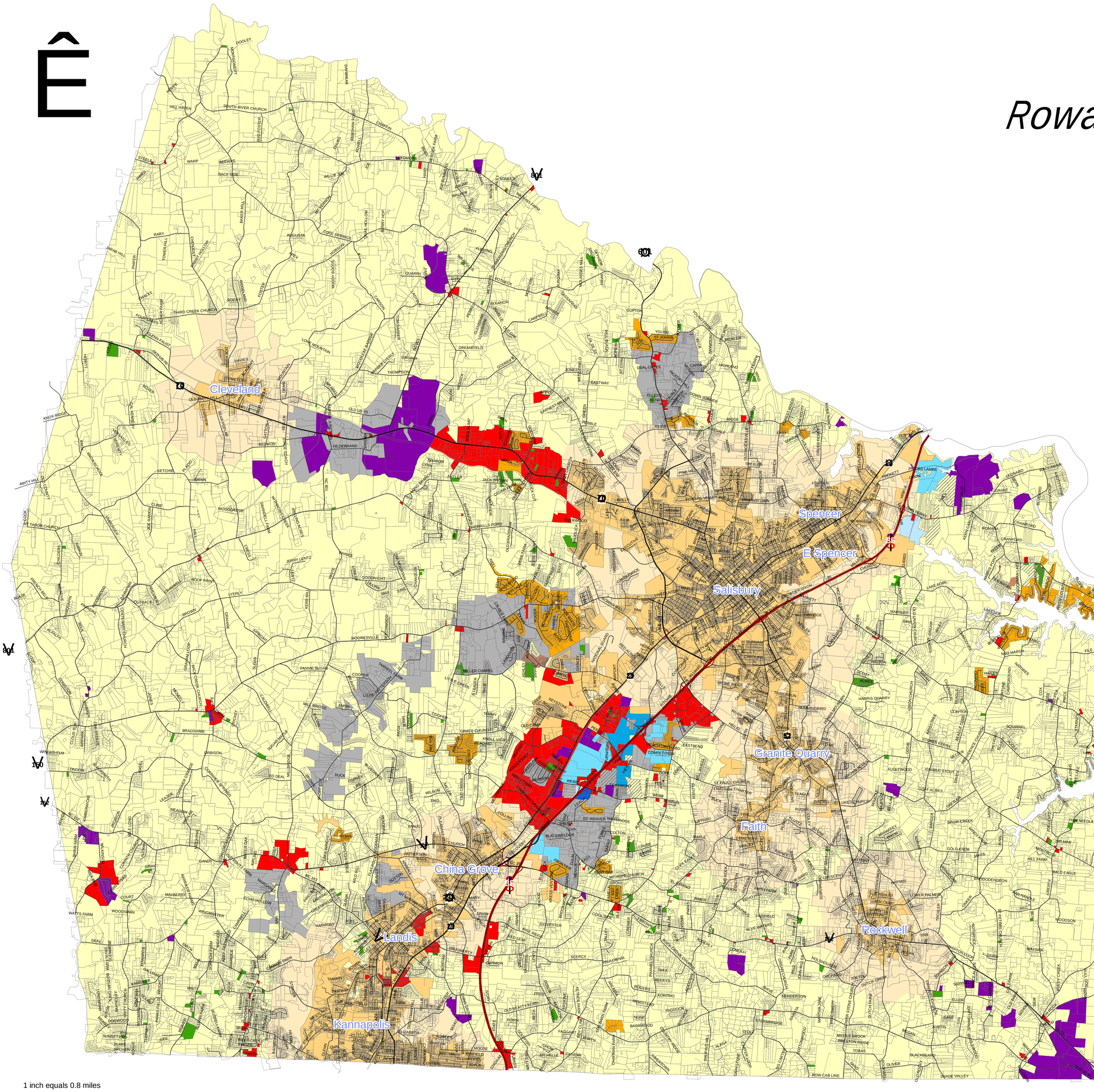
N
W E
S

0 0.5 1 2 3 4 5 Miles

Cabarrus County Zoning Districts

Map Prepared by Cabarrus County Planning Services, December 2005.

Rowan County Zoning



LEGEND

ZONING

- RS
- RR
- RR-AO
- RR-MHO
- RA
- RA-AO
- RA-MHO
- MFR
- MHP
- INST
- NB
- CBI
- CBI-MHO
- CBI CUD
- IND
- IND CUD
- 85-ED-1
- 85-ED-2
- 85-ED-3
- 85-ED-4

Roads

- INTERSTATE
- UNITED STATES HIGHWAY
- NORTH CAROLINA HIGHWAY
- STATE MAINTAINED ROADS
- CITY\TOWN STREET
- OTHER ROADS

- City Limits
- ETJ
- Parcels

Rowan County Department of Planning & Development
June 2, 2009

1 inch equals 0.8 miles

General zoning districts (Per Section 21-32)

(a) Rural Agricultural, RA. This district is developed to provide for a minimum level of land use regulations appropriate for outlying areas of the county. These outlying areas typically consist of rural single-family housing, larger tracts of land used for agriculture or in fields and forest land, with some nonresidential uses intermingled. Multifamily uses are discouraged in this district. This district would provide for protection from the most intensive land uses while containing provisions for a variety of less intensive land uses. It is the intent of this district to rely upon development standards to protect residences from potential adverse impacts of allowed nonresidential uses. The most intensive land uses would not be allowed in this district.

(b) Rural Residential, RR. This zoning district is comprised of areas of the county in which moderate levels of single-family housing has occurred or is occurring. In this district, agricultural uses have been replaced to a significant degree with single-family housing. The regulations in this district are intended to provide a land owner with an opportunity to engage in limited business or commercial activities. Multifamily uses are not allowed.

(c) Residential Suburban, RS. The purpose of this zoning district is to protect existing residential neighborhoods and promote the creation of more residential neighborhoods. These areas are typically near major thoroughfares and have or could be provided significant infrastructure. Commercial uses, business uses and multifamily uses are generally not allowed.

(d) Multifamily Residential, MFR. This district is intended to allow for a wide range of residential uses and will be the primary location for multifamily development. This district will typically be located near arterials or collectors. The development of multifamily developments within this district cannot be predetermined and cannot be adequately controlled by general district standards. Therefore specific development proposals for multifamily developments in this district shall be reviewed and approved by the board of commissioners. Approval of the site plan may include the addition of fair and reasonable standards to the site plan. No other uses allowed in the MFR district shall require site plan approval by the board of commissioners unless expressly required by this chapter. Additional approval standards for multifamily residential developments are listed in article III. The requirements of this district shall not apply to duplexes on individual lots but shall apply to multiple duplexes on an individual lot.

(e) Manufactured Home Park, MHP.

(1) This district is established in order to provide for the proper location and planning of manufactured home parks, excluding family manufactured home parks. Special requirements shall be applied to these parks which shall specify improvements to the park to ensure the public health, safety and welfare of the park inhabitants as well as the surrounding area. Designation of an area as being in the MHP district provides design and appearance criteria which are more appropriate for rental manufactured housing and/or spaces, including vinyl or similar skirting, clustering of units and reduced road construction standards. These standards are not applicable to manufactured homes and/or lots located outside a MHP district. This district requires site plan review for development of manufactured home parks by the board of commissioners. This review is required because the use may have particular impacts on the surrounding area and the county as a whole. Approval of the site plan may include the addition of fair and reasonable standards to the site plan. No other uses allowed in the MHP district shall require site plan approval by the board of commissioner unless expressly required by this chapter.

(2) Manufactured home parks, existing at the effective date of this chapter and registered

as provided by the county mobile home park ordinance are zoned as conforming uses, even though they may not meet the development standards of this chapter. Expansions of the existing registered manufactured home parks or construction of new manufactured home parks, approved under the county mobile home park ordinance may be initiated or continue unless no work has begun within six (6) months of the date of issuance of a "permit to develop" under that ordinance, or work has ceased for a period of twelve (12) months.

(3) Other manufactured home parks, which meet the intent of this section by having improvements similar to the requirements of this chapter may also be zoned as conforming uses. However, all expansions of any manufactured home park, existing at the effective date of this chapter shall meet all requirements of this chapter unless expressly provided otherwise. Development standards for a manufactured home park are listed in article III.

(f) Commercial, Business, Industrial, CBI. This zone allows for a wide range of commercial, business and light industrial activities which provide goods and services. This district is typically for more densely developed suburban areas, major transportation corridors, and major cross-roads communities. However this district may also exist or be created in an area other than listed in this subsection if the existing or proposed development is compatible with the surrounding area and the overall public good is served.

(g) Industrial, IND. This district is intended to provide for industrial activities involving extraction, manufacturing, processing, assembling, storage, and distribution of products. The district is also designed to accommodate other, more intense nonresidential uses which generate adverse side effects such as noise, odor or dust. The district is typically applied in areas with maximum accessibility to major highways, rail lines, and other significant transportation systems. However this district may also exist or be created in an area other than listed in this subsection if the existing or proposed development is compatible with the surrounding area and the overall public good is served.

(h) Neighborhood Business, NB. This district is designed for retail, limited small manufacturing facilities and service oriented business centers which serve small trading areas. As a result the list of allowed uses is more limited than those in the CBI district. The development standards for these business areas are designed to promote sound, permanent business development and to protect abutting and surrounding residential areas from undesirable aspects of nearby commercial development. This district is also designed to provide opportunities for potential development within the NB district.

Areas zoned NB shall be so located as to conveniently serve the community population. The establishment and subsequent development of this district shall not create or expand problems associated with traffic volumes or circulation. As the district is established to provide for small neighborhood oriented business areas limitations on gross floor area is established. Limitations on total impervious surface are established to minimize the adverse impacts of this type of development on adjacent residential areas. Generally, the NB district shall be two (2) acres or larger. However a lot of record, smaller than two (2) acres may be considered for rezoning to NB if the owner of the lot does not own adjacent property which may be included in the rezoning request.

(i) Institutional, INST. The purpose of the Institutional district is to recognize and permit the creation of defined areas for the unified and orderly development of major cultural, educational, medical, governmental, religious and other institutions in order to support and enhance their benefits to the community in a manner which protects adjacent residential uses. Trade school facilities teaching a trade, for example truck driving or welding, which have that activity on site, shall meet zoning requirements for that use.

Economic development districts established for I-85 (Per Section 21-34)

(a) The following districts are hereby established to preserve, encourage and enhance the economic development opportunities in areas adjacent and near I-85 in accordance to plans adopted by the county board of commissioners. It is recognized that I-85 is uniquely important in the future of the county because of the great potential for development of all types that exist along this corridor. Development within these districts shall be of types which maximize the economic benefits to the county while minimizing the potential impacts.

(b) The district are designed to accommodate, as appropriate, uses such as manufacturing, distribution, retail, service industries, corporate parks. Certain individual uses may be allowed as uses by right in some districts, while other more intensive uses may require a higher level of review and approval by the county. The districts encourage and allow more creative design of land development than may be provided on other general zoning districts. This flexibility is provided for planned unit developments.

(c) The district are labeled as 85-ED 1 through 4. "85" represents the relationship to I-85. "ED" represents the economic development designation for the sites.

(1) 85-ED-1. The purpose of the 85-ED-1 district is to encourage the location of "high capital investment/high wage/low employment/clean" industries. Certain industries shall be allowed as permitted uses standards provided to protect adjacent neighborhoods. Other heavy industries may be allowed as conditional uses. If part of a larger master plan limited accessory and ancillary retail and service uses may be allowed.

a. In the 85-ED-1 district the following uses are permitted by right with a minimum lot size of five (5) acres:

Manufacturing group:

Printing and publishing (SIC 27).

Rubber and miscellaneous plastics products (SIC 30).

Fabricated metal products (SIC 34), except:

Ammunition, except for small arms (SIC 3483).

Ordnance and accessories (SIC 3489).

Industrial machinery and equipment (SIC 35).

Electrical and electronic equipment (SIC 36), except:

Power distribution and specialty transformers (SIC 3612).

Transportation equipment (SIC 37).

Instruments and related products (SIC 38).

Miscellaneous manufacturing industries (SIC 39).

b. The following are allowed with the issuance of a conditional use permit:

Manufacturing group:

Lumber and wood products (SIC 24).

Furniture and fixtures (SIC 25).

Plastic materials, synthetic resins, etc. (SIC 282).

Drugs (SIC 283).

Paper and allied products (SIC 26).

Stone, clay, glass, and concrete products (SIC 32).

Primary metal industries (SIC 33).

Services group:

Racing, including track operation (SIC 7948).

c. Approval of a PUD with a minimum lot size of twenty (20) acres will allow the above uses in addition to accessory and ancillary uses on up to ten (10) percent of the total acreage.

Transportation, communication, and utilities group:

Local and interurban passenger transit (SIC 41).

Transportation services (SIC 47).

Retail trade group:

General merchandise stores (SIC 53).

Food stores (SIC 54).

Eating and drinking places (SIC 58).

Miscellaneous retail (SIC 59).

Finance, insurance, and real estate group:

Depository institutions (SIC 60).

Service industries group:

Hotels, rooming houses, camps, and other lodging places (SIC 70).

Personal services (SIC 72).

Business services (SIC 73).

Automotive repair, services, and parking (SIC 75).

(2) 85-ED-2. In areas where existing conditions such as surrounding development, access etc. may make the area less marketable for uses listed exclusively in the 85-ED-1 district then the 85-ED-2 district may be appropriate. The primary additions to this district are distribution and wholesaling operations.

a. Certain industries shall be allowed as permitted uses with standards provided to protect adjacent neighborhoods. Other heavy industries and distribution and wholesale operations may be allowed as conditional uses. If part of a larger master plan limited accessory and ancillary retail and service uses may be allowed.

Manufacturing group:

Printing and publishing (SIC 27).

Rubber and miscellaneous plastics products (SIC 30).

Fabricated metal products (SIC 34), except:

Ammunition, except for small arms (SIC 3483).

Ordnance and accessories (SIC 3489).

Industrial machinery and equipment (SIC 35).

Electrical and electronic equipment (SIC 36), except:

Power distribution and specialty transformers (SIC 3612).

Transportation equipment (SIC 37).

Instruments and related products (SIC 38).

Miscellaneous manufacturing industries (SIC 39).

Service industries group:

Engineering and management services (SIC 87).

b. The following are allowed with the issuance of a conditional use permit:

Manufacturing group:

Lumber and wood products (SIC 24).

Furniture and fixtures (SIC 25).

Plastic materials, synthetic resins, etc. (SIC 282).

Drugs (SIC 283).

Paper and allied products (SIC 26).

Stone, clay, glass, and concrete products (SIC 32).

Primary metal industries (SIC 33).

Transportation, communication, and utilities group:

Local and interurban passenger transit (SIC 41).

Motor freight transportation and warehousing (SIC 42).

Transportation services (SIC 47).

Wholesale trade group:

Wholesale trade--durable goods (SIC 50).

Wholesale trade--nondurable goods (SIC 51).

Services group:

Racing, including track operation (SIC 7948).

c. Approval of a PUD with a minimum lot size of twenty (20) acres will allow the above uses in addition to accessory and ancillary uses on up to ten (10) percent of the total acreage.

Transportation, communication, and utilities group:

Local and interurban passenger transit (SIC 41).

Transportation services (SIC 47).

Retail trade group:

General merchandise stores (SIC 53).

Food stores (SIC 54).

Eating and drinking places (SIC 58).

Miscellaneous retail (SIC 59).

Finance, insurance, and real estate group:

Depository institutions (SIC 60).

Service industries group:

Hotels, rooming houses, camps, and other lodging places (SIC 70).

Personal services (SIC 72).

Business services (SIC 73).

Automotive repair, services, and parking (SIC 75).

(3) 85-ED-3 Corporate Park District. Some areas with good interstate visibility, good access and good surrounding environment may be suitable for high-end corporate headquarters. This may or may not include manufacturing. The purpose of the district is to provide for a high-quality mixture of employment uses of varying types in a single coordinated development. Minimum development size is twenty (20) acres and will require approval of a PUD.

a. Allowed primary uses are:

Manufacturing group:

Lumber and wood products (SIC 24).

Furniture and fixtures (SIC 25).

Paper and allied products (SIC 26).

Printing and publishing (SIC 27).

Plastic materials, synthetic resins, etc. (SIC 282).

Drugs (SIC 283).

Rubber and miscellaneous plastics products (SIC 30).

Stone, clay, glass, and concrete products (SIC 32).

Primary metal industries (SIC 33).

Fabricated metal products (SIC 34), except:

Ammunition, except for small arms (SIC 3483).

Ordnance and accessories (SIC 3489).

Industrial machinery and equipment (SIC 35).

Electrical and electronic equipment (SIC 36), except:

Power distribution and specialty transformers (SIC 3612).

Transportation equipment (SIC 37).

Instruments and related products (SIC 38).

Miscellaneous manufacturing industries (SIC 39).

Transportation, communication, and utilities group:

Local and interurban passenger transit (SIC 41).

Motor freight transportation and warehousing (SIC 42).

Transportation services (SIC 47).

Service industries group:

Hotels, rooming houses, camps, and other lodging places (SIC 70).

Personal services (SIC 72).

Business services (SIC 73).

Automotive repair, services, and parking (SIC 75).

Health services (SIC 80).

Legal services (SIC 81).

Educational services (SIC 82).

Membership organizations (SIC 86).

Engineering and management services (SIC 87).

b. Allowed accessory and ancillary uses on up to twenty (20) percent of the total acreage:

Transportation, communication, and utilities group:

Local and interurban passenger transit (SIC 41).

Transportation services (SIC 47).

Wholesale trade group:

Wholesale trade--durable goods (SIC 50).

Wholesale trade--nondurable goods (SIC 51).

Retail trade group:

General merchandise stores (SIC 53).

Food stores (SIC 54).

Eating and drinking places (SIC 58).

Miscellaneous retail (SIC 59).

Finance, insurance, and real estate group:

Depository institutions (SIC 60).

Service industries group:

Hotels, rooming houses, camps, and other lodging places (SIC 70).

Personal services (SIC 72).

Business services (SIC 73).

Automotive repair, services, and parking (SIC 75).

(4) 85-ED-4 Retail Center. Many areas near the interstate will draw interest from retailers. It is often appropriate or desirable to have a portion of an area zoned for larger retail development. This helps ensure availability of most retail and service needs in a location nearby and accessible to major employment and residential areas. Minimum development size is twenty (20) acres and will require approval of a PUD.

a. Allowed primary and accessory uses are:

Retail trade group:

Building materials, hardware, garden supply, and mobile (SIC 52).

General merchandise stores (SIC 53).

Food stores (SIC 54).

Automotive dealers and gasoline service stations (SIC 55).

Apparel and accessory stores (SIC 56).

Furniture, home furnishings and equipment stores (SIC 57).

Eating and drinking places (SIC 58).

Miscellaneous retail (SIC 59).

Finance, insurance, and real estate group:

Depository institutions (SIC 60).

Nondepository credit institutions (SIC 61).

Security, commodity brokers, and services (SIC 62).

Insurance carriers (SIC 63).

Insurance agents, brokers, and service (SIC 64).

Real estate (SIC 65).

Holding and other investment offices (SIC 67).

Service industries group:

Hotels, rooming houses, camps, and other lodging places (SIC 70).

Personal services (SIC 72).

Business services (SIC 73).

Automotive repair, services, and parking (SIC 75).

Miscellaneous repair services (SIC 76).

Motion pictures (SIC 78).

Amusement and recreational services (SIC 79).

Health services (SIC 80).

Legal services (SIC 81).

Educational services (SIC 82).

Social services (SIC 83).

Museums, art galleries, botanical and zoological garden (SIC 84).

Membership organizations (SIC 86).

Engineering and management services (SIC 87).

Miscellaneous services (SIC 89).

(5) *Approval process for PUDs.* All PUDs shall be reviewed and approved as required for conditional use permits in article III of this chapter. Uses included in PUDs which require conditional use approval as freestanding uses shall not require separate a separate conditional use permit approval if approved as part of a PUD.

(6) *Other zoning criteria.* Notwithstanding limits on reduction of setbacks in article XIII of this chapter, all standards are subject to modification in site plan approval process. However, in no situation shall the required buffer from project perimeter be reduced if adjacent to a residentially zoned area.

a. *Buffers.* Forty (40) feet from project perimeter.

b. *Screening.* In accordance with article IX, screening for a PUD shall be determined using the predominant use of the PUD or relevant portion thereof.

c. *Street frontage.* Minimum of one hundred (100) feet for development.

d. *Maximum lot coverage.* Eighty (80) percent of lot area.

e. *Development size.* Development sizes are as permitted below. Permitted and conditional uses on lots five (5) acres or more but less than twenty (20) acres in size are only allowed on lots of record existing at the effective date of the ordinance from which this chapter derives, or on aggregations of lots existing at the effective date of the ordinance, creating a lot five (5) acres or larger in size.

1. *85-ED-1.*

   Permitted used . . .. 5 acres

   Conditional uses . ... 5 acres

   PUDs .... 20 acres

2. *85-ED-2.*

   Permitted used . . .. 5 acres

   Conditional uses . . .. 5 acres

   PUDs . . .. 20 acres

3. *85-ED-3.*

   PUDs . ... 20 acres

4. *85-ED-3.*

   PUDs . ... 20 acres

f. *Subdivision requirements.* All subdivisions of property must be approved as a PUD.

g. *Maximum building height.* No maximum height.

h. *Parking.* As required in zoning ordinance.

i. *Signs.* As provided in zoning ordinance.

j. *Circulation system.* Requires access to major or minor thoroughfare or interstate service road. No access to local streets is allowed. Interior streets are designed to connect to other adjoining property within a 85-ED district. This requirement may be waived if it is found that connection to adjoining property is not appropriate due to incompatibility of adjacent development.

k. *Nuisance conditions.* The project shall no cause detrimental levels of noise, dust, odor etc. to nearby areas.

l. *Loading, maintenance and outdoor storage areas.* All loading, maintenance and outdoor storage areas shall be located to the rear or side of the building, but shall not face a side street.

m. *Open space.* Open space shall be suitably landscaped with grass and/or trees and shrubs. Within a PUD the open space shall be pedestrian oriented. Parking or vehicular access is not allowed.

n. *Lighting.* Lighting shall be provided at intersections, along walkways and in parking lots. The maximum height of lighting is twenty-five (25) feet. Spacing of lighting shall be four (4) times the height.

o. *Building character and style.* Building designs within a PUD shall strive to establish a distinctive style and maintain a high quality development standard. Buildings should include similar architectural styles but should not be identical throughout the development. The site plan shall at a minimum describe building materials colors and architectural features of the development.

p. *Pedestrian facilities and design.* Within a PUD, the site plan shall provide for a unified and well-organized arrangement of buildings, service areas, parking, etc., to provide a high level of convenience and safety for pedestrians, employees, and visitors.

q. *Landscaping.* Approval of PUD shall include at a minimum the following:

    1. Trees shall be planted on both sides of interior access streets used by the public. These trees shall be ten (10) feet tall at planting and a minimum of twenty (20) feet tall at maturation, and shall be of similar size and shape. The trees shall be planted no further than forty (40) feet apart.

    2. Entranceways and medians shall be landscaped with trees and/or shrubs as appropriate for the type of development.

APPENDIX 9

EEP FLOODPLAIN REQUIREMENTS CHECKLIST

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. Edward Curtis), NC Floodplain Mapping Unit (attn. John Gerber) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Little Buffalo Creek (Stream Restoration)
Name if stream or feature:	Little Buffalo Creek
County:	Cabarrus

Name of river basin:	Yadkin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Gold Hill
DFIRM panel number for entire site:	3710568200J (11/05/08)
Consultant name:	The Louis Berger Group, Inc.
Phone number:	919.866.4400
Address:	1001 Wade Avenue – Suite 400 Raleigh, NC 27605

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1” = 500”.

Summarize stream reaches or wetland areas according to their restoration priority.

See attached Restoration Plan.

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)? ☐ Yes ☒ No
If project is located in a SFHA, check how it was determined: ☐ Redelineation ☐ Detailed Study ☐ Limited Detail Study

☐ Approximate Study ☐ Don't know
List flood zone designation:
Check if applies: ☑ AE Zone ☐ Floodway ☐ Non-Encroachment ☉ None ☐ A Zone ☐ Local Setbacks Required ☐ No Local Setbacks Required
If local setbacks are required, list how many feet:
Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?

☐ Yes ☒ No
Land Acquisition (Check) ☐ State owned (fee simple) ☐ Conservation easment (Design Bid Build) ☑ Conservation Easement (Full Delivery Project) Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)
Is community/county participating in the NFIP program? ☐ Yes ☒ No Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)
Name of Local Floodplain Administrator: Robbie Fox Phone Number: (704) 920-2138

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

- [x] No Action
- [ ] No Rise
- [ ] Letter of Map Revision
- [ ] Conditional Letter of Map Revision
- [ ] Other Requirements

List other requirements:

Comments:

Name: Edward Samanns Signature: _____

Title: Director of Environmental Sciences Date: April 5, 2013

APPENDIX 10

BENTHOS SURVEY RESULTS

Appendix 10 Table 1: Benthos Survey Results Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147					
1.1.1. SPECIES	**T.V.**	**F.F.G.**	**UT7**	**LBC Restoration**	**LBC Reference**
NEMATODA	**6**				1
MOLLUSCA					
Bivalvia					
Veneroida					
Sphaeriidae		**FC**			
Pisidium sp.	**6.5**	**FC**	1		
Gastropoda					
Basommatophora					
Physidae					
Physella sp.	**8.8**	**CG**	32		1
ANNELIDA					
Oligochaeta					
Tubificida					
Naididae					
Dero sp.	**10**	**CG**		2	1
Tubificidae w.o.h.c.	**7.1**	**CG**	1	7	2
ARTHROPODA					
Crustacea					
Cladocera					
Daphnidae					
Ceriodaphnia sp.				1	
Decapoda					
Cambaridae	**7.5**		1	1	
Cambarus sp.	**7.6**	**CG**			1
Procambarus sp.	**7**	**SH**			2
Insecta					
Collembola					2
Ephemeroptera					
Heptageniidae					
Stenonema femoratum	**7.2**	**SC**			4
Odonata					
Calopterygidae					
Calopteryx sp.	**7.8**	**P**			2
Coenagrionidae					
Enallagma sp.	**8.9**	**P**			1
Libellulidae					
Perithemis tenera	**9.9**	**P**			1
Hemiptera					
Belostomatidae					
Belostoma sp.	**9.8**	**P**		1	
Corixidae	**9**		1	1	

Appendix 10 Table 1: Benthos Survey Results Little Buffalo Creek Stream Mitigation Project EEP Project No. 94147					
Veliidae					
Microvelia sp.		**P**		1	
Megaloptera					
Corydalidae		**P**			
Nigronia serricornis	**5**	**P**			1
Sialidae		**P**			
Sialis sp.	**7.2**	**P**			4
Coleoptera					
Cucurlionidae					1
Dytiscidae					
Neoporus sp.	**8.6**		1		1
Elmidae		**CG**			
Stenelmis sp.	**5.1**	**SC**			3
Diptera					
Ceratopogonidae				1	1
Chironomidae					
Ablabesmyia mallochi	**7.2**	**P**			4
Chironomus sp.	**9.6**	**CG**	100	239	49
Conchapelopia sp.	**8.4**	**P**			27
Cryptochironomus sp.	**6.4**	**P**			6
Goeldichironomus sp.		**CG**	1	6	
Microtendipes pedellus gp.	**5.5**	**CG**			5
Natarsia sp.	**10**	**P**	2		2
Parachironomus sp.	**9.4**	**P**		1	1
Paratanytarsus sp.	**8.5**	**CG**			1
Polypedilum flavum (convictum)	**4.9**	**SH**			11
Polypedilum illinoense	**9**	**SC**		2	17
Polypedilum scalaenum	**8.4**				7
Procladius sp.	**9.1**	**P**	2		1
Tanytarsus sp.	**6.8**	**FC**		6	36
Culicidae			29	14	1
Anopheles sp.	**8.6**	**FC**	1		1
Culex sp.	**10**	**FC**	8	46	2
Sciomyzidae			1		
Tipulidae		**SH**			
Hexatoma sp.	**4.3**	**P**			2
TOTAL NO. OF ORGANISMS			**181**	**329**	**202**
TOTAL NO. OF SPECIES			**14**	**15**	**34**
EPT			**0**	**0**	**1**
BIOTIC INDEX assigned values			**9.05**	**9.14**	**7.59**

*North Carolina Tolerance Values (T.V.) range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes

*F.F.G.-Functional Feeding Group: CG=Collector/Gatherer, FC=Filtering/Collectors, SC=Scrapers, SH=Shredders, P=Predators and PI=Piercer

APPENDIX 11

AGENCY CORESPONDENCE

March 23, 2010

Mr. Michael O'Rourke
The Louis Berger Group, Inc.
1001 Wade Avenue, Suite 400
Raleigh, North Carolina 27605

Subject: Categorical Exclusion Form for
Little Buffalo Creek – Full Delivery Project
Yadkin River Basin – CU# 03040105
Cabarrus County
Contract No. 002029

Dear Mr. O'Rourke:

Attached please find the approved Categorical Exclusion Form for the subject full delivery project. Please include a copy of the signed form in your Restoration Plan. You may submit an invoice in the amount of $ 92,550.00 (5% of contract) for completion of the Task 1 deliverable.

If you have any questions, or wish to discuss this matter further, please contact me at any time. I can be reached at (919) 715-1656, or email me at guy.pearce@ncmail.net.

Sincerely,

Guy C. Pearce
EEP Full Delivery Program Supervisor

cc: file

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Little Buffalo Creek Stream Restoration
County Name:	Cabarrus County
EEP Number:	NCDENR Contract # 2029
Project Sponsor:	The Louis Berger Group
Project Contact Name:	Michael O'Rourke, The Louis Berger Group
Project Contact Address:	1001 Wade Avenue Suite 400, Raleigh, NC 27605
Project Contact E-mail:	morourke@louisberger.com
EEP Project Manager:	Guy Pearce

Project Description

For Official Use Only

Reviewed By:

3/23/2010
Date

Guy C Pearce
EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

3-16-10
Date

Daniel C Brown
For Division Administrator
FHWA

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

February 3, 2010

Eric Voigt
The Louis Berger Group, Inc.
801 East Main Street
Suite 500
Richmond, VA 23219

Re: Little Buffalo Creek Stream Mitigation, Cabarrus County, ER 10-0183

Dear Mr. Voigt:

Thank you for your letter of January 22, 2010, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

THE LOUIS BERGER GROUP, INC.
1001 Wade Ave. Raleigh, North Carolina 27605
Tel (919) 866-4400 Fax (919) 755-3502 www.louisberger.com

Marella Buncick
US Fish and Wildlife Service
Asheville Field Office
160 Zillicoa Field Office
Asheville, NC 28801

November 16, 2009

Subject: EEP Stream Restoration Project in Cabarrus County,
Yadkin-Pee Dee River Basin 03040105

Dear Ms. Buncick,

The Little Buffalo Creek Stream Mitigation Project is an EEP Full Delivery Project. The Little Buffalo Creek Stream Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Within the proposed project site Little Buffalo Creek and its tributaries have impaired water quality due to stressors that are biological (bacteria such as fecal coliform), chemical (fertilizers) and physical (cattle on streambanks and riparian zone) in origin. Coupled with the poor water quality, the lack of riparian buffers throughout much of the site has greatly devalued both aquatic and terrestrial habitat. Additionally, the site has diminished capacity to manage flood flows due to the erosion of, and damage to, many of the streambanks onsite. The Louis Berger Group (Berger) proposes to restore, enhance, and preserve up to nearly 14,000 linear feet of stream channel along Little Buffalo Creek and its tributaries. The project will also include the restoration of 50 foot riparian buffers on both sides Little Buffalo Creek and its tributaries. Anticipated benefits are enhanced wildlife habitats, improved water quality and improved flood storage along Little Buffalo Creek.

We have already obtained an updated species list for Cabarrus County from your web site (http://nc-es.fws.gov/es/countyfr.html). The threatened or endangered species are:

Carolina heelsplitter	*Lasmigona decorate*	Historic
Schweinitz's sunflower	*Helianthus schweinitzii*	Current

We are requesting that you please provide any known information for each species in the county. The USFWS will be contacted if suitable habitat for any listed species is found or if we determine that the project may affect one or more federally listed species or designated critical habitat.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from construction of the stream restoration project on the subject property. A USGS map showing the approximate property lines and areas of potential ground disturbance is enclosed.

If we have not heard from you in 30 days we will assume that our species list is correct, that you do not have any comments regarding associated laws, and that you do not have any information relevant to this project at the current time.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

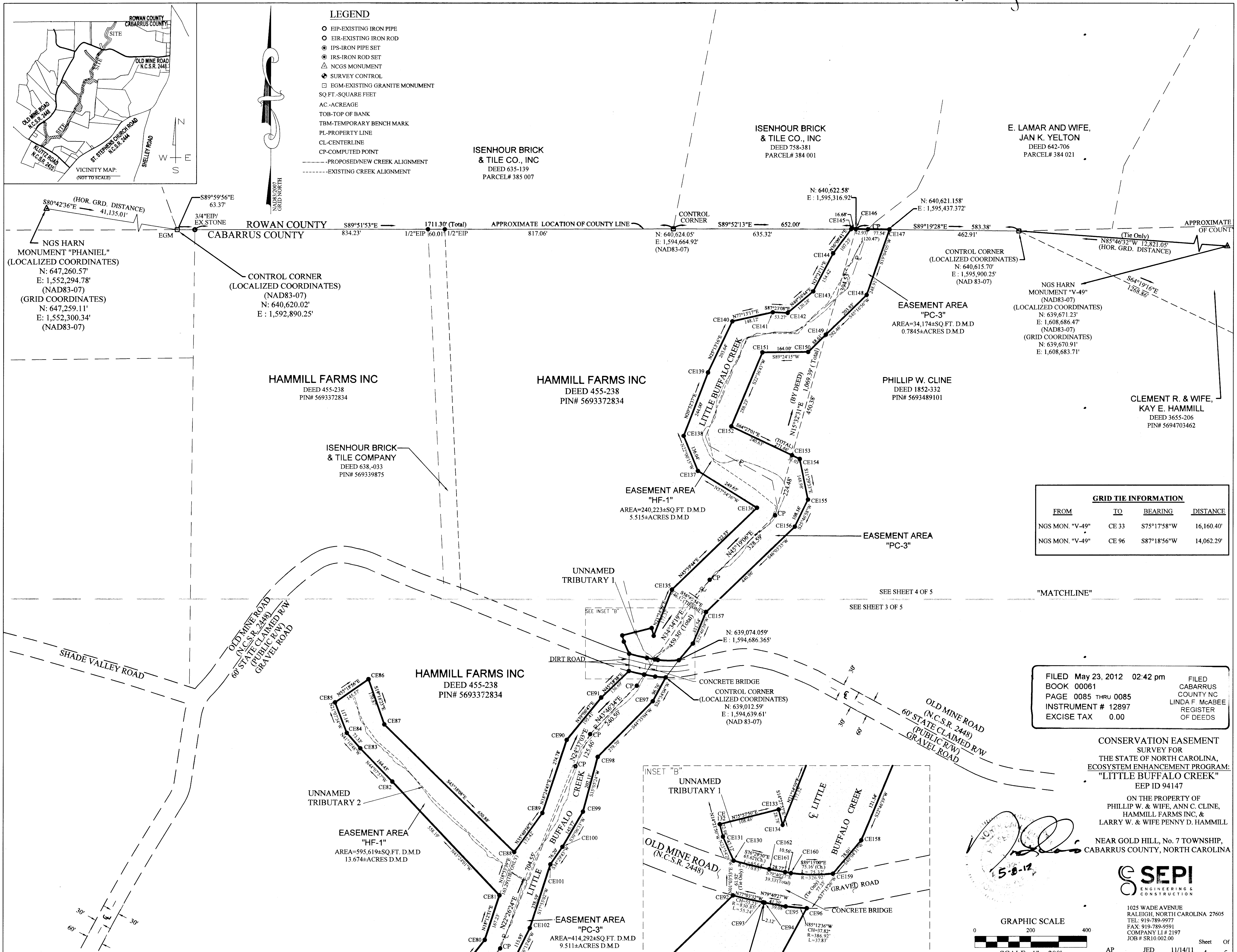
Michael O'Rourke (MICHAEL O'ROURKE FOR TINA SEKULA)

Tina Sekula
Senior Environmental Scientist
Louis Berger Group, Inc.
1001 Wade Avenue, Suite 400
Raleigh, NC 27605

cc: Michael O'Rourke (Berger)
Guy Pearce (NCEEP)

APPENDIX 12

CONSERVATION EASEMENT DOCUMENTATION



LEGEND
EIP-EXISTING IRON PIPE
EIR-EXISTING IRON ROD
IPS-IRON PIPE SET
IRS-IRON ROD SET
NCGS MONUMENT
SURVEY CONTROL
EGM-EXISTING GRANITE MONUMENT
SQ.FT.-SQUARE FEET
AC.-ACREAGE
TOB-TOP OF BANK
TBM-TEMPORARY BENCH MARK
PL-PROPERTY LINE
CL-CENTERLINE
CP-COMPUTED POINT
PROPOSED/NEW CREEK ALIGNMENT
EXISTING CREEK ALIGNMENT
NAD83/2007 GRID NORTH
VICINITY MAP: (NOT TO SCALE)
ROWAN COUNTY
CABARRUS COUNTY
SITE
OLD MINE ROAD N.C.S.R. 2448
ST. STEPHENS CHURCH ROAD N.C.S.R. 2444
KLUTTZ ROAD N.C.S.R. 2435
SHELLEY ROAD
ISENHOUR BRICK & TILE CO., INC
DEED 635-139
PARCEL# 385 007
ISENHOUR BRICK & TILE CO., INC
DEED 758-381
PARCEL# 384 001
E. LAMAR AND WIFE, JAN K. YELTON
DEED 642-706
PARCEL# 384 021
ROWAN COUNTY
CABARRUS COUNTY
APPROXIMATE LOCATION OF COUNTY LINE
NGS HARN MONUMENT "PHANIEL"
(LOCALIZED COORDINATES)
N: 647,260.57'
E: 1,552,294.78'
(NAD83-07)
(GRID COORDINATES)
N: 647,259.11'
E: 1,552,300.34'
(NAD83-07)
CONTROL CORNER
(LOCALIZED COORDINATES)
(NAD83-07)
N: 640,620.02'
E: 1,592,890.25'
CONTROL CORNER
N: 640,624.05'
E: 1,594,664.92'
(NAD83-07)
N: 640,622.58'
E: 1,595,316.92'
N: 640,621.158'
E: 1,595,437.372'
CONTROL CORNER
(LOCALIZED COORDINATES)
N: 640,615.70'
E: 1,595,900.25'
(NAD 83-07)
NGS HARN MONUMENT "V-49"
(NAD83-07)
(LOCALIZED COORDINATES)
N: 639,671.23'
E: 1,608,686.47'
(NAD83-07)
(GRID COORDINATES)
N: 639,670.91'
E: 1,608,683.71'
APPROXIMATE OF COUNTY
HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834
HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834
PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101
CLEMENT R. & WIFE, KAY E. HAMMILL
DEED 3655-206
PIN# 5694703462
ISENHOUR BRICK & TILE COMPANY
DEED 638,-033
PIN# 569339875
EASEMENT AREA "PC-3"
AREA=34,174±SQ.FT. D.M.D
0.7845±ACRES D.M.D
EASEMENT AREA "HF-1"
AREA=240,223±SQ.FT. D.M.D
5.515±ACRES D.M.D
EASEMENT AREA "PC-3"
LITTLE BUFFALO CREEK
UNNAMED TRIBUTARY 1
SEE SHEET 4 OF 5
"MATCHLINE"
SEE SHEET 3 OF 5
N: 639,074.059'
E: 1,594,686.365'
DIRT ROAD
CONCRETE BRIDGE
CONTROL CORNER
(LOCALIZED COORDINATES)
N: 639,012.59'
E: 1,594,639.61'
(NAD 83-07)
SHADE VALLEY ROAD
OLD MINE ROAD (N.C.S.R. 2448) 60' STATE CLAIMED R/W (PUBLIC R/W) GRAVEL ROAD
HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834
UNNAMED TRIBUTARY 2
EASEMENT AREA "HF-1"
AREA=595,619±SQ.FT. D.M.D
13.674±ACRES D.M.D
EASEMENT AREA "PC-3"
AREA=414,292±SQ.FT. D.M.D
9.511±ACRES D.M.D
INSET "B"
UNNAMED TRIBUTARY 1
LITTLE BUFFALO CREEK
OLD MINE ROAD (N.C.S.R. 2448)
GRAVEL ROAD
CONCRETE BRIDGE
GRAPHIC SCALE
SCALE 1" = 200'

GRID TIE INFORMATION

FROM	TO	BEARING	DISTANCE
NGS MON. "V-49"	CE 33	S75°17'58"W	16,160.40'
NGS MON. "V-49"	CE 96	S87°18'56"W	14,062.29'

FILED May 23, 2012 02:42 pm
BOOK 00061
PAGE 0085 THRU 0085
INSTRUMENT # 12897
EXCISE TAX 0.00

FILED CABARRUS COUNTY NC LINDA F. McABEE REGISTER OF DEEDS

CONSERVATION EASEMENT
SURVEY FOR
THE STATE OF NORTH CAROLINA,
ECOSYSTEM ENHANCEMENT PROGRAM:
"LITTLE BUFFALO CREEK"
EEP ID 94147

ON THE PROPERTY OF
PHILLIP W. & WIFE, ANN C. CLINE,
HAMMILL FARMS INC, &
LARRY W. & WIFE PENNY D. HAMMILL

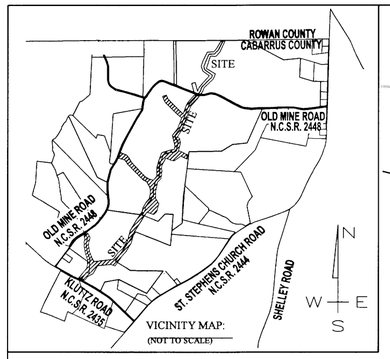
NEAR GOLD HILL, No. 7 TOWNSHIP,
CABARRUS COUNTY, NORTH CAROLINA

5-8-12

SEPI ENGINEERING & CONSTRUCTION
1025 WADE AVENUE
RALEIGH, NORTH CAROLINA 27605
TEL: 919-789-9977
FAX: 919-789-9591
COMPANY LI # 2197
JOB # SR10.002.00

Drawn By	Approved By	Date	Sheet	Of
AP	JED	11/14/11	4	5

DK 61 Pg 8



VICINITY MAP:
(NOT TO SCALE)

LEGEND

- EIP-EXISTING IRON PIPE
- EIR-EXISTING IRON ROD
- IPS-IRON PIPE SET
- IRS-IRON ROD SET
- NGS MONUMENT
- SURVEY CONTROL
- EGM-EXISTING GRANITE MONUMENT

SQ.FT.-SQUARE FEET
AC.-ACREAGE
TOB-TOP OF BANK
TBM-TEMPORARY BENCH MARK
PL-PROPERTY LINE
CL-CENTERLINE
CP-COMPUTED POINT
-PROPOSED/NEW CREEK ALIGNMENT
-EXISTING CREEK ALIGNMENT

SEE SHEET 4 OF 5
SEE SHEET 3 OF 5

"MATCHLINE"

SHADE VALLEY ROAD

OLD MINE ROAD
(N.C.S.R. 2448)
60' STATE CLAIMED R/W
(PUBLIC R/W)
GRAVEL ROAD

30' ℄ 30'
60'

UNNAMED TRIBUTARY 1

SEE INSET "B"

CE135 CE157 CP

N: 639,074.059'
E : 1,594,686.365'

DIRT ROAD

CONCRETE BRIDGE

CONTROL CORNER
(LOCALIZED COORDINATES)
N: 639,012.59'
E : 1,594,639.61'
(NAD 83-07)

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

CE86 CE85 CE87 CE84 CE83 CE82 CE81 CE88 CE89 CE90 CE91 CE97 CE98 CE99 CE100 CE101 CE102 CE103 CE104 CE105 CE106 CE107 CE108 CE109 CE110 CE111 CE112 CE113 CE114 CE115 CE116 CE117 CE118 CE119 CE120

UNNAMED TRIBUTARY 2

EASEMENT AREA
"HF-1"
AREA=595,619±SQ.FT. D.M.D
13.674±ACRES D.M.D

LITTLE BUFFALO CREEK

EASEMENT AREA
"PC-3"
AREA=414,292±SQ.FT. D.M.D
9.511±ACRES D.M.D

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

EASEMENT AREA
"HF-1"

UNNAMED TRIBUTARY 4

IRA E. McQUEEN
(HUSBAND) &
KATHERINE WAGONER
MCQUEEN
DEED 462-102
PIN# 5693572113

INSET "B"

UNNAMED TRIBUTARY 1

CE133 CE132 CE134 CE131 CE130 CE162 CE160 CE161 CE158 CE159 CE92 CE95 CE96 CE93 CE94

OLD MINE ROAD
(N.C.S.R. 2448)

LITTLE BUFFALO CREEK

GRAVED ROAD

CONCRETE BRIDGE

N: 639,022.75'
E : 1,594,563.48'

GRID TIE INFORMATION			
FROM	TO	BEARING	DISTANCE
NGS MON. "V-49"	CE 33	S75°17'58"W	16,160.40'
NGS MON. "V-49"	CE 96	S87°18'56"W	14,062.29'

NAD 83-07
GRID NORTH

HAMMILL FARMS INC
DEED 455-238
PIN# 5693372834

CE58 CE59 CE57 CE56 CE60 CE61 CE62 CE63 CE64 CE65 CE66 CE67 CE68 CE69 CE70 CE71 CE72 CE73 CE74 CE75 CE76 CE77 CE78 CE79 CE80 CE55 CE54 CE53 CE52 CE51 CE50 CE49 CE48 CE47 CE46

DIRT ROAD

EASEMENT AREA
"HF-1"
AREA=595,619±SQ.FT. D.M.D
13.674±ACRES D.M.D

UNNAMED TRIBUTARY 3

EASEMENT AREA
"HF-1"

EASEMENT AREA
"PC-3"
AREA=414,292±SQ.FT. D.M.D
9.511±ACRES D.M.D

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

CHRISTOPHER A. &
WIFE, JOY H. PINTO
DEED 5613-001
PIN# 5693561288

EIR

1"EIP

EGM

EGM

S04°04'55"W
62.77'

FILED	May-23, 2012 02:42 pm
BOOK	00061
PAGE	0084 THRU 0084
INSTRUMENT #	12896
EXCISE TAX	0.00

FILED
CABARRUS
COUNTY NC
LINDA F. McABEE
REGISTER
OF DEEDS

CONSERVATION EASEMENT
SURVEY FOR
THE STATE OF NORTH CAROLINA,
ECOSYSTEM ENHANCEMENT PROGRAM:
"LITTLE BUFFALO CREEK"
EEP ID 94147

ON THE PROPERTY OF
PHILLIP W. & WIFE, ANN C. CLINE,
HAMMILL FARMS INC, &
LARRY W. & WIFE PENNY D. HAMMILL

NEAR GOLD HILL, No. 7 TOWNSHIP,
CABARRUS COUNTY, NORTH CAROLINA

12-5-12

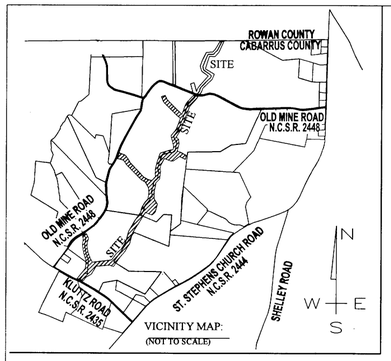
SEPI ENGINEERING & CONSTRUCTION
1025 WADE AVENUE
RALEIGH, NORTH CAROLINA 27605
TEL: 919-789-9977
FAX: 919-789-9591
COMPANY LI # 2197
JOB # SR10.002.00

GRAPHIC SCALE
0 200 400
SCALE 1" = 200'

AP	JED	11/14/11	Sheet 3	Of 5
Drawn By	Approved By	Date		

SEE SHEET 3 OF 5
SEE SHEET 2 OF 5

bc61 Pg83



NAD83/2007
GRID NORTH

SEE SHEET 3 OF 5
SEE SHEET 2 OF 5

"MATCHLINE"

LEGEND

- EIP-EXISTING IRON PIPE
- EIR-EXISTING IRON ROD
- IPS-IRON PIPE SET
- IRS-IRON ROD SET
- NGS MONUMENT
- SURVEY CONTROL
- EGM-EXISTING GRANITE MONUMENT

SQ.FT.-SQUARE FEET
AC.-ACREAGE
TOB-TOP OF BANK
TBM-TEMPORARY BENCH MARK
PL-PROPERTY LINE
CL-CENTERLINE
CP-COMPUTED POINT
----------PROPOSED/NEW CREEK ALIGNMENT
----------EXISTING CREEK ALIGNMENT

PHILLIP W.
& WIFE,
ANN C. CLINE
DEED 7148-097
PIN# 5693141529

EASEMENT AREA
"PC-1"
AREA=195,252±SQ.FT. D.M.D
4.482±ACRES D.M.D

OLD MINE ROAD
(N.C.S.R. 2448)
60' STATE CLAIMED R/W
(PUBLIC R/W)
GRAVEL ROAD

(2)76"CMP

CONTROL CORNER
(LOCALIZED COORDINATES)
N: 634,586.63'
E : 1,590,826.77'
(NAD 83-07)

LARRY W. & WIFE
PENNY D. HAMMILL
DEED 2755-264
PIN# 5693140046

EASEMENT AREA
"LH-1"
AREA=39,715±SQ.FT. D.M.D
0.912±ACRES D.M.D

EX. RR/SPIKE

N: 633,697.47'
E: 1,591,019.41'

GPS CONTROL POINT 1
(LOCALIZED COORDINATES)
(NAD83-07)
N: 633,823.19'
E: 1,590,752.80'
(NAD83-07)
(GRID COORDINATES)
N: 633,823.570'
E: 1,590,852.754'

ASPHALT ROAD

(LOCALIZED
COORDINATES)
N: 633,642.09'
E: 1,591,149.97'
(NAD83/2007)

(2)90"CMP

GPS CONTROL POINT
(LOCALIZED COORDINATES)
(NAD83-07)
N: 633,579.68'
E: 1,591,179.15'
(NAD83-07)
(GRID COORDINATES)
N: 633,580.153'
E: 1,591,179.100'

KLUTTZ ROAD
(N.C.S.R. 2435)
60' STATE CLAIMED R/W
(PUBLIC R/W)
(PAVED)

PATRICIA H. WILLIAMS
FILE 2007 #00-E-460
PIN# 5693036167

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

EASEMENT AREA
"PC-2"

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

EASEMENT AREA
"PC-2"
AREA=408,807±SQ.FT. D.M.D
9.385±ACRES D.M.D

EASEMENT AREA
"HF-1"

AREA=1,243±SQ.FT. D.M.D
0.029±ACRES D.M.D

INSET "A"

UNNAMED
TRIBUTARY 7

UNNAMED
TRIBUTARY 5

EASEMENT AREA
"PC-3"

UNNAMED
TRIBUTARY 6

LITTLE BUFFALO CREEK

AREA=
4,243±SQ.FT. D.M.D
0.097±ACRES D.M.D

CONTROL CORNER
(LOCALIZED COORDINATES)
N: 635,570.26'
E : 1,593,055.04'
(NAD 83-07)

PILE OF
STONE

EIP/EX.STONE

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

PHILLIP W. CLINE
DEED 1852-332
PIN# 5693489101

STEVEN A. WHITE
DEED 598-486
PIN# 5693454710

JOHN ALLEN JR., & WIFE,
REBECCA B. HAMMILL
DEED 442-661
PIN# 5693456082

JOHN ALLEN JR., & WIFE,
REBECCA B. HAMMILL
DEED 424-593
PIN# 5693443349

SHERMAN T. MAYNE
DEED 419-676
PIN# 5693247361

RUTH H. BLACK
DEED 374-293
PIN# 5693225904

RICHARD L. & WIFE,
KIMBERLY C. KING
DEED 6586-218
PIN# 5693443349

RITA CORL HOOKS
FILE 2004 #00-E-86
PIN# 5693328864

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

PHILLIP W. & WIFE,
ANN C. CLINE
DEED 794-250
PIN# 5693240902

ST. STEPHENS CHURCH ROAD
N.C.S.R. 2444

GRID TIE INFORMATION

FROM	TO	BEARING	DISTANCE
NGS MON. "V-49"	CE 33	S75°17'58"W	16,160.40'
NGS MON. "V-49"	CE 96	S87°18'56"W	14,062.29'
CONTROL PNT. 1	CE 10	N05°32'03"E	767.01'

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BOOK 00061
PAGE 0083 THRU 0083
INSTRUMENT # 12895
EXCISE TAX 0.00
FILED CABARRUS COUNTY NC LINDA F. McABEE REGISTER OF DEEDS

GRAPHIC SCALE
0 200' 400'
SCALE 1" = 200'

CONSERVATION EASEMENT
SURVEY FOR
THE STATE OF NORTH CAROLINA,
ECOSYSTEM ENHANCEMENT PROGRAM:
"LITTLE BUFFALO CREEK"
EEP ID 94147
ON THE PROPERTY OF
PHILLIP W. & WIFE, ANN C. CLINE,
HAMMILL FARMS INC, &
LARRY W. & WIFE PENNY D. HAMMILL

NEAR GOLD HILL, No. 7 TOWNSHIP,
CABARRUS COUNTY, NORTH CAROLINA

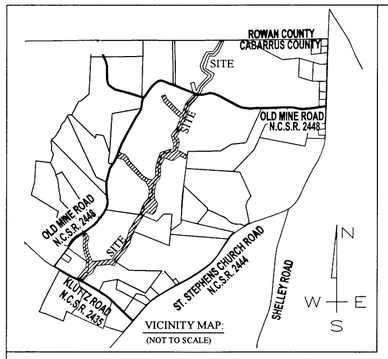
05-8-12

SEPI ENGINEERING & CONSTRUCTION

1025 WADE AVENUE
RALEIGH, NORTH CAROLINA 27605
TEL: 919-789-9977
FAX: 919-789-9591
COMPANY LI # 2197
JOB # SR10.002.00

Drawn By	Approved By	Date	Sheet	Of
AP	JED	11/14/11	2	5

Bk61 Pg82



VICINITY MAP:
(NOT TO SCALE)

CERTIFICATE OF OWNERSHIP AND DEDICATION

I (WE) HEREBY CERTIFY THAT I AM (WE ARE) THE OWNER(S) OF THE PROPERTY SHOWN AND DESCRIBED HEREON AND THAT I (WE) HEREBY ADOPT THIS PLAN OF SUBDIVISION WITH MY (OUR) FREE CONSENT, ESTABLISHED MINIMUM BUILDING LINES, AND DEDICATE ALL ROADS, ALLEYS, WALKS, PARKS, AND OTHER SITES TO THE PUBLIC USE EXCEPT AS NOTED. FURTHER, I (WE) CERTIFY THE LAND AS SHOWN HEREON IS WITHIN THE PLATTING JURISDICTION OF CABARRUS COUNTY.

5/16/12
OWNER Hammill Farms, Inc. DATE 5/16/12

OWNER DATE 5/16/12

OWNER DATE 5/16/12

OWNER DATE 5/16/12

STATE OF NORTH CAROLINA
COUNTY OF CABARRUS

I, NOTARY PUBLIC, DO HEREBY CERTIFY THAT John A. Hammill, Jr., Pres. of Hammill Farms, Inc.; Phillip W. & Ann C. Cline & Larry W. & Penny D. Cline

APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE DUE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL SEAL THIS 16th DAY OF May 20 12

Lucinda F. Lindsay
NOTARY PUBLIC
MY COMMISSION EXPIRES 7/24/2014

STATE OF NORTH CAROLINA, CABARRUS COUNTY

I Greg D. Bell, REVIEW OFFICER FOR CABARRUS COUNTY, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

Greg D. Bell 5/23/12
REVIEW OFFICER DATE

NORTH CAROLINA, CABARRUS COUNTY

THE FOREGOING CERTIFICATE(S) OF _____ IS (ARE) CERTIFIED TO BE CORRECT. THIS INSTRUMENT WAS PRESENTED FOR REGISTRATION ON AND RECORDED IN THIS OFFICE AT BOOK_____, PAGE_____ THIS_____ DAY OF_____, 20____ AT _____O'CLOCK___M.

BY_____
REGISTER OF DEEDS

CERTIFICATE OF APPROVAL BY THE SUBDIVISION ADMINISTRATOR

I,_____, SUBDIVISION ADMINISTRATOR OF CABARRUS COUNTY HEREBY APPROVE THE FINAL PLAT OF THE SUBDIVISION ENTITLED_____

N/A

ON THE_____DAY OF_____MONTH, OF THE_____YEAR.

_____
SUBDIVISION ADMINISTRATOR

I, JON ERIC DAVIS, CERTIFY THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION, AND THE FOLLOWING INFORMATION WAS USED TO PERFORM THE SURVEY:
1) CLASS OF SURVEY: CLASS II , 95 % CONFIDENCE LEVEL AS PER FGDC GEOSPATIAL ACCURACY STANDARDS, PART 2 : STANDARDS FOR GEODETIC NETWORKS
2) POSITIONAL ACCURACY: THE POINT DATA PROVIDED FOR THE CONTROL TIES MEETS ACCURACY STANDARDS FOR BOTH THE LOCAL AND NETWORK ACCURACY HAVING MET THE 5 CM ACCURACY FOR HORIZONTAL COORDINATE VALUES.
3) TYPE OF GPS FIELD PROCEDURE: VRS
4) DATE OF SURVEY: MARCH 2010
5) DATUM/EPOCH: NAD 83-2007
6) PUBLISHED/FIXED CONTROL USED: NGS MONUMENTS "V-49", & "PHANIEL"
7) GEOID MODEL: GEOID09
8) COMBINED GRID FACTOR: 0.999854043
9) UNITS: NORTH CAROLINA STATE PLANE COORDINATES > US SURVEY FEET

ADDITIONAL NOTES/INFORMATION: EQUIPMENT USED TO PERFORM VRS OBSERVATIONS WAS THE TOPCON GR3. FIXED ANTENNA HEIGHT @ 2.0 METERS.

I, JON ERIC DAVIS , CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION, FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION, (DEED DESCRIPTION RECORDED IN BOOK 455 , PAGE 238 ,) THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN BOOK 794 , PAGE 250 ,LINE THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,0000+ , THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S.47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 8th DAY OF MAY A.D., 20 12 .

JON ERIC DAVIS, PLS-3464

NORTH CAROLINA PROFESSIONAL SEAL L-3464 5-8-12 JON ERIC DAVIS

SURVEYOR CERTIFICATION FOR SUBDIVISION

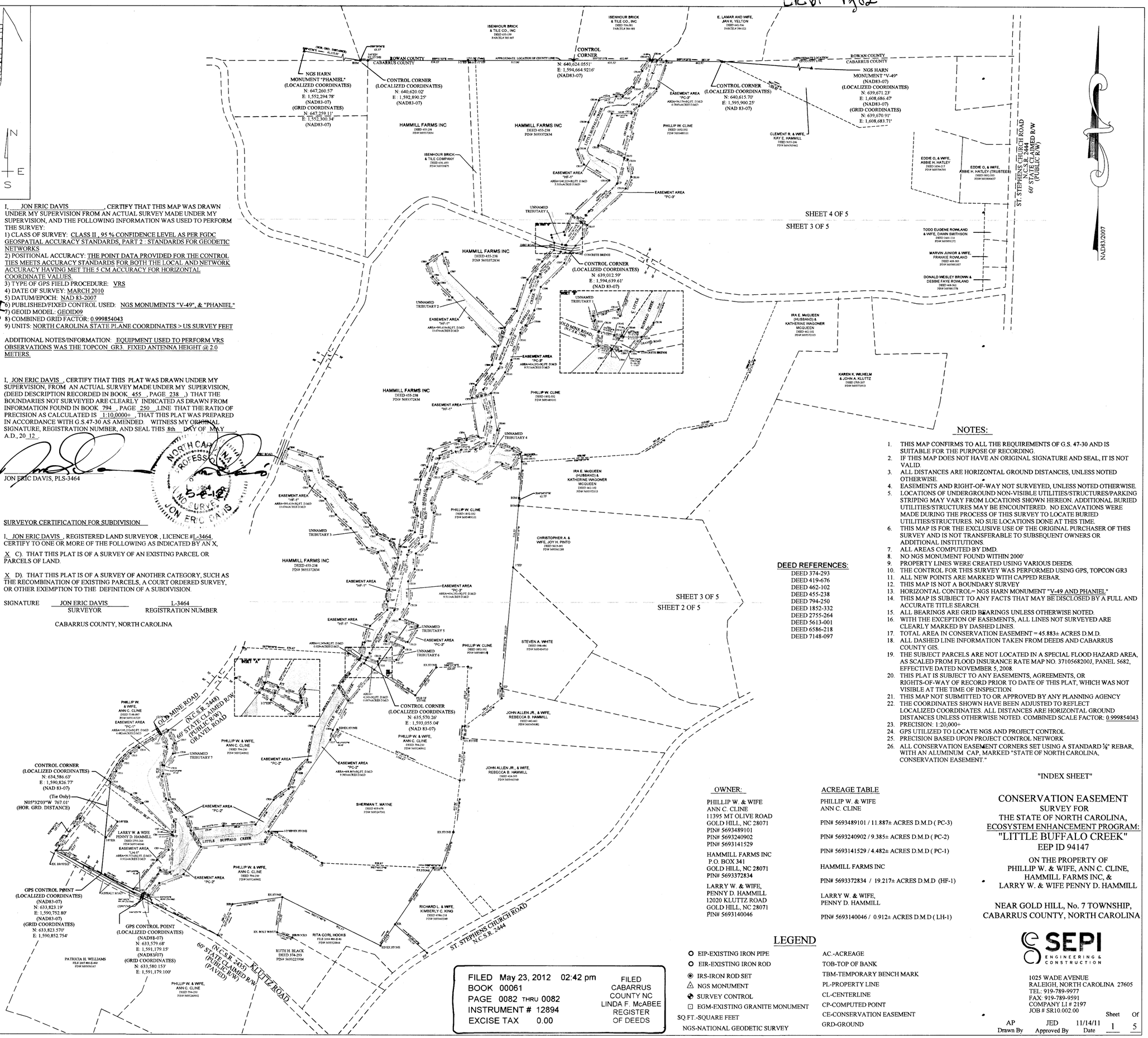
I, JON ERIC DAVIS , REGISTERED LAND SURVEYOR , LICENCE #L-3464, CERTIFY TO ONE OR MORE OF THE FOLLOWING AS INDICATED BY AN X,

X C). THAT THIS PLAT IS OF A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND.

X D). THAT THIS PLAT IS OF A SURVEY OF ANOTHER CATEGORY, SUCH AS THE RECOMBINATION OF EXISTING PARCELS, A COURT ORDERED SURVEY, OR OTHER EXEMPTION TO THE DEFINITION OF A SUBDIVISION.

SIGNATURE JON ERIC DAVIS SURVEYOR L-3464 REGISTRATION NUMBER

CABARRUS COUNTY, NORTH CAROLINA



GRAPHIC SCALE
0 500' 1000'
SCALE 1" = 500'

DEED REFERENCES:
DEED 374-293
DEED 419-676
DEED 462-102
DEED 455-238
DEED 794-250
DEED 1852-332
DEED 2755-264
DEED 5613-001
DEED 6586-218
DEED 7148-097

NOTES:
1. THIS MAP CONFIRMS TO ALL THE REQUIREMENTS OF G.S. 47-30 AND IS SUITABLE FOR THE PURPOSE OF RECORDING.
2. IF THIS MAP DOES NOT HAVE AN ORIGINAL SIGNATURE AND SEAL, IT IS NOT VALID.
3. ALL DISTANCES ARE HORIZONTAL GROUND DISTANCES, UNLESS NOTED OTHERWISE.
4. EASEMENTS AND RIGHT-OF-WAY NOT SURVEYED, UNLESS NOTED OTHERWISE.
5. LOCATIONS OF UNDERGROUND NON-VISIBLE UTILITIES/STRUCTURES/PARKING STRIPING MAY VARY FROM LOCATIONS SHOWN HEREON. ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE MADE DURING THE PROCESS OF THIS SURVEY TO LOCATE BURIED UTILITIES/STRUCTURES. NO SUE LOCATIONS DONE AT THIS TIME.
6. THIS MAP IS FOR THE EXCLUSIVE USE OF THE ORIGINAL PURCHASER OF THIS SURVEY AND IS NOT TRANSFERABLE TO SUBSEQUENT OWNERS OR ADDITIONAL INSTITUTIONS.
7. ALL AREAS COMPUTED BY DMD.
8. NO NGS MONUMENT FOUND WITHIN 2000'
9. PROPERTY LINES WERE CREATED USING VARIOUS DEEDS.
10. THE CONTROL FOR THIS SURVEY WAS PERFORMED USING GPS, TOPCON GR3
11. ALL NEW POINTS ARE MARKED WITH CAPPED REBAR.
12. THIS MAP IS NOT A BOUNDARY SURVEY
13. HORIZONTAL CONTROL= NGS HARN MONUMENT "V-49 AND PHANIEL"
14. THIS MAP IS SUBJECT TO ANY FACTS THAT MAY BE DISCLOSED BY A FULL AND ACCURATE TITLE SEARCH.
15. ALL BEARINGS ARE GRID BEARINGS UNLESS OTHERWISE NOTED.
16. WITH THE EXCEPTION OF EASEMENTS, ALL LINES NOT SURVEYED ARE CLEARLY MARKED BY DASHED LINES.
17. TOTAL AREA IN CONSERVATION EASEMENT = 45.883± ACRES D.M.D.
18. ALL DASHED LINE INFORMATION TAKEN FROM DEEDS AND CABARRUS COUNTY GIS.
19. THE SUBJECT PARCELS ARE NOT LOCATED IN A SPECIAL FLOOD HAZARD AREA, AS SCALED FROM FLOOD INSURANCE RATE MAP NO. 3710568200J, PANEL 5682, EFFECTIVE DATED NOVEMBER 5, 2008.
20. THIS PLAT IS SUBJECT TO ANY EASEMENTS, AGREEMENTS, OR RIGHTS-OF-WAY OF RECORD PRIOR TO DATE OF THIS PLAT, WHICH WAS NOT VISIBLE AT THE TIME OF INSPECTION.
21. THIS MAP NOT SUBMITTED TO OR APPROVED BY ANY PLANNING AGENCY
22. THE COORDINATES SHOWN HAVE BEEN ADJUSTED TO REFLECT LOCALIZED COORDINATES. ALL DISTANCES ARE HORIZONTAL GROUND DISTANCES UNLESS OTHERWISE NOTED. COMBINED SCALE FACTOR: 0.999854043
23. PRECISION: 1:20,000+
24. GPS UTILIZED TO LOCATE NGS AND PROJECT CONTROL.
25. PRECISION BASED UPON PROJECT CONTROL NETWORK
26. ALL CONSERVATION EASEMENT CORNERS SET USING A STANDARD ⅝" REBAR, WITH AN ALUMINUM CAP, MARKED "STATE OF NORTH CAROLINA, CONSERVATION EASEMENT."

"INDEX SHEET"

OWNER:

PHILLIP W. & WIFE
ANN C. CLINE
11395 MT OLIVE ROAD
GOLD HILL, NC 28071
PIN# 5693489101
PIN# 5693240902
PIN# 5693141529

HAMMILL FARMS INC
P.O. BOX 341
GOLD HILL, NC 28071
PIN# 5693372834

LARRY W. & WIFE,
PENNY D. HAMMILL
12020 KLUTTZ ROAD
GOLD HILL, NC 28071
PIN# 5693140046

ACREAGE TABLE

PHILLIP W. & WIFE
ANN C. CLINE

PIN# 5693489101 / 11.887± ACRES D.M.D (PC-3)

PIN# 5693240902 / 9.385± ACRES D.M.D (PC-2)

PIN# 5693141529 / 4.482± ACRES D.M.D (PC-1)

HAMMILL FARMS INC

PIN# 5693372834 / 19.217± ACRES D.M.D (HF-1)

LARRY W. & WIFE,
PENNY D. HAMMILL

PIN# 5693140046 / 0.912± ACRES D.M.D (LH-1)

LEGEND

- EIP-EXISTING IRON PIPE
- EIR-EXISTING IRON ROD
- IRS-IRON ROD SET
- NGS MONUMENT
- SURVEY CONTROL
- EGM-EXISTING GRANITE MONUMENT
- SQ.FT.-SQUARE FEET
- NGS-NATIONAL GEODETIC SURVEY
- AC.-ACREAGE
- TOB-TOP OF BANK
- TBM-TEMPORARY BENCH MARK
- PL-PROPERTY LINE
- CL-CENTERLINE
- CP-COMPUTED POINT
- CE-CONSERVATION EASEMENT
- GRD-GROUND

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FILED CABARRUS COUNTY NC LINDA F. McABEE REGISTER OF DEEDS

CONSERVATION EASEMENT SURVEY FOR THE STATE OF NORTH CAROLINA, ECOSYSTEM ENHANCEMENT PROGRAM:

"LITTLE BUFFALO CREEK"

EEP ID 94147

ON THE PROPERTY OF
PHILLIP W. & WIFE, ANN C. CLINE,
HAMMILL FARMS INC, &
LARRY W. & WIFE PENNY D. HAMMILL

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AP	JED	11/14/11	1	5