ORIGINAL

DYE BRANCH STREAM RESTORATION PLAN

TOWN OF MOORESVILLE
IREDELL COUNTY, NORTH CAROLINA

NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

Ecosystem Enhancement PROGRAM

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Dye Branch Stream Restoration Plan

Town of Mooresville
Iredell County, North Carolina

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Prepared For:

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1.0 Introduction

1.1 Project Description

The proposed Dye Branch stream restoration project is located within the City Limits of Mooresville, North Carolina. Mulkey, Inc. (Mulkey) was contracted through the North Carolina Ecosystem Enhancement Program (EEP) to provide design and construction management services as part of an On-Call Services Agreement. This urban stream restoration project covers a portion of Dye Branch and one of its tributaries, Cemetery Branch, situated immediately east of the Mooresville downtown area. Specifically, the project begins along Dye Branch at the culvert outlet under Center Avenue and extends downstream nearly 3,500 linear feet to the last residential property at the southern end of McLelland Avenue. The proposed restoration of Cemetery Branch begins immediately downstream of the Church Street culvert and extends approximately 1,000 linear feet to its confluence with Dye Branch. The two combined streams total approximately 4,597 linear feet of existing stream channel. This does not include the length of the culverts. Figure 1 denotes the project area associated with both stream channels and includes directions to the project site.

These segments of Dye Branch and Cemetery Branch were selected for their excellent opportunities to restore natural stream functions, establish effective riparian buffers and restore overall healthy floodplain stability in this urbanized section of town. The Dye Branch project is entirely within urban confines, consisting primarily of residential areas and a city park. The landuse within and surrounding the project site is either periodically maintained or dominated by exotic, invasive vegetative species such as Chinese privet (*Ligustrum sinense*) and kudzu (*Pueraria lobata*). The lack of overall riparian vegetation, the condition of the existing vegetation and the excessive stormwater runoff from the surrounding urban areas has caused severe streambank erosion and poor water quality conditions. The restoration of Dye Branch and Cemetery Branch incorporates natural channel design methodologies and will total approximately 4,353 linear feet of stream channel, an overall decrease of nearly 244 linear feet of stream length. These efforts will utilize Priority II, III and IV stream restoration principles to reestablish the stream channels within their historical floodplains. The restoration effort will also include utility relocation and removal and/or eradication of exotic, invasive plants. No jurisdictional wetlands will be impacted as part of project implemetation.

2.0 Goals and Objectives

The goals and objectives of this stream restoration plan will result in:

- Providing a stable system of stream channels that neither aggrades nor degrades while maintaining their dimension, pattern, and profile with the capacity to transport the watershed's water and sediment load;
- Improving the overall water quality and aquatic habitat by reducing sediment and waste inputs into the stream caused by bank erosion, mass-wasting, and stormwater runoff; and
- Improving the overall viability of the riparian vegetative communities through establishment of native species and elimination of invasive and exotic species.

3.0 General Watershed Information

Dye Branch and Cemetery Branch are situated within the Yadkin-Pee Dee River Basin. The site is within the US Geological Survey (USGS) hydrological unit code (HUC) 03040105 and the NC Division of Water Quality (NCDWQ) sub-basin 03-07-11. This sub-basin is known as the Upper Rocky River Watershed, covering approximately 277 square miles or 177,300 acres. Forests and pastureland account for approximately 90% of the land use within the sub-basin. The remaining ten percent is considered urban.

Dye Branch originates approximately 1,300 feet north of the project beginning from several intermittent drainages and culvert outlets. The stream flows in a southerly direction through the project area and empties into the Rocky River four miles downstream. The drainage area associated with the Dye Branch watershed covers nearly 0.6 square miles (384 acres). Cemetery Branch flows in a southeasterly direction to its confluence with Dye Branch approximately 1,000 linear feet downstream from the beginning of the project. The drainage area of the watershed of Cemetery Branch covers approximately 0.06 square miles (38.4 acres). The drainage areas associated with both streams are presented in Figure 2.

The dominant land use within the watershed is primarily urban, occupying approximately 85 percent of all land area within the watershed. Contrary to overall landuse in the Rocky River watershed, this portion of Dye Branch is exclusively classified as urban. The downtown area of Mooresville, which houses government complexes and commercial areas, including small businesses and restaurants, covers the northern-most section of the watershed. Residential neighborhoods and their yardscapes, as well as parks, are also included within the urban land use category, encompassing the majority of the land use in the watershed. Impervious surfaces and intensely maintained areas account for another ten percent of the land area. This large area of impervious surface can be attributed to the close proximity of parking lots adjacent to commercial and governmental buildings, as well as the presence of numerous secondary roadways in the immediate watershed area. Forest lands within the watershed are limited to small, narrow areas that account for the remaining percentage of the land use.

According to the North Carolina Department of Environment and Natural Resources (NCDENR), Dye Branch is currently classified as C (Secondary Recreation) waters according to the 1974 assessment (NCDENR, 2003). Cemetery Branch is not classified and therefore assumes the same classification as Dye Branch. According to the latest report issued by the NCDENR (2004), Dye Branch, from its source to its confluence with the Rocky River, is also currently listed as a 303(d) impaired stream within the 03-07-11 sub-basin. It is impaired for aquatic life with potential sources of pollution from urban runoff/storm sewers and a minor municipal point source (NCDENR, 2004).

Water quality information has been collected from two sampling sites along Dye Branch; one on SR 1147 approximately 2.5 miles downstream of the project area and the other on SR 1142 approximately 4 miles downstream of the site. The sampling site on SR 1147 received a North Carolina Biotic Index (NCBI) rating of "Fair" in 1985 and 1990. The sampling site located on SR 1142 was rated "Poor" in 2001. These ratings are based on the number of benthic macroinvertebrate taxa present in the intolerant groups Ephemeroptera, Plecoptera and

Trichoptera (EPTs) and the value of the NCBI. The ratings can range from Poor to Excellent and primarily reflect the influence of chemical pollutants (NCDENR, 2002).

Currently, there are 24 National Pollutant Discharge Elimination System (NPDES) dischargers within the 03-07-11 sub-basin, which includes portions of Mecklenburg and Cabarrus Counties. In recent years, one large industrial facility in the Dye Branch watershed which contributed waste to the Mooresville Waste Water Treatment Plant (WWTP) closed, nearly eliminating toxicity problems associated with that discharge. The Mooresville WWTP had only a few minor compliance problems between 1998 and 2001, most of which were resolved quickly. However, there is a significant amount of developed area in the Dye Branch watershed and the City of Mooresville will likely be required by NCDWQ to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules.

3.1 Current Property Ownership

The Dye Branch project site will be held in perpetuity under the strictures of a conservation easement. Approximately twenty-one individual landowners currently own and/or adjoin the land contained within this conservation easement. The majority of the acreage within the easement is owned by the Town of Mooresville. The remaining landowners, as documented by the Iredell County GIS/Mapping Department as of July 2005, are listed in Appendix A.

4.0 Existing Conditions

4.1 Existing Topography

The topography of the project site has been altered over the years by the increased urbanization of the downtown area. Within the project area and its vicinity, slopes have been graded, areas have been filled and the majority of the vegetation has been removed in order to make way for the city park, neighborhoods and other urban development. In all likelihood, the width of the floodplain has also been changed. The current floodplains of Dye Branch and Cemetery Branch vary in width above Cabarrus Avenue and narrow towards the terminus of the project. Elevations range across the project from a high of 850 feet above mean sea level at the upper limit, or beginning, to a low of 810 feet at the end.

4.2 Existing Natural Features

4.2.1 Geology

The Dye Branch Site is within the Piedmont physiographic province; specifically, the Southern Outer Piedmont Ecoregion (Griffith et al., 2002). It is underlain by the Charlotte Belt, a region consisting of intrusive, granitic rock, which formed during the Permian and Pennyslvanian Periods (265 to 325 million years ago) (NCDLR, 1985).

4.2.2 Soils

Soils found at the Dye Branch Site lie within the Felsic Crystalline System of the western Piedmont (Daniels et al., 1999). According to the Iredell County Soil Survey, Chewacla, Cecil fine sandy loam and Colfax sandy loam are the soils underlying the project area (Figure 3). The Chewacla soils are deep, somewhat poorly drained soils which have formed from recent alluvium on nearly level floodplains along streams that drain from the Mountains and Piedmont physiographic provinces. The Cecil soils are eroded, well-drained soils located on 6 to 15 percent slopes bordering drainageways. The Colfax soils are somewhat poorly drained upland soils along drainageways with 2 to 6 percent slopes.

Based on the Soil Survey of Iredell County, Chewacla and Colfax soils comprise the floodplain portion of the site, while the adjacent uplands consist mainly of Cecil soils. Chewacla soils are classified by the Natural Resources Conservation Service (NRCS) as fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts. Colfax soils are classified as fine-loamy, mixed, subactive, thermic Aquic Fragiudults. Chewacla and Colfax soils are classified as Hydric B soils because their composition is not entirely hydric, but retain a hydric status due to inclusions of Hydric A soils. These inclusions are most commonly Wehadkee and Worsham soils.

4.3 Existing Hydrologic Features

Mulkey surveyed the existing conditions at the project site by using total station survey equipment with GPS survey grade receivers. Existing condition surveys included longitudinal profiles, cross sections, pebble counts, and bar samples to determine the current state of the stream channels. Existing longitudinal profiles were conducted by identifying each stream feature (riffle, run, pool, or glide) and surveying specific points at those features. These specific locations included top of bank, bankfull, waters edge or surface, and thalweg. In addition, 10 cross sections on Dye Branch and four along Cemetery Branch were selected and surveyed at representative stream features throughout the project. These cross section helped to fully characterize the dimension of the existing channels (Figure 4 and Appendix B). Following the completion of the existing channel surveys, pebble counts were conducted at specific cross section locations as well as a bar sample analysis. Data pertaining to each stream channel are discussed in the following sections.

4.3.1 Jurisdictional Streams

According to the North Carolina Administrative Code, Dye Branch and Cemetery Branch both meet the jurisdictional definition for perennial streams. Perennial streams have water flowing in a well-defined channel for a majority of the year (greater than 90 percent of the time). Another stream channel was identified in the project area whose confluence is approximately 500 feet downstream of the confluence of Dye Branch and Cemetery Branch; however, it meets only the jurisdictional definition of an intermittent stream. Intermittent streams contain water for only part of the year, typically during winter and spring when the aquatic bed is below the water table (NCAC, 1999).

4.3.1.1 Dye Branch

Dye Branch flows in close proximity to downtown Mooresville. The substantial amount of impervious surface and lack of vegetation throughout the watershed has contributed to the flashy flood conditions and actively eroding streambanks of the existing stream channel. Little to no riparian buffer exists along the stream within the project area, which has further exacerbated the destabilization of the stream.

The existing Dye Branch channel within the project area has been separated into three reaches. The first reach begins at the culvert outlet under Center Avenue and ends at the McLelland Avenue culvert. The second reach begins at the McLelland Avenue culvert outlet and ends at the Cabarrus Avenue culvert and the third reach begins at the Cabarrus Avenue culvert outlet and ends at the last residential property on Cabarrus Avenue. The slope along Dye Branch ranges from 0.0060 ft/ft (or 0.6%) in its upper reach to an average slope of 0.0110 ft/ft (or 1.1%) in the lower reach. Existing profile information for Dye Branch can be found in Appendix B. Dye Branch is classified as an unstable E4 channel along the upper two reaches of

the project according to the Rosgen stream classification system (Rosgen, 1994). It transitions to a G4c stream type as the slope increases through the lower reach.

The bank height ratios also vary between the reaches. Bank height ratios note the difference between the bankfull elevation and the lowest stream bank. Commonly, stable channels exhibit bank height ratios between 1.0 and 1.3; however, these numbers may increase based on stream classification and overall entrenchement. The existing ratios were approximatley 1.0 along the upper two reaches. As for the lower reach, Mulkey observed ratios ranging up to 5.0 further denoting the overall instability of this reach. A summary of the cross section data used to determine these classifications is presented in Table 1 and existing cross section views are presented in Appendix B. Additional information including existing pattern data for Dye Branch can be found with all the morphological data in Appendix C.

The composition of the stream bed and banks is an important facet of stream character, influencing channel form and hydraulics, erosion rates and sediment supply. The stream bed along Dye Branch was characterized using two protocols, the modified Wolman Pebble Count (Rosgen, 1993) and the bar sample analysis. The bar sample analysis provides data for both comparison purposes and sediment transport validations.

According to the modified Wolman Pebble Count procedure, the average d_{50} (50% of the sampled population is equal to or finer than the representative particle diameter) is approximately 5.0 mm for Dye Branch, which falls into the fine gravel size category. Pebble counts were taken at 10 locations along Dye Branch. The locations included 5 riffles, 3 runs, 1 glide and 1 pool cross section. To provide a more detailed picture of the pebble counts, counts were taken within specific areas of the stream channel. Samples taken between bankfull elevations were categorized as "Classification" samples and those taken below the water surface were used as the "Wetted Perimeter" samples. The classification samples determine the stream's material size as it relates to bankfull events and its overall stream material classification. The wetted perimeter samples are used to describe the movement of sediment within the active bed. The particle size distribution data which includes the classification, wetted perimeter, and bar sample are presented in Appendix D.

The stability rating of the existing Dye Branch channel was determined by using the Pfankuch Channel Stability and Bank Erosion Hazard Index (BEHI) Forms. All three reaches associated with Dye Branch were assessed. The Pfankuch rating for the Dye Branch channel was estimated to be between 114 and 125, which ranks as "Poor" according to the rating system established for an E4 and G4c Rosgen stream types. The BEHI rating was "Extreme" for all three reaches. These stream channel stability evaluations can be found in Appendix E.

4.3.1.2 Cemetery Branch

Cemetery Branch was classified as an unstable E4 stream. The average slope of this channel is 0.0190 ft/ft (or 1.9%). The streambanks associated with this tributary have been destablilized by its urban surroundings, lack of vegetation and ongoing flow regimes. A summary of the cross section data used to determine this classification is also presented in Table 1 along with the data for Dye Branch. Existing cross section views are presented in Appendix B. Additional information including existing pattern data for Cemetery Branch can be found with all the morphological data in Appendix C.

According to the modified Wolman Pebble Count procedure, the average d_{50} for the stream classification was approximately 6.0 mm, which falls into the fine gravel size category (Appendix D). The Pfankuch Channel Stability rating for Cemetery Branch was estimated to be 117, which is considered "Poor" for an E4 Rosgen stream type. The BEHI evaluation conducted on Cemetery Branch determined that the channel has "Extreme" bank erosion potential.

Table 1. Summary of Existing Cross Sections – Dye Branch and Cemetery Branch

Cross Section	Station No.	Morph. Feature	Bankfull Area (ft^2)	Ent. Ratio *	W/D Ratio*	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Stream Class.*
1	1+53	Riffle	14.3	2.6	14.2	16.2	0.88	C4
2	2+10	Run	18.2	1.9	12.2	17.1	1.1	--
3	5+61	Riffle	19.7	3.2	7.9	15.6	1.3	E4
4	8+73	Run	19.4	>5	6.5	14.5	1.3	--
5	10+13	Riffle	18.1	>5	7.0	14.4	1.3	E4
6	15+71	Riffle	22.9	>5	6.2	15.6	1.5	--
7	26+22	Pool	20.8	1.5	9.5	17.2	1.2	--
8	26+42	Glide	21.3	2.5	27	26.1	0.8	--
9	26+99	Run	20.3	1.9	74.6	38.3	0.5	--
10	31+91	Riffle	17.4	1.5	12.5	17.1	1.0	G4c
Cemetery	4+68	Pool	14.6	>5	1.2	15.3	0.9	--
Cemetery	4+71	Glide	7.1	3.1	10.5	10	0.7	--
Cemetery	9+08	Riffle	6.8	2.0	7.0	9.0	0.8	E4
Cemetery	9+18	Run	8.3	4.2	4.8	8.8	0.9	--

*Notes: Ent. Ratio is "Entrenchment Ratio"
W/D Ratio is "Width/Depth Ratio"
Stream classification is only viable along riffle sections.

4.3.2 Jurisdictional Wetlands

Jurisdictional wetland determinations were performed using the three-parameter approach as prescribed in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987). One jurisdictional wetland exists within the boundaries of the project site. This wetland is located along the left side of Cemetery Branch approximately 500 feet downstream of the Church Street culvert. The wetland area totals approximately 0.098 acres and will likely be contained within the permanent conservation easement, once it is finalized. Wetland determination forms for the Dye Branch site are presented in Appendix F. The wetland covers nearly 0.098 acres and is characterized as a small depressional area adjacent to Cemetery Branch. It is dominated by herbaceous species that are mowed on a continuous basis. The wetland provides only modest habitat, very limited water storage capacity, and based on low opportunity, plays only a minor role in improving water quality at the site. This wetland will not be impacted by the enhancement of the Cemetery Branch channel and does not have an USACE Action ID Number appointed to it.

4.4 Existing Plant Communities

The vegetative communities found within the project area can be characterized by two major groupings. These groupings include Urban/Disturbed Land and Piedmont Bottomland Forest (Figure 5). Each plant community with its distinct assemblage of plants arose in response to diverse topography and the influences of changing land uses over time. Scientific names are presented along with the common names the first time the species is cited, but subsequent textual references to the same species will be limited only to its common name.

4.4.1 Urban/Disturbed Land

The urban/disturbed land is the most dominant vegetative community, where it accounts for approximately 85% of the total land area within the project area. The upper reach of the project is dominated by kudzu (*Pueraria lobata*), covering essentially the entire floodplain of Dye Branch. Most of middle reach, situated between Mc Lelland Road and Cabarrus Avenue, is within the City Park confines and is periodically maintained to the top of the stream bank. This area is dominated by fescue (*Festuca* spp.) along the entire left side of the stream and approximately 1,300 feet downstream from McLelland Road along the right side of the channel. Further downstream, the right side of the channel is primarily forested to Cabarrus Avenue. The lower reach of the project consists of residential yardscapes dominated by fescue and Chinese privet (*Ligustrum sinese*) along the left side of the stream, facing downstream. The right side is forested.

Cemetery Branch also lies within the City Park confines. The majority of the banks surrounding this channel consist primarily of fescue and other weeds which are maintained on a periodical basis.

4.4.2 Piedmont Bottomland Forest

Vegetation found in this community is consistent with the Schafale and Weakley's (1990) Piedmont Bottomland Forest classification. This vegetative community exists along the forested portion of the project site along the right side of Dye Branch above Cabarrus Avenue and continues along the right side to the end of the project. This community is also present along Cemetery Branch approximately 100 feet downstream of the Church Street culvert and extends approximately 300 feet along the left side of the channel. Dominant species found within this vegetative community include red maple (*Acer rubrum*), black willow (*Salix nigra*), sycamore (*Platanus occidentalis*), yellow poplar (*Liriodendron tulipifera*), box elder (*Acer negundo*), Chinese privet (*Ligustrum sinense*) and giant cane (*Arundinaria gigantea*). Piedmont Bottomland Forests are generally situated on floodplain ridges and terraces other than active levees adjacent to the stream channel. They are underlain by various alluvial soils, including the Chewacla and Congaree series. These communities are flooded; however, they are seldom disturbed by flowing water. Bottomland forests are believed to form a stable climax forest, having an un-even aged canopy with primarily gap phase regeneration, although the possibility of unusually deep and prolonged flooding may make widespread mortality more likely than in uplands (Schafale and Weakley, 1990).

4.5 Invasive Plant Species

Invasive, or non-native species, are the dominant plant species within the project area. Extensive quantities of Chinese privet and kudzu were observed along the stream banks, floodplain, and throughout the project site.

4.6 Threatened and Endangered Species

According to the US Fish and Wildlife Service (USFWS), neither threatened nor endangered species are known to occur in Iredell County. However, one threatened due to similarity of appearance (T S/A) species and three federal species of concern (FSC) have been documented for Iredell County. Information regarding these federally listed species of concern can be found in Table 2.

Table 2. Federally Listed Species

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements	Suitable Habitat	Biological Conclusion
Alleghany woodrat	*Neotoma magister*	FSC	SC	A small mammal found in rocky places and abandoned buildings in deciduous or mixed forests in the northern mountains and adjacent Piedmont.	No	Not Applicable
Bog turtle	*Clemmys muhlenbergii*	T(S/A)	T	A turtle found in bogs, wet pastures, and wet thickets.	No	Not Applicable
Heller's trefoil	*Lotus helleri*	FSC	SR-T	A vascular plant found in open woods over clay soils and roadsides.	No	Not Applicable
Tall larkspur	*Delphinium exaltatum*	FSC*	--	A vascular plant found in rich woods (and edges of woods), rocky slopes, semi-open woodlands, glades and prairie openings.	No	Not Applicable

SC—Special Consern
SR-T—Significantly Rare and Is Proposed for Threatened Status
*Historic record – the species was last observed in the county more than 50 years ago

4.7 Environmental Issues

Federal, state, and local databases were searched using a designated one-mile radius to determine whether the study area or neighboring areas have a regulatory history of environmental problems that could have an adverse impact on the study area. These databases included the following:

- National Priorities List (NPL);
- Resource Conservation and Recovery Information System (RCRIS) which includes information on Treatment, Storage, and/or Disposal (TSD);
- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS);
- Resource Conservation and Recovery Act Information System - Small and Large Quantity Generator and/or Transporter (RCRA);
- Emergency Response Notification System (ERNS);

- State Inactive Hazardous Site Program List, known as the State Priorities List (SPL);
- State Landfills (Landfills);
- Leaking Underground Storage Tanks (LUST);
- Owners of Underground Storage Tanks (UST);
- Delisted NPL;
- RCRA Administration Action Tracking System (RAATS);
- Hazardous Materials Incident Report System (HMIRS);
- PCB Activity Database (PADS);
- Facilities Index System (FINDS);
- Toxic Release Inventory System (TRIS);
- Federal Superfund Liens (NPL Liens);
- State of North Carolina Hazardous Substance Disposal Site (NC HSDS);
- Toxic Substances Control Act identifying Chemical Substance Inventory List (TSCA);
- Records of Decision (ROD);
- Superfund (CERCLA) Consent Decrees (CONSENT); and
- Former Manufactured Gas Sites (Coal Gas).

A copy of the EDR report is provided in Appendix G. EDR did not report any on-site sources of potential contamination. However, EDR listed several sites of potential contamination within a one-half mile surrounding the study area. Those sites include seven LUST sites, six of which are within the Dye Branch drainage area. The LUST sites within Dye Branch drainage area are: Mooresville Town Library, 121 East Catawba Ave.; Burlington Mills, 476 South Main St. (2 sites); Bills Exxon, 204 South Main St.; Glaspy's Auto Service, 152 South Main St.; Shepherd's, 126 East Center Avenue; and Mooresville Amoco Service, 151 South Broad St. One of the sites at Burlington Mills, Bills Exxon, Glaspy's Auto Service and Mooresville Amoco Service have not been closed out, which indicates reports on the ongoing clean up process are still being generated.

The Mulkey team conducted a cursory investigation for any Recognized Environmental Concerns (RECs) throughout the site. The investigation included only a visual scan of the property. RECs are characterized as the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property (ASTM E1527-00). None were observed as part of the existing conditions survey.

A building containing a men's and women's bathroom is located along the middle reach in Glenwood Memorial Park. No other buildings, sheds or other structures were observed in the project area.

4.8 Cultural Resources

Mulkey conducted a review of properties determined eligible for the National Register of Historic Places at the State Historic Preservation Office (SHPO) for the study area and surrounding areas. According to the files, two locations have been placed on the National Register within a one-mile radius of the study area. Those locations include the Mooresville Historic District and Broad Street Row. The Mooresville Historic District lies approximately one third-mile northwest of the project area and extends northeast from NC 152 for approximately 0.5 miles encompassing both Broad and Main Streets. Broad Street Row is located approximately one quarter-mile west of the project area along Broad Street between Wilson Avenue and NC 152. In addition, Mulkey contacted the North Carolina State Archaeological Office to determine if documented archaeological sites occur at or near the project area. No sites were identified within a one-mile radius of the project area.

4.9 Utility Realignment

The City of Mooresville has agreed to realign the sewer line that currently exists inside the project area between Center Avenue and the confluence of Dye and Cemetery Branch (upper and middle reaches). The proposed realignment includes relocating the sewer line outside of the floodprone area along the right side of the stream (looking downstream) in order to position it outside the buffer requirement for stream restoration. Three crossings along these two reaches currently exist. The existing crossing on the upper reach will be abandoned and the remaining two crossings on the middle reach will be relocated to intersect the channel only underneath the proposed riffle sections. Reason being, riffle sections are generally the most stable sections of a channel. Aggradation and degradation processes do occur as part of maintaining the dynamic equilibrium within the active streambed; however, grade control will be implemented to insure these processes are minimized to the extent practicable through these areas. Mulkey will incorporate the crossings in the design of Dye Branch and to the extent practicable will set the elevation of the stream above the sewer line so that the crossing will run subsurface to the channel.

5.0 Natural Channel Design

5.1 Reference Reach Analyses

Four reference reaches have been identified for use on the Dye Branch stream restoration project. All four reference reaches, Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam Creek and UT to Mine Creek, were chosen because they represent the stable, urban, piedmont stream type.

5.1.1 Derita Branch

Derita Branch is situated in Mecklenburg County, approximately 2.5 miles north of Charlotte on the northside of SR 2480 (Figure 6). Derita Branch is characterized as a first order, perennial stream and classifies as an urban E4 stream type. Specific morphological data for this reference reach are given within the morphological table found in Appendix C. Its watershed is approximately 0.25 square miles (166 acres) and encompasses an urban neighborhood and commercialized property. Common riparian species found along this stream corridor include American holly (*Ilex opaca)*, red maple, sweetgum (*Liquidambar styraciflua*), hackberry (*Celtis laevigata*), flowering dogwood (*Cornus florida*), water oak (*Quercus nigra*), white oak (*Quercus alba*), black cherry (*Prunus serotina*) and poison ivy (*Toxicodendron radicans*).

5.1.2 Unnamed Tributary to Lake Jeanette

UT to Lake Jeanette is situated in Guilford County, approximately 0.5 miles upstream of the SR 2348 crossing of Lake Jeanette (also referred to as Richland Lake) (Figure 7). UT to Lake Jeanette is characterized as a second order, perennial stream and classifies as a rural C5 stream type. Specific morphological data for this reference reach are given within the morphological table found in Appendix C. Its watershed is also approximately 0.25 square miles (166 acres) and encompasses a relatively low density suburban neighborhood within the City of Greensboro. Riparian species commonly found along this stream corridor include of American holly, red maple, American Beech (*Fagus grandifolia),* ironwood (*Carpinus caroliniana*) flowering dogwood, white oak and yellow poplar.

5.1.3 Unnamed Tributary to Southwest Prong Beaverdam Creek

UT to SW Prong Beaverdam Creek is located in Wake County, immediately upstream of the intersection of Lake Boone Trail and Runnymeade Road (Figure 8). UT to SW Prong Beaverdam Creek is characterized as a first order, perennial stream and classifies as an urban C5 stream type. Specific morphological data for this reference reach are given within the morphological table found in Appendix C. Its watershed covers approximately 0.28 square miles (180 acres) and encompasses an older urban neighborhood in the City of Raleigh. Common species located along the riparian zone of this stream include tag alder (*Alnus serrulata*), red maple, river birch (*Betula nigra*), sweetgum, flowering dogwood, tulip poplar, giant cane, poison ivy, jewelweed (*Impatiens campensis*) and bamboo (*Phyllostachys aurea*).

5.1.4 Unnamed Tributary to Mine Creek

UT to Mine Creek is located in Wake County, along the east side of North Hills Drive in Raleigh (Figure 9). UT to Mine Creek is characterized as a first order, perennial stream and classifies as an urban B4/1 stream type. Specific morphological data for this reference reach are given within the morphological table found in Appendix C. Its watershed covers approximately 0.17 square miles (109 acres) and encompasses an older residential area in the City of Raleigh. Common species located along the riparian zone of this stream include sycamore, river birch, sweetgum, flowering dogwood, tulip poplar, poison ivy, and jewelweed (*Impatiens campensis*).

5.2 Sediment Transport Analyses

Sediment plays a major role in the influence of channel stability and morphology (Rosgen, 1996). A stable stream has the capacity to move its sediment load without aggrading or degrading. Sediment analyses are generally divided into measurements of bedload and suspended sediment (washload), changes in sediment storage, size distributions and source areas. Washload is normally composed of fine sands, silts and clay transported in suspension at a rate that is determined by availability and not hydraulically controlled. Bedload is transported by rolling, sliding, or hopping (saltating) along the bed. At higher discharges, some portion of the bedload can be suspended, especially if there is a sand component in the bedload. Bed material transport rates are essentially controlled by the size and nature of the bed material and hydraulic conditions (Hey and Rosgen, 1997).

Two measures are used to calculate sediment loads for natural channel design projects: (1) sediment transport competency and (2) sediment transport capacity. Competency is a stream's ability to move particles of a given size. It is expressed as a measure of force (lbs/ft^2). Capacity is a stream's ability to move a quantity of sediment and is a measurement of stream power,

expressed in units of lbs/ft·sec. These analyses are conducted to ensure that the designed stream beds including Dye Branch and Cemetery Branch do not aggrade or degrade during bankfull conditions. Brief descriptions of these two analyses are presented in the following sub-sections. Entrainment and velocity calculation sheets used for these analyses are presented in Appendix H and I, respectively. The locations of the sediment sampling points are depicted in Figure 4.

5.2.1 Sediment Competency Analysis

The critical dimensionless shear stress (τ^*_{ci}) is the measure of force required to initiate general movement of particles in a bed of a given composition. This calculation is part of several calculations used to determine aggradation/degradation along the stream channel. For shear stresses exceeding this critical value, essentially all grain sizes are transported at rates in proportion to their presence in the bed (Wohl, 2000). For gravel-bed streams, the critical dimensionless shear stress is generally calculated using surface and subsurface particle samples from representative riffle sections. The critical dimensionless shear stress calculation is presented below.

$$\tau^*_{ci} = 0.0834\ (d_i/d_{50})^{-0.872}$$ where,

τ^*_{ci} = critical dimensionless shear stress (lbs/ft^2)

d_i = median particle size of riffle bed surface (mm)

d_{50} = median particle size of subsurface sample (mm)

Note that d_i and d_{50} values were empirically determined by *in situ* measurements. Based on the d_i of 6.0 mm and the d_{50} of 2.8 mm in reach 1, the critical dimensionless shear stress was calculated to be approximately 0.0429 lbs/ft^2 utilizing the calculation above. This critical dimensionless shear stress is used as part of the aggradation analysis presented in the following section.

The shear stress placed on the sediment particles is the force that entrains and moves the particles. The critical shear for the proposed channel has to be sufficient to move the D_{84} of the bed material. The critical shear stress was calculated and plotted on the Modified Shield's curve to determine the approximate size of particles that will be moved (Rosgen, 2001).

Based on the Modified Shield's curve, particles ranging from 20 mm to 90 mm could be moved within reach one of the Dye Branch channel, with an average moveable size of 40 mm. The largest particle found on the depositional bars was 24 mm. The D_{84} and D_{100} in this reaches are 10 mm and 22 mm, respectively. The middle and lower reaches of Dye Branch can move particles ranging from 30 mm to 100 mm, with and average moveable particle size of 65 mm. The largest particle found on depositional bars in these reaches was 45.7 mm. The D_{84} and D_{100} of the reach were 9.3 mm and 150 mm, respectively. Therefore, the proposed design has sufficient shear stress to move the bedload associated with all three reaches Based on Shield's curve, Cemetery Branch can move particles ranging from 45 mm to 180 mm. The D_{84} and D_{100} of Cemetery Branch are 10.2 and 15.0 mm, respectively.

Mulkey also utilitized another method to calculate critical shear stress for each reach studied as taught by Dave Rosgen, PhD., PH, with Wildland Hydrology, Inc. However, when this method

was used to calculate the shear stress of the proposed design, the middle and lower reaches of Dye Branch indicated instability. When the dimensions of reaches two and three were adjusted to create a "stable" entrainment; width/depth (W/D) ratios were out of the range observed in stable channels. Since the Shield's curve calculations indicate that all reaches are capable of moving their supplied sediment only the results from the Sheild's curve analysis were considered appropriate for these reaches.

5.2.2 Sediment Transport Capacity

Stream power was calculated for both the existing and design channel conditions to determine the effect of the restoration on sediment transport capacity. A stream's capacity is defined as the maximum load a stream can transport at a given time. The capacity of a stream to move sediment is directly related to velocity and stream power. The existing channel exhibited an excess of stream power as noted by the mass wasting of banks and excessive bank height ratios. By adjusting width-to-depth ratios and providing a floodplain at the bankfull stage, the proposed design reduces both stream power and velocity; thereby, reducing capacity to only that needed to move the sediment supplied by the watershed.

5.2.3 Aggradation/Degradation Analysis

New channel construction associated with natural channel design projects generally includes the design and layout of a channel with increased length and sinuosity and reduced slope as compared with the existing channel. However, there are some situations where the existing channel exhibits excessive and unstable patterns. The new channel design in these cases will result in an increase in slope and a decrease in channel length. The data associated with these channels must prove that the adjusted channel slope will not cause the stream to aggrade or degrade. The upper portion of Dye Branch maintains a relatively stable profile; therefore the proposed design will only slightly decrease the channel's slope (0.00415 ft/ft), and improve its dimension and pattern. The middle portion of Dye Branch was designed to have a slightly greater slope (0.0094 ft/ft) than the existing channel (0.008 ft/ft) due to the shorter length of the new channel alignment. The proposed design for the lower portion of Dye Branch will result in a new and slightly shorter channel with less slope (0.0102 ft/ft) than the existing channel (0.0110 ft/ft) and a lower width/depth ratio. The proposed width/depth ratios were adjusted in conjunction with the slope to ensure that the proposed stream will transport its sediment over time without aggrading or degrading.

Calculations of critical depth are required. These calculations represent the need to transport large sediment particles, usually defined as the largest particle of the riffle sub-pavement sample. As a result, critical depth can be compared with the design mean riffle depth in order to verify that the design stream has sufficient competency to move large particles without causing the thalweg to aggrade or degrade. The calculation for critical water depth is shown below.

$$d_{cr} = \frac{1.65\,(\tau^*_{ci})D_i}{S}$$

where,

d_{cr}	= critical water depth (ft)
τ^*_{ci}	= critical dimensionless shear stress (lbs/ft^2)
D_i	= largest particle of bar or sub-pavement sample (ft)
S	= average channel slope (ft/ft)

5.2.4 Sediment Transport Summary

Based on the calculations for competency, aggradation, degradation and capacity, bankfull conditions in the design channel will entrain particles ranging from 15 to 110 mm. The D_{100} of Dye Branch is approximately 64 mm. The design channel is predicted to remain stable over time based on the establishment of proper dimension, pattern and profile and an active floodplain. The addition of riparian vegetation will further enhance the long term stability of the entire system.

5.3 Proposed Design

Design methodologies are based on natural channel design concepts outlined by Rosgen (1994, 1996, 1998). These methodologies include existing and reference reach channel surveys, data interpretations and geomorphological comparisons of all channel features. Based on field observations and preliminary ideas, the project will attempt to implement restoration similar to Priority Levels II and III. The Priority Level II Restoration involves construction of a new channel with a floodplain bench at the bankfull elevation. This will be implemented along the the entire portion of the Dye Branch stream channel. The Priority Level III Restoration will involve the reconstruction or installation of additional bankfull benches within the existing channel confines. This restoration type will be implemented along Cemetery Branch. A summary of the existing and proposed streams at the project site is outlined in Table 3. A Conceptual Design for Dye Branch can be found in the Attachments section.

Table 3. Dye Branch Stream Restoration Summary

Stream	Priority Level	Type	Existing Length of Channel* (lf)	Proposed Length of Channel* (lf)
Dye Branch	II	Restoration	3628.51	3353.89
Cemetery Branch	III	Restoration	968.28	998.64
		Total	4596.79	4352.53

* Lengths do not include culverts.

5.3.1 Dye Branch

It is anticipated that Priority Level II Restoration design measures will be applied to approximately 3,353 linear feet of Dye Branch, the entire length of project along the main channel (Appendix J). This restoration will transform the stream from an unstable E4/G4c stream type to a stable C4 stream type. The upper reach, from the project's beginning at Station 0+00 to Station 6+25 averages a slope of 0.0042 ft/ft (or 0.4%), which is the flattest of the three sections of channel. Cross vanes, j-hook vanes, single arm rock vanes and rootwads will be used along this segment to provide overall stability and grade control. Bankfull cross sectional areas average 24.1 square feet for riffles and 36.4 square feet for pools and are also found in Appendix J. The upper reach stream channel will contain floodplain benches and improved meander pattern, which will help reduce stream velocities.

The middle reach, which exhibits a slope of 0.0094 ft/ft (or 0.9%), will provide a gradual transition between the upper and the lower reaches. Bankfull cross sectional areas associated with the middle reach average 20.0 square feet for riffles to 29.0 square feet for pools. The subsequent decrease in overall areas as compared with the upper reach is due to the increased slope. Approximately 630 ft of new channel will excavated from Station 14+60 to Station

20+90 in order to further stabilize the stream. The remainder of this reach will utilize floodplain benches and radius improvements. Structures used through this section will include cross vanes, j-hook vanes, and single arm rock vanes. Rootwads will be installed at specific areas to relieve stress from outside bends and to provide natural habitat for aquatic life.

The lower reach of Dye Branch, extending from Station 22+90 to Station 35+22, exhibits slopes averaging 0.0102 ft/ft (or 1.0%), which are the steepest throughout the project. Due to this increase of slope, the bankfull cross sectional areas have decreased as the stream flows from the upper to the lower reach. The bankfull cross sectional areas associated with the lower reach average 18.8 square feet for riffles and 29.0 square feet for pools. This reach will also utilize cross vanes, j-hooks, single arm vanes, and rootwads. In addition to the structures, floodplain benches and improvements to the overall pattern of the channel will aid in decreasing velocities and further stabilize the stream.

5.3.2 Cemetery Branch

Stream restoration associated with Cemetery Branch will be exclusively Priority Level III Restoration. This restoration will change the stream from an unstable E4 stream type to a stable B4 stream type. The restoration will begin approximately 40 ft downstream of the Church Street culvert and extend approximately 1,000 linear ft to its confluence with Dye Branch. Bankfull cross sectional areas proposed for this stream channel are 7.0 square feet for riffles and 10.3 square feet for pools. Cross vanes, single arm rock vanes and rootwads will be installed to provide grade control and improve overall channel stability. Minor pattern improvements are also proposed.

5.4 Proposed Construction Sequence

Construction of the project will be carried out in three phases to ensure adequate implementation of sedimentation controls, channel stability, and maximum vegetation survival. During the first phase, primary construction access roads, spoil areas, and staging areas will be established. During the second phase, the majority of the restoration activities will take place along both Dye Branch and Cemetery Branch. These will include establishing the proper dimension, pattern, and profile along each of the channels followed by structure installation. The consequent filling of the abandoned channels will also be completed as part of the second phase. Disturbed banks will be seeded, mulched, and matted immediately upon completion of any grading. The final phase will involve minor grading, site preparation (sub-soiling), removal of temporary access roads and staging areas, and the installation of plant material.

Initially, the primary construction access roads, spoil areas, and the staging areas will be established throughout the entire Dye Branch Stream Restoration Site. Once these areas have been established, erosion and sedimentation control devices will be installed. Also, temporary fencing will be installed around the project site.

The second phase of the project will involve construction of new channels and placement of structures for Dye Branch and Cemetery Branch. These structures will provide stability and habitat for the stream channel and will include cross vanes, j-hook vanes, single-arm rock vanes, and rootwads. Construction of the new channel must be staged to ensure the most economical use of equipment and materials, and to ensure that sedimentation controls and channel stability efforts are maximized. As the majority of the construction will occur within the existing channel, the stream's water will be pumped around the construction.

The new Dye Branch channel will be constructed from Center Street to McLelland Avenue (Station 0+00 to Station 6+25). Special stilling basins will be utilized to filter any groundwater that accumulates within the proposed channel. Pumping the perennial flow and filtering the groundwater will further ensure superior sediment control since groundwater difficulties are anticipated. Spoil generated from excavation of the new channel will eventually be used to fill the existing stream channel downstream of McLelland Avenue. The majority of the excavation spoil from upstream of McLelland Avenue will be stockpiled on the Town of Mooresville's property at the southern end of McLelland Avenue as detailed on the erosion control plans, to reduce material-handling time and to minimize compaction of the substrate.

Between McLelland Avenue and Cabarrus Street (Station 7+50 to Station 22+00), the channel will be constructed in much the same manner as the upstream portion. Perennial flows will be pumped from the culvert at McLelland Avenue to below Station 14+60 where the proposed channel departs from the existing channel. All required grading and structure installation will occur upstream of Station 14+60 prior to construction of the new location channel. Once this segment is complete, the new location segment of channel will be constructed while the flow remains in the existing channel. Again, all groundwater seepage into the proposed channel will be pumped into special stilling basins for filtering. All spoil material will be stockpiled on the east side of the existing channel near the basketball courts as detailed on the erosion control plans, to reduce material-handling time and to minimize compaction of the substrate.

Once the water is diverted into the new location segment of Dye Branch, filling of the old channel will commence. Approximately one quarter-acre of area will be graded to resemble that of a vernal pool. The unnamed, intermittent tributary will be routed into this depressional area to provide a hydrologic source. At the downstream limit of the depression, a small channel will be constructed to allow water to flow out of the depression in times of excessive rainfall and to prevent stagnation.

The final leg of main channel construction is below Cabarrus Street (Station 22+90 to Station 35+22). Due to very limited access and extremely unstable vertical banks, all equipment will have to enter the construction area from the lower limit of the project. Most of the channel work will occur with equipment in the channel. However, to minimize any potential negative impacts to the water quality and to minimize sedimentation, all flow will be pumped from the outlet of the culvert under Cabarrus Street to downstream of the construction limits. Large amounts of debris consisting of broken concrete, tires, and miscellaneous rubbish will be removed and hauled off site to a permitted landfill. Any excavated material from the segment of stream channel will be utilized to construct bankfull benches along the left bank (facing downstream).

The new Cemetery Branch channel will be constructed from Station 0+40 to the new Dye Branch channel while pumping all flow around the construction area. Bankfull benches will be constructed along areas with steep unstable banks. Every attempt will be made to utilize all excavated material on-site; however, due to limited filling of old channels some material may have to be hauled off-site. North Carolina State University will have constructed a diversion structure at the upstream limit of Cemetery Branch. This structure will not be disturbed during construction.

The final phase of the construction process will involve minor grading and sub-soiling of the site, removal and amelioration of temporary access roads, and removal of erosion and sedimentation control measures as the site is stabilized. The sub-soiling will be done to mitigate soil compaction of by heavy equipment and urbanization and to create micro-topographic features adjacent to the stream channel. Removal of temporary access roads and staging areas will start at the beginning of the project and proceed downstream. This will allow the removal of all temporary materials and the renovation of disturbed areas. Following the final grading activities, native trees and shrubs will be planted at the site during the dormant season.

6.0 Flood Analyses

Portions of the Dye Branch Site, including the channel of Dye Branch and its immediate floodplain are located within the Federal Emergency Management Association's (FEMA) 100-year flood boundary, as depicted on Figure 10 (FEMA, 1980). These areas are inundated by the 100-year flood where Base Flood Elevations (BFE) have been determined, but no floodway. Section 60.3 (c)(10) of the National Flood Insurance Program (NFIP) regulations at 44 Code of Federal Regulations (CFR) states that a community shall "require until a regulatory floodway is designated, that no new construction, substantial improvements, or any other development (including fill) shall be permitted within Zones A1-30 and AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community". Although there are no regulatory floodways designated for any portion of the Dye Branch site, hydraulic models for both existing and proposed conditions were developed using FEMA's 100-year discharge. Using FEMA's discharge and the existing topography, a model was developed to analyze existing water surface elevations (WSEL) versus the mapped elevations. The existing conditions model shows WSEL higher than the FEMA model. Discrepancies in WSEL can be attributed to the original 1980 FEMA model having distinctly lower inverts than the surveyed inverts taken in early 2005. In order to ensure compliance with federal regulations, a set of design discharges were formulated and included in both the existing and proposed conditions models to determine if there was an increase or decrease in WSEL using the new survey data.

Design discharges were determined using the U.S. Army Corps of Engineers' Hydrologic Modeling System (HEC-HMS). HEC-HMS is a computer program designed to simulate the surface runoff response of a river basin to precipitation by representing the basin as an interconnected system of hydrologic components. In order for the model to predict the peak discharges, the following information must be known:

- Drainage Areas
- Rainfall Totals and Temporal Distribution
- Time of Concentration/Lag Times
- Soil Conservation Service (SCS) Curve Numbers
- Stream and Reservoir Routings

Limits of flooding were determined using HEC-RAS software from the US Army Corps of Engineers Hydrologic Engineering Center. Water surface profiles for the 2-year, 5-year, 10-

year, 25-year, 50-year, and 100-year storm events were computed. These models show that there is no increase in base flood elevation due to the restoration of Dye Branch, specifically; all of the studied cross sections showed a decrease in WSEL. Data from the 50-year and 100-year storm events is included in Table 4.

Table 4. Flood Analyses for the 50-Year and 100-Year Storm Events.

Dye Branch Profile: 50 yr

Station (proposed)	Q Total (cfs)	Water Surface Elevation		
		Existing (ft)	Proposed (ft)	Difference (ft)
0.68	850	803.37	802	-1.37
411.87	850	805.98	805.03	-0.95
776.83	850	808.28	807.9	-0.38
1073	850	811.82	810.95	-0.87
1284.09	850	814.84	813.76	-1.08
1341.72	Culvert			
1383.64	700	822.46	822.44	-0.02
1461.36	700	822.49	822.45	-0.04
1833.18	700	822.55	822.5	-0.05
2231.02	700	822.6	822.48	-0.12
2529.54	700	824.08	823.93	-0.15
2764.51	700	826.56	826.37	-0.19
2969.73	700	828.37	827.67	-0.70
3035.08	700	829.39	828	-1.39
3103.58	Culvert			
3161.46	700	832.01	831.87	-0.14
3235.01	700	831.99	831.87	-0.12
3628.84	700	833.24	832.52	-0.72
3759.36	700	833.74	833.1	-0.64

Dye Branch Profile: 100 yr

Station (proposed)	Q Total (cfs)	Water Surface Elevation		
		Existing (ft)	Proposed (ft)	Difference (ft)
0.68	1000	803.78	802.36	-1.42
411.87	1000	806.41	805.4	-1.01
776.83	1000	808.78	808.33	-0.45
1073	1000	812.3	811.38	-0.92
1284.09	1000	815.87	814.15	-1.72
1341.72	Culvert			
1383.64	750	822.61	822.55	-0.06
1461.36	750	822.64	822.56	-0.08
1833.18	750	822.7	822.61	-0.09
2231.02	750	822.76	822.6	-0.16
2529.54	750	824.29	824.04	-0.25
2764.51	750	826.66	826.51	-0.15
2969.73	750	828.46	827.78	-0.68
3035.08	750	829.52	828.11	-1.41
3103.58	Culvert			
3161.46	750	832.11	831.95	-0.16
3235.01	750	832.08	831.95	-0.13
3628.84	750	833.4	832.65	-0.75
3759.36	750	833.91	833.23	-0.68

7.0 Typical Drawings

Seven different structure types made of natural materials will be utilized as part of the design sequence. These structures include single-arm rock vanes, j-hook rock vanes, cross vanes, rootwads, step pools, constructed riffles, and double log drop structures. Details for these structures can be found in Appendix K.

7.1 Single-Arm Rock Vane

These structures are designed to dissipate the secondary circulation cells which cause stress in the near bank region. They also force the thalweg away from the bank and towards the middle of the channel. These structures are placed on the outsides of meander bends. Footer rocks are placed on one side of the channel bottom for stability. More rocks are then placed at an angle to the stream bank, gradually inclining in elevation until they are located at the proposed bankfull elevation. At the point at which the structure reaches the bankfull elevation, rocks are placed perpendicular to the rock vane arm and embedded into the bank. These additional rocks provide a linkage to the existing stream bank as well as providing added protection during heavy flows.

7.2 J-Hook Rock Vanes

These structures are also designed to dissipate the secondary circulation cells which cause stress in the near bank region. They also force the thalweg away from the bank and towards the

middle of the channel. Similar in design to single-arm rock vanes, these structures are placed on the outsides of meander bends. Footer rocks are placed on one side of the channel bottom for stability. More rocks are then placed at an angle to the stream bank, gradually inclining in elevation until they are located above the bankfull surface directly adjacent to the stream bank. Additional rocks are placed in the channel to give the structure a "J" shape. These extra rocks are added to maintain the pool and provide additional fish habitat.

7.3 Cross Vanes

These structures serve to maintain the integrity and composition of the riffle while promoting scour along the center of the channel, away from the adjacent banks. The design shape is roughly that of the letter "U" with the apex situated on the upstream side in the riffle section. Footer rocks are placed in the channel bottom for stability. Rocks are then placed on the top of these footer rocks in the middle of the channel at approximately the same elevation as the designed stream bed. Rocks are then placed at an angle to the stream bank on either side of the channel. These rocks gradually incline to the bankfull elevation. Water flowing downstream is forced over these rocks towards the middle of the channel on either side of the structure, effectively scouring a pool immediately downstream. Cross vanes are used primarily for stabilization and grade control, but the structures also provide habitat for fisheries and other aquatic wildlife.

7.4 Root Wads

The objectives of these structures are to: provide in-stream and overhead cover for aquatic organisms, including fish; provide shade, detritus and terrestrial insect habitat; and provide minimal protection of the stream bank from erosion. Generally, a footer log and boulder are placed on the channel bottom and abut the stream bank along the outside of the meander bend. This provides support for the rootwad and stability (minimal) to the stream bank. A large tree rootwad (or root-ball) is then placed on the stream bank with additional boulders and rocks on either side for stability. Flowing water is deflected away from the bank and towards the center of the channel.

7.5 Step Pool Structures

Step pool structures are used primarily for grade control. They are implemented in cases involving significant slope changes, or drops, over short distances. Step pool structures are designed using a combination of small plunge pools in a stair-step fashion similar to a series of "nested" cross vanes. The construction implementation of these structures is similar with that of the cross vane, whereby footer rocks are placed in the channel bottom for stability. Rocks are then placed on the top, and slightly upstream of these footer rocks to create a series of stepped, alternating pools. Each pool is created by placing the header rocks in the middle of the channel at approximately the same elevation as the designed stream bed. Other header rocks are then placed at an angle to the stream bank on either side of the channe, with the rocks gradually inclining to the bankfull elevation. Water flowing downstream is forced over this system of steps and consequently alternates back and fourth across the centerline of the channel, effectively maintaing the scour pool at the bottom of each step. Like cross vanes, step pools also provide bank stabilization along both sides of the channel as well as habitat for fisheries and other aquatic wildlife.

7.6 Constructed Riffles

Constructed riffles provide an alternative mechanism for establishing grade control along the steeper sections of a channel. They are designed to house a thick laver of native bed material, and in some cases gravel or surge stone, installed in the bed at a riffle location. Generally, constructed riffles exhibit a boulder or log sill at both the upstream and downstream end location to serve as grade control. These sills are vertically keyed into the streambed using geotextile fabric overlain with the riffle bed material to prohibit scour and undermining. Rip rap toe protection is also installed along the horizontal length of each constructed riffle against the left and right edge-of-waters for further scour protection. Bedload and sediment transport capabilities are maintained throughout the reach resulting in a stable riffle section.

7.7 Double Log Drop Structures

These structures are used to create habitat diversity while providing grade control in a situation where the streambed has a relatively small drop over a relatively short distance. Double log drop structures are designed using a set of small plunge pools in a stepped fashion created by a pair of angled log weirs. Similar to step pools, footer rocks are placed in the channel bottom at the downstream end of the structure for stability. Rocks and rebar pins are used to secure the logs in place. The logs are installed to create a series of two stepped, alternating pools. A rootwad is generally installed in the streambank at the lower pool to help deflect the stream flow to the middle of the channel. Water flowing downstream is forced over a pair of small steps while alternating back and fourth across the centerline of the channel, effectively maintaing scour pools at the bottom of each step. Native hardwood trees are used for the logs and rootwads for this structure. Geotextile fabric is used to vertically key the logs into the streambed. Double log drop structures are another design concept used to provide habitat for fisheries and other aquatic wildlife while serving ultimately as grade control.

8.0 Stream Riparian Planting Plan

The planting plan for the riparian and upland buffers of the Dye Branch site will provide post-construction erosion control and riparian habitat enhancement. The planting plan will also attempt to blend existing vegetative communities into recently restored areas. Plantings in the buffer areas will include native species appropriate for the Piedmont physiographic province and the project site. Plants within the floodplain will be flood tolerant species, which can accommodate periodic flooding events throughout the year. A variety of trees and shrubs will be planted to provide cover and habitat for wildlife as well as soil stabilization.

Tree and shrub species will be planted in specific planting zones. These planting zones will accommodate plant species which have specific requirements for growth. Hydrology and topography are main factors that dictate a plant's ability to survive and to thrive following planting. These planting zones will be created around these requirements and will include the following zones: Zone 1 (Stream Banks), Zone 2 (Riparian Buffer), Zone 3 (Wetlands), and Zone 4 (Upland Buffers). A list of species in each Zone can be found in Table 5.

Table 5. Recommended Plant Species and Planting Zones.

Planting Zone	Zone Description	Recommended Plant Species ^	
		Scientific Name	Common Name
1	Stream Banks	*Alnus serrulata*	Tag alder
		Betula nigra	River birch
		Cephalanthus occidentalis	Buttonbush
		Cornus amomum	Silky dogwood
		Hibiscus mosheutos	Marsh mallow
		Lindera benzoin	Spicebush
		Salix nigra	Black willow
		Salix sericea	Silky willow
		Sambucus canadensis	Elderberry
2	Riparian Buffer	*Betula nigra*	River birch
		Fraxinus pennsylvanica	Green ash
		Lindera benzoin	Spicebush
		Plantanus occidentalis	Sycamore
		Quercus nigra	Water oak
		Quercus phellos	Willow oak
		Sambucus canadensis	Elderberry
3	Wetlands	*Alnus serrulata*	Tag alder
		Cephalanthus occidentalis	Buttonbush
		Cornus amomum	Silky dogwood
		Fraxinus pennsylvanica	Green ash
		Hibiscus mosheutos	Marsh mallow
		Salix nigra	Black willow
		Salix sericea	Silky willow
4	Vernal Pools	*Boehmeria cylindrica*	False nettle
		Carex lurida	Lurid sedge
		Carex intumescens	Bladder sedge
		Cyperus strigosus	Umbrella sedge
		Eleocharis obtusa	Blunt spike-rush
		Eupatorium fistulosum	Joe-pye weed
		Juncus coriaceus	Leathery rush
		Juncus effuses	Soft rush
		Saururus cernuus	Lizard's tail
5	Upland Buffer	*Carya tomentosa*	Mockernut hickory
		Cornus florida	Flowering dogwood
		Diospryos virginiana	Persimmon
		Ilex opaca	American holly
		Juniperus virginiana	Eastern red cedar
		Pinus echinata	Shortleaf pine
		Pinus strobus	White pine
		Pinus virginiana	Virginia pine
		Prunus serotina	Black cherry
		Quercus alba	White oak
		Quercus falcata	Southern red oak

^ List is alphabetized by scientific name within each planting zone.

Shrubs and trees with extensive, deep rooting systems will assist in stabilizing the banks in the long term. Native grasses, transplants, and live stakes will be utilized at the site for immediate stabilization as well as erosion control matting along the newly created stream banks. Vegetation will be planted in a random fashion in an effort to mimic natural plant communities. Colonization of local herbaceous vegetation will inevitably occur, which will provide additional soil stability. Tree species will be planted as bare root stock on random eight-foot centers at a

frequency of 680 stems per acre. Shrub species will be dispersed among these tree species also on random eight-foot centers. Larger plant stock will be established in areas immediately adjacent to channel structures. These areas will also receive much denser plantings in order to expedite the stabilization of the soil through greater rooting mass. Planting stock will be culled to remove inferior specimens, so only healthy, viable stock will be planted at the project site. Planting of species will utilize dormant plant stock and will be performed to the extent practicable between December 1st and March 15th.

8.1 Invasive Species Management

Invasive species control at the project site will be focused on effectively eliminating kudzu (*Pueraria lobata*) and Chinese privet (*Ligustrum sinense*) from the riparian areas along Dye Branch and Cemetery Branch. Eliminating these invasive species will provide long-term benefits for existing plant species and those that will be established. Controlling these species will likely involve both mechanical and chemical control mechanisms. The Town of Mooresville will oversee and maintain the invasive species aspect.

Kudzu is predominantly found along the portion of Dye Branch between Center Avenue and McLelland Avenue. This particular area accounts for approximately 4 acres of kudzu infestation. The remaining portion of the kudzu is found along the forested area adjacent to Cemetery Branch. Chinese privet is most prevalent along the lower reach of Dye Branch, below Cabarrus Avenue.

Kudzu can be controlled by utilizing chemical applications of clopyralid herbicide during its most active periods of growth, which usually occur during the months of June and July. The most effective period to apply clopyralid herbicide is just prior to or during its blooming period. Application rates range from two thirds to one and one third pints per acre.

Chinese privet is generally difficult to control due its growth habit and waxy leaf surface. Initially, mechanical control of this species is the best method. Mechanical control will significantly reduce the plant's stature, whereby stimulating a cluster of young growth, which provide an easier, more effective herbicide application. Mechanical control of this species should be done in early spring or late fall. Applications of 4 to 6 pints per acre of imazapyr herbicide during the active growing season will provide effective control of Chinese privet.

9.0 Stormwater Wetland

In an effort to improve water quality at the project site, North Carolina State University (NCSU) was contracted to construct stormwater treatment wetlands. These wetlands will be situated immediately south of Cemetery Branch and just west of Dye Branch, in what currently is a mowed and maintained field. A diversion structure containing a weir, will be located immediately downstream of the Church Street culvert. It will control the stormwater entering the wetlands at a rate up to 8 cubic feet per second. Once the weir reaches it capacity the water will overflow into Cemetery Branch. This will only remove a very small amount of flow equivalent to the first inch (1") of rainfall; therefore, the bankfull peak discharge of Cemetery Branch will not be affected. Downstream of the diversion structure, an energy dissipater is proposed to lower velocities out the the weir. This dissipater is designed to accommodate the entire 10-year peak flow as the flow to the stormwater wetland system may periodically be shut off for maintenance.

The water that enters the wetlands will be filtered through three "wetland cells" connected by conveyance pipe. Once the water is filtered through the cells it will flow into a small v-ditch and be directed into Dye Branch. This process will have no affect on the bankfull discharge of Dye Branch due to the peak discharge from the wetland being small relative to that of Dye Branch.

10.0 Stream Monitoring Plan

Monitoring will determine the degree of success the mitigation project has achieved in meeting the objectives of providing proper channel functions and increased habitat quality. This monitoring data will provide the EEP and resource agencies with evidence that the goals of the Dye Branch project have been met. Monitoring of the site will include an assessment of geomorphology and riparian vegetation at least once each year for a total of five years adhering to the USACE Stream Mitigation Guidelines. Monitoring reports will be submitted annually to the EEP by December of each year. The monitoring reports will follow the most current EEP Monitoring Report Template and include detailed analysis of the new stream and floodplain, plant survivability, photos, and photo location points as well as a description of any problems and recommendations for remedial measures. Photo point locations are shown on Figure 4 and pre-construction photos of these areas can be found in Appendix A. In the event that success criteria are not met, remedial measures will be installed to achieve success, as directed by the EEP.

Upon completion of the project, an as-built channel survey will be conducted. The survey will document the dimension, pattern, and profile of the restored channel. Permanent cross sections will be established at an approximate frequency determined by the EEP. The locations will be selected to represent approximately 50% riffle and 50% pool areas. The as-built survey will include photo documentation at all cross sections, a plan view diagram, a longitudinal profile, vegetation information and pebble counts. The as-built plan will serve as a reference for demonstrating and quantifying the magnitude and frequency of problem events.

10.1 Stream Channel Assessment

During the first-year Mulkey will evaluate the restored portion of Dye Branch and Cemetery Branch in regard to overall channel stability. Since streams are considered as "active" or "dynamic" systems, restoration is achieved by allowing the channel to develop a stable dimension, pattern, and profile such that, over time, the stream features (riffle, run, pool, and glide) are maintained and the channel does not aggrade or degrade. Minor morphologic adjustments from the design stream are anticipated based on the correlation of reference reach data, excessive sediment deposition from upstream sources, and on-going changes in land use within the watershed in addition to the effects of extraordinary meteorological events.

10.2 Vegetation Success

Vegetation requirements state that 260 stems/acre must be viable for success after the five year monitoring period. Should the performance criteria outlined above not be met during the monitoring period, Mulkey will provide the EEP with a remediation proposal, detailing corrective actions and/or maintenance actions proposed, and an implementation schedule. Upon review and approval/modification of proposed corrective measures by the EEP and the

regulatory agencies, Mulkey will oversee the implementation of the necessary corrective measures.

10.3 Monitoring Data

Monitoring data for each monitoring year will consist of the following:

1. Stream Channel Assessment
   - Channel stability

2. Vegetation Data
   - Number of stems/acre of woody species
   - Percent of survival of planted woody species
   - Species composition, including non-dominants
   - Quantitative measure of noxious species
   - Overall condition of the planted species
   - Photo reference locations of each plot

10.4 Reporting

The first-year monitoring reports will be submitted to the EEP's designated representative for coordination with the appropriate regulatory agencies on an annual basis. The first-year of monitoring will have two submittals, one being the As-Built drawings and the second being the First Year Annual Monitoring Report, which will follow the most current EEP Monitoring Template. It is understood that the EEP will coordinate any necessary monitoring report submittals with the regulatory agencies. If monitoring reports indicate any deficiencies in achieving the success criteria on schedule, a remedial action plan will be included in the annual monitoring reports. Mulkey will be available to coordinate any agency site visits, both before and after restoration activities have been completed. Vegetative monitoring will be conducted during the summer months of each monitoring year.

10.5 Exotic/Invasive Species

Invasive species will be identified and controlled so that none become dominant species or alter the desired community structure of the site. Specific areas have already been identified to contain invasive plants. Invasive species within these areas will be controlled using the most appropriate means that is suitable to EEP.

11.0 Stream Performance Criteria

Based on the Classification Key for Natural Rivers (Rosgen, 1996), restoration activities will ultimately result in the classification of a C-stream type for Dye Branch and a B-stream type for Cemetery Branch. The C-stream types are slightly entrenched, meandering, gravel dominated, riffle-pool channels with well developed floodplains. Pool to pool spacing for this stream type averages five-to-seven bankfull channel widths in length. The stream banks are generally composed of sand and gravel material, with stream beds exhibiting little difference in pavement and sub-pavement material composition. Rates of lateral migration are influenced by the presence and condition of riparian vegetation. The C-stream type, is best characterized by the presence of point bars and other depositional features, it is very susceptible to shifts in both lateral and vertical stability caused by direct channel disturbance and changes in the flow and sediment regimes of the contributing watershed. As a result, stream success criteria will be

based on overall stability. It is expected that channel adjustment will occur throughout the restored reaches; however, excessive adjustment and potential stream instability will be judged to be occurring if the width/depth ratio is measured to be greater than 18, the bank height ratio is greater than 1.4; radius of curvature ratio is less than 1.5, or the development of head cuts occur. These limits are established based on reference reach data for C stream types in North Carolina.

The B-stream types are moderately entrenched, have a lower sinuosity and less developed floodplain than the C-stream type and are usually confined to narrow valleys. The B-stream type exhibits a width/depth ratio greater than 12 and a pool to pool spacing between four-and-five bankfull widths in length. Both streambank erosion rates and aggradation/degradation processes are usually low. The bed morphology is dominated by "rapids", produced from debris constriction and a confining valley.

12.0 References

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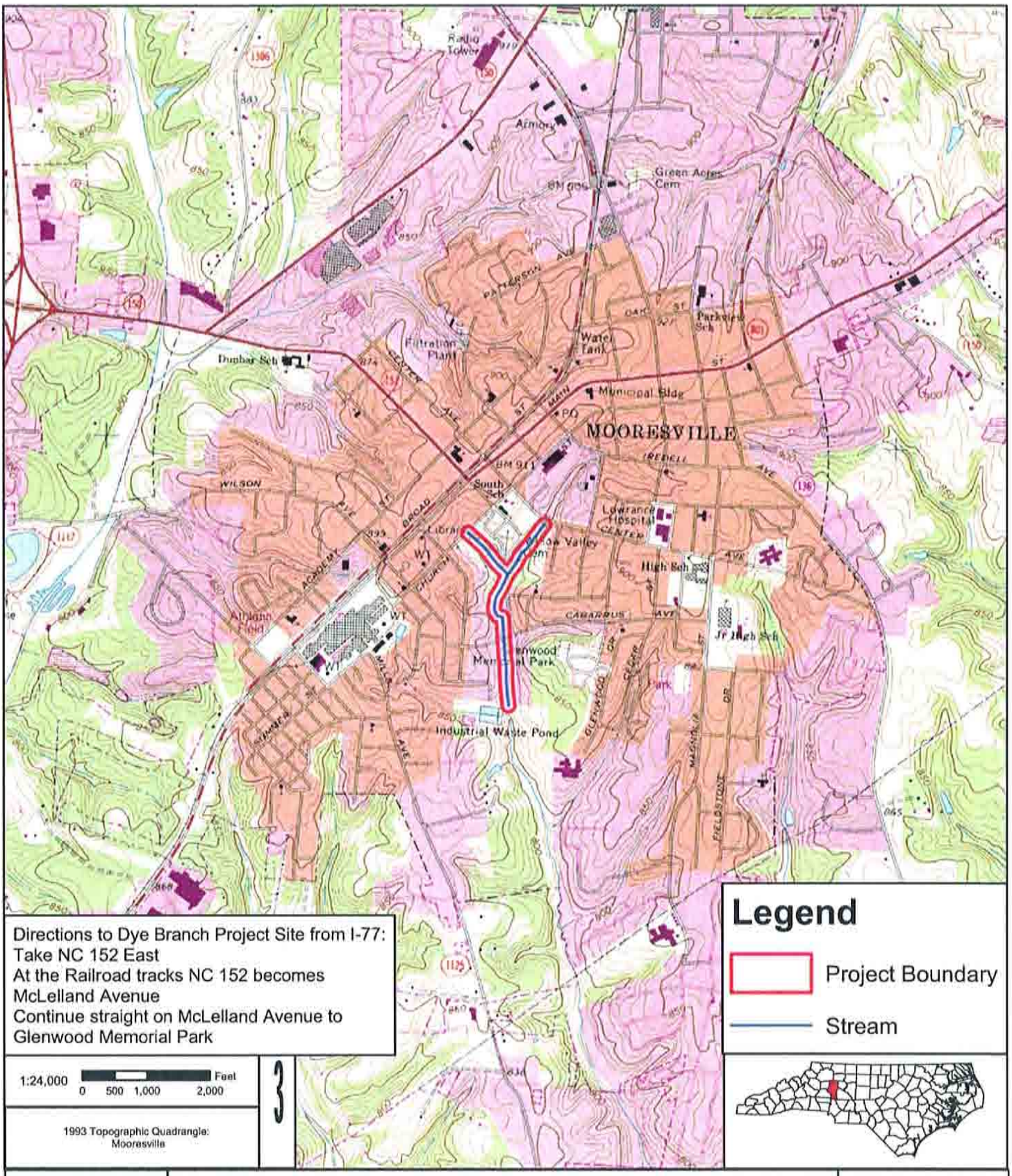


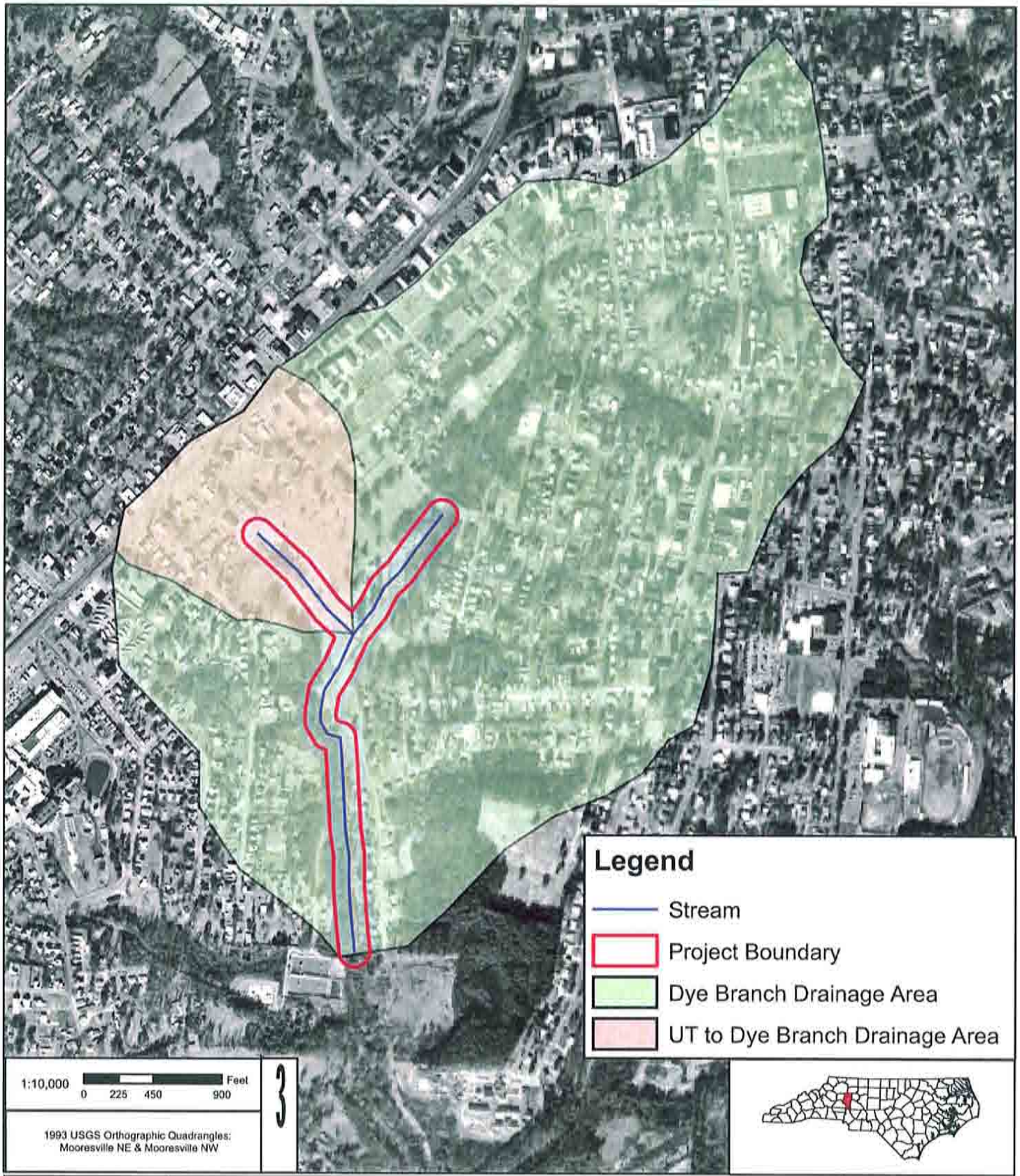
VICINITY MAP

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Ecosystem Enhancement Program

Figure 1



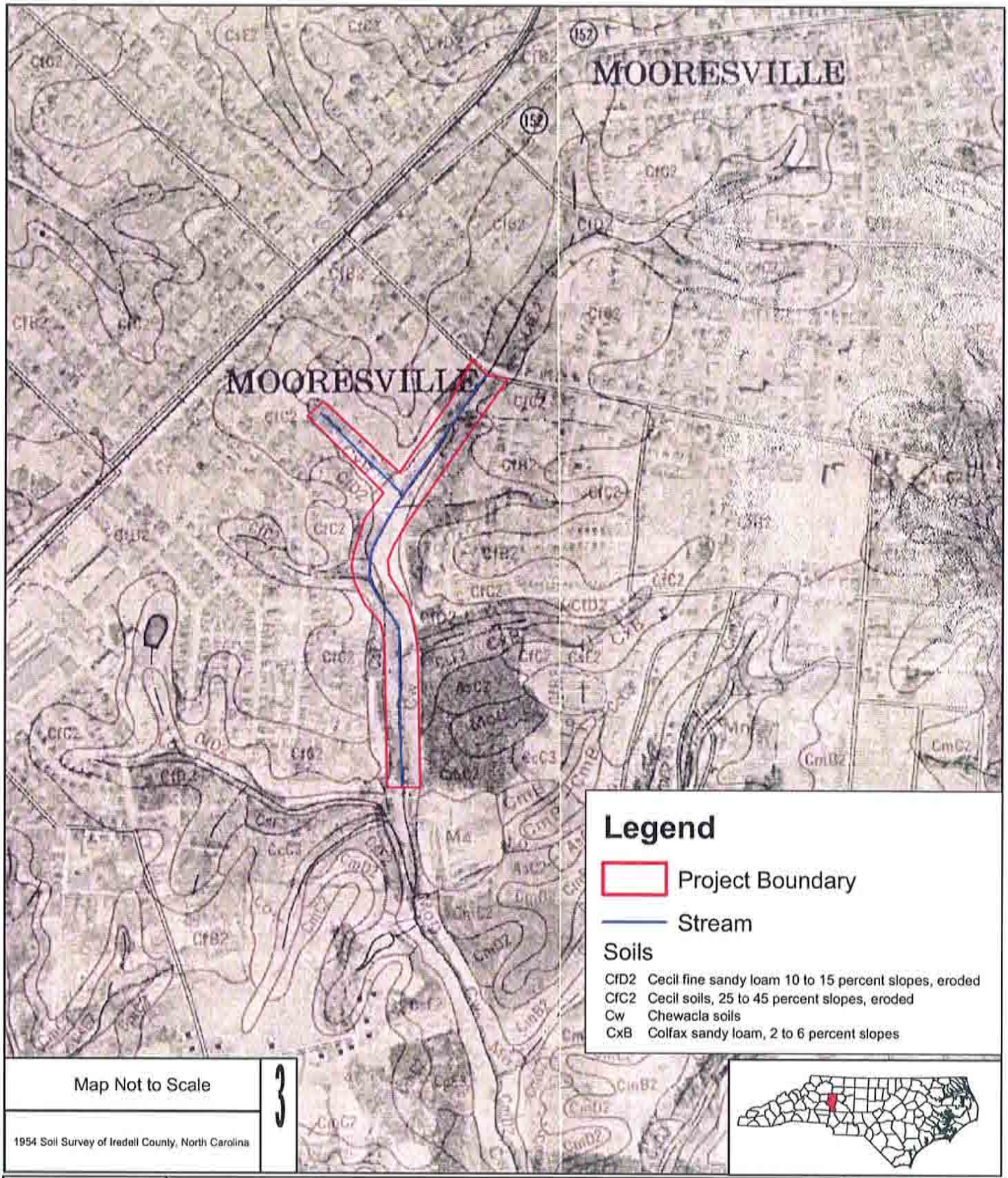
DRAINAGE AREA

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Ecosystem Enhancement

Figure 2



Ecosystem Enhancement Program

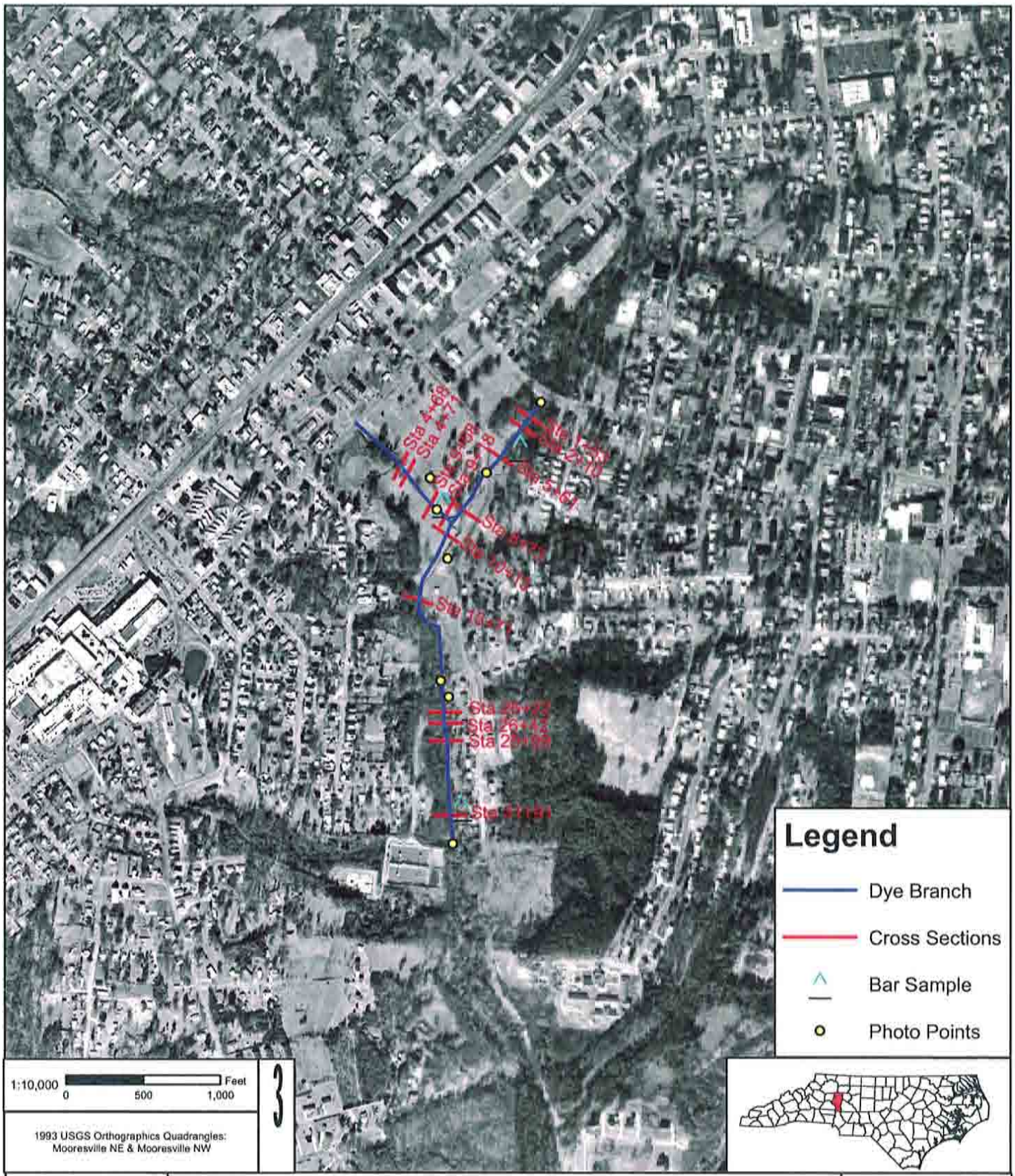
SOILS

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Figure

3



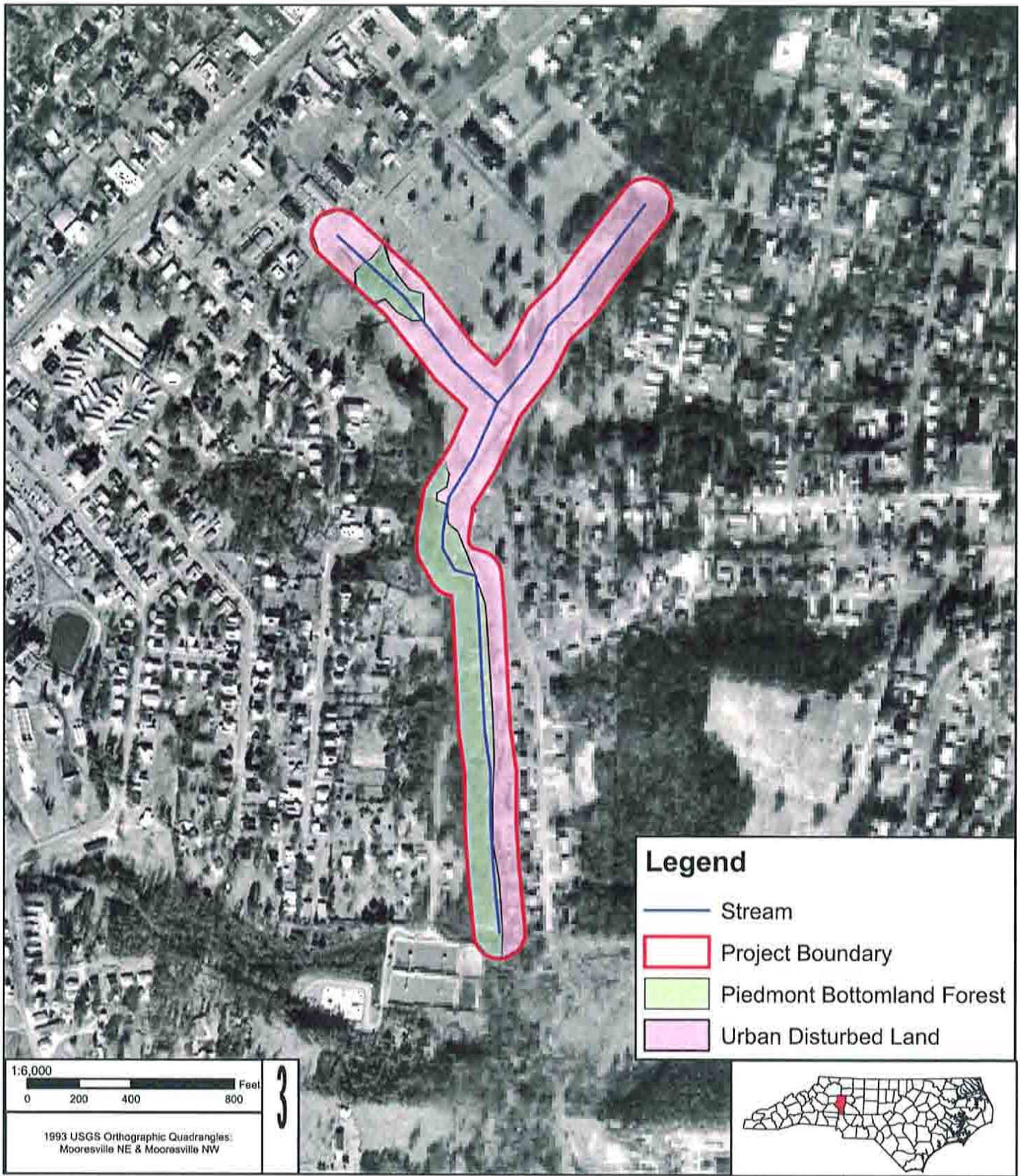
CROSS SECTION, BAR SAMPLE AND PHOTO POINT LOCATIONS

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Ecosystem Enhancement Program

Figure 4



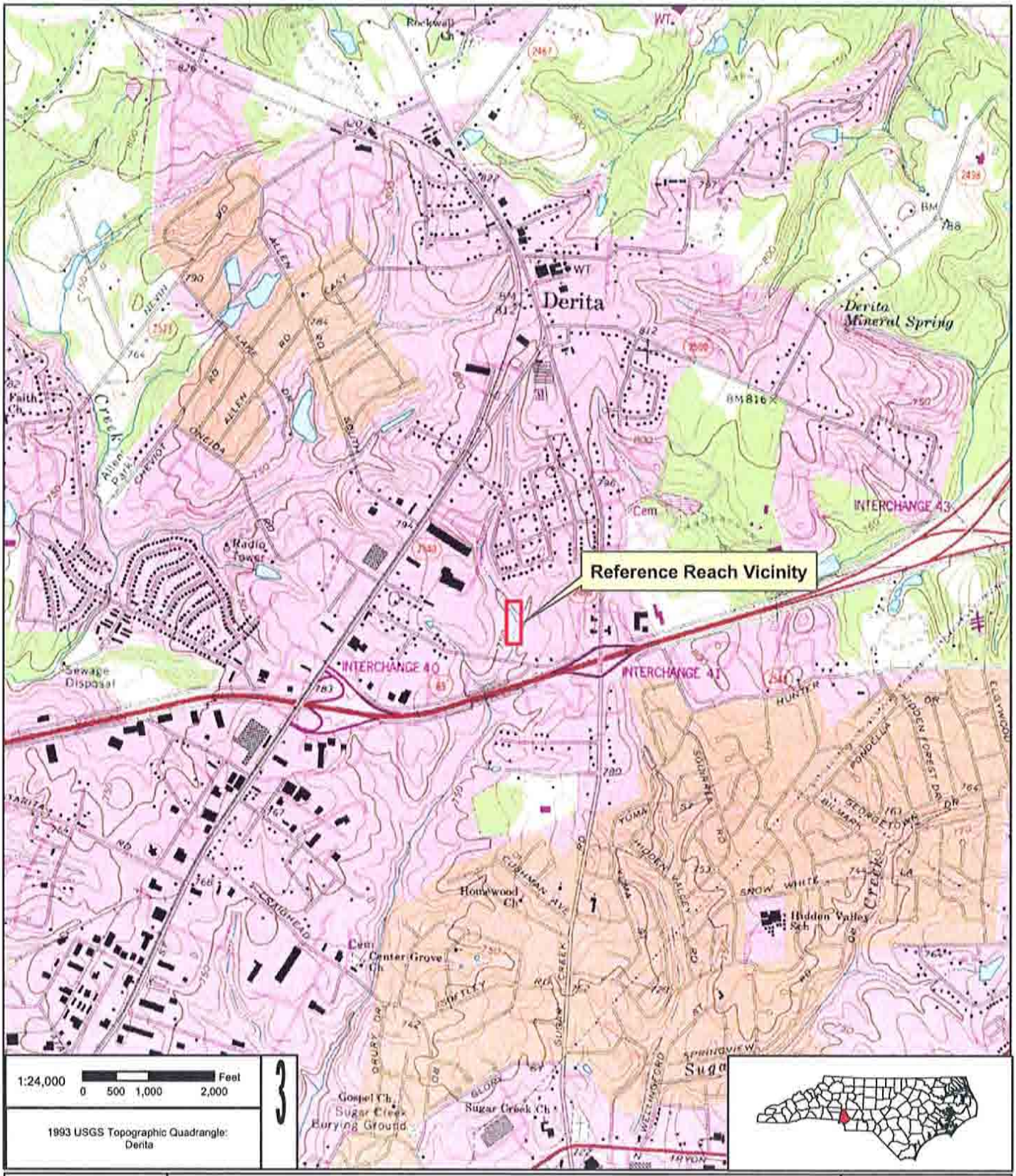
VEGETATIVE COMMUNITIES

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Ecosystem Enhancement Program

Figure 5

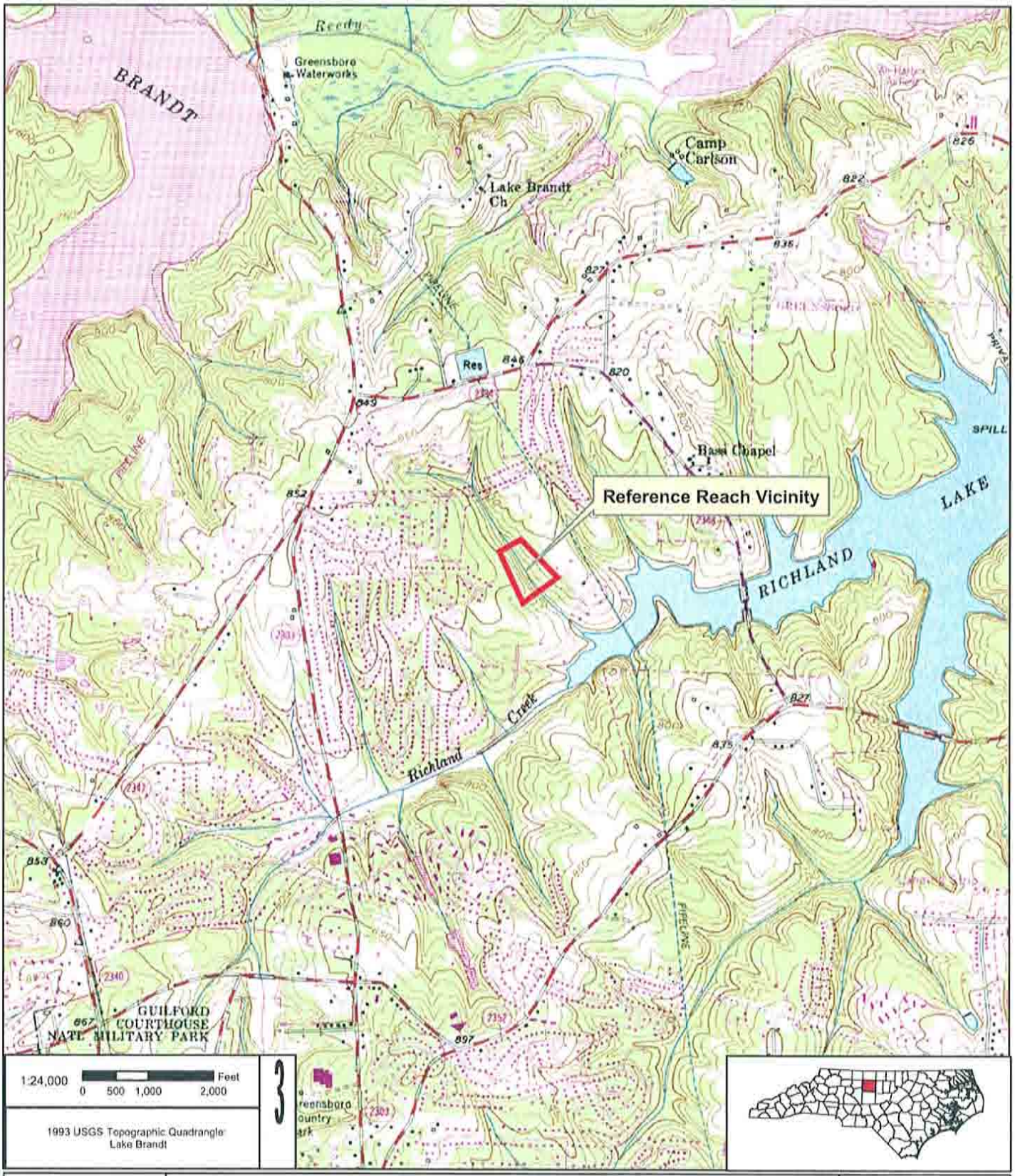


REFERENCE REACH VICINITY

DERITA BRANCH

MECHLENBURG COUNTY, NORTH CAROLINA

Figure 6



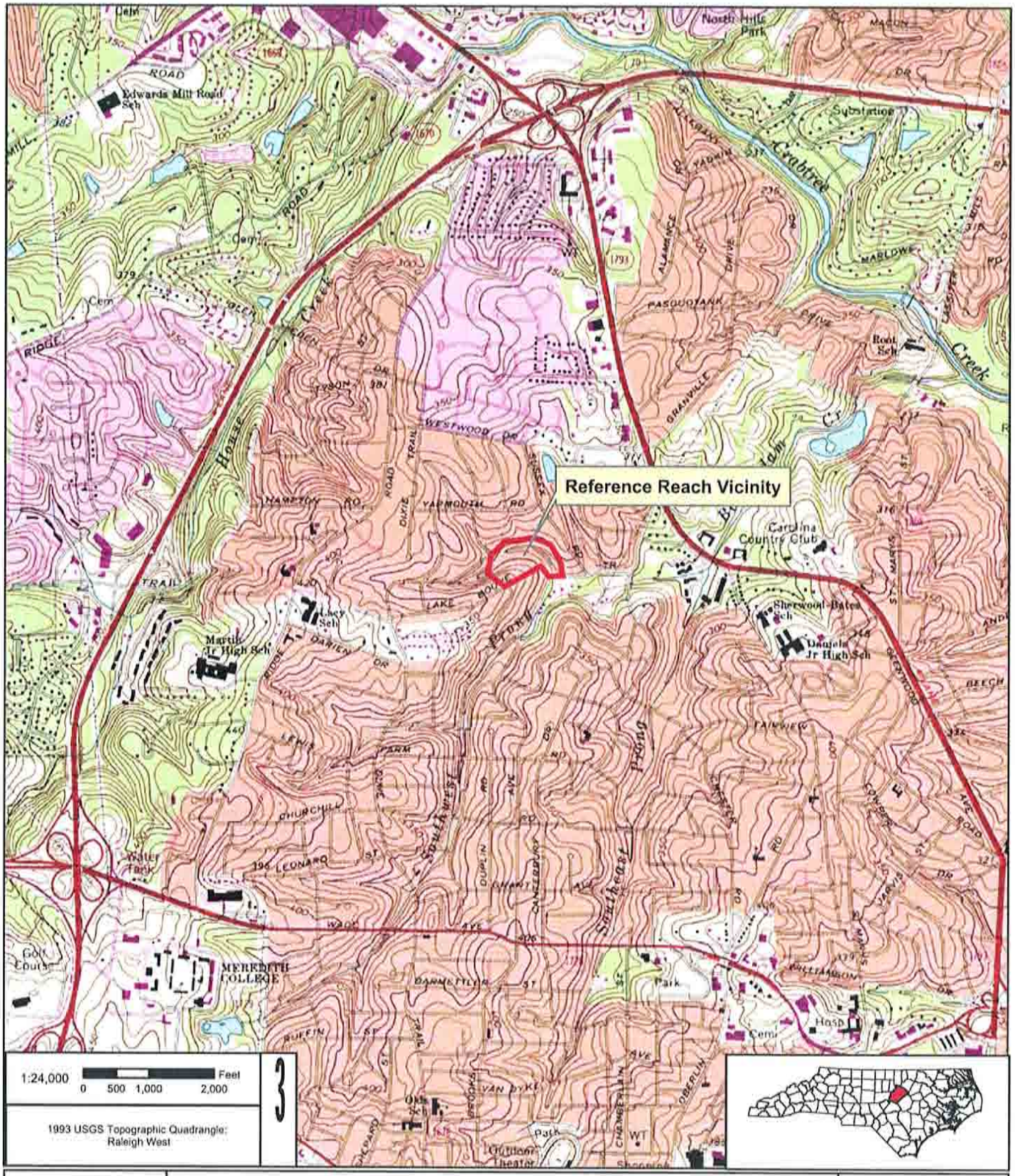
REFERENCE REACH VICINITY

UT TO LAKE JEANETTE

GUILFORD COUNTY, NORTH CAROLINA

Ecosystem Enhancement Program

Figure 7



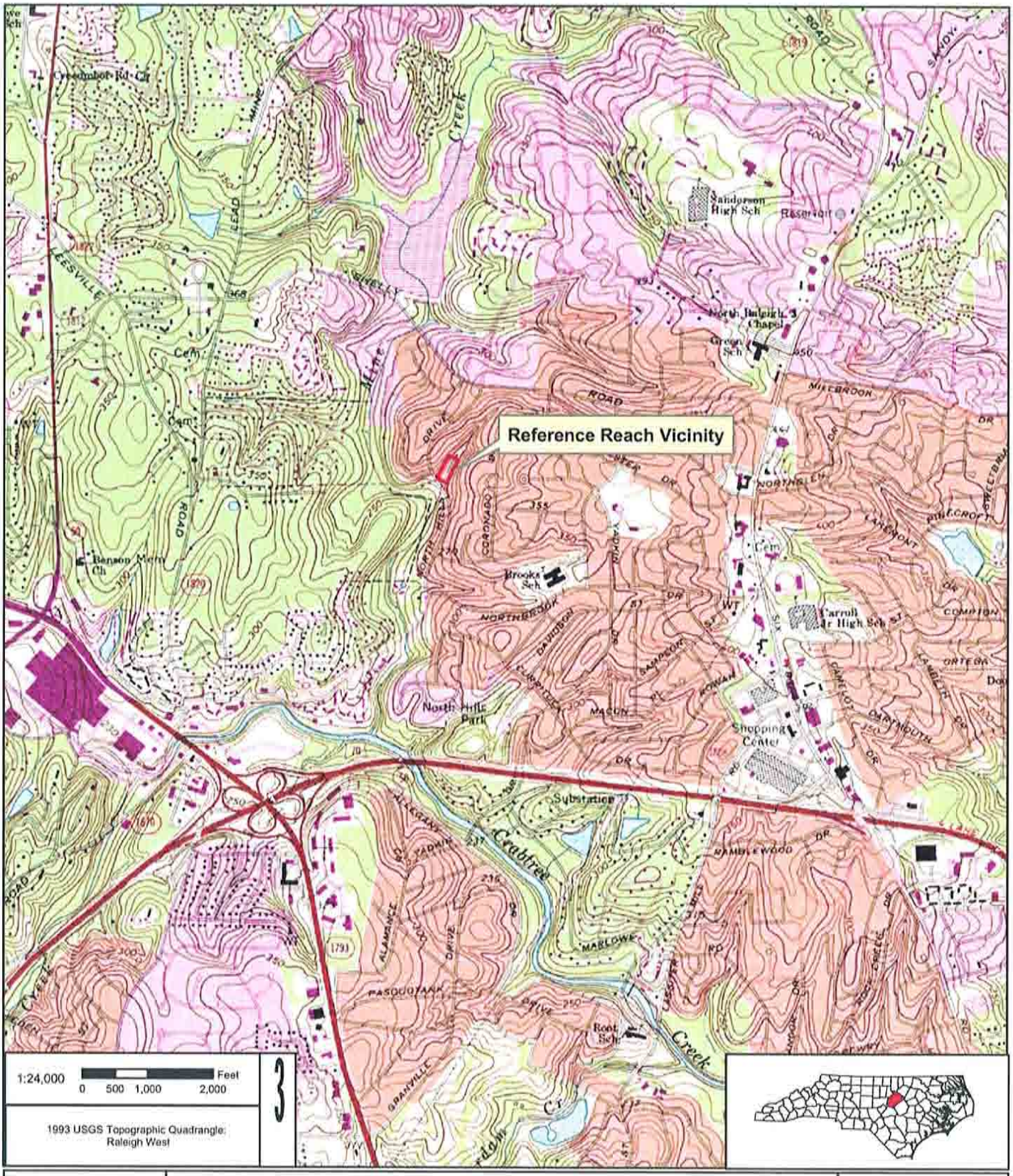
REFERENCE REACH VICINITY

UT TO SW PRONG BEAVERDAM CREEK

WAKE COUNTY, NORTH CAROLINA

Ecosystem Enhancement Program

Figure 8



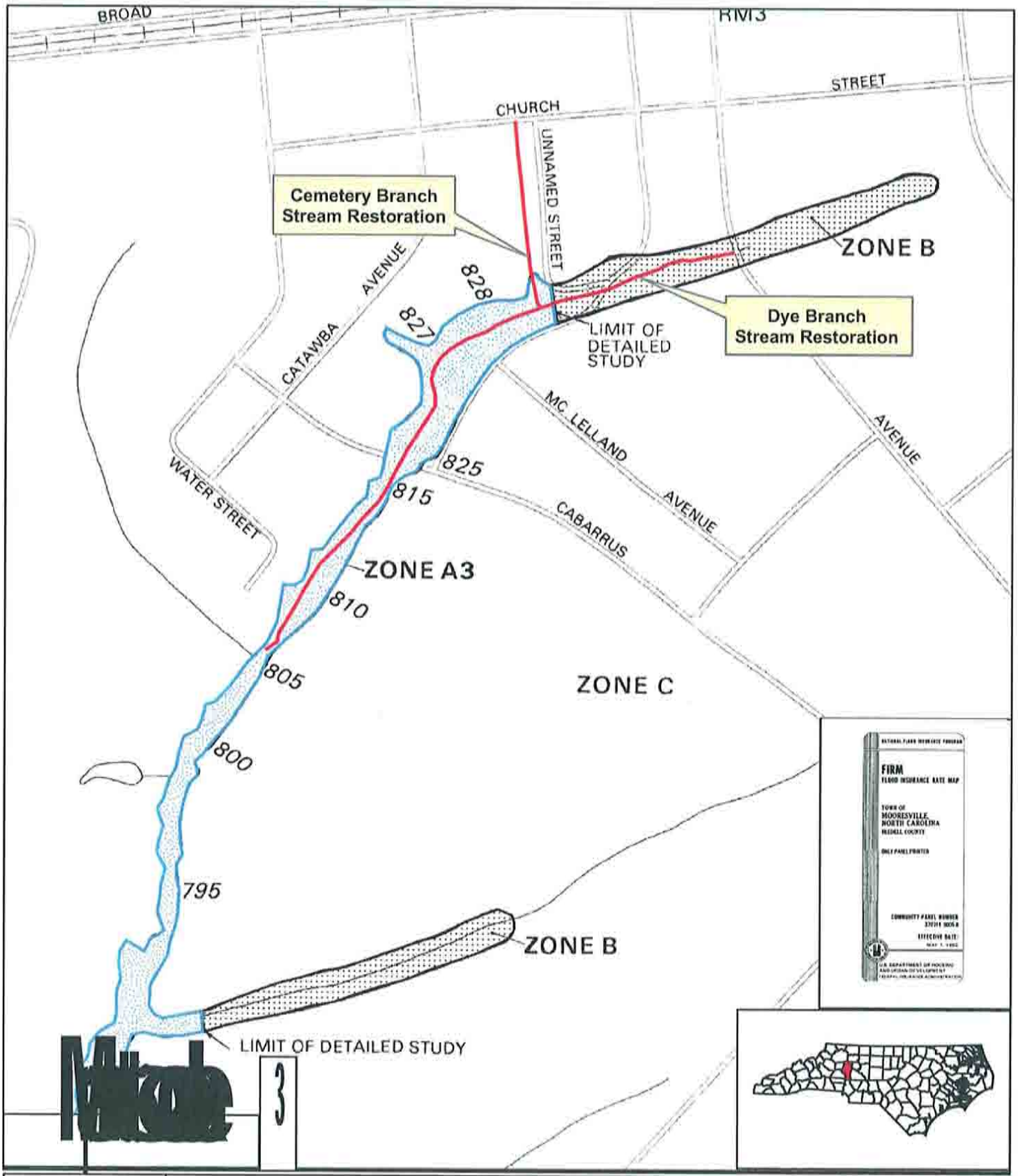
REFERENCE REACH VICINITY

UT TO MINE CREEK

WAKE COUNTY, NORTH CAROLINA

Figure

9



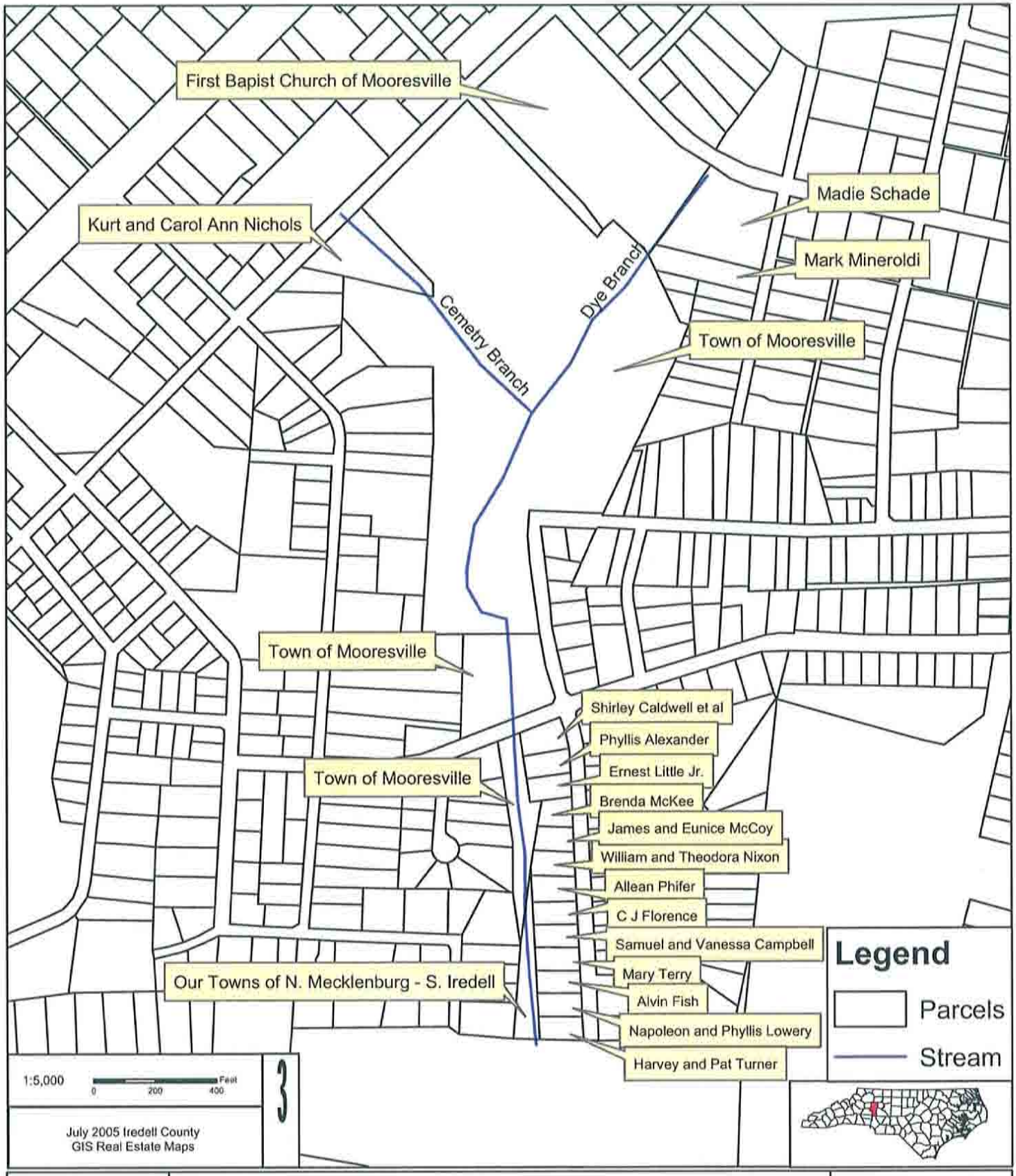
FEMA FLOOD STUDY

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Figure

10



Ecosystem Enhancement Program

LANDOWNER LISTING

DYE BRANCH STREAM RESTORATION

IREDELL COUNTY, NORTH CAROLINA

Appendix

K

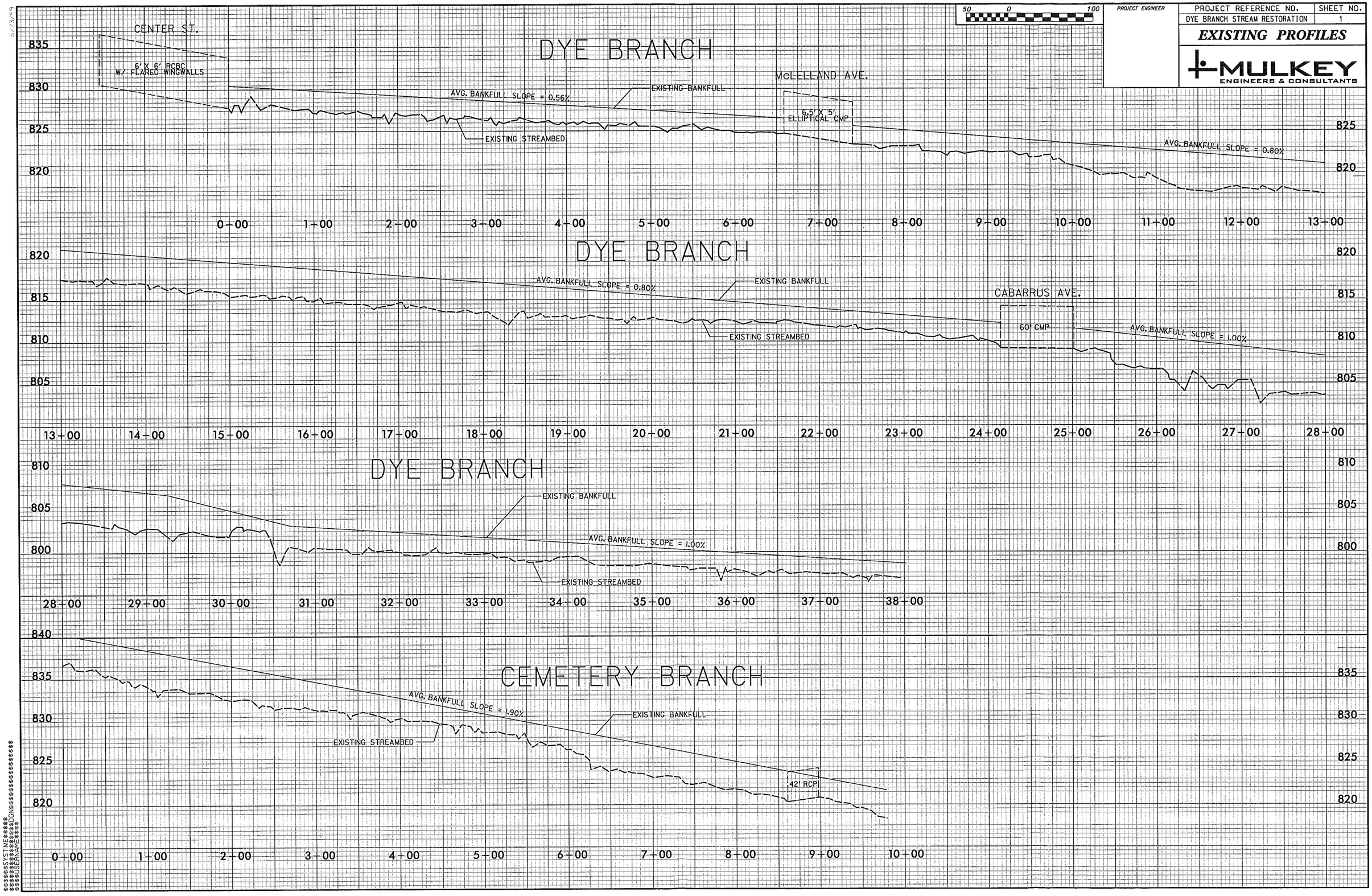
50 0 100

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
DYE BRANCH STREAM RESTORATION	1

EXISTING PROFILES

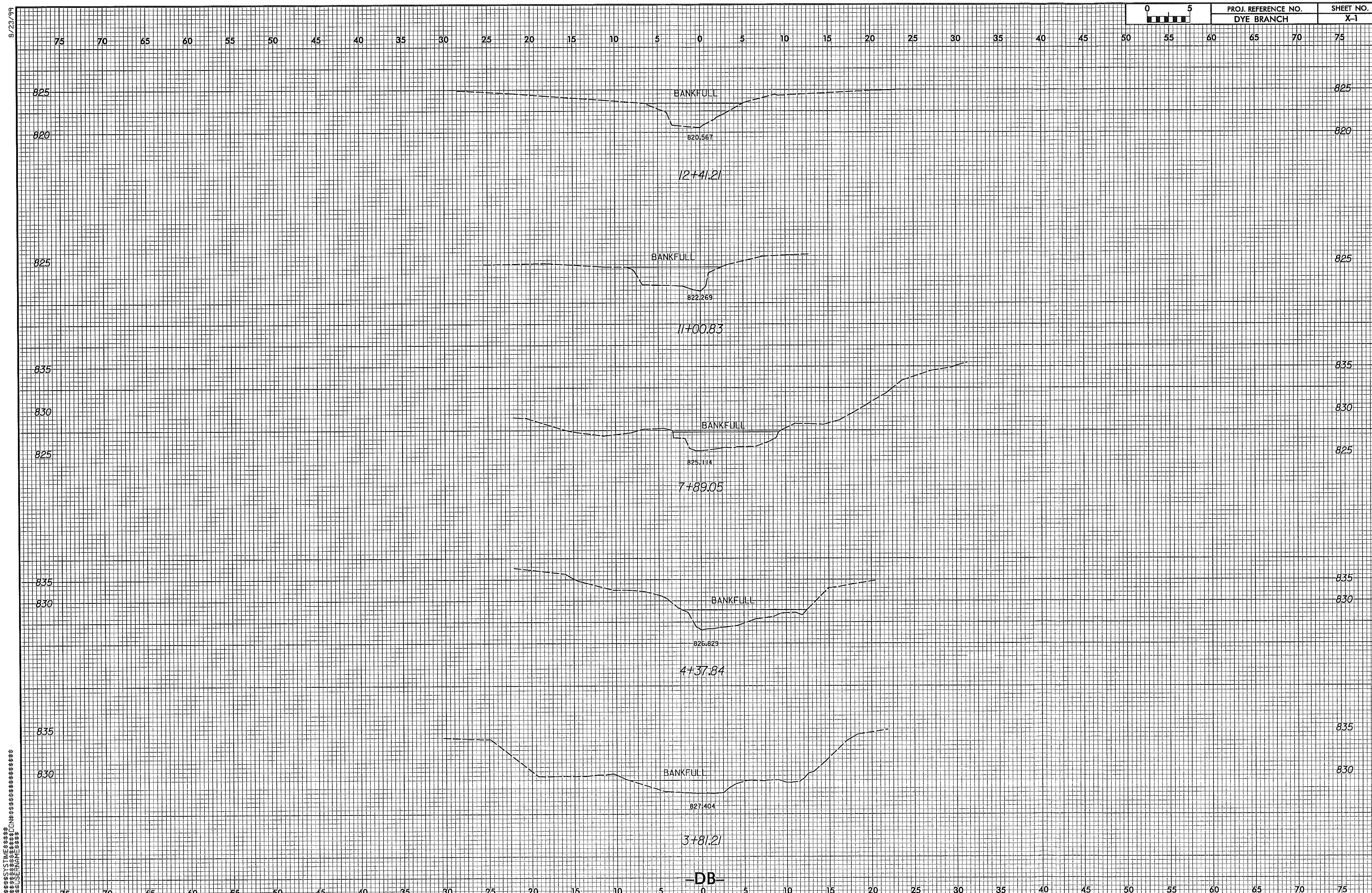
MULKEY ENGINEERS & CONSULTANTS



$$$$SYSTIME$$$$
$$$$ENGINEER$$$$
$$$$DESCRIPTION$$$$

PROJ. REFERENCE NO.	SHEET NO.
DYE BRANCH	X-1

8/23/99



$$$$$$SYSTIME$$$$$
$$$$$$$$$$$$$$DGN$$$$$$$$$$$$$$$$$$$$$
$$$$USERNAME$$$$$

8/23/99

0 5	PROJ. REFERENCE NO.	SHEET NO.
	DYE BRANCH	X-2

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

810
805
800

BANKFULL

800.288

34+18.83

815
810
805

BANKFULL

807.066

29+26.58

810
805

BANKFULL

805.912

28+69.97

810
805

BANKFULL

805.307

28+50.11

820
815

BANKFULL

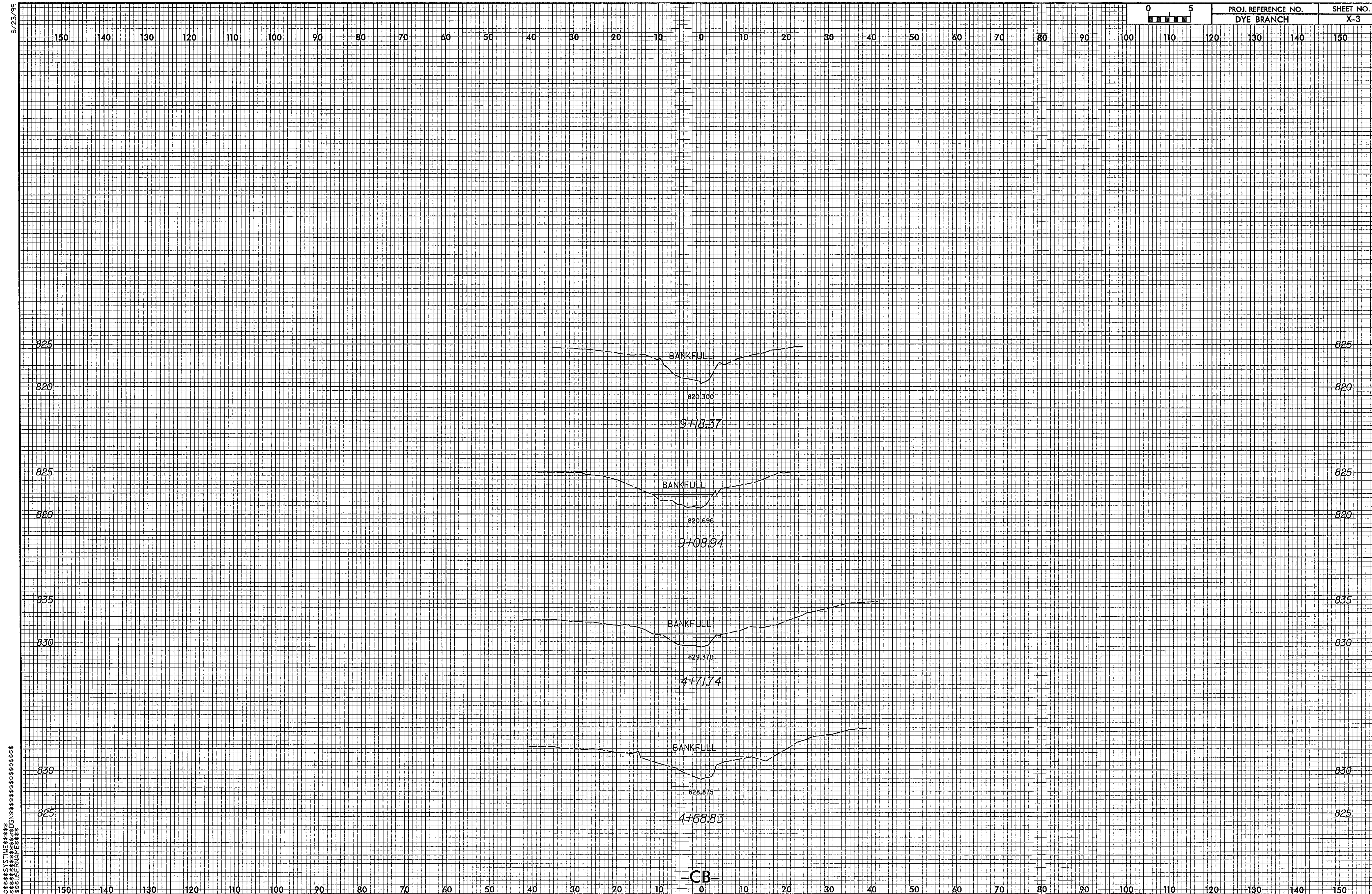
815.367

17+99.38

-DB-

$$$$$$SYSTIME$$$$$$
$$$$$$$$$$$$$$$$$$DGN$$$$$$$$$$$$$$$$$$
$$$$$$USERNAME$$$$$$

PROJ. REFERENCE NO.	SHEET NO.
DYE BRANCH	X-3



MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Cemetery Branch
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
1. Stream Type		Unstable E4		C4		E4	C4	C5
2. Drainage Area (sq. mi)		0.06		0.06		0.250	0.25	0.28
3. Bankfull Width (Wbkf) ft	Mean:	6.98	Mean:	10.0	Mean:	11.25	9.50	11.77
	Minimum:		Minimum:		Minimum:		8.90	9.90
	Maximum:		Maximum:		Maximum:		12.10	14.10
4. Bankfull Mean Depth (dbkf) ft	Mean:	0.97	Mean:	0.7	Mean:	1.63	0.80	0.80
	Minimum:		Minimum:		Minimum:		0.70	0.70
	Maximum:		Maximum:		Maximum:		0.80	1.00
5. Width/Depth Ratio (Wbkf/dbkf)	Mean:	7.19	Mean:	14.3	Mean:	6.89	11.70	14.97
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
6. Bankfull Cross-Sectional Area (Abkf) sq ft	Mean:	6.76	Mean:	7.0	Mean:	18.35	7.70	9.38
	Minimum:		Minimum:		Minimum:		6.80	7.80
	Maximum:		Maximum:		Maximum:		8.40	10.50
7. Bankfull Mean Velocity (Vbkf) fps	Mean:	7.2	Mean:	6.2	Mean:	5.86	4.55	4.80
	Minimum:	6.6	Minimum:	5.5	Minimum:	5.27		4.10
	Maximum:	7.8	Maximum:	6.7	Maximum:	6.98		5.20
8. Bankfull Discharge (Qbkf) cfs	Mean:	49.0	Mean:	43.1	Mean:	107.4	35	45
	Minimum:	44.3	Minimum:	38.4	Minimum:	96.7		38.00
	Maximum:	52.8	Maximum:	46.6	Maximum:	126.1		46.00
9. Maximum Bankfull Depth (dmax) ft	Mean:	1.52	Mean:	1.1	Mean:	2.4	1.30	1.28
	Minimum:		Minimum:	0.8	Minimum:		1.20	1.00
	Maximum:		Maximum:	1.6	Maximum:		1.30	1.70
10. Ratio of Low Bank Height to Maximum Bankfull Depth (lbh/dmax)	Mean:	1.49	Mean:	1.0	Mean:	1.2	1.00	1.00
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
11. Width of Flood Prone Area (Wfpa) ft	Mean:	14.2	Mean:	28.0	Mean:	100.0	25.00	90.00
	Minimum:		Minimum:		Minimum:		19.00	
	Maximum:		Maximum:		Maximum:		36.00	
12. Entrenchment Ratio (Wfpa/Wbkf)	Mean:	2.0	Mean:	2.8	Mean:	8.9	3.80	7.65
	Minimum:	0.0	Minimum:		Minimum:			
	Maximum:	0.0	Maximum:		Maximum:			
13. Meander Length (Lm) ft	Mean:	42.0	Mean:	55.2	Mean:	79.0	50.2	71.0
	Minimum:	13.6	Minimum:	46.0	Minimum:	29.0	26.0	33.0
	Maximum:	71.0	Maximum:	64.4	Maximum:	155.0	69.0	144.0
14. Ratio of Meander Length to Bankfull Width (Lm/Wbkf)	Mean:	6.0	Mean:	6.0	Mean:	7.0	5.28	6.03
	Minimum:	2.0	Minimum:	4.6	Minimum:	2.6	2.92	2.80
	Maximum:	10.2	Maximum:	6.4	Maximum:	13.8	5.70	12.24
15. Radius of Curvature (Rc) ft	Mean:	19.6	Mean:	27.6	Mean:	36.8	9.70	18.00
	Minimum:	3.9	Minimum:	18.4	Minimum:	25.5	5.00	11.10
	Maximum:	37.0	Maximum:	36.8	Maximum:	48.0	22.00	38.00
16. Ratio of Radius of Curvature to Bankfull Width (Rc/Wbkf)	Mean:	2.8	Mean:	2.8	Mean:	3.3	1.02	1.53
	Minimum:	0.6	Minimum:	1.8	Minimum:	2.3	0.56	0.94
	Maximum:	5.3	Maximum:	3.7	Maximum:	4.3	1.82	3.23
17. Belt Width (Wblt) ft	Mean:	10.8	Mean:	32.2	Mean:	41.0	33	71
	Minimum:	5.3	Minimum:	23.0	Minimum:	28.3	26	30
	Maximum:	22.6	Maximum:	41.4	Maximum:	53.7	40	119
18. Meander Width Ratio (Wblt/Wbkf)	Mean:	1.5	Mean:	3.2	Mean:	3.6	3.47	6.03
	Minimum:	0.8	Minimum:	2.3	Minimum:	2.5		2.55
	Maximum:	3.2	Maximum:	4.1	Maximum:	4.8		10.11
21. Sinuosity (Stream length/valley distance) (K)	Mean:	1.14	Mean:	1.14	Mean:	1.15	1.39	2.22
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
22. Valley Slope (ft/ft)	Mean:	0.0217	Mean:	0.0217	Mean:	0.0077	0.0076	0.0300
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
23. Average Water Surface Slope for Reach (Savg)	Mean:	0.0190	Mean:	0.0190	Mean:	0.0067	0.0057	0.0130
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
24. Pool Slope (Spool) ft/ft	Mean:	0.0110	Mean:	0.0019	Mean:	0.0000	0.0005	0.0011
	Minimum:	0.0010	Minimum:	0.0000	Minimum:	0.0000		0.0000
	Maximum:	0.0280	Maximum:	0.0038	Maximum:	0.0000		0.0030
25. Ratio of Pool Slope to Average Slope (Spool/Savg)	Mean:	0.579	Mean:	0.100	Mean:	0.000	0.08	0.08
	Minimum:	0.053	Minimum:	0.000	Minimum:	0.000		0.00
	Maximum:	1.474	Maximum:	0.200	Maximum:	0.000		0.23
26. Maximum Pool Depth (dpool) ft	Mean:	2.6	Mean:	2.0	Mean:	3.2	2.90	2.40
	Minimum:		Minimum:		Minimum:		2.40	1.80
	Maximum:		Maximum:		Maximum:		2.90	2.90
27. Ratio of Maximum Pool Depth to Bankfull Mean Depth (dpool/dbkf)	Mean:	2.7	Mean:	2.9	Mean:	2.0	3.63	3.00
	Minimum:	0.0	Minimum:		Minimum:	0.0		2.25
	Maximum:	0.0	Maximum:		Maximum:	0.0		3.63
28. Pool Width (Wpool) ft	Mean:	13.1	Mean:	14.0	Mean:	15.6	10.70	9.90
	Minimum:		Minimum:		Minimum:		8.00	9.10
	Maximum:		Maximum:		Maximum:		20.70	10.50
29. Ratio of Pool Width to Bankfull Width (Wpool/Wbkf)	Mean:	1.9	Mean:	1.4	Mean:	1.4	1.13	0.84
	Minimum:	0.0	Minimum:		Minimum:	0.0		0.77
	Maximum:	0.0	Maximum:		Maximum:	0.0		0.89

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Cemetery Branch
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
30. Bankfull Cross-sectional Area at Pool (Apool) sq ft	Mean:	14.7	Mean:	10.3	Mean:	29.8	10.75	13.50
	Minimum		Minimum:		Minimum:		9.90	11.40
	Maximum:		Maximum:		Maximum:		11.60	16.00
31. Ratio of Pool Area to Bankfull Area (Apool/Abkf)	Mean:	2.2	Mean:	1.5	Mean:	1.6	1.40	1.44
	Minimum:	0.0	Minimum:		Minimum:			
	Maximum:	0.0	Maximum:		Maximum:			
32. Pool to Pool Spacing (p-p) ft	Mean:	86.0	Mean:	27.6	Mean:	140.8	40.20	36.50
	Minimum	22.8	Minimum:	18.4	Minimum:		20.7	18
	Maximum:	228.2	Maximum:	32.2	Maximum:		54.80	58.00
33. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/Wbkf)	Mean:	12.3	Mean:	2.8	Mean:	12.5	4.23	3.10
	Minimum:	3.3	Minimum:	1.8	Minimum:	0.0	2.2	1.53
	Maximum:	32.7	Maximum:	3.2	Maximum:	0.0	5.80	4.93
34. Pool Length (Lp) ft	Mean:	8.2	Mean:	20.7	Mean:	24.0	N/A	10.50
	Minimum	4.7	Minimum:	13.8	Minimum:	15.1		3.5
	Maximum:	11.9	Maximum:	27.6	Maximum:	32.8		30.00
35. Ratio of Pool Length to Bankfull Width (Lp/Wbkf)	Mean:	1.2	Mean:	2.1	Mean:	2.1	N/A	0.89
	Minimum:	0.7	Minimum:	1.4	Minimum:	1.3		0.30
	Maximum:	1.7	Maximum:	2.8	Maximum:	2.9		2.55
36. Riffle Slope (Sriff) ft/ft	Mean:	0.0340	Mean:	0.0475	Mean:	0.0160	N/A	0.04
	Minimum:	0.0120	Minimum:		Minimum:	0.0064		0.022
	Maximum:	0.0880	Maximum:		Maximum:	0.0290		0.05
37. Ratio of Riffle Slope to Average Slope (Sriff/Savg)	Mean:	1.789	Mean:	2.5	Mean:	2.4	N/A	2.69
	Minimum:	0.632	Minimum:		Minimum:	1.0		1.69
	Maximum:	4.632	Maximum:		Maximum:	4.3		4.00
38. Maximum Riffle Depth (driff) ft	Mean:	1.5	Mean:	1.1	Mean:	2.40	1.30	1.30
	Minimum:		Minimum:		Minimum:		1.2	1
	Maximum:		Maximum:		Maximum:		1.30	1.70
39. Ratio of Maximum Riffle Depth to Bankfull Mean Depth (driff/dbkf)	Mean:	1.6	Mean:	1.6	Mean:	1.5	1.63	1.63
	Minimum:	0.0	Minimum:		Minimum:	0.0	1.71	1.25
	Maximum:	0.0	Maximum:		Maximum:	0.0	1.63	2.13
40. Run Slope (Srun) ft/ft	Mean:	0.0080	Mean:	0.0150	Mean:	0.0071	N/A	0.01
	Minimum:	0.0000	Minimum:	0.0050	Minimum:	0.0018		0.003
	Maximum:	0.0320	Maximum:	0.0250	Maximum:	0.0114		0.02
41. Ratio of Run Slope to Average Slope (Srun/Savg)	Mean:	0.421	Mean:	0.789	Mean:	1.054	N/A	0.69
	Minimum	0.000	Minimum:	0.263	Minimum:	0.275		0.23
	Maximum:	1.684	Maximum:	1.316	Maximum:	1.703		1.31
42. Maximum Run Depth (drun) ft	Mean:	2.2	Mean:	1.4	Mean:	2.7	N/A	1.60
	Minimum:		Minimum:		Minimum:			1.4
	Maximum:		Maximum:		Maximum:			1.70
43. Ratio of Run Depth to Bankfull Mean Depth (drun/dbkf)	Mean:	2.2	Mean:	2.0	Mean:	1.7	N/A	2.00
	Minimum	0.0	Minimum:		Minimum:			1.75
	Maximum:	0.0	Maximum:		Maximum:			2.13
44. Slope of Glide (Sglide) ft/ft	Mean:	0.0010	Mean:	0.0060	Mean:	0.0065	N/A	0.00
	Minimum:	0.0009	Minimum:	0.0000	Minimum:	0.0006		0
	Maximum:	0.0010	Maximum:	0.0120	Maximum:	0.0124		0.01
45. Ratio of Glide Slope to Average Water Slope (Sglide/Savg)	Mean:	0.051	Mean:	0.316	Mean:	0.969	N/A	0.12
	Minimum	0.048	Minimum:	0.000	Minimum:	0.092		0
	Maximum:	0.054	Maximum:	0.632	Maximum:	1.847		0.38
46. Maximum Glide Depth (dglide) ft	Mean:	1.5	Mean:	1.2	Mean:	2.4	N/A	1.55
	Minimum:		Minimum:		Minimum:			1.3
	Maximum:		Maximum:		Maximum:			1.80
47. Ratio of Glide Depth to Bankfull Mean Depth (dglide/dbkf)	Mean:	1.6	Mean:	1.7	Mean:	1.5	N/A	1.94
	Minimum	0.0	Minimum:		Minimum:			1.625
	Maximum:	0.0	Maximum:		Maximum:			2.25

Materials:	Existing		Proposed		Reference Reach		Reference Reach	Reference Reach
Particle Size Distribution of Channel Material								
D16	0.9		0.9		0.38			0.042
D35	1.2		1.2		0.7			0.3
D50	2.0		2.0		6			1.0
D84	8.0		8.0		10.7			17.0
D95	10.1		10.1		11.2			42.0
Particle Size Distribution of Bar Material	Pavement	Subpavement	Pavement	Subpavement	Pavement	Subpavement	Pavement	Pavement
D16	4.1	<0.1	4.1	<0.1	7.8	<0.1	0.8	0.2
D35	5.3	<0.1	5.3	<0.1	10	<0.1	1.7	1.9
D50	8.0	<0.1	8.0	<0.1	10.3	3	2.4	6.0
D84	10.2	7.1	10.2	7.1	10.9	11.3	6.9	22.0
D95	10.4	11.3	10.4	11.3	11.2	11.9	9.5	37.0
Largest Size Particle on Bar	88.9		88.9					45.0

TABLE 1

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Dye Branch Reach 1
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
1. Stream Type		Unstable E4		C4		E4	C4	C5
2. Drainage Area (sq. mi)		0.6		0.6		0.250	0.25	0.28
3. Bankfull Width (Wbkf) ft	Mean:	12.5	Mean:	17.2	Mean:	11.25	9.50	11.77
	Minimum:		Minimum:		Minimum:		8.90	9.90
	Maximum:		Maximum:		Maximum:		12.10	14.10
4. Bankfull Mean Depth (dbkf) ft	Mean:	1.58	Mean:	1.40	Mean:	1.63	0.80	0.80
	Minimum:		Minimum:		Minimum:		0.70	0.70
	Maximum:		Maximum:		Maximum:		0.80	1.00
5. Width/Depth Ratio (Wbkf/dbkf)	Mean:	7.9	Mean:	12.3	Mean:	6.89	11.70	14.97
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
6. Bankfull Cross-Sectional Area (Abkf) sq ft	Mean:	19.7	Mean:	24.1	Mean:	18.35	7.70	9.38
	Minimum:		Minimum:		Minimum:		6.80	7.80
	Maximum:		Maximum:		Maximum:		8.40	10.50
7. Bankfull Mean Velocity (Vbkf) fps	Mean:	5.6	Mean:	5.0	Mean:	5.86	4.55	4.80
	Minimum:	5.4	Minimum:	4.7	Minimum:	5.27		4.10
	Maximum:	5.9	Maximum:	5.3	Maximum:	6.98		5.20
8. Bankfull Discharge (Qbkf) cfs	Mean:	110.6	Mean:	120.5	Mean:	107.4	35	45
	Minimum:	105.7	Minimum:	113.3	Minimum:	96.7		38.00
	Maximum:	115.7	Maximum:	127.7	Maximum:	128.1		46.00
9. Maximum Bankfull Depth (dmax) ft	Mean:	2.2	Mean:	2.1	Mean:	2.4	1.30	1.28
	Minimum:		Minimum:		Minimum:		1.20	1.00
	Maximum:		Maximum:		Maximum:		1.30	1.70
10. Ratio of Low Bank Height to Maximum Bankfull Depth (lbh/dmax)	Mean:	1.1	Mean:	1.0	Mean:	1.2	1.00	1.00
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
11. Width of Flood Prone Area (Wfpa) ft	Mean:	40.2	Mean:	48.0	Mean:	100.0	25.00	90.00
	Minimum:		Minimum:		Minimum:		19.00	
	Maximum:		Maximum:		Maximum:		36.00	
12. Entrenchment Ratio (Wfpa/Wbkf)	Mean:	3.2	Mean:	2.8	Mean:	8.9	3.80	7.65
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
13. Meander Length (Lm) ft	Mean:	60.3	Mean:	51.2	Mean:	79.0	50.2	71.0
	Minimum:	20.6	Minimum:	26.2	Minimum:	29.0	26.0	33.0
	Maximum:	102.9	Maximum:	73.5	Maximum:	155.0	69.0	144.0
14. Ratio of Meander Length to Bankfull Width (Lm/Wbkf)	Mean:	4.8	Mean:	3.0	Mean:	7.0	5.28	6.03
	Minimum:	1.7	Minimum:	1.5	Minimum:	2.6	2.92	2.80
	Maximum:	8.2	Maximum:	4.3	Maximum:	13.8	5.70	12.24
15. Radius of Curvature (Rc) ft	Mean:	39.7	Mean:	19.5	Mean:	36.8	9.70	18.00
	Minimum:	16.1	Minimum:	12.3	Minimum:	25.5	5.00	11.10
	Maximum:	86.4	Maximum:	29.6	Maximum:	48.0	22.00	38.00
16. Ratio of Radius of Curvature to Bankfull Width (Rc/Wbkf)	Mean:	3.2	Mean:	1.1	Mean:	3.3	1.02	1.53
	Minimum:	1.3	Minimum:	0.7	Minimum:	2.3	0.56	0.94
	Maximum:	6.9	Maximum:	1.7	Maximum:	4.3	1.82	3.23
17. Belt Width (Wblt) ft	Mean:	14.8	Mean:	29.0	Mean:	41.0	33	71
	Minimum:	8.9	Minimum:	19.1	Minimum:	28.3	26	30
	Maximum:	25.3	Maximum:	40.3	Maximum:	53.7	40	119
18. Meander Width Ratio (Wblt/Wbkf)	Mean:	1.2	Mean:	1.7	Mean:	3.6	3.47	6.03
	Minimum:	0.7	Minimum:	1.1	Minimum:	2.5		2.55
	Maximum:	2.0	Maximum:	2.3	Maximum:	4.8		10.11
21. Sinuosity (Stream length/valley distance) (K)	Mean:	1.14	Mean:	1.14	Mean:	1.15	1.39	2.22
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
22. Valley Slope (ft/ft)	Mean:	0.0064	Mean:	0.0064	Mean:	0.0077	0.0076	0.0300
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
23. Average Water Surface Slope for Reach (Savg)	Mean:	0.0056	Mean:	0.0052	Mean:	0.0067	0.0057	0.0130
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
24. Pool Slope (Spool) ft/ft	Mean:		Mean:	0.0006	Mean:	0.0000	0.0005	0.0011
	Minimum:		Minimum:	0.0000	Minimum:	0.0000		0.0000
	Maximum:		Maximum:	0.0012	Maximum:	0.0000		0.0030
25. Ratio of Pool Slope to Average Slope (Spool/Savg)	Mean:		Mean:	0.1	Mean:	0.000	0.08	0.08
	Minimum:		Minimum:	0.0	Minimum:	0.000		0.00
	Maximum:		Maximum:	0.2	Maximum:	0.000		0.23
26. Maximum Pool Depth (dpool) ft	Mean:		Mean:	3.3	Mean:	3.2	2.90	2.40
	Minimum:		Minimum:		Minimum:		2.40	1.80
	Maximum:		Maximum:		Maximum:		2.90	2.90
27. Ratio of Maximum Pool Depth to Bankfull Mean Depth (dpool/dbkf)	Mean:	0.0	Mean:	2.4	Mean:	2.0	3.63	3.00
	Minimum	0.0	Minimum:		Minimum:	0.0		2.25
	Maximum:	0.0	Maximum:		Maximum:	0.0		3.63
28. Pool Width (Wpool) ft	Mean		Mean:	24.0	Mean:	15.6	20.70	9.90
	Minimum:		Minimum:		Minimum:		8.00	9.10
	Maximum:		Maximum:		Maximum:		10.70	10.50
29. Ratio of Pool Width to Bankfull Width (Wpool/Wbkf)	Mean:	0.0	Mean:	1.4	Mean:	1.4	2.18	0.64
	Minimum	0.0	Minimum:		Minimum:	0.0		0.77
	Maximum:	0.0	Maximum:		Maximum:	0.0		0.69

TABLE 1

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Dye Branch Reach 1
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
30. Bankfull Cross-sectional Area at Pool (Apool) sq ft	Mean:		Mean:	32.9	Mean:	29.8	10.75	13.50
	Minimum:		Minimum:		Minimum:		9.90	11.40
	Maximum:		Maximum:		Maximum:		11.60	16.00
31. Ratio of Pool Area to Bankfull Area (Apool/Abkf)	Mean:	0.0	Mean:	1.4	Mean:	1.6	1.40	1.44
	Minimum:	0.0	Minimum:		Minimum:			
	Maximum:	0.0	Maximum:		Maximum:			
32. Pool to Pool Spacing (p-p) ft	Mean:		Mean:	47.7	Mean:	140.8	40.20	36.50
	Minimum:		Minimum:	39.8	Minimum:		20.7	18
	Maximum:		Maximum:	55.7	Maximum:		54.8	58
33. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/Wbkf)	Mean:	0.0	Mean:	2.8	Mean:	12.5	4.23	3.10
	Minimum:	0.0	Minimum:	2.3	Minimum:	0.0	2.20	1.53
	Maximum:	0.0	Maximum:	3.2	Maximum:	0.0	5.80	4.93
34. Pool Length (Lp) ft	Mean:		Mean:	27.8	Mean:	24.0	N/A	10.50
	Minimum:		Minimum:	15.9	Minimum:	15.1		3.50
	Maximum:		Maximum:	39.8	Maximum:	32.8		30.00
35. Ratio of Pool Length to Bankfull Width (Lp/Wbkf)	Mean:	0.0	Mean:	1.6	Mean:	2.1	N/A	0.89
	Minimum:	0.0	Minimum:	0.9	Minimum:	1.3		0.30
	Maximum:	0.0	Maximum:	2.3	Maximum:	2.9		2.55
36. Riffle Slope (Sriff) ft/ft	Mean:	0.0146	Mean:	0.0150	Mean:	0.0160	N/A	0.0350
	Minimum:	0.0027	Minimum:		Minimum:	0.0064		0.0220
	Maximum:	0.0388	Maximum:		Maximum:	0.0290		0.0520
37. Ratio of Riffle Slope to Average Slope (Sriff/Savg)	Mean:	2.615	Mean:	2.9	Mean:	2.385	N/A	2.69
	Minimum:	0.479	Minimum:		Minimum:	0.954		1.69
	Maximum:	6.921	Maximum:		Maximum:	4.331		4.00
38. Maximum Riffle Depth (driff) ft	Mean:	2.2	Mean:	2.1	Mean:	2.40	1.30	1.30
	Minimum:		Minimum:		Minimum:		1.20	1.00
	Maximum:		Maximum:		Maximum:		1.30	1.70
39. Ratio of Maximum Riffle Depth to Bankfull Mean Depth (driff/dbkf)	Mean:	1.4	Mean:	1.5	Mean:	1.5	1.63	1.63
	Minimum:	0.0	Minimum:		Minimum:	0.0	1.71	1.25
	Maximum:	0.0	Maximum:		Maximum:	0.0	1.63	2.13
40. Run Slope (Srun) ft/ft	Mean:	0.0049	Mean:	0.0050	Mean:	0.0071	N/A	0.0090
	Minimum:	0.0008	Minimum:	0.0010	Minimum:	0.0018		0.0030
	Maximum:	0.0225	Maximum:	0.0100	Maximum:	0.0114		0.0170
41. Ratio of Run Slope to Average Slope (Srun/Savg)	Mean:	0.875	Mean:	0.962	Mean:	1.054	N/A	0.69
	Minimum:	0.142	Minimum:	0.192	Minimum:	0.275		0.23
	Maximum:	4.013	Maximum:	1.923	Maximum:	1.703		1.31
42. Maximum Run Depth (drun) ft	Mean:	2.3	Mean:	2.3	Mean:	2.7	N/A	1.6
	Minimum:		Minimum:		Minimum:			1.4
	Maximum:		Maximum:		Maximum:			1.7
43. Ratio of Run Depth to Bankfull Mean Depth (drun/dbkf)	Mean:	1.5	Mean:	1.6	Mean:	1.7	N/A	2.00
	Minimum:	0.0	Minimum:		Minimum:			1.75
	Maximum:	0.0	Maximum:		Maximum:			2.13
44. Slope of Glide (Sglide) ft/ft	Mean:		Mean:	0.0020	Mean:	0.0065	N/A	0.0016
	Minimum:		Minimum:	0.0000	Minimum:	0.0006		0.0000
	Maximum:		Maximum:	0.0040	Maximum:	0.0124		0.0050
45. Ratio of Glide Slope to Average Water Slope (Sglide/Savg)	Mean:		Mean:	0.385	Mean:	0.969	N/A	0.12
	Minimum:		Minimum:	0.000	Minimum:	0.092		0.00
	Maximum:		Maximum:	0.769	Maximum:	1.847		0.38
46. Maximum Glide Depth (dglide) ft	Mean:		Mean:	2.3	Mean:	2.4	N/A	1.55
	Minimum:		Minimum:		Minimum:			1.30
	Maximum:		Maximum:		Maximum:			1.80
47. Ratio of Glide Depth to Bankfull Mean Depth (dglide/dbkf)	Mean:	0.0	Mean:	1.6	Mean:	1.5	N/A	1.94
	Minimum:	0.0	Minimum:		Minimum:			1.63
	Maximum:	0.0	Maximum:		Maximum:			2.25

Materials:	Existing		Proposed		Reference Reach		Reference Reach	Reference Reach
Particle Size Distribution of Channel Material								
D16	<0.1		<0.1		0.38		N/A	0.042
D35	2.2		2.2		0.7		N/A	0.3
D50	4.5		4.5		6		N/A	1.0
D84	10		10		10.7		N/A	17.0
D95	10.5		10.5		11.2		N/A	42.0
Particle Size Distribution of Bar Material	Pavement	Subpavement	Pavement	Subpavement	Pavement	Subpavement	Pavement	Pavement
D16	2.6	<0.1	2.6	<0.1	7.8	<0.1	0.8	0.2
D35	4.7	<0.1	4.7	<0.1	10	<0.1	1.7	1.9
D50	6.0	2.8	6.0	2.8	10.3	3.0	2.4	6.0
D84	10	7.8	10	7.8	10.9	11.3	6.9	22.0
D95	10.5	10.6	10.5	10.6	11.2	11.9	9.5	37.0
Largest Size Particle on Bar	24		24					45.0

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Dye Branch Reach 2
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
1. Stream Type		Unstable E4		C4		E4	C4	C5
2. Drainage Area (sq. mi)		0.6		0.6		0.250	0.25	0.28
3. Bankfull Width (Wbkf) ft	Mean:	11.20	Mean:	16.1	Mean:	11.25	9.50	11.77
	Minimum:		Minimum:		Minimum:		8.90	9.90
	Maximum:		Maximum:		Maximum:		12.10	14.10
4. Bankfull Mean Depth (dbkf) ft	Mean:	1.60	Mean:	1.24	Mean:	1.63	0.80	0.80
	Minimum:		Minimum:		Minimum:		0.70	0.70
	Maximum:		Maximum:		Maximum:		0.80	1.00
5. Width/Depth Ratio (Wbkf/dbkf)	Mean:	7.00	Mean:	13.0	Mean:	6.89	11.70	14.97
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
6. Bankfull Cross-Sectional Area (Abkf) sq ft	Mean:	18.10	Mean:	20.0	Mean:	18.35	7.70	9.38
	Minimum:		Minimum:		Minimum:		6.80	7.80
	Maximum:		Maximum:		Maximum:		8.40	10.50
7. Bankfull Mean Velocity (Vbkf) fps	Mean:	6.5	Mean:	6.2	Mean:	5.86	4.55	4.80
	Minimum:	6.2	Minimum:	5.8	Minimum:	5.27		4.10
	Maximum:	6.9	Maximum:	6.6	Maximum:	6.98		5.20
8. Bankfull Discharge (Qbkf) cfs	Mean:	118.1	Mean:	124.0	Mean:	107.4	35	45
	Minimum:	112.2	Minimum:	116.0	Minimum:	96.7		38.00
	Maximum:	124.8	Maximum:	132.0	Maximum:	128.1		46.00
9. Maximum Bankfull Depth (dmax) ft	Mean:	2.8	Mean:	1.8	Mean:	2.4	1.30	1.28
	Minimum:		Minimum:	1.2	Minimum:		1.20	1.00
	Maximum:		Maximum:	2.4	Maximum:		1.30	1.70
10. Ratio of Low Bank Height to Maximum Bankfull Depth (lbh/dmax)	Mean:	1.00	Mean:	1.0	Mean:	1.2	1.00	1.00
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
11. Width of Flood Prone Area (Wfpa) ft	Mean:	89.5	Mean:	80.0	Mean:	100.0	25.00	90.00
	Minimum:		Minimum:		Minimum:		19.00	
	Maximum:		Maximum:		Maximum:		36.00	
12. Entrenchment Ratio (Wfpa/Wbkf)	Mean:	8.0	Mean:	5.0	Mean:	8.9	3.80	7.65
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
13. Meander Length (Lm) ft	Mean:	79.7	Mean:	113.4	Mean:	79.0	50.2	71.0
	Minimum:	40.1	Minimum:	60.3	Minimum:	29.0	26.0	33.0
	Maximum:	172.7	Maximum:	152.5	Maximum:	155.0	69.0	144.0
14. Ratio of Meander Length to Bankfull Width (Lm/Wbkf)	Mean:	7.1	Mean:	7.0	Mean:	7.0	5.28	6.03
	Minimum:	3.6	Minimum:	3.7	Minimum:	2.6	2.92	2.80
	Maximum:	15.4	Maximum:	9.5	Maximum:	13.8	5.70	12.24
15. Radius of Curvature (Rc) ft	Mean:	52.4	Mean:	39.9	Mean:	36.8	9.70	18.00
	Minimum:	14.5	Minimum:	27.8	Minimum:	25.5	5.00	11.10
	Maximum:	148.8	Maximum:	58.7	Maximum:	48.0	22.00	38.00
16. Ratio of Radius of Curvature to Bankfull Width (Rc/Wbkf)	Mean:	4.7	Mean:	2.5	Mean:	3.3	1.02	1.53
	Minimum:	1.3	Minimum:	1.7	Minimum:	2.3	0.56	0.94
	Maximum:	13.3	Maximum:	3.6	Maximum:	4.3	1.82	3.23
17. Belt Width (Wblt) ft	Mean:	24.3	Mean:	44.88	Mean:	41.0	33	71
	Minimum:	6.6	Minimum:	25.9	Minimum:	28.3	26	30
	Maximum:	56.9	Maximum:	58.2	Maximum:	53.7	40	119
18. Meander Width Ratio (Wblt/Wbkf)	Mean:	2.2	Mean:	2.8	Mean:	3.6	3.47	6.03
	Minimum:	0.6	Minimum:	1.6	Minimum:	2.5		2.55
	Maximum:	5.1	Maximum:	3.6	Maximum:	4.8		10.11
21. Sinuosity (Stream length/valley distance) (K)	Mean:	1.21	Mean:	1.30	Mean:	1.15	1.39	2.22
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
22. Valley Slope (ft/ft)	Mean:	0.0097	Mean:	0.0097	Mean:	0.0077	0.0076	0.0300
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
23. Average Water Surface Slope for Reach (Savg)	Mean:	0.0080	Mean:	0.0094	Mean:	0.0067	0.0057	0.0130
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
24. Pool Slope (Spool) ft/ft	Mean:	N/A	Mean:	0.0008	Mean:	0.0000	0.0005	0.0011
	Minimum:		Minimum:	0.0000	Minimum:	0.0000		0.0000
	Maximum:		Maximum:	0.0015	Maximum:	0.0000		0.0030
25. Ratio of Pool Slope to Average Slope (Spool/Savg)	Mean:	N/A	Mean:	0.080	Mean:	0.000	0.08	0.08
	Minimum:		Minimum:	0.000	Minimum:	0.000		0.00
	Maximum:		Maximum:	0.160	Maximum:	0.000		0.23
26. Maximum Pool Depth (dpool) ft	Mean:	N/A	Mean:	3.3	Mean:	3.2	2.90	2.40
	Minimum:		Minimum:		Minimum:		2.40	1.80
	Maximum:		Maximum:		Maximum:		2.90	2.90
27. Ratio of Maximum Pool Depth to Bankfull Mean Depth (dpool/dbkf)	Mean:	N/A	Mean:	2.7	Mean:	2.0	3.63	3.00
	Minimum:		Minimum:		Minimum:	0.0		2.25
	Maximum:		Maximum:		Maximum:	0.0		3.63

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Dye Branch Reach 2
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
28. Pool Width (Wpool) ft	Mean:	N/A	Mean:	24.0	Mean:	15.6	20.70	9.90
	Minimum:		Minimum:		Minimum:		8.00	9.10
	Maximum:		Maximum:		Maximum:		10.70	10.50
29. Ratio of Pool Width to Bankfull Width (Wpool/Wbkf)	Mean:	N/A	Mean:	1.5	Mean:	1.4	2.18	0.84
	Minimum:		Minimum:		Minimum:	0.0		0.77
	Maximum:		Maximum:		Maximum:	0.0		0.89
30. Bankfull Cross-sectional Area at Pool (Apool) sq ft	Mean:	N/A	Mean:	29.0	Mean:	29.8	10.75	13.50
	Minimum:		Minimum:		Minimum:		9.90	11.40
	Maximum:		Maximum:		Maximum:		11.60	16.00
31. Ratio of Pool Area to Bankfull Area (Apool/Abkf)	Mean:	N/A	Mean:	1.5	Mean:	1.6	1.40	1.44
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
32. Pool to Pool Spacing (p-p) ft	Mean:	N/A	Mean:	48.3	Mean:	140.8	40.20	36.50
	Minimum:		Minimum:	40.3	Minimum:		20.7	18
	Maximum:		Maximum:	56.4	Maximum:		54.60	58.00
33. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/Wbkf)	Mean:	N/A	Mean:	3.0	Mean:	12.5	4.23	3.10
	Minimum:		Minimum:	2.5	Minimum:	0.0	2.2	1.53
	Maximum:		Maximum:	3.5	Maximum:	0.0	5.80	4.93
34. Pool Length (Lp) ft	Mean:	N/A	Mean:	24.2	Mean:	24.0	N/A	10.50
	Minimum:		Minimum:	16.1	Minimum:	15.1		3.5
	Maximum:		Maximum:	48.3	Maximum:	32.8		30.00
35. Ratio of Pool Length to Bankfull Width (Lp/Wbkf)	Mean:	N/A	Mean:	1.5	Mean:	2.1	N/A	0.9
	Minimum:		Minimum:	1.0	Minimum:	1.3		0.3
	Maximum:		Maximum:	3.0	Maximum:	2.9		2.5
36. Riffle Slope (Sriff) ft/ft	Mean:	0.0141	Mean:	0.0190	Mean:	0.0160	N/A	0.0350
	Minimum:	0.0016	Minimum:		Minimum:	0.0064		0.0220
	Maximum:	0.0419	Maximum:		Maximum:	0.0290		0.0520
37. Ratio of Riffle Slope to Average Slope (Sriff/Savg)	Mean:	1.758	Mean:	2.0	Mean:	2.385	N/A	2.69
	Minimum:	0.198	Minimum:		Minimum:	0.954		1.69
	Maximum:	5.233	Maximum:		Maximum:	4.331		4.00
38. Maximum Riffle Depth (driff) ft	Mean:	2.810	Mean:	1.8	Mean:	2.40	1.30	1.30
	Minimum:		Minimum:		Minimum:		1.2	1
	Maximum:		Maximum:		Maximum:		1.30	1.70
39. Ratio of Maximum Riffle Depth to Bankfull Mean Depth (driff/dbkf)	Mean:	1.8	Mean:	1.5	Mean:	1.5	1.63	1.63
	Minimum:		Minimum:		Minimum:	0.0	1.71	1.25
	Maximum:		Maximum:		Maximum:	0.0	1.63	2.13
40. Run Slope (Srun) ft/ft	Mean:	0.0073	Mean:	0.0060	Mean:	0.0071	N/A	0.01
	Minimum:	0.0002	Minimum:	0.0020	Minimum:	0.0018		0.003
	Maximum:	0.0595	Maximum:	0.0100	Maximum:	0.0114		0.02
41. Ratio of Run Slope to Average Slope (Srun/Savg)	Mean:	0.906	Mean:	0.638	Mean:	1.054	N/A	0.69
	Minimum:	0.019	Minimum:	0.213	Minimum:	0.275		0.23
	Maximum:	7.439	Maximum:	1.064	Maximum:	1.703		1.31
42. Maximum Run Depth (drun) ft	Mean:	2.84	Mean:	2.4	Mean:	2.7	N/A	1.60
	Minimum:	2.83	Minimum:		Minimum:			1.4
	Maximum:	2.85	Maximum:		Maximum:			1.70
43. Ratio of Run Depth to Bankfull Mean Depth (drun/dbkf)	Mean:	1.78	Mean:	1.9	Mean:	1.7	N/A	2.00
	Minimum:	1.77	Minimum:		Minimum:			1.75
	Maximum:	1.78	Maximum:		Maximum:			2.13
44. Slope of Glide (Sglide) ft/ft	Mean:	N/A	Mean:	0.0030	Mean:	0.0065	N/A	0.00
	Minimum:		Minimum:	0.0000	Minimum:	0.0006		0
	Maximum:		Maximum:	0.0060	Maximum:	0.0124		0.01
45. Ratio of Glide Slope to Average Water Slope (Sglide/Savg)	Mean:	N/A	Mean:	0.319	Mean:	0.969	N/A	0.12
	Minimum:		Minimum:	0.000	Minimum:	0.092		0
	Maximum:		Maximum:	0.638	Maximum:	1.847		0.38
46. Maximum Glide Depth (dglide) ft	Mean:	N/A	Mean:	2.0	Mean:	2.4	N/A	1.55
	Minimum:		Minimum:		Minimum:			1.3
	Maximum:		Maximum:		Maximum:			1.80
47. Ratio of Glide Depth to Bankfull Mean Depth (dglide/dbkf)	Mean:	N/A	Mean:	1.6	Mean:	1.5	N/A	1.94
	Minimum:		Minimum:		Minimum:			1.625
	Maximum:		Maximum:		Maximum:			2.25

Materials:	Existing		Proposed		Reference Reach		Reference Reach	Reference Reach
Particle Size Distribution of Channel Material								
D16	0.15		0.15		0.38		N/A	0.042
D35	0.4		0.4		0.7		N/A	0.3
D50	3.3		3.3		6		N/A	1.0
D84	10.3		10.3		10.7		N/A	17.0
D95	13.7		13.7		11.2		N/A	42.0
Particle Size Distribution of Bar Material	Pavement	Subpavement	Pavement	Subpavement	Pavement	Subpavement	Pavement	Pavement
D16	4.2	<0.1	4.2	<0.1	7.8	<0.1	0.8	0.2
D35	6.8	0.1 - 2	6.8	<0.1	10	<0.1	1.7	1.9
D50	8.8	2.8	8.8	2.8	10.3	3	2.4	6.0
D84	12.4	7.8	12.4	7.8	10.9	11.3	6.9	22.0
D95	>16	10.6	>16	10.6	11.2	11.9	9.5	37.0
Largest Size Particle on Bar	45.7		45.7					45.0

TABLE 1

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Dye Branch Reach 3
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
1. Stream Type		G4c		C4		E4	C4	C5
2. Drainage Area (sq. mi)		0.6		0.6		0.250	0.25	0.28
3. Bankfull Width (Wbkf) ft	Mean:	14.8	Mean:	15.0	Mean:	11.25	9.50	11.77
	Minimum:		Minimum:		Minimum:		8.90	9.90
	Maximum:		Maximum:		Maximum:		12.10	14.10
4. Bankfull Mean Depth (dbkf) ft	Mean:	1.2	Mean:	1.3	Mean:	1.63	0.80	0.80
	Minimum:		Minimum:		Minimum:		0.70	0.70
	Maximum:		Maximum:		Maximum:		0.80	1.00
5. Width/Depth Ratio (Wbkf/dbkf)	Mean:	12.5	Mean:	12.0	Mean:	6.89	11.70	14.97
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
6. Bankfull Cross-Sectional Area (Abkf) sq ft	Mean:	17.4	Mean:	18.8	Mean:	18.35	7.70	9.38
	Minimum:		Minimum:		Minimum:		6.80	7.80
	Maximum:		Maximum:		Maximum:		8.40	10.50
7. Bankfull Mean Velocity (Vbkf) fps	Mean:	6.7	Mean:	6.7	Mean:	5.86	4.55	4.80
	Minimum:	6.1	Minimum:	6.0	Minimum:	5.27		4.10
	Maximum:	7.2	Maximum:	7.3	Maximum:	6.98		5.20
8. Bankfull Discharge (Qbkf) cfs	Mean:	117.3	Mean:	126.4	Mean:	107.4	35	45
	Minimum:	105.4	Minimum:	112.5	Minimum:	96.7		38.00
	Maximum:	126.0	Maximum:	136.5	Maximum:	128.1		46.00
9. Maximum Bankfull Depth (dmax) ft	Mean:	2.4	Mean:	1.9	Mean:	2.4	1.30	1.28
	Minimum:		Minimum:		Minimum:		1.20	1.00
	Maximum:		Maximum:		Maximum:		1.30	1.70
10. Ratio of Low Bank Height to Maximum Bankfull Depth (lbh/dmax)	Mean:	4.9	Mean:	1.0	Mean:	1.2	1.00	1.00
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
11. Width of Flood Prone Area (Wfpa) ft	Mean:	22.0	Mean:	50.0	Mean:	100.0	25.00	90.00
	Minimum:		Minimum:		Minimum:		19.00	
	Maximum:		Maximum:		Maximum:		36.00	
12. Entrenchment Ratio (Wfpa/Wbkf)	Mean:	1.5	Mean:	3.3	Mean:	8.9	3.80	7.65
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
13. Meander Length (Lm) ft	Mean:	103.0	Mean:	67.7	Mean:	79.0	50.2	71.0
	Minimum:	62.0	Minimum:	49.7	Minimum:	29.0	26.0	33.0
	Maximum:	156.9	Maximum:	93.2	Maximum:	155.0	69.0	144.0
14. Ratio of Meander Length to Bankfull Width (Lm/Wbkf)	Mean:	7.0	Mean:	4.5	Mean:	7.0	5.28	6.03
	Minimum:	4.2	Minimum:	3.3	Minimum:	2.6	2.92	2.80
	Maximum:	10.6	Maximum:	6.2	Maximum:	13.8	5.70	12.24
15. Radius of Curvature (Rc) ft	Mean:	42.1	Mean:	40.2	Mean:	36.8	9.70	18.00
	Minimum:	11.0	Minimum:	22.6	Minimum:	25.5	5.00	11.10
	Maximum:	81.9	Maximum:	58.5	Maximum:	48.0	22.00	38.00
16. Ratio of Radius of Curvature to Bankfull Width (Rc/Wbkf)	Mean:	2.9	Mean:	2.7	Mean:	3.3	1.02	1.53
	Minimum:	0.7	Minimum:	1.5	Minimum:	2.3	0.56	0.94
	Maximum:	5.6	Maximum:	3.9	Maximum:	4.3	1.82	3.23
17. Belt Width (Wblt) ft	Mean:	30.6	Mean:	36.57	Mean:	41.0	33	71
	Minimum:	15.6	Minimum:	26.00	Minimum:	28.3	26	30
	Maximum:	67.7	Maximum:	47.30	Maximum:	53.7	40	119
18. Meander Width Ratio (Wblt/Wbkf)	Mean:	2.1	Mean:	2.4	Mean:	3.6	3.47	6.03
	Minimum:	1.1	Minimum:	1.7	Minimum:	2.5		2.55
	Maximum:	4.6	Maximum:	3.2	Maximum:	4.8		10.11
21. Sinuosity (Stream length/valley distance) (K)	Mean:	1.14	Mean:	1.20	Mean:	1.15	1.39	2.22
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
22. Valley Slope (ft/ft)	Mean:	0.0125	Mean:	0.0125	Mean:	0.0077	0.0076	0.0300
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
23. Average Water Surface Slope for Reach (Savg)	Mean:	0.0110	Mean:	0.0102	Mean:	0.0067	0.0057	0.0130
	Minimum:		Minimum:		Minimum:			
	Maximum:		Maximum:		Maximum:			
24. Pool Slope (Spool) ft/ft	Mean:	0.0071	Mean:	0.0010	Mean:	0.0000	0.0005	0.0011
	Minimum:	0.0004	Minimum:	0.0000	Minimum:	0.0000		0.0000
	Maximum:	0.0174	Maximum:	0.0021	Maximum:	0.0000		0.0030
25. Ratio of Pool Slope to Average Slope (Spool/Savg)	Mean:	0.650	Mean:	0.1	Mean:	0.000	0.08	0.08
	Minimum:	0.038	Minimum:	0.0	Minimum:	0.000		0.00
	Maximum:	1.584	Maximum:	0.2	Maximum:	0.000		0.23
26. Maximum Pool Depth (dpool) ft	Mean:	3.1	Mean:	3.3	Mean:	3.2	2.90	2.40
	Minimum:		Minimum:		Minimum:		2.40	1.80
	Maximum:		Maximum:		Maximum:		2.90	2.90
27. Ratio of Maximum Pool Depth to Bankfull Mean Depth (dpool/dbkf)	Mean:	2.6	Mean:	2.6	Mean:	2.0	3.63	3.00
	Minimum:	0.0	Minimum:		Minimum:	0.0		2.25
	Maximum:	0.0	Maximum:		Maximum:	0.0		3.63

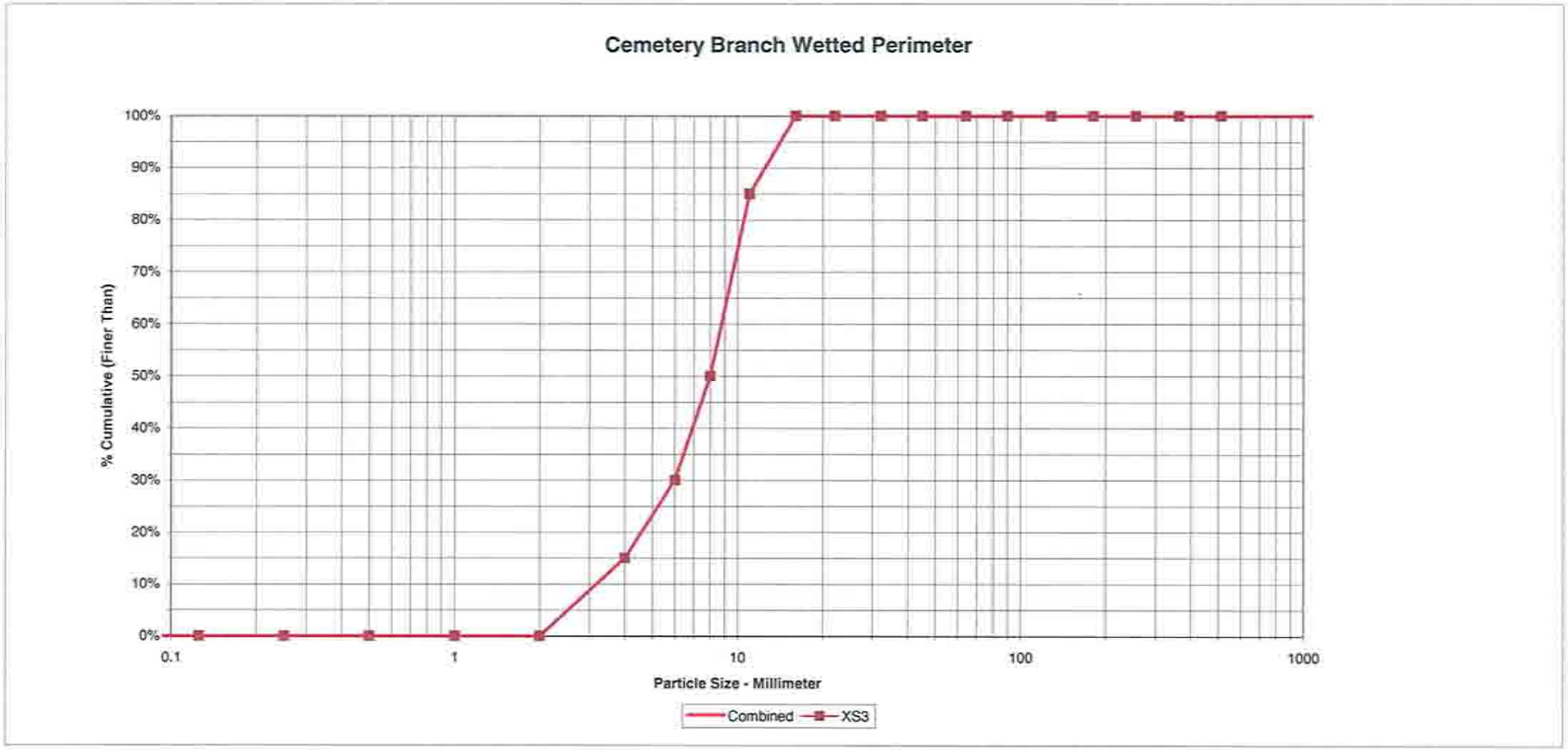
TABLE 1

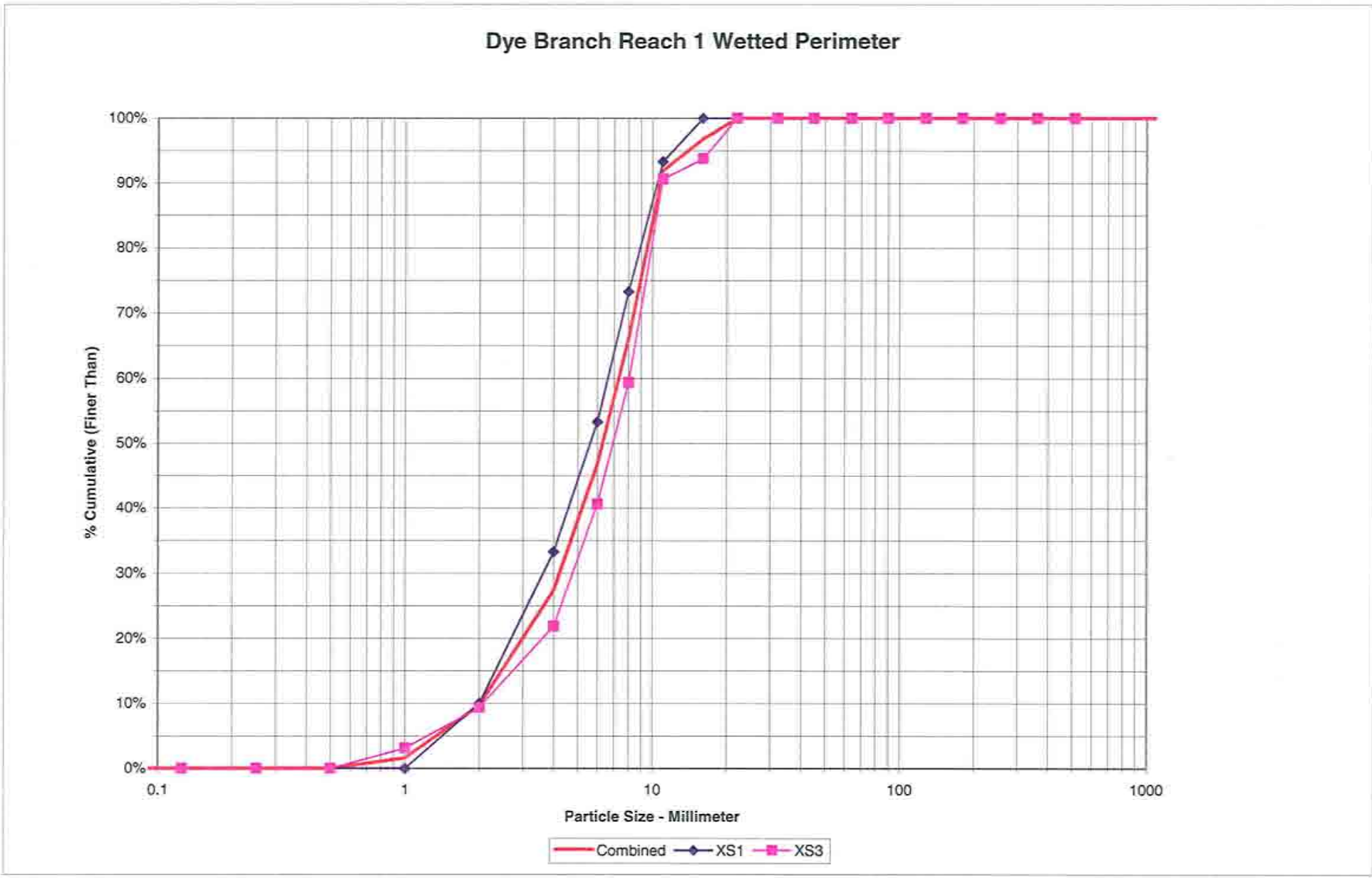
MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA (Adapted from Rosgen, 1996)

Restoration Site: Dye Branch Reach 3
USGS Gage Station:
Reference Reach: Derita Branch, UT to Lake Jeanette, UT to SW Prong Beaverdam
Surveyors: Mulkey
Date: 5/27/2005
Weather:

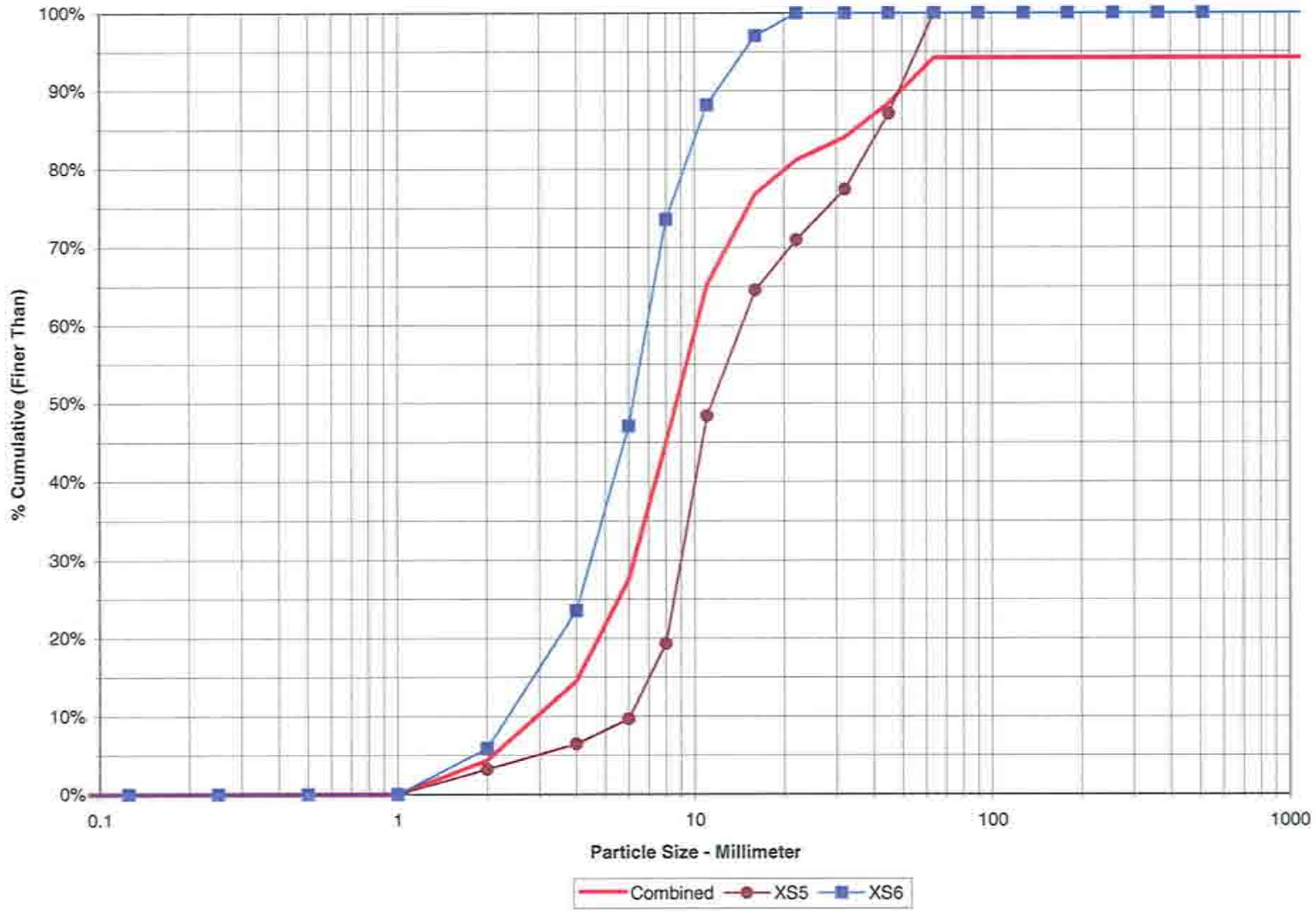
Variables		Existing Channel		Proposed Reach		Reference Reach Derita Branch	Reference Reach UT to Lake Jeanette	Reference Reach UT SW Prong Bvdm
28. Pool Width (Wpool) ft	Mean:	14.3	Mean:	24.0	Mean:	15.6	20.70	9.90
	Minimum:		Minimum:		Minimum:		8.00	9.10
	Maximum:		Maximum:		Maximum:		10.70	10.50
29. Ratio of Pool Width to Bankfull Width (Wpool/Wbkf)	Mean:	1.0	Mean:	1.6	Mean:	1.4	2.18	0.84
	Minimum:	0.0	Minimum:		Minimum:	0.0		0.77
	Maximum:	0.0	Maximum:		Maximum:	0.0		0.89
30. Bankfull Cross-sectional Area at Pool (Apool) sq ft	Mean:	20.8	Mean:	29.0	Mean:	29.8	10.75	13.50
	Minimum:		Minimum:		Minimum:		9.90	11.40
	Maximum:		Maximum:		Maximum:		11.60	16.00
31. Ratio of Pool Area to Bankfull Area (Apool/Abkf)	Mean:	1.2	Mean:	1.5	Mean:	1.6	1.40	1.44
	Minimum:	0.0	Minimum:		Minimum:			
	Maximum:	0.0	Maximum:		Maximum:			
32. Pool to Pool Spacing (p-p) ft	Mean:	162	Mean:	51	Mean:	141	40	37
	Minimum:	79	Minimum:	42	Minimum:		21	18
	Maximum:	261	Maximum:	59	Maximum:		55	58
33. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/Wbkf)	Mean:	11.0	Mean:	3.4	Mean:	12.5	4.2	3.1
	Minimum:	5.4	Minimum:	2.8	Minimum:	0.0	2.2	1.5
	Maximum:	17.7	Maximum:	3.9	Maximum:	0.0	5.8	4.9
34. Pool Length (Lp) ft	Mean:	24.8	Mean:	38.0	Mean:	24.0	N/A	10.5
	Minimum:	2.9	Minimum:	25.4	Minimum:	15.1		3.5
	Maximum:	120.1	Maximum:	50.7	Maximum:	32.8		30.0
35. Ratio of Pool Length to Bankfull Width (Lp/Wbkf)	Mean:	1.7	Mean:	2.5	Mean:	2.1	N/A	0.9
	Minimum:	0.2	Minimum:	1.7	Minimum:	1.3		0.3
	Maximum:	8.1	Maximum:	3.4	Maximum:	2.9		2.5
36. Riffle Slope (Sriff) ft/ft	Mean:	0.0207	Mean:	0.0260	Mean:	0.0160	N/A	0.04
	Minimum:	0.0031	Minimum:		Minimum:	0.0064		0.022
	Maximum:	0.1214	Maximum:		Maximum:	0.0290		0.05
37. Ratio of Riffle Slope to Average Slope (Sriff/Savg)	Mean:	1.9	Mean:	2.6	Mean:	2.4	N/A	2.7
	Minimum:	0.3	Minimum:		Minimum:	1.0		1.7
	Maximum:	11.0	Maximum:		Maximum:	4.3		4.0
38. Maximum Riffle Depth (driff) ft	Mean:	2.4	Mean:	1.9	Mean:	2.40	1.20	1.30
	Minimum:		Minimum:		Minimum:		1.2	1
	Maximum:		Maximum:		Maximum:		1.30	1.70
39. Ratio of Maximum Riffle Depth to Bankfull Mean Depth (driff/dbkf)	Mean:	2.0	Mean:	1.5	Mean:	1.5	1.5	1.6
	Minimum:	0.0	Minimum:		Minimum:	0.0	1.7	1.3
	Maximum:	0.0	Maximum:		Maximum:	0.0	1.6	2.1
40. Run Slope (Srun) ft/ft	Mean:	0.0081	Mean:	0.0090	Mean:	0.0071	N/A	0.01
	Minimum:	0.0010	Minimum:	0.0030	Minimum:	0.0018		0.003
	Maximum:	0.0384	Maximum:	0.0150	Maximum:	0.0114		0.02
41. Ratio of Run Slope to Average Slope (Srun/Savg)	Mean:	0.7	Mean:	0.9	Mean:	1.1	N/A	0.7
	Minimum:	0.1	Minimum:	0.3	Minimum:	0.3		0.2
	Maximum:	3.5	Maximum:	1.5	Maximum:	1.7		1.3
42. Maximum Run Depth (drun) ft	Mean:	2.6	Mean:	2.0	Mean:	2.7	N/A	1.60
	Minimum:		Minimum:		Minimum:			1.4
	Maximum:		Maximum:		Maximum:			1.70
43. Ratio of Run Depth to Bankfull Mean Depth (drun/dbkf)	Mean:	2.2	Mean:	1.6	Mean:	1.7	N/A	2.0
	Minimum:	0.0	Minimum:		Minimum:			1.8
	Maximum:	0.0	Maximum:		Maximum:			2.1
44. Slope of Glide (Sglide) ft/ft	Mean:	0.0053	Mean:	0.0030	Mean:	0.0065	N/A	0.00
	Minimum:	0.0000	Minimum:	0.0000	Minimum:	0.0006		0
	Maximum:	0.0148	Maximum:	0.0060	Maximum:	0.0124		0.01
45. Ratio of Glide Slope to Average Water Slope (Sglide/Savg)	Mean:	0.5	Mean:	0.3	Mean:	1.0	N/A	0.1
	Minimum:	0.0	Minimum:	0.0	Minimum:	0.1		0.0
	Maximum:	1.3	Maximum:	0.6	Maximum:	1.8		0.4
46. Maximum Glide Depth (dglide) ft	Mean:	2.4	Mean:	1.9	Mean:	2.4	N/A	1.55
	Minimum:		Minimum:		Minimum:			1.3
	Maximum:		Maximum:		Maximum:			1.80
47. Ratio of Glide Depth to Bankfull Mean Depth (dglide/dbkf)	Mean:	2.0	Mean:	1.5	Mean:	1.5	N/A	1.9
	Minimum:	0.0	Minimum:		Minimum:			1.6
	Maximum:	0.0	Maximum:		Maximum:			2.3

Materials:	Existing		Proposed		Reference Reach		Reference Reach	Reference Reach
Particle Size Distribution of Channel Material								
D16	0.15		0.15		0.38		N/A	0.042
D35	0.28		0.28		0.7		N/A	0.3
D50	0.56		0.56		6		N/A	1.0
D84	10.7		10.7		10.7		N/A	17.0
D95	12.99		12.99		11.2		N/A	42.0
Particle Size Distribution of Bar Material	Pavement	Subpavement	Pavement	Subpavement	Pavement	Subpavement	Pavement	Pavement
D16	0.43	<0.1	0.43	<0.1	7.8	<0.1	0.8	0.2
D35	1.3	0.1 - 2	1.3	0.1 - 2	10	<0.1	1.7	1.9
D50	2.6	2.8	2.6	2.8	10.3	3	2.4	6.0
D84	9.3	7.8	9.3	7.8	10.9	11.3	6.9	22.0
D95	10.7	10.6	10.7	10.6	11.2	11.9	9.5	37.0
Largest Size Particle on Bar		45.7		45.7				45.0

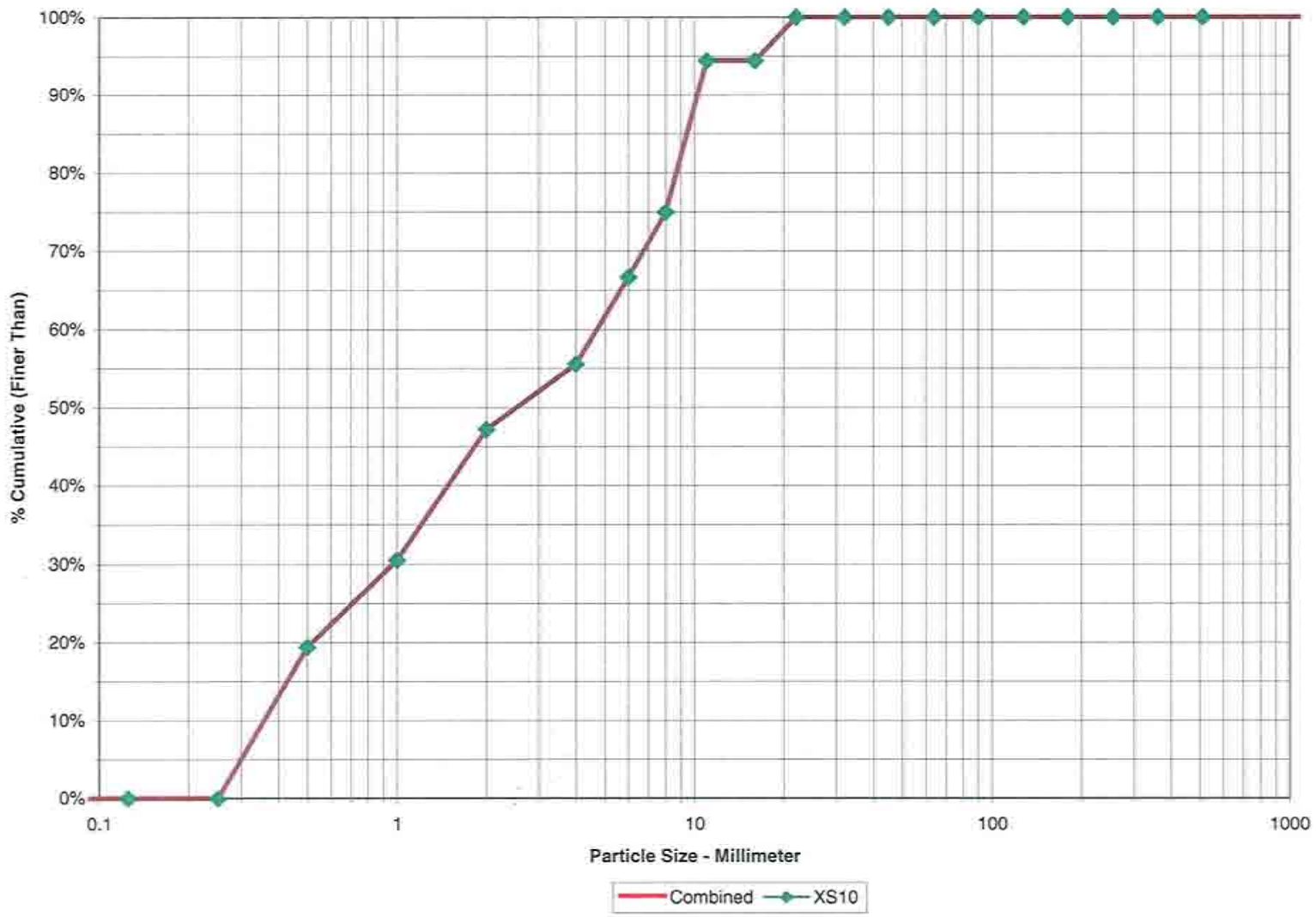

Cemetery Branch Wetted Perimeter
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% Cumulative (Finer Than)
0.1
1
10
100
1000
Particle Size - Millimeter
Combined
XS3


Dye Branch Reach 1 Wetted Perimeter
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% Cumulative (Finer Than)
0.1
1
10
100
1000
Particle Size - Millimeter
Combined
XS1
XS3

Dye Branch Reach 2 Particle Wetted Perimeter



Dye Branch Reach 3 Wetted Perimeter



Stream: Cemetery Branch **Reach/Station:** Reach 1 **Cross Section:** #3 **Date:** 6/1/2005 **Crew:** LT

Erodibility Variable/Value			Index	Bank Erosion Potential
Bank Height/Bankfull Height				
Bank Height (ft) A	Bankfull Height (ft) B	A/B	4.6	Moderate
4.0	3.0	1.3		
Root Depth/Bank Height				
Root Depth (%) C	C/A		10.0	Extreme
0.15	0.04			
Weighted Root Density				
Root Density (%) D	D*(C/A)		10.0	Extreme
0.6	0.02			
Bank Angle				
Bank Angle (degrees)			6.8	High
85.0				
Surface Protection				
Surface Protection (%)			1.9	Very Low
80.0				
Materials:			10.0	
Stratification:			8.0	
TOTAL SCORE:			51.3	Extreme

Erodibility Variable		Bank Erosion Potential					
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height/ Bankfull Height	Value	1.0 - 1.1	1.11 - 1.19	1.2 - 1.5	1.6 - 2.0	2.1 - 2.8	>2.8
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Root Depth/ Bank Height	Value	1.0 - 0.9	0.89 - 0.5	0.49 - 0.3	0.29 - 0.15	0.14 - 0.05	<0.05
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Weighted Root Density	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 5.0	<5.0
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Bank Angle	Value	0 - 20	21 - 60	61 - 80	81 - 90	91 - 119	>119
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Surface Protection	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 10	<10
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)
Boulders (Banks composed of boulders have low bank erosion potential)
Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
Gravel (Add 5-10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points if sand is exposed to erosional processes)
Silt/Clay (+ 0: no adjustment)

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Total Score

Very Low	*Low*	*Moderate*	*High*	*Very High*	*Extreme*
5 - 9.5	10 - 19.5	20 - 29.5	30 - 39.5	40 - 45	46 - 50

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY

Reach Location: **Cemetery Branch**

Date: **6/23/2005** Observers: **LT**

		CATEGORY	EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

		CATEGORY	GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constructions. Raw banks may be up to 12".	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

		CATEGORY	FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. Frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident.	12
	9	Deposition	Moderate deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, i.e. 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moderate change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constructions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

		CATEGORY	POOR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 60%+	8
	2	Mass Wasting	Frequent or large, causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moderate to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density. Fewer species and less vigor indicate poor, discontinuous and shallow root mass.	9
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Frequent obstructions cause erosion year-long. Sediment traps full, channel migration occurring.	8
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predominately fin particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predominately bright, 65%+ exposed or scoured surfaces.	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom is a state of flux or change nearly year-long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

Stream Type: E4

Reach Condition Table for _E4__ Stream Type	
GOOD	
FAIR	
POOR	x

Sum of Totals for Excellent, Good, Fair, and Poor Ratings: 117

Reach Condition:

Remarks:

Stream: Dye Branch **Reach/Station:** Reach 1 **Cross Section:** **Date:** 3/14/05 **Crew:** LT, MA

Erodibility Variable/Value			Index	Bank Erosion Potential
Bank Height/Bankfull Height				
Bank Height (ft) A	Bankfull Height (ft) B	A/B	4.6	Moderate
4.0	3.0	1.3		
Root Depth/Bank Height				
Root Depth (%) C	C/A		10.0	Extreme
0.15	0.04			
Weighted Root Density				
Root Density (%) D	D*(C/A)		10.0	Extreme
0.75	0.03			
Bank Angle				
Bank Angle (degrees)			6.8	High
85.0				
Surface Protection				
Surface Protection (%)			1.9	Very Low
80.0				
Materials:			10.0	
Stratification:			8.0	
TOTAL SCORE:			51.4	Extreme

Erodibility Variable		Bank Erosion Potential					
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height/ Bankfull Height	Value	1.0 - 1.1	1.11 - 1.19	1.2 - 1.5	1.6 - 2.0	2.1 - 2.8	>2.8
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Root Depth/ Bank Height	Value	1.0 - 0.9	0.89 - 0.5	0.49 - 0.3	0.29 - 0.15	0.14 - 0.05	<0.05
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Weighted Root Density	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 5.0	<5.0
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Bank Angle	Value	0 - 20	21 - 60	61 - 80	81 - 90	91 - 119	>119
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Surface Protection	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 10	<10
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)
Boulders (Banks composed of boulders have low bank erosion potential)
Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
Gravel (Add 5-10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points if sand is exposed to erosional processes)
Silt/Clay (+ 0: no adjustment)

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Total Score

Very Low	*Low*	*Moderate*	*High*	*Very High*	*Extreme*
5 - 9.5	10 - 19.5	20 - 29.5	30 - 39.5	40 - 45	46 - 50

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY

Reach Location: Dye Branch Reach 1

Date: 3/14/2005 Observers: LT & MA

CATEGORY		EXCELLENT	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient <30%	2
	2 Mass Wasting	No evidence of past or future mass wasting.	3
	3 Debris Jam Potential	Essentially absent from immediate channel area.	2
	4 Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5 Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6 Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7 Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8 Cutting	Little or none. Infreq. raw banks less than 6".	4
	9 Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10 Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11 Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12 Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13 Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14 Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15 Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
		TOTAL	

CATEGORY		GOOD	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient 30-40%	4
	2 Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3 Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4 Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5 Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6 Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7 Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8 Cutting	Some, intermittently at outcurves and constructions. Raw banks may be up to 12".	6
	9 Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10 Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11 Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12 Consolidation of Particles	Moderately packed with some overlapping.	4
	13 Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14 Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15 Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
		TOTAL	

CATEGORY		FAIR	
UPPER BANKS	1 Landform Slope	Bank slope gradient 40-60%	6
	2 Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3 Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4 Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5 Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6 Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7 Obstructions to Flow	Moder. Frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8 Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident.	12
	9 Deposition	Moderate deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10 Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11 Brightness	Mixture dull and bright, i.e. 35-65% mixture range.	3
	12 Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13 Bottom Size Distribution	Moderate change in sizes. Stable materials 20-50%	12
	14 Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constructions, and bends. Some filling of pools.	18
	15 Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
		TOTAL	

CATEGORY		POOR	
UPPER BANKS	1 Landform Slope	Bank slope gradient 60%+	8
	2 Mass Wasting	Frequent or large, causing sediment nearly year long or imminent danger of same.	12
	3 Debris Jam Potential	Moderate to heavy amounts, predom. larger sizes.	8
	4 Vegetative Bank Protection	<50% density. Fewer species and less vigor indicate poor, discontinuous and shallow root mass.	9
LOWER BANKS	5 Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6 Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7 Obstructions to Flow	Frequent obstructions cause erosion year-long. Sediment traps full, channel migration occurring.	8
	8 Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9 Deposition	Extensive deposits of predominately fin particles. Accelerated bar development.	16
BOTTOM	10 Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11 Brightness	Predominately bright, 65%+ exposed or scoured surfaces.	4
	12 Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13 Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14 Scouring and Deposition	More than 50% of the bottom is a state of flux or change nearly year-long.	24
	15 Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		TOTAL	

Stream Type: _____

Reach Condition Table for ___ Stream Type
GOOD
FAIR
POOR

Sum of Totals for Excellent, Good, Fair, and Poor Ratings: 114

Reach Condition:

Remarks:

Stream: Dye Branch **Reach/Station:** Reach 2 **Cross Section:** **Date:** 3/14/05 **Crew:** LT,MA

Erodibility Variable/Value			Index	Bank Erosion Potential
Bank Height/Bankfull Height				
Bank Height (ft) A	Bankfull Height (ft) B	A/B	4.6	Low
4.0	3.0	1.3		
Root Depth/Bank Height				
Root Depth (%) C	C/A		10.0	Extreme
0.05	0.01			
Weighted Root Density				
Root Density (%) D	D*(C/A)		10.0	Extreme
0.6	0.01			
Bank Angle				
Bank Angle (degrees)			5.9	Moderate
80.0				
Surface Protection				
Surface Protection (%)			9.0	Very High
10.0				
Materials:			10.0	
Stratification:			8.0	
TOTAL SCORE:			57.5	Extreme

Erodibility Variable		Bank Erosion Potential					
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height/ Bankfull Height	Value	1.0 - 1.1	1.11 - 1.19	1.2 - 1.5	1.6 - 2.0	2.1 - 2.8	>2.8
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Root Depth/ Bank Height	Value	1.0 - 0.9	0.89 - 0.5	0.49 - 0.3	0.29 - 0.15	0.14 - 0.05	<0.05
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Weighted Root Density	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 5.0	<5.0
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Bank Angle	Value	0 - 20	21 - 60	61 - 80	81 - 90	91 - 119	>119
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Surface Protection	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 10	<10
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)
Boulders (Banks composed of boulders have low bank erosion potential)
Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
Gravel (Add 5-10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points if sand is exposed to erosional processes)
Silt/Clay (+ 0: no adjustment)

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Total Score

Very Low	*Low*	*Moderate*	*High*	*Very High*	*Extreme*
5 - 9.5	10 - 19.5	20 - 29.5	30 - 39.5	40 - 45	46 - 50

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY

Reach Location: **Dye Branch Reach 2**

Date: **3/14/2005** Observers: **LT, MA**

	CATEGORY	EXCELLENT	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient <30%	2
	2 Mass Wasting	No evidence of past or future mass wasting.	3
	3 Debris Jam Potential	Essentially absent from immediate channel area.	2
	4 Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5 Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6 Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7 Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8 Cutting	Little or none. Infreq. raw banks less than 6".	4
	9 Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10 Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11 Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12 Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13 Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14 Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15 Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
		TOTAL	

	CATEGORY	GOOD	
UPPER BANKS	1 Landform Slope	Bank Slope Gradient 30-40%	4
	2 Mass Wasting	Infrequent. Mostly healed over. Low future potential.	6
	3 Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4 Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5 Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6 Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7 Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8 Cutting	Some, intermittently at outcurves and constructions. Raw banks may be up to 12".	6
	9 Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10 Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11 Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12 Consolidation of Particles	Moderately packed with some overlapping.	4
	13 Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14 Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15 Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
		TOTAL	

	CATEGORY	FAIR	
UPPER BANKS	1 Landform Slope	Bank slope gradient 40-60%	6
	2 Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3 Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4 Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5 Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6 Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7 Obstructions to Flow	Moder. Frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8 Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident.	12
	9 Deposition	Moderate deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10 Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11 Brightness	Mixture dull and bright, i.e. 35-65% mixture range.	3
	12 Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13 Bottom Size Distribution	Moderate change in sizes. Stable materials 20-50%	12
	14 Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constructions, and bends. Some filling of pools.	18
	15 Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
		TOTAL	

	CATEGORY	POOR	
UPPER BANKS	1 Landform Slope	Bank slope gradient 60%+	8
	2 Mass Wasting	Frequent or large, causing sediment nearly year long or imminent danger of same.	12
	3 Debris Jam Potential	Moderate to heavy amounts, predom. larger sizes.	8
	4 Vegetative Bank Protection	<50% density. Fewer species and less vigor indicate poor, discontinuous and shallow root mass,	12
LOWER BANKS	5 Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6 Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7 Obstructions to Flow	Frequent obstructions cause erosion year-long. Sediment traps full, channel migration occurring.	8
	8 Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9 Deposition	Extensive deposits of predominately fin particles. Accelerated bar development.	16
BOTTOM	10 Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11 Brightness	Predominately bright, 65%+ exposed or scoured surfaces.	4
	12 Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13 Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14 Scouring and Deposition	More than 50% of the bottom is a state of flux or change nearly year-long.	24
	15 Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
		TOTAL	

Stream Type: _____

Reach Condition Table for ___ Stream Type
GOOD
FAIR
POOR

Sum of Totals for Excellent, Good, Fair, and Poor Ratings: 125

Reach Condition:

Remarks:

Stream: Dye Branch **Reach/Station:** Reach 3 **Cross Section:** **Date:** 3/14/05 **Crew:** LT, MA

Erodibility Variable/Value			Index	Bank Erosion Potential
Bank Height/Bankfull Height				
Bank Height (ft) A	Bankfull Height (ft) B	A/B	5.3	Moderate
7.0	5.0	1.4		
Root Depth/Bank Height				
Root Depth (%) C	C/A		10.0	Extreme
0.25	0.04			
Weighted Root Density				
Root Density (%) D	D*(C/A)		10.0	Extreme
0.3	0.01			
Bank Angle				
Bank Angle (degrees)			5.9	Moderate
80.0				
Surface Protection				
Surface Protection (%)			6.5	High
25.0				
Materials:			10.0	
Stratification:			9.0	
TOTAL SCORE:			56.7	Extreme

Erodibility Variable		Bank Erosion Potential					
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height/ Bankfull Height	Value	1.0 - 1.1	1.11 - 1.19	1.2 - 1.5	1.6 - 2.0	2.1 - 2.8	>2.8
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Root Depth/ Bank Height	Value	1.0 - 0.9	0.89 - 0.5	0.49 - 0.3	0.29 - 0.15	0.14 - 0.05	<0.05
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Weighted Root Density	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 5.0	<5.0
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Bank Angle	Value	0 - 20	21 - 60	61 - 80	81 - 90	91 - 119	>119
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10
Surface Protection	Value	100 - 80	79 - 55	54 - 30	29 - 15	14 - 10	<10
	Index	1.0 - 1.9	2.0 - 3.9	4.0 - 5.9	6.0 - 7.9	8.0 - 9.0	10

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)
Boulders (Banks composed of boulders have low bank erosion potential)
Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
Gravel (Add 5-10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points if sand is exposed to erosional processes)
Silt/Clay (+ 0: no adjustment)

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Total Score

Very Low	*Low*	*Moderate*	*High*	*Very High*	*Extreme*
5 - 9.5	10 - 19.5	20 - 29.5	30 - 39.5	40 - 45	46 - 50

CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY

Reach Location: **Dye Branch Reach 3**

Date: **3/14/2005** Observers: **LT, MA**

		CATEGORY	EXCELLENT	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient <30%	2
	2	Mass Wasting	No evidence of past or future mass wasting.	3
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass.	3
LOWER BANKS	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1
	6	Bank Rock Content	65%+ with large angular boulders. 12"+ common.	2
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed.	2
	8	Cutting	Little or none. Infreq. raw banks less than 6".	4
	9	Deposition	Little or no enlargement of channel or pt. bars.	4
BOTTOM	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1
	11	Brightness	Surfaces dull, dark or stained. Gen. not bright.	1
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2
	13	Bottom Size Distribution	No size change evident. Stable mater. 80-100%	4
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6
	15	Aquatic Vegetation	Abundant Growth moss-like, dark green perennial. In swift water too.	1
			TOTAL	

		CATEGORY	GOOD	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient 30-40%	4
	2	Mass Wasting	Infrequent. Mostly healed over. Low future potential	6
	3	Debris Jam Potential	Present, but mostly small twigs and limbs.	4
	4	Vegetative Bank Protection	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6
LOWER BANKS	5	Channel Capacity	Adequate. Bank overflows rare. W/D ratio 8-15	2
	6	Bank Rock Content	40-65%. Mostly small boulders to cobbles 6-12"	4
	7	Obstructions to Flow	Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm.	4
	8	Cutting	Some, intermittently at outcurves and constructions. Raw banks may be up to 12".	6
	9	Deposition	Some new bar increase, mostly from coarse gravel.	8
BOTTOM	10	Rock Angularity	Rounded corners and edges, surfaces smooth, flat.	2
	11	Brightness	Mostly dull, but may have <35% bright surfaces.	2
	12	Consolidation of Particles	Moderately packed with some overlapping.	4
	13	Bottom Size Distribution	Distribution shift light. Stable material 50-80%.	8
	14	Scouring and Deposition	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12
	15	Aquatic Vegetation	Common. Algae forms in low velocity and pool areas. Moss here too.	2
			TOTAL	

		CATEGORY	FAIR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 40-60%	6
	2	Mass Wasting	Frequent or large, causing sediment nearly year long.	9
	3	Debris Jam Potential	Moderate to heavy amounts, mostly larger sizes.	6
	4	Vegetative Bank Protection	<50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9
LOWER BANKS	5	Channel Capacity	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	3
	6	Bank Rock Content	20-40% with most in the 3-6" diameter class.	6
	7	Obstructions to Flow	Moder. Frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6
	8	Cutting	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident.	12
	9	Deposition	Moderate deposition of new gravel and course sand on old and some new bars.	12
BOTTOM	10	Rock Angularity	Corners and edges well rounded in two dimensions.	3
	11	Brightness	Mixture dull and bright, i.e. 35-65% mixture range.	3
	12	Consolidation of Particles	Mostly loose assortment with no apparent overlap.	6
	13	Bottom Size Distribution	Moderate change in sizes. Stable materials 20-50%	12
	14	Scouring and Deposition	30-50% affected. Deposits & scour at obstructions, constructions, and bends. Some filling of pools.	18
	15	Aquatic Vegetation	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3
			TOTAL	

		CATEGORY	POOR	
UPPER BANKS	1	Landform Slope	Bank slope gradient 60%+	8
	2	Mass Wasting	Frequent or large, causing sediment nearly year long or imminent danger of same.	12
	3	Debris Jam Potential	Moderate to heavy amounts, predom. larger sizes.	8
	4	Vegetative Bank Protection	<50% density. Fewer species and less vigor indicate poor, discontinuous and shallow root mass,	12
LOWER BANKS	5	Channel Capacity	Inadequate. Overbank flows common. W/D ratio >25	4
	6	Bank Rock Content	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Frequent obstructions cause erosion year-long. Sediment traps full, channel migration occurring.	8
	8	Cutting	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Extensive deposits of predominately fin particles. Accelerated bar development.	16
BOTTOM	10	Rock Angularity	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Predominately bright, 65%+ exposed or scoured surfaces	4
	12	Consolidation of Particles	No packing evident. Loose assortment easily moved.	8
	13	Bottom Size Distribution	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	More than 50% of the bottom is a state of flux or change nearly year-long.	24
	15	Aquatic Vegetation	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4
			TOTAL	

Stream Type: _____

Reach Condition Table for ___ Stream Type
GOOD
FAIR
POOR

Sum of Totals for Excellent, Good, Fair, and Poor Ratings: 125

Reach Condition:

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	Dye Branch	Date:	4/26/2005
Applicant/Owner:	Ecosystem Enhancement Program	County:	Iredell
Investigator(s):	Layna Thrush	State:	NC
Do Normal Circumstances exist on the site?	Yes [X] No [ ]	Community ID:	*Wetland*
Is the site significantly disturbed (Atypical Situation)?	Yes [ ] No [X]	Transect ID:	*WA*
Is this area a potential Problem Area?	Yes [ ] No [X]	Plot ID:	*WA2*
(If needed, explain on reverse)			

VEGETATION

	Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
1.	*Festuca spp.*	*herb*	*FACU*	9.			
2.	*Juncus effusus*	*herb*	*FACW+*	10.			
3.	*Lonicera japonica*	*herb*	*FAC-*	11.			
4.	*Sambucus canadensis*	*shrub*	*FACW-*	12.			
5.	*Salix nigra*	*tree*	*OBL*	13.			
6.				14.			
7.				15.			
8.				16.			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-). *60%*

Remarks: *Very little mature trees. Mostly dominated by herb layer.*

HYDROLOGY

[ ] Recorded Data (Describe in Remarks)
- [ ] Stream, Lake, or tide Gauge
- [ ] Aerial Photographs
- [ ] Other

[X] No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: 3 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- [ ] Inundated
- [x] Saturated in Upper 12 Inches
- [ ] Water Marks
- [ ] Drift Lines
- [ ] Sediment Deposits
- [x] Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- [x] Oxidized Root Channels in Upper 12 Inches
- [ ] Water-Stained Leaves
- [ ] Local Soil Survey Data
- [ ] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): *Colfax sandy loam*

Drainage Class: Field Observations: *Somewhat Poorly Drained*

Taxonomy (Subgroup): *Fine-loamy, mixed, subactive, thermic Aquic Fragiudults*

Confirm Mapped Type? Yes [ ] No [x]

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0 to 3	*A*	*10YR 4/3*	*7.5YR 4/6*	*common/distinct*	*silt loam*
3 to 8	*B*	*2.5YR 4/6*	*7.5YR 4/1*	*many/prominent*	*loam*
8 to 12+	*Bt*	*7.5YR 4/1*	*2.5YR 4/6*	*many/prominent*	*loam*

Hydric Soil Indicators:

- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Aquic Moisture Regime
- [ ] Reducing Conditions
- [x] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic Content in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [x] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? [x] Yes [ ] No

Wetland Hydrology Present? [x] Yes [ ] No

Hydric Soils Present? [x] Yes [ ] No

Is this Sampling Point Within a Wetland? [x] Yes [ ] No

Remarks: *Sampling point was approximatley 8 ft. downslope from WA2.*

The EDR Radius Map
with GeoCheck®

Dye Branch
Glenwood Memorial Park
MOORESVILLE, NC 28115

Inquiry Number: 01415917.1r

May 06, 2005

EDR™ Environmental Data Resources Inc

The Standard in Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06460

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

FORM-ERN

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The report meets the government records search requirements of ASTM Standard Practice for Environmental Site Assessments, E 1527-00. Search distances are per ASTM standard or custom distances requested by the user.

TARGET PROPERTY INFORMATION

ADDRESS

GLENWOOD MEMORIAL PARK
MOORESVILLE, NC 28115

COORDINATES

Latitude (North):	35.576200 - 35° 34' 34.3"
Longitude (West):	80.812500 - 80° 48' 45.0"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	516989.3
UTM Y (Meters):	3936761.5
Elevation:	834 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property:	35080-E7 MOORESVILLE, NC
Source:	USGS 7.5 min quad index

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the ASTM E 1527-00 search radius around the target property for the following databases:

FEDERAL ASTM STANDARD

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP	CERCLIS No Further Remedial Action Planned
CORRACTS	Corrective Action Report
RCRA-TSDF	Resource Conservation and Recovery Act Information
RCRA-LQG	Resource Conservation and Recovery Act Information
RCRA-SQG	Resource Conservation and Recovery Act Information
ERNS	Emergency Response Notification System

STATE ASTM STANDARD

SHWS	Inactive Hazardous Sites Inventory

EXECUTIVE SUMMARY

SWF/LF	List of Solid Waste Facilities
UST	Petroleum Underground Storage Tank Database
OLI	Old Landfill Inventory
VCP	Responsible Party Voluntary Action Sites
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land

FEDERAL ASTM SUPPLEMENTAL

CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
Delisted NPL	National Priority List Deletions
FINDS	Facility Index System/Facility Identification Initiative Program Summary Report
HMIRS	Hazardous Materials Information Reporting System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
NPL Liens	Federal Superfund Liens
PADS	PCB Activity Database System
US ENG CONTROLS	Engineering Controls Sites List
ODI	Open Dump Inventory
UMTRA	Uranium Mill Tailings Sites
FUDS	Formerly Used Defense Sites
INDIAN RESERV	Indian Reservations
DOD	Department of Defense Sites
RAATS	RCRA Administrative Action Tracking System
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
SSTS	Section 7 Tracking Systems
FTTS INSP	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

STATE OR LOCAL ASTM SUPPLEMENTAL

NC HSDS	Hazardous Substance Disposal Site
AST	AST Database
DRYCLEANERS	Drycleaning Sites

EDR PROPRIETARY HISTORICAL DATABASES

Coal Gas	Former Manufactured Gas (Coal Gas) Sites

BROWNFIELDS DATABASES

US BROWNFIELDS	A Listing of Brownfields Sites
US INST CONTROL	Sites with Institutional Controls
Brownfields	Brownfields Projects Inventory
INST CONTROL	No Further Action Sites With Land Use Restrictions Monitoring
VCP	Responsible Party Voluntary Action Sites

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified.

EXECUTIVE SUMMARY

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STATE ASTM STANDARD

LUST: The Leaking Underground Storage Tank Incidents Management Database contains an inventory of reported leaking underground storage tank incidents. The data come from the Department of Environment, & Natural Resources' Incidents by Address.

A review of the LUST list, as provided by EDR, and dated 03/04/2005 has revealed that there are 7 LUST sites within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
MOORESVILLE TOWN LIBRARY	***121 EAST CATAWBA AVE***	***1/4 - 1/2 NW***	***1***	***6***
BURLINGTON MILLS	***476 SOUTH MAIN STREET***	***1/4 - 1/2 WNW***	***A3***	***9***
BILLS EXXON(MOORESVILLE QUICKL	***204 S. MAIN ST, MOORESV***	***1/4 - 1/2 NNW***	***4***	***11***
GLASPY'S AUTO SERVICE	***152 SOUTH MAIN STREET***	***1/4 - 1/2 N***	***B5***	***13***
SHEPHERD'S	***126 EAST CENTER AVENUE***	***1/4 - 1/2 N***	***6***	***18***
MOORESVILLE AMOCO SERVICE	***151 S BROAD ST***	***1/4 - 1/2 N***	***B7***	***25***
J.T. ALEXANDER	***HWY 115 N***	***1/4 - 1/2 NNW***	***9***	***34***

STATE OR LOCAL ASTM SUPPLEMENTAL

LUST TRUST: This database contains information about claims against the State Trust Funds for reimbursements for expenses incurred while remediating Leaking USTs.

A review of the LUST TRUST list, as provided by EDR, and dated 03/11/2005 has revealed that there is 1 LUST TRUST site within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
CARPET DEPOT	239 WEST CENTER STREET	1/4 - 1/2 N	10	36

IMD: Incident Management Database.

A review of the IMD list, as provided by EDR, and dated 06/15/2004 has revealed that there are 9 IMD sites within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
MOORESVILLE TOWN LIBRARY	***121 EAST CATAWBA AVE***	***1/4 - 1/2 NW***	***1***	***6***
BURLINGTON INDUSTRIES	476 SOUTH MAIN STREET	1/4 - 1/2 WNW	A2	8
BURLINGTON MILLS	***476 SOUTH MAIN STREET***	***1/4 - 1/2 WNW***	***A3***	***9***

EXECUTIVE SUMMARY

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
BILLS EXXON(MOORESVILLE QUICKL	*204 S. MAIN ST, MOORESV*	*1/4 - 1/2 NNW*	*4*	*11*
GLASPY'S AUTO SERVICE	*152 SOUTH MAIN STREET*	*1/4 - 1/2 N*	*B5*	*13*
SHEPHERD'S	*126 EAST CENTER AVENUE*	*1/4 - 1/2 N*	*6*	*18*
MOORESVILLE AMOCO SERVICE	*151 S BROAD ST*	*1/4 - 1/2 N*	*B7*	*25*
SERVICE AUTO SUPPLY	101 SOUTH BROAD STREET	1/4 - 1/2 N	8	33
J.T. ALEXANDER	*HWY 115 N*	*1/4 - 1/2 NNW*	*9*	*34*

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
OLD MOORE PLACE	IMD, LUST
IREDELL MILK TRANSPORTATION #2	IMD, LUST
SUPERBA PRINT WORKS	RCRA-SQG, IMD, LUST
COUNTRY CORNER MARINA	IMD, LUST
FRIENDLY FARE GROCERY (CAPPI'S)	LUST
CURT'S KWICK STOP	LUST
RUN IN STORE HWY 21	LUST
CASHION FAMILY FARM, FORMER	IMD, LUST
KEENER - GOODSON PROPERTY	IMD, LUST
CARISBROOK IND.	IMD, LUST
SUPERBA PRINT WORKS	LUST TRUST
WILCO SERVICE STATION HIGHWAY 150	LUST TRUST
PHIFER J JOHNSON BULLDOZING I	UST
M B OVERCASH	UST
REAL CHICKEN INC	UST
COOK'S AUTOMOTIVE	UST
CLYLE II	UST
J.T. SMITH STORE	UST
CATAWBA TIMBER CO. MOORESVILL	UST
GENERAL STORE	UST
SOUTHERN CONV 185-23623	UST
BRAWLEY CONST. CO.	UST
FRIENDLY FARE GROCERY	UST
RUN-IN HIGHWAY 21 (HILLTOP 66	UST
WILLIAM C. WALLER	UST
KEN F. SMITH'S GROCERY	UST
MRS. R.E. BUMGARDNER	UST
SHINN'S STORE	UST
TRADING POST	UST
LARRY HUDSON / TRADING POST	UST
SLOAN C. BROTHERTON	UST
SUPERBA PRINT WORKS	RCRA-SQG, FINDS
PHIL WILL ENTERPRISES	RCRA-SQG, FINDS
MOTORSPORTS FABRICATION	RCRA-SQG, FINDS
BEN HESS MOTOR SPORTS LTD	RCRA-SQG, FINDS
FLAGSHIP AIRLINES MAINT FACILI	IMD
AEROQUIP CORP	IMD
E.F. BELK & SONS	IMD
MELCHOR PROPERTY	IMD
PARKER HANNIFIN #2	IMD
PARKER HANNIFIN	IMD
FRIENDLY FARE GROCERY (NO FILE	IMD
MOORESVILLE DUMP	OLI

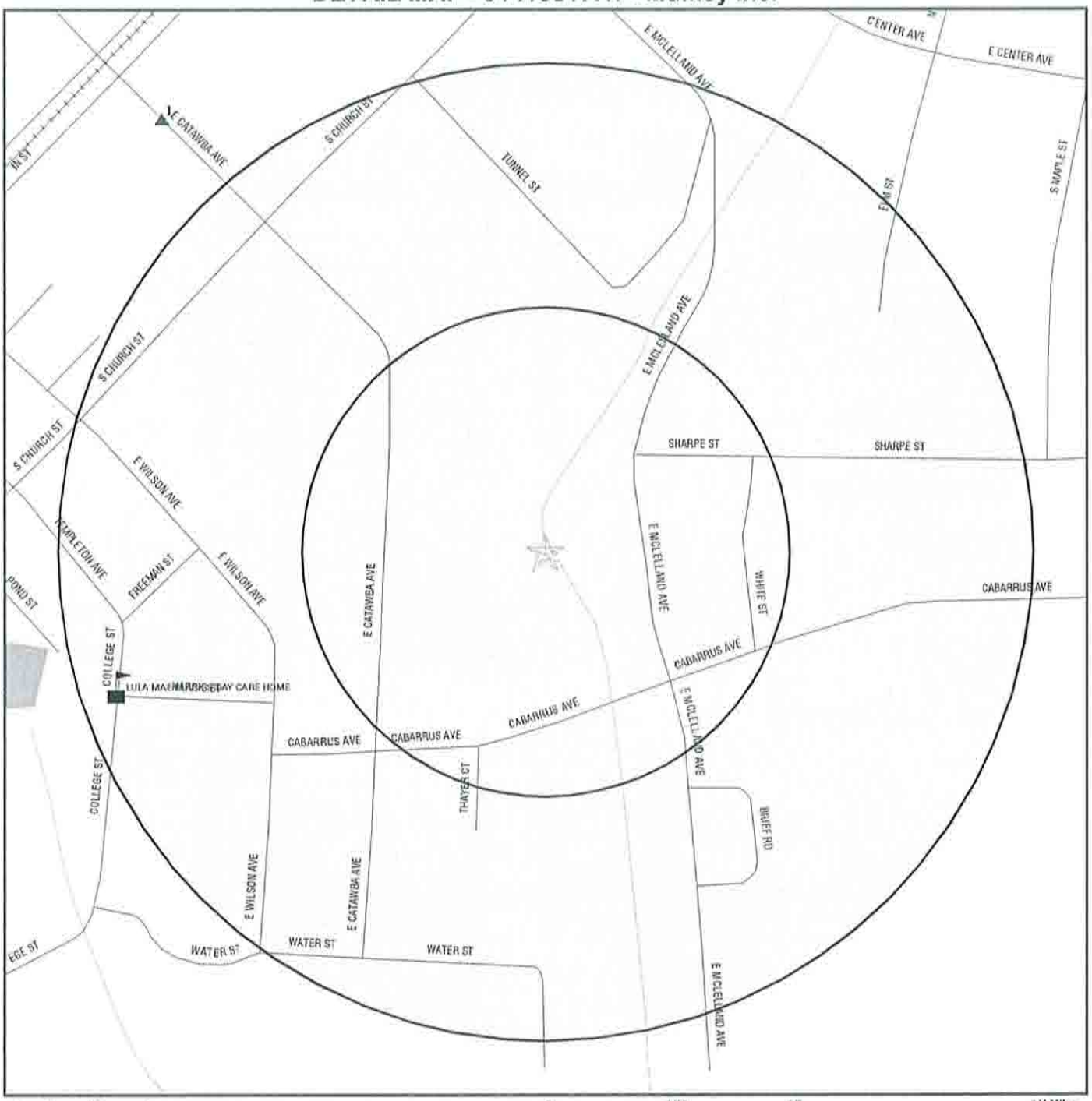
OVERVIEW MAP - 01415917.1r - Mulkey Inc.

0 1/4 1/2 1 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Coal Gasification Sites
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- Federal Wetlands
- Hazardous Substance Disposal Sites

TARGET PROPERTY:	Dye Branch	CUSTOMER:	Mulkey Inc.
ADDRESS:	Glenwood Memorial Park	CONTACT:	Layna Thrush
CITY/STATE/ZIP:	MOORESVILLE NC 28115	INQUIRY #:	01415917.1r
LAT/LONG:	35.5762 / 80.8125	DATE:	May 06, 2005 1:29 pm

DETAIL MAP - 01415917.1r - Mulkey Inc.



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Coal Gasification Sites
- Sensitive Receptors
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- Federal Wetlands
- Hazardous Substance Disposal Sites

TARGET PROPERTY:	Dye Branch	CUSTOMER:	Mulkey Inc.
ADDRESS:	Glenwood Memorial Park	CONTACT:	Layna Thrush
CITY/STATE/ZIP:	MOORESVILLE NC 28115	INQUIRY #:	01415917.1r
LAT/LONG:	35.5762 / 80.8125	DATE:	May 06, 2005 1:29 pm

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL ASTM STANDARD								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.250	0	0	NR	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRA TSD		0.500	0	0	0	NR	NR	0
RCRA Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRA Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
STATE ASTM STANDARD								
State Haz. Waste		1.000	0	0	0	0	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	7	NR	NR	7
UST		0.250	0	0	NR	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
FEDERAL ASTM SUPPLEMENTAL								
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
NPL Liens		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
FUDS		1.000	0	0	0	0	NR	0
INDIAN RESERV		1.000	0	0	0	0	NR	0
DOD		1.000	0	0	0	0	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
STATE OR LOCAL ASTM SUPPLEMENTAL								
NC HSDS		1.000	0	0	0	0	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
AST		TP	NR	NR	NR	NR	NR	0
LUST TRUST		0.500	0	0	1	NR	NR	1
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
IMD		0.500	0	0	9	NR	NR	9
EDR PROPRIETARY HISTORICAL DATABASES								
Coal Gas		1.000	0	0	0	0	NR	0
BROWNFIELDS DATABASES								
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
Brownfields		0.500	0	0	0	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0

NOTES:

AQUIFLOW - see EDR Physical Setting Source Addendum

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

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1 **MOORESVILLE TOWN LIBRARY** **IMD S105764931**
NW **121 EAST CATAWBA AVE** **LUST N/A**
1/4-1/2 **MOORESVILLE, NC 28115**
1565 ft.

Relative:
Higher

Actual:
911 ft.

LUST:

Incident Number:	27382	Date Occurred:	1/9/2003
5 Min Quad:	Not reported	Lat/Long:	353446 / 804857
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	Not reported	GPS Confirmed:	No
UST Number:	MO-6647	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	1/9/2003

Responsible Party:

Company:	TOWN OF MOORESVILLE
Contact Person:	ERSKINE SMITH
Address:	413 N MAIN STREET
City/Stat/Zip:	MOORESVILLE, NC 28115
County:	Not reported

Comm / Non-comm UST Site:	Non commercial
Tank Regulated Status:	Non Regulated
Regional Officer Project Mgr:	ARL
Risk Classification:	L
Risk Classification Based On Review:	L
Corrective Action Plan Type:	Not reported
Level Of Soil Cleanup Achieved:	soil to GW levels
Closure Request Date:	Not reported
Close Out:	5/22/2003
Contamination Type:	SL
NORR Issued Date:	Not reported

NOV Issued Date:	Not reported	Phase Of LSA Req:	Not reported
Site Risk Reason:	Not reported	Land Use:	Residential
MTBE:	0	# Of Supply Wells:	0
Telephone:	7046633800	Flag:	0
Error Flag:	0	LUR Filed:	Not reported
Error Code:	Not reported	LUR Filed:	Not reported
Valid:	No	Total Tanks:	1
MTBE1:	Unknown	Flag1:	No
Cleanup:	1/9/2003	Current Status:	File Located in House
RBCA GW:	Not reported	PETOPT:	4
CD Num:	0	Reel Num:	0
RPOW:	Yes	RPOP:	No
RPL:	Yes		
Type:	Not reported		
Ownership:	Private	Location:	Residence
Owner/Operator:	Not reported	Operation Type:	Residential
Site Priority:	Not reported	Priority Update:	Not reported
Wells Affected:	No	Wells Affected #:	Not reported
Samples Taken:	Yes	Samples Include:	S
5minquad:	Not reported	Error Type:	Not reported

Incident Description: SOIL CONTAMINATION WAS DISCOVERED ADJACENT TO A HOME HEATING OIL UST.

Last Modified:	5/22/2003		
Incident Phase:	Closed Out		
NOV Issued:	Not reported	NORR Issued:	Not reported
45 Day Report:	Not reported	SOC Sighned:	Not reported
Close-out Report:	Not reported	RS Designation:	Not reported

MOORESVILLE TOWN LIBRARY (Continued) **S105764931**

Public Meeting Held: Not reported
Corrective Action Planned: Not reported
Reclassification Report: Not reported
Closure Request Date: Not reported
Comments: Not reported

IMD:
Incident Number: 27382
Region: MOR
Date Occurred: 01/09/03
Submit Date: 01/09/03
GW Contam: No
Soil Contam: Yes
Operator: ERSKINE SMITH
413 N MAIN STREET
MOORESVILLE, NC 28115
Contact Phone: 7046633800
Priority Code: Not reported
Priority Update: / /
Site Priority: Not reported
Dem Contact: ARL
Wells Affected: No
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: Not reported
Incident Desc: SOIL CONTAMINATION WAS DISCOVERED ADJACENT TO A HOME HEATING OIL UST.
Ownership: Private
Operation: Residential
Material: Not reported
Qty Lost: Not reported
Qty Recovered: Not reported
Source: Leak-underground
Type: Gasoline/diesel
Location: Residence
Setting: Not reported
Wells Contam: Not reported
Sampled By: Y
Samples Include: S
Owner Company: TOWN OF MOORESVILLE
Lat/Long: 353446 / 804857
Risk Site L
Lat/Long Decimal: 35.57944 / 80.81583
Lat/Long Number 353446 / 804857
GPS: EST
Incident Phase: Closed Out
NOV Issued: / /
45 Day Report: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: / /
Closure Request Date: / /

Agency : Not reported
Last Modified 05/22/03
SOC Sighned: / /
RS Designation: / /

A2
WNW
1/4-1/2
1839 ft.

Relative:
Higher

Actual:
923 ft.

BURLINGTON INDUSTRIES
476 SOUTH MAIN STREET
MOORESVILLE, NC

IMD **S105425771**
N/A

Site 1 of 2 in cluster A

IMD:

Incident Number:	86089
Region:	MOR
Date Occurred:	11/13/01
Submit Date:	02/01/02
GW Contam:	Yes
Soil Contam:	Not reported
Operator:	, 702 OBERLIN ROAD, SUITE 150 RALEIGH
Contact Phone:	Not reported
Priority Code:	E
Priority Update:	/ /
Site Priority:	0
Dem Contact:	DWM
Wells Affected:	No
Num Affected:	0
Sampled By:	Samples Include:
7.5 Min Quad:	Not reported
5 Min Quad:	Not reported
Incident Desc:	MINOR SOLVENT CONTAMINATION. ALSO MINOR PCBS. WORKING THROUGH BROWNFIELDS PROGRAM.
Ownership:	Not Reported
Operation:	Not Reported
Material:	Not reported
Qty Lost:	Not reported
Qty Recovered:	Not reported
Source:	Unknown
Type:	Other inorganics
Location:	Not reported
Setting:	Not reported
Wells Contam:	Not reported
Sampled By:	Not reported
Samples Include:	Not reported
Owner Company:	CHEROKEE INVESTMENT PARTNERS
Lat/Long:	Not reported
Risk Site	Not reported
Lat/Long Decimal:	0 / 0
Lat/Long Number	0 / 0
GPS:	NOD
Incident Phase:	NOD
NOV Issued:	/ /
45 Day Report:	/ /
Public Meeting Held:	/ /
Corrective Action Planned:	/ /
Reclassification Report:	/ /
Close-out Report:	/ /
Closure Request Date:	/ /

Agency :	DWQ
Last Modified	02/01/02
SOC Sighned:	/ /
RS Designation:	/ /

A3 **BURLINGTON MILLS** IMD S105764533
WNW **476 SOUTH MAIN STREET** LUST N/A
1/4-1/2 **MOORESVILLE, NC**
1839 ft.

Site 2 of 2 in cluster A

Relative:
Higher

Actual:
923 ft.

LUST:

Incident Number:	8171	Date Occurred:	Not reported
5 Min Quad:	Not reported	Lat/Long:	Not reported
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	Not reported	GPS Confirmed:	Not reported
UST Number:	MO-3239	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	6/9/1989

Responsible Party:

Company:	BURLINGTON INDUSTRIES
Contact Person:	Not reported
Address:	PO BOX 540
City/Stat/Zip:	MOORESVILLE, NC 28115
County:	IREDELL

Comm / Non-comm UST Site:	Commercial		
Tank Regulated Status:	Regulated		
Regional Officer Project Mgr:	ARL		
Risk Classification:	L		
Risk Classification Based On Review:	L		
Corrective Action Plan Type:	Not reported		
Level Of Soil Cleanup Achieved:	soil to GW levels		
Closure Request Date:	3/26/2002		
Close Out:	3/28/2002		
Contamination Type:	GW		
NORR Issued Date:	Not reported		
NOV Issued Date:	Not reported	Phase Of LSA Req:	1
Site Risk Reason:	Not reported	Land Use:	Industrial/commercial
MTBE:	Not reported	# Of Supply Wells:	0
Telephone:	Not reported	Flag:	0
Error Flag:	0	LUR Filed:	Not reported
Error Code:	Not reported	LUR Filed:	Not reported
Valid:	No	Total Tanks:	1
MTBE1:	No	Flag1:	No
Cleanup:	6/9/1989	Current Status:	File Located in Archives
RBCA GW:	Not reported	PETOPT:	3
CD Num:	115	Reel Num:	0
RPOW:	No	RPOP:	No
RPL:	No		
Type:	Pirf		
Ownership:	Private	Location:	Facility
Owner/Operator:	Not reported	Operation Type:	Industrial
Site Priority:	E	Priority Update:	2/15/1998
Wells Affected:	Not reported	Wells Affected #:	0
Samples Taken:	Not reported	Samples Include:	Not reported
5minquad:	Not reported	Error Type:	Not reported

Incident Description: SOIL SAMPLES TAKEN AT SITE DETECTED CONTAMINATION.

Last Modified:	4/2/2002		
Incident Phase:	Closed Out		
NOV Issued:	Not reported	NORR Issued:	Not reported
45 Day Report:	Not reported	SOC Sighned:	Not reported
Close-out Report:	3/28/2002	RS Designation:	Not reported
Public Meeting Held:	Not reported		
Corrective Action Planned:	Not reported		
Reclassification Report:	Not reported		

BURLINGTON MILLS (Continued) **S105764533**

Closure Request Date: Not reported
Comments: Not reported

IMD:
Incident Number: 8171
Region: MOR
Date Occurred: / /
Submit Date: 06/11/92
GW Contam: Yes
Soil Contam: No
Operator: Not reported
PO BOX 540
MOORESVILLE, NC 28115
IREDE County
Contact Phone: Not reported
Priority Code: E
Priority Update: 02/15/98
Site Priority: E
Dem Contact: ARL
Wells Affected: Not reported
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: Not reported
Incident Desc: SOIL SAMPLES TAKEN AT SITE DETECTED CONTAMINATION.
Ownership: Private
Operation: Industrial
Material: GASOLINE
Qty Lost: Not reported
Qty Recovered: UNK
Source: Leak-underground
Type: Gasoline/diesel
Location: Facility
Setting: Urban
Wells Contam: Not reported
Sampled By: Not reported
Samples Include: Not reported
Owner Company: BURLINGTON INDUSTRIES
Lat/Long: Not reported
Risk Site L
Lat/Long Decimal: 0 / 0
Lat/Long Number 0 / 0
GPS: NOD
Agency : DWM
Incident Phase: Closed Out
Last Modified 04/02/02
NOV Issued: / /
45 Day Report: / /
SOC Sighned: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: 03/28/02
RS Designation: / /
Closure Request Date: / /

4
NNW
1/4-1/2
2086 ft.

BILLS EXXON(MOORESVILLE QUICKL — **IMD** **S102868669**
204 S. MAIN ST, MOORESVILLE — **LUST** **N/A**
MOORESVILLE, NC

Relative:
Higher

Actual:
919 ft.

LUST:

Incident Number:	18099	Date Occurred:	2/1/1994
5 Min Quad:	N65e	Lat/Long:	35 / 80
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	0-002016	GPS Confirmed:	Not reported
UST Number:	MO-5240	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	8/11/1997

Responsible Party:

Company:	MOORESVILLE OIL COMPANY
Contact Person:	BOBBY GRAHAM
Address:	P.O. BOX 28
City/Stat/Zip:	MOORESVILLE, NC 28115
County:	IREDELL

Comm / Non-comm UST Site:	Commercial		
Tank Regulated Status:	Regulated		
Regional Officer Project Mgr:	KWC		
Risk Classification:	L		
Risk Classification Based On Review:	L		
Corrective Action Plan Type:	Not reported		
Level Of Soil Cleanup Achieved:	Not reported		
Closure Request Date:	Not reported		
Close Out:	Not reported		
Contamination Type:	GW		
NORR Issued Date:	Not reported		
NOV Issued Date:	Not reported	Phase Of LSA Req:	Not reported
Site Risk Reason:	Not reported	Land Use:	Not reported
MTBE:	Not reported	# Of Supply Wells:	0
Telephone:	Not reported	Flag:	0
Error Flag:	0	LUR Filed:	Not reported
Error Code:	Not reported	LUR Filed:	Not reported
Valid:	No	Total Tanks:	1
MTBE1:	Unknown	Flag1:	No
Cleanup:	2/1/1994	Current Status:	File Located in House
RBCA GW:	Not reported	PETOPT:	Not reported
CD Num:	0	Reel Num:	0
RPOW:	No	RPOP:	No
RPL:	No		
Type:	Pirf		
Ownership:	Private	Location:	Facility
Owner/Operator:	BOBBY GRAHAM	Operation Type:	Commercial
Site Priority:	E	Priority Update:	5/30/1998
Wells Affected:	Not reported	Wells Affected #:	0
Samples Taken:	3	Samples Include:	1
5minquad:	Not reported	Error Type:	Not reported
Incident Description:	GW CONTAM. FOUND AS PART OF CLOSURE OF 3 USTS.		
Last Modified:	Not reported		
Incident Phase:	RE		
NOV Issued:	Not reported	NORR Issued:	Not reported
45 Day Report:	Not reported	SOC Sighned:	Not reported
Close-out Report:	Not reported	RS Designation:	Not reported
Public Meeting Held:	Not reported		
Corrective Action Planned:	Not reported		
Reclassification Report:	Not reported		
Closure Request Date:	Not reported		

BILLS EXXON(MOORESVILLE QUICKL (Continued) **S102868669**

Comments: Not reported

IMD:
Incident Number: 18099
Region: MOR
Date Occurred: 02/01/94
Submit Date: 12/22/97
GW Contam: Yes
Soil Contam: No
Operator: BOBBY GRAHAM
P.O. BOX 28
MOORESVILLE, NC 28115
IREDE County
Contact Phone: Not reported
Priority Code: L
Priority Update: 05/30/98
Site Priority: E
Dem Contact: KWC
Wells Affected: Not reported
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: N65E
Incident Desc: GW CONTAM. FOUND AS PART OF CLOSURE OF 3 USTS.
Ownership: Private
Operation: Commercial
Material: GASOLINE
Qty Lost: Not reported
Qty Recovered: Not reported
Source: Leak-underground
Type: Gasoline/diesel
Location: Facility
Setting: Urban
Wells Contam: Not reported
Sampled By: Responsible Parties
Samples Include: Groundwater Samples
Owner Company: MOORESVILLE OIL COMPANY
Lat/Long: 35 / 80
Risk Site L
Lat/Long Decimal: 35.57278 / 80.82417
Lat/Long Number 353422 / 804927
GPS: NOD
Incident Phase: RE
NOV Issued: / /
45 Day Report: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: / /
Closure Request Date: / /

Agency : DWM
Last Modified / /
SOC Sighned: / /
RS Designation: / /

B5 **GLASPY'S AUTO SERVICE** **IMD** **U003698170**
North **152 SOUTH MAIN STREET** **LUST** **N/A**
1/4-1/2 **MOORESVILLE, NC 28115** **UST**
2195 ft.

Site 1 of 2 in cluster B

Relative:
Higher

Actual:
926 ft.

LUST:

Incident Number:	19930	Date Occurred:	12/1/1998
5 Min Quad:	N65D	Lat/Long:	353453 / 804853
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	0-035894	GPS Confirmed:	Not reported
UST Number:	MO-5641	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	1/4/1999
Responsible Party:			
Company:	TEXACO		
Contact Person:	JUDSON POLIKOFF		
Address:	1111 BAGBY STREET		
City/Stat/Zip:	HOUSTON, TX 77002		
County:	HARRIS		
Comm / Non-comm UST Site:	Commercial		
Tank Regulated Status:	Regulated		
Regional Officer Project Mgr:	CBC		
Risk Classification:	L		
Risk Classification Based On Review:	I		
Corrective Action Plan Type:	Not reported		
Level Of Soil Cleanup Achieved:	Not reported		
Closure Request Date:	Not reported		
Close Out:	Not reported		
Contamination Type:	GW		
NORR Issued Date:	4/14/1999		
NOV Issued Date:	Not reported	Phase Of LSA Req:	1
Site Risk Reason:	Free product	Land Use:	Not reported
MTBE:	Not reported	# Of Supply Wells:	0
Telephone:	713-752-6872	Flag:	0
Error Flag:	0	LUR Filed:	Not reported
Error Code:	Not reported	LUR Filed:	Not reported
Valid:	No	Total Tanks:	1
MTBE1:	Yes	Flag1:	No
Cleanup:	12/1/1998	Current Status:	File Located in House
RBCA GW:	Not reported	PETOPT:	3
CD Num:	0	Reel Num:	0
RPOW:	Yes	RPOP:	No
RPL:	No		
Type:	PIRF		
Ownership:	Private	Location:	Facility
Owner/Operator:	JUDSON C. POLIKE	Operation Type:	Commercial
Site Priority:	Not reported	Priority Update:	5/17/1999
Wells Affected:	Not reported	Wells Affected #:	Not reported
Samples Taken:	3	Samples Include:	2
5minquad:	Not reported	Error Type:	Not reported

Incident Description: REMOVED 3 USTS, SOILCONTAM. AT 4,590 PPM.

Last Modified:	Not reported		
Incident Phase:	RE		
NOV Issued:	Not reported	NORR Issued:	Not reported
45 Day Report:	Not reported	SOC Sighned:	Not reported
Close-out Report:	Not reported	RS Designation:	Not reported
Public Meeting Held:	Not reported		
Corrective Action Planned:	Not reported		
Reclassification Report:	Not reported		

GLASPY'S AUTO SERVICE (Continued) **U003698170**

Closure Request Date: Not reported
Comments: Removal of three gasoline USTs on 12/1/98. Closure samples indicate a release. LSA required. Abandonment in place of one 550-gallon waste oil UST in December 1998. Subsequent soil samples completed closure. LSA investigation revealed 2.5+ feet o
f free product in MW-4 and GCL exceedances in MW-3.

IMD:
Incident Number: 19930
Region: MOR
Date Occurred: 12/01/98
Submit Date: 05/17/99
GW Contam: Yes
Soil Contam: No
Operator: JUDSON POLIKOFF
1111 BAGBY STREET
HOUSTON, TX 77002
HARRI County
Contact Phone: 713-752-6872
Priority Code: Not reported
Priority Update: 05/17/99
Site Priority: Not reported
Dem Contact: CBC
Wells Affected: Not reported
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: N65D
Incident Desc: REMOVED 3 USTS, SOILCONTAM. AT 4,590 PPM.
Ownership: Private
Operation: Commercial
Material: GASOLINE
Qty Lost: Not reported
Qty Recovered: Not reported
Source: Leak-underground
Type: Gasoline/diesel
Location: Facility
Setting: Urban
Wells Contam: Not reported
Sampled By: Responsible Parties
Samples Include: Soil Samples
Owner Company: TEXACO
Lat/Long: 353453 / 804853
Risk Site L
Lat/Long Decimal: 35.58139 / 80.81472
Lat/Long Number 353453 / 804853
GPS: NOD
Agency : DWM
Incident Phase: RE
Last Modified / /
NOV Issued: / /
45 Day Report: / /
SOC Sighned: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: / /
RS Designation: / /
Closure Request Date: / /

UST:
Facility ID: 0-035894

GLASPY'S AUTO SERVICE (Continued) **U003698170**

Telephone:	(713) 752-6673
Owner name :	TEXACO
Owner Address:	1111 BAGBY STREET
	HOUSTON, TX 77002
Owner Phone :	(713) 752-6872
Tank capacity :	3000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Unknown
Interior Protection:	Unknown
Exterior Protection:	Unknown
Piping material :	Unknown
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	1
Date installed:	12/31/1975
Date removed:	1/12/1998
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NIU

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	12/31/1975
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58182 / 80.81370
Lat/Long 1 :	35 34 54.5 / 80 48 49.3
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	12/14/1998

Facility ID:	0-035894
Telephone:	(713) 752-6673
Owner name :	TEXACO
Owner Address:	1111 BAGBY STREET

GLASPY'S AUTO SERVICE (Continued) **U003698170**

	HOUSTON, TX 77002
Owner Phone :	(713) 752-6872
Tank capacity :	3000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Unknown
Interior Protection:	Unknown
Exterior Protection:	Unknown
Piping material :	Unknown
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	2
Date installed:	12/31/1975
Date removed:	1/12/1998
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NIU

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	12/31/1975
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58182 / 80.81370
Lat/Long 1 :	35 34 54.5 / 80 48 49.3
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	12/14/1998

Facility ID:	0-035894
Telephone:	(713) 752-6673
Owner name :	TEXACO
Owner Address:	1111 BAGBY STREET
	HOUSTON, TX 77002
Owner Phone :	(713) 752-6872

GLASPY'S AUTO SERVICE (Continued) **U003698170**

Tank capacity :	4000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Unknown
Interior Protection:	Unknown
Exterior Protection:	Unknown
Piping material :	Unknown
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	3
Date installed:	12/31/1975
Date removed:	1/12/1998
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NIU

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	12/31/1975
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58182 / 80.81370
Lat/Long 1 :	35 34 54.5 / 80 48 49.3
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	12/14/1998

Facility ID:	0-035894
Telephone:	(713) 752-6673
Owner name :	TEXACO
Owner Address:	1111 BAGBY STREET
	HOUSTON, TX 77002
Owner Phone :	(713) 752-6872
Tank capacity :	550
Comment :	Not reported
Tank product :	Oil, New/Used/Mixture

GLASPY'S AUTO SERVICE (Continued) **U003698170**

Tank material :	Unknown
Interior Protection:	Unknown
Exterior Protection:	Unknown
Piping material :	Unknown
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	4
Date installed:	12/31/1974
Date removed:	Not reported
Status:	Temporary Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NIU

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	12/21/1998
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58182 / 80.81370
Lat/Long 1 :	35 34 54.5 / 80 48 49.3
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	12/14/1998

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6 **SHEPHERD'S** **IMD** **U001436122**
North **126 EAST CENTER AVENUE** **LUST** **N/A**
1/4-1/2 **MOORESVILLE, NC 28115** **UST**
2217 ft.

Relative:
Higher

Actual:
935 ft.

LUST:

Incident Number:	27225	Date Occurred:	1/5/1993
5 Min Quad:	Not reported	Lat/Long:	Not reported
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	Not reported	GPS Confirmed:	No
UST Number:	MO-2091	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	2/4/1993

Responsible Party:

Company:	Not reported
Contact Person:	Not reported

SHEPHERD'S (Continued) **U001436122**

Address: Not reported
City/Stat/Zip: Not reported
County: Not reported
Comm / Non-comm UST Site: Commercial
Tank Regulated Status: Regulated
Regional Officer Project Mgr: RBK
Risk Classification: Not reported
Risk Classification Based On Review: Not reported
Corrective Action Plan Type: Not reported
Level Of Soil Cleanup Achieved: Not reported
Closure Request Date: Not reported
Close Out: 2/14/1994
Contamination Type: SL
NORR Issued Date: Not reported
NOV Issued Date: Not reported
Site Risk Reason: Not reported
MTBE: Not reported
Telephone: Not reported
Error Flag: 0
Error Code: Not reported
Valid: No
MTBE1: Unknown
Cleanup: 1/5/1993
RBCA GW: Not reported
CD Num: 33
RPOW: No
RPL: No
Type: Not reported
Ownership: P
Owner/Operator: Not reported
Site Priority: Not reported
Wells Affected: No
Samples Taken: Yes
5minquad: Not reported
Phase Of LSA Req: Not reported
Land Use: Not reported
Of Supply Wells: 0
Flag: 0
LUR Filed: Not reported
LUR Filed: Not reported
Total Tanks: 1
Flag1: No
Current Status: File Located in Archives
PETOPT: 3
Reel Num: 0
RPOP: No
Location: Facility
Operation Type: Commercial
Priority Update: Not reported
Wells Affected #: Not reported
Samples Include: Not reported
Error Type: Not reported
Incident Description: 2 PPM ; SITE IS CLOSED; JT ALEXANDER PO 88 MOORESVILLE NC 28115 COMM/REG
Last Modified: 2/14/1994
Incident Phase: Closed Out
NOV Issued: Not reported
45 Day Report: Not reported
Close-out Report: Not reported
NORR Issued: Not reported
SOC Sighned: Not reported
RS Designation: Not reported
Public Meeting Held: Not reported
Corrective Action Planned: Not reported
Reclassification Report: Not reported
Closure Request Date: Not reported
Comments: Not reported

IMD:
Incident Number: 27225
Region: MOR
Date Occurred: 01/05/93
Submit Date: 02/04/93
GW Contam: No
Soil Contam: Yes
Operator: Not reported
Not reported
Not reported
Contact Phone: Not reported
Priority Code: Not reported

SHEPHERD'S (Continued) **U001436122**

Priority Update: / /
Site Priority: Not reported
Dem Contact: RBK
Wells Affected: No
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: Not reported
Incident Desc: 2 PPM ; SITE IS CLOSED; JT ALEXANDER PO 88 MOORESVILLE NC 28115 COMM/REG
Ownership: P
Operation: Commercial
Material: GASOLINE
Qty Lost: UNKNOWN
Qty Recovered: NONE
Source: Leak-underground
Type: Gasoline/diesel
Location: Facility
Setting: Not reported
Wells Contam: Not reported
Sampled By: Y
Samples Include: Not reported
Owner Company: Not reported
Lat/Long: Not reported
Risk Site Not reported
Lat/Long Decimal: 0 / 0
Lat/Long Number 0 / 0
GPS: EST
Agency : DWM
Incident Phase: Closed Out
Last Modified 02/14/94
NOV Issued: / /
45 Day Report: / /
SOC Sighned: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: / /
RS Designation: / /
Closure Request Date: / /

UST:
Facility ID: 0-010721
Telephone: (704) 664-1566
Owner name : J.T. ALEXANDER & SON INC
Owner Address: P.O. BOX 88 / STATESVILLE HWY.
MOORESVILLE, NC 28115
Owner Phone : (704) 664-1566
Tank capacity : 4000
Comment : Not reported
Tank product : Gasoline, Gasoline Mixture
Tank material : Steel
Interior Protection: None
Exterior Protection: Paint
Piping material : Steel
Certify Type : Not reported
Leak Detection Type : Not reported
Leak Detection Type 2: Not reported
Leak Detection Piping 1: Not reported
Corrosn Protec Tank: Not reported
Corrosn Protec Pipe: Not reported

SHEPHERD'S (Continued) **U001436122**

Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	1
Date installed:	11/5/1964
Date removed:	12/29/1992
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	1/31/1990
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	.00000 / .00000
Lat/Long 1 :	Not reported
GPS String Confirmed:	No
Initials of Individual Confirming GPS:	Not reported
Tank ID Number:	Not reported
Last Update:	11/3/1989

Facility ID:	0-010721
Telephone:	(704) 664-1566
Owner name :	J.T. ALEXANDER & SON INC
Owner Address:	P.O. BOX 88 / STATESVILLE HWY.
	MOORESVILLE, NC 28115
Owner Phone :	(704) 664-1566
Tank capacity :	4000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03

SHEPHERD'S (Continued) **U001436122**

Tank ID:	2
Date installed:	11/5/1964
Date removed:	12/29/1992
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON
Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	1/31/1990
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	.00000 / .00000
Lat/Long 1 :	Not reported
GPS String Confirmed:	No
Initials of Individual Confirming GPS:	Not reported
Tank ID Number:	Not reported
Last Update:	11/3/1989

Facility ID:	0-010721
Telephone:	(704) 664-1566
Owner name :	J.T. ALEXANDER & SON INC
Owner Address:	P.O. BOX 88 / STATESVILLE HWY.
	MOORESVILLE, NC 28115
Owner Phone :	(704) 664-1566
Tank capacity :	3000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	3
Date Installed:	11/5/1964
Date removed:	12/29/1992

SHEPHERD'S (Continued) **U001436122**

Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON
Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	1/31/1990
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	.00000 / .00000
Lat/Long 1 :	Not reported
GPS String Confirmed:	No
Initials of Individual Confirming GPS:	Not reported
Tank ID Number:	Not reported
Last Update:	11/3/1989

Facility ID:	0-010721
Telephone:	(704) 664-1566
Owner name :	J.T. ALEXANDER & SON INC
Owner Address:	P.O. BOX 88 / STATESVILLE HWY.
	MOORESVILLE, NC 28115
Owner Phone :	(704) 664-1566
Tank capacity :	3000
Comment :	Not reported
Tank product :	Kerosene, Kerosene Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	4
Date installed:	11/5/1964
Date removed:	12/29/1992
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No

SHEPHERD'S (Continued) **U001436122**

Product Type:	NON
Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	1/8/1980
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	.00000 / .00000
Lat/Long 1 :	Not reported
GPS String Confirmed:	No
Initials of Individual Confirming GPS:	Not reported
Tank ID Number:	Not reported
Last Update:	11/3/1989

Facility ID:	0-010721
Telephone:	(704) 664-1566
Owner name :	J.T. ALEXANDER & SON INC
Owner Address:	P.O. BOX 88 / STATESVILLE HWY.
	MOORESVILLE, NC 28115
Owner Phone :	(704) 664-1566
Tank capacity :	550
Comment :	Not reported
Tank product :	Kerosene, Kerosene Mixture
Tank material :	Unknown
Interior Protection:	Unknown
Exterior Protection:	Unknown
Piping material :	Unknown
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	5
Date installed:	11/5/1964
Date removed:	12/29/1992
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON
Piping System Type Code:	Not reported
Piping System Type Description:	Not reported

SHEPHERD'S (Continued) **U001436122**

Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	1/31/1990
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	.00000 / .00000
Lat/Long 1 :	Not reported
GPS String Confirmed:	No
Initials of Individual Confirming GPS:	Not reported
Tank ID Number:	Not reported
Last Update:	11/3/1989

B7 **MOORESVILLE AMOCO SERVICE** **IMD** **U001437258**
North **151 S BROAD ST** **LUST** **N/A**
1/4-1/2 **MOORESVILLE, NC 28115** **UST**
2282 ft.

Site 2 of 2 in cluster B

Relative: Higher

Actual: 920 ft.

LUST:

Incident Number:	6722	Date Occurred:	4/9/1990
5 Min Quad:	N65D	Lat/Long:	353457 / 804848
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	0-017464	GPS Confirmed:	Not reported
UST Number:	MO-3079	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	5/9/1990

Responsible Party:

Company:	Not reported
Contact Person:	Michael Peebles
Address:	169 East Plaza Drive
City/Stat/Zip:	Mooresville, NC 28115
County:	IR

Comm / Non-comm UST Site:	Commercial
Tank Regulated Status:	Regulated
Regional Officer Project Mgr:	CBC
Risk Classification:	L
Risk Classification Based On Review:	U
Corrective Action Plan Type:	Not reported
Level Of Soil Cleanup Achieved:	Not reported
Closure Request Date:	Not reported
Close Out:	Not reported
Contamination Type:	SL
NORR Issued Date:	Not reported

NOV Issued Date:	Not reported	Phase Of LSA Req:	1
Site Risk Reason:	Not reported	Land Use:	Not reported
MTBE:	Not reported	# Of Supply Wells:	0
Telephone:	7046642928	Flag:	0
Error Flag:	0	LUR Filed:	Not reported
Error Code:	Not reported	LUR Filed:	Not reported
Valid:	No	Total Tanks:	1

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

MTBE1:	Unknown	Flag1:	No
Cleanup:	5/18/2004	Current Status:	File Located in House
RBCA GW:	Not reported	PETOPT:	3
CD Num:	0	Reel Num:	0
RPOW:	Yes	RPOP:	No
RPL:	No		
Type:	Pirf		
Ownership:	Private	Location:	Facility
Owner/Operator:	MICHAEL PEEBLES	Operation Type:	Commercial
Site Priority:	E	Priority Update:	5/30/1998
Wells Affected:	No	Wells Affected #:	0
Samples Taken:	3	Samples Include:	2
5minquad:	Not reported	Error Type:	Not reported

Incident Description: UPON REMOVAL OF USTS, SOIL SAMPLES CONFIRMED CONTAMINATION.

Last Modified:	Not reported		
Incident Phase:	Follow Up		
NOV Issued:	Not reported	NORR Issued:	Not reported
45 Day Report:	Not reported	SOC Sighned:	Not reported
Close-out Report:	Not reported	RS Designation:	Not reported

Public Meeting Held:	Not reported
Corrective Action Planned:	Not reported
Reclassification Report:	Not reported
Closure Request Date:	Not reported

Comments: ANHR cbc 7/12/2004 - downtown Mooresville. Soil samples collected in 1990 indicated a release from the regulated USTs. Tanks were not properly closed until May 2004. Two 2,000-gallon and two 5,000-gallon gasoline USTs were removed and one 550-gal
lon waste oil tank was closed in place. Closure sampling indicates three source areas - waste oil and three gasoline. No over-excavation was undertaken. LSA required.

IMD:

Incident Number:	6722
Region:	MOR
Date Occurred:	04/09/90
Submit Date:	07/16/91
GW Contam:	No
Soil Contam:	Yes
Operator:	MICHAEL PEEBLES 151 South Broad St. MOORESVILLE, NC 28115 IR County
Contact Phone:	Not reported
Priority Code:	L
Priority Update:	05/30/98
Site Priority:	E
Dem Contact:	FAB
Wells Affected:	No
Num Affected:	0
Sampled By:	Samples Include:
7.5 Min Quad:	Not reported
5 Min Quad:	Not reported
Incident Desc:	UPON REMOVAL OF USTS, SOIL SAMPLES CONFIRMED CONTAMINATION.
Ownership:	Private
Operation:	Commercial
Material:	GASOLINE
Qty Lost:	Not reported
Qty Recovered:	NONE

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

Source: Leak-underground
Type: Gasoline/diesel
Location: Facility
Setting: Rural
Wells Contam: Not reported
Sampled By: Responsible Parties
Samples Include: Soil Samples
Owner Company: MOORESVILLE AMOCO
Lat/Long: 353457 / 804848
Risk Site L
Lat/Long Decimal: 35.58250 / 80.81333
Lat/Long Number 353457 / 804848
GPS: NOD
Incident Phase: RE
NOV Issued: / /
45 Day Report: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: / /
Closure Request Date: / /

Agency : DWM
Last Modified / /
SOC Sighned: / /
RS Designation: / /

UST:
Facility ID: 0-017464
Telephone: (704) 664-2928
Owner name : W D PEEBLES
Owner Address: 151 S BROAD
MOORESVILLE, NC 28115
Owner Phone : (999) 999-9999
Tank capacity : 280
Comment : Not reported
Tank product : Kerosene, Kerosene Mixture
Tank material : Steel
Interior Protection: None
Exterior Protection: Paint
Piping material : Steel
Certify Type : Not reported
Leak Detection Type : Not reported
Leak Detection Type 2: Not reported
Leak Detection Piping 1: Not reported
Corrosn Protec Tank: Not reported
Corrosn Protec Pipe: Not reported
Spill and Overfill : Not reported
Financial Responsiblity : Not reported
Region: 03
Tank ID: 1
Date installed: 3/25/1978
Date removed: Not reported
Status: Currently In Use
Compartment Tank : No
Main Tank : No
Product Type: NON
Piping System Type Code: Not reported
Piping System Type Description: Not reported
Corrosion Protection Tank1: Not reported
Corrosion Protection Tank Date: Not reported
Corrosion Piping: Not reported

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	Not reported
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58229 / 80.81392
Lat/Long 1 :	35 34 56.2 / 80 48 50.1
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	9/16/2004

Facility ID:	0-017464
Telephone:	(704) 664-2928
Owner name :	W D PEEBLES
Owner Address:	151 S BROAD
	MOORESVILLE, NC 28115
Owner Phone :	(999) 999-9999
Tank capacity :	5000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	2
Date installed:	3/25/1978
Date removed:	5/18/2004
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NIU

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	Not reported
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58229 / 80.81392
Lat/Long 1 :	35 34 56.2 / 80 48 50.1
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	9/16/2004

Facility ID:	0-017464
Telephone:	(704) 664-2928
Owner name :	W D PEEBLES
Owner Address:	151 S BROAD
	MOORESVILLE, NC 28115
Owner Phone :	(999) 999-9999
Tank capacity :	5000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	3
Date installed:	3/25/1978
Date removed:	5/18/2004
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

Water Supply Well:	Not reported
Tank Last Used Date:	Not reported
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58229 / 80.81392
Lat/Long 1 :	35 34 56.2 / 80 48 50.1
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	9/16/2004

Facility ID:	0-017464
Telephone:	(704) 664-2928
Owner name :	W D PEEBLES
Owner Address:	151 S BROAD
	MOORESVILLE, NC 28115
Owner Phone :	(999) 999-9999
Tank capacity :	2000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	4
Date installed:	3/25/1978
Date removed:	5/18/2004
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	Not reported
Tank Certified Number:	Not reported

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58229 / 80.81392
Lat/Long 1 :	35 34 56.2 / 80 48 50.1
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	9/16/2004

Facility ID:	0-017464
Telephone:	(704) 664-2928
Owner name :	W D PEEBLES
Owner Address:	151 S BROAD
	MOORESVILLE, NC 28115
Owner Phone :	(999) 999-9999
Tank capacity :	550
Comment :	Not reported
Tank product :	Oil, New/Used/Mixture
Tank material :	Steel
Interior Protection:	None
Exterior Protection:	Paint
Piping material :	Steel
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	5
Date installed:	3/25/1978
Date removed:	5/18/2004
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	Not reported
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported

MOORESVILLE AMOCO SERVICE (Continued) **U001437258**

Lat/Long :	35.58229 / 80.81392
Lat/Long 1 :	35 34 56.2 / 80 48 50.1
GPS String Confirmed:	Yes
Initials of Individual Confirming GPS:	TNB
Tank ID Number:	Not reported
Last Update:	9/16/2004

Facility ID:	0-017464
Telephone:	(704) 664-2928
Owner name :	W D PEEBLES
Owner Address:	151 S BROAD
	MOORESVILLE, NC 28115
Owner Phone :	(999) 999-9999
Tank capacity :	2000
Comment :	Not reported
Tank product :	Gasoline, Gasoline Mixture
Tank material :	9
Interior Protection:	Unknown
Exterior Protection:	Unknown
Piping material :	16
Certify Type :	Not reported
Leak Detection Type :	Not reported
Leak Detection Type 2:	Not reported
Leak Detection Piping 1:	Not reported
Corrosn Protec Tank:	Not reported
Corrosn Protec Pipe:	Not reported
Spill and Overfill :	Not reported
Financial Responsiblity :	Not reported
Region:	03
Tank ID:	6
Date installed:	3/25/1978
Date removed:	5/18/2004
Status:	Permanent Closed
Compartment Tank :	No
Main Tank :	No
Product Type:	NON

Piping System Type Code:	Not reported
Piping System Type Description:	Not reported
Corrosion Protection Tank1:	Not reported
Corrosion Protection Tank Date:	Not reported
Corrosion Piping:	Not reported
Corrosion Protection Piping Date:	Not reported
Overfill:	Not reported
Spill Overfill Date:	Not reported
Financial Responsibility Code:	Not reported
Financial Responsibility Description:	Not reported
Surface Water:	Not reported
Water Supply Well:	Not reported
Tank Last Used Date:	Not reported
Tank Certified Number:	Not reported
Date Last Certified:	Not reported
Begin Certified Number:	Not reported
End Certified Number:	Not reported
Lat/Long :	35.58229 / 80.81392
Lat/Long 1 :	35 34 56.2 / 80 48 50.1
GPS String Confirmed:	Yes

MOORESVILLE AMOCO SERVICE (Continued) U001437258

Initials of Individual Confirming GPS: TNB
Tank ID Number: Not reported
Last Update: 9/16/2004

8
North
1/4-1/2
2416 ft.

Relative:
Higher

Actual:
927 ft.

SERVICE AUTO SUPPLY
101 SOUTH BROAD STREET
MOORESVILLE, NC

IMD **S106349484**
N/A

IMD:
Incident Number: 86921
Region: MOR
Date Occurred: 02/19/04
Submit Date: 02/23/04
GW Contam: NOD
Soil Contam: Not reported
Operator: BROWN, FRED
341 TEETER RD
MOORESVILLE, NC
Contact Phone: Not reported
Priority Code: NOD
Priority Update: / /
Site Priority: Not reported
Dem Contact: ARL
Wells Affected: No
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: Not reported
Incident Desc: LOW LEVELS OF OIL & GREASE TPH DETECTED IN SOIL SAMPLES TAKEN AT FORMER ENGINE PARTS WASHER. OPHSCA NOTICE SENT.
Ownership: Federal
Operation: 8
Material: Not reported
Qty Lost: Not reported
Qty Recovered: Not reported
Source: Spill-surface
Type: Other petroleum product
Location: Not reported
Setting: Not reported
Wells Contam: Not reported
Sampled By: Not reported
Samples Include: Not reported
Owner Company: Not reported
Lat/Long: Not reported
Risk Site Not reported
Lat/Long Decimal: 0 / 0
Lat/Long Number 0 / 0
GPS: NOD
Incident Phase: Discovery
NOV Issued: 02/20/04
45 Day Report: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: / /
Closure Request Date: / /

Agency : DWQ
Last Modified 02/23/04
SOC Sighned: / /
RS Designation: / /

9
NNW
1/4-1/2
2471 ft.

J.T. ALEXANDER
HWY 115 N
MOORESVILLE, NC

IMD **S101643149**
LUST **N/A**

Relative:
Higher

Actual:
930 ft.

LUST:

Incident Number:	13431	Date Occurred:	1/26/1995
5 Min Quad:	M65Q	Lat/Long:	353625 / 804858
Source Type:	Leak-underground	Region:	Mooresville
Facility ID:	0-010713	GPS Confirmed:	No
UST Number:	MO-4274	Testlat:	Not reported
Product Type:	Petroleum	Date Reported:	2/9/1995

Responsible Party:

Company:	J.T. ALEXANDER & SON
Contact Person:	Not reported
Address:	P.O. BOX 88
City/Stat/Zip:	MOORESVILLE, NC 28115
County:	IR

Comm / Non-comm UST Site:	Commercial		
Tank Regulated Status:	Regulated		
Regional Officer Project Mgr:	KWC		
Risk Classification:	H		
Risk Classification Based On Review:	L		
Corrective Action Plan Type:	natural attenuation (not an L-CAP)		
Level Of Soil Cleanup Achieved:	Residential levels		
Closure Request Date:	6/10/1999		
Close Out:	6/10/1999		
Contamination Type:	GW		
NORR Issued Date:	Not reported		
NOV Issued Date:	6/14/1995	Phase Of LSA Req:	Not reported
Site Risk Reason:	Not reported	Land Use:	Not reported
MTBE:	Not reported	# Of Supply Wells:	0
Telephone:	Not reported	Flag:	0
Error Flag:	0	LUR Filed:	Not reported
Error Code:	Not reported	LUR Filed:	Not reported
Valid:	No	Total Tanks:	1
MTBE1:	Unknown	Flag1:	No
Cleanup:	1/26/1995	Current Status:	File Located in Archives
RBCA GW:	Not reported	PETOPT:	3
CD Num:	115	Reel Num:	0
RPOW:	No	RPOP:	No
RPL:	No		
Type:	Pirf		
Ownership:	Private	Location:	Facility
Owner/Operator:	Not reported	Operation Type:	Commercial
Site Priority:	065B	Priority Update:	5/15/1998
Wells Affected:	No	Wells Affected #:	0
Samples Taken:	3	Samples Include:	1
5minquad:	Not reported	Error Type:	Not reported
Incident Description:	Not reported		
Last Modified:	6/22/1999		
Incident Phase:	Closed Out		
NOV Issued:	9/24/1996	NORR Issued:	Not reported
45 Day Report:	Not reported	SOC Sighned:	Not reported
Close-out Report:	6/11/1999	RS Designation:	Not reported
Public Meeting Held:	Not reported		
Corrective Action Planned:	Not reported		
Reclassification Report:	Not reported		
Closure Request Date:	Not reported		

J.T. ALEXANDER (Continued) **S101643149**

Comments: Not reported

IMD:
Incident Number: 13431
Region: MOR
Date Occurred: 01/26/95
Submit Date: 06/14/95
GW Contam: Yes
Soil Contam: No
Operator: Not reported
P.O. BOX 88
MOORESVILLE, NC 28115
IR County
Contact Phone: Not reported
Priority Code: H
Priority Update: 05/15/98
Site Priority: 065B
Dem Contact: KWC
Wells Affected: No
Num Affected: 0
Sampled By: Samples Include:
7.5 Min Quad: Not reported
5 Min Quad: M65Q
Incident Desc: Not reported
Ownership: Private
Operation: Commercial
Material: GASOLINE
Qty Lost: Not reported
Qty Recovered: Not reported
Source: Leak-underground
Type: Gasoline/diesel
Location: Facility
Setting: Urban
Wells Contam: Not reported
Sampled By: Responsible Parties
Samples Include: Groundwater Samples
Owner Company: J.T. ALEXANDER & SON
Lat/Long: 353625 / 804858
Risk Site H
Lat/Long Decimal: 35.60694 / 80.81611
Lat/Long Number 353625 / 804858
GPS: EST
Incident Phase: Closed Out
NOV Issued: 09/24/96
45 Day Report: / /
Public Meeting Held: / /
Corrective Action Planned: / /
Reclassification Report: / /
Close-out Report: 06/11/99
Closure Request Date: / /

Agency : DWM
Last Modified 06/22/99

SOC Sighned: / /

RS Designation: / /

Map ID / Direction / Distance / Distance (ft.) / Elevation	Site	Database(s)	EDR ID Number / EPA ID Number
10 **North** **1/4-1/2** **2568 ft.**	**CARPET DEPOT** **239 WEST CENTER STREET** **MOORESVILLE, NC**	**LUST TRUST**	**S105922631** **N/A**

Relative:
Higher

Actual:
911 ft.

LUST TRUST:

Facility ID :	Not reported	
Site ID :	24489	
Site Note:	Not reported	
Site Eligible?:	Yes	
Commercial Find :	100% Non-Commercial	
Priority Rank:	Not reported	
3rd Party Deductable Amount:		0
Sum of 3rd Party Amounts Applied:		0
Deductable Amount:	0	

Click this hyperlink while viewing on your computer to access additional NC LUST TRUST detail in the EDR Site Report.

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
MOORESVILLE	U001439413	PHIFER J JOHNSON BULLDOZING I	RT 1 BOX 590	28115	UST
MOORESVILLE	S103131012	FLAGSHIP AIRLINES MAINT FACILI	RT 1, BRITT HANGAR		IMD
MOORESVILLE	U001197622	M B OVERCASH	RT 10, BOX 7599	28115	UST
MOORESVILLE	U003144009	REAL CHICKEN INC	RT 11 BOX 11	28115	UST
MOORESVILLE	S105764778	OLD MOORE PLACE	SR 1100(BRAWLEY SCHOOL ROAD		IMD, LUST
MOORESVILLE	U001437259	COOK'S AUTOMOTIVE	HWY 115 SOUTH	28115	UST
MOORESVILLE	S104913549	AEROQUIP CORP	HWY 115		IMD
MOORESVILLE	S105702947	IREDELL MILK TRANSPORTATION #2	SR 1150		IMD, LUST
MOORESVILLE	U001437237	CLYLE II	HWY 115N	28115	UST
MOORESVILLE	U001437241	J.T. SMITH STORE	HWY 115N	28115	UST
MOORESVILLE	S105485750	MOORESVILLE DUMP	SR 1306, 2 MI NW OF TOWN		OLI
MOORESVILLE	1004745471	SUPERBA PRINT WORKS	HWY 150	28115	RCRA-SQG, FINDS
MOORESVILLE	1004745601	SUPERBA PRINT WORKS	HWY 150	28115	RCRA-SQG, IMD, LUST
MOORESVILLE	U001437393	CATAWBA TIMBER CO. MOORESVILL	HWY 150 BYPASS	28115	UST
MOORESVILLE	U001439019	GENERAL STORE	HWY 150 WEST	28115	UST
MOORESVILLE	1004376217	SUPERBA PRINT WORKS	HIGHWAY 150 BYPASS		LUST TRUST
MOORESVILLE	S105218253	WILCO SERVICE STATION HIGHWAY 150	HIGHWAY 150		LUST TRUST
MOORESVILLE	S105764464	COUNTRY CORNER MARINA	HWY 150 WEST OF I-77		IMD, LUST
MOORESVILLE	S105764520	E.F. BELK & SONS	HWY 150 MOORESVILLE		IMD
MOORESVILLE	U003145633	SOUTHERN CONV 185-23623	HWY 150+21 200 EAST PLAZA DRIV	28115	UST
MOORESVILLE	S105911903	MELCHOR PROPERTY	HWY 150, MOORESVILLE		IMD
MOORESVILLE	U001437373	BRAWLEY CONST. CO.	HWY 150E	28115	UST
MOORESVILLE	S106799503	FRIENDLY FARE GROCERY (CAPPI'S)	8373 HWY 152 WEST	28115	LUST
MOORESVILLE	S106799565	CURT'S KWICK STOP	5945 HWY 152	28115	LUST
MOORESVILLE	U001188501	FRIENDLY FARE GROCERY	HIGHWAY 152 - ROUTE 3	28115	UST
MOORESVILLE	U003295289	RUN-IN HIGHWAY 21 (HILLTOP 66	ROUTE 2, BOX 826	28115	UST
MOORESVILLE	1004744610	PHIL WILL ENTERPRISES	HWY 21 S	28115	RCRA-SQG, FINDS
MOORESVILLE	S105764483	RUN IN STORE HWY 21	HWY 21 AT SR 1135	28115	LUST
MOORESVILLE	S104913550	PARKER HANNIFIN #2	HIGHWAY 21		IMD
MOORESVILLE	S104913556	PARKER HANNIFIN	HWY 21		IMD
MOORESVILLE	S105764917	CASHION FAMILY FARM, FORMER	HIGHWAY 21		IMD, LUST
MOORESVILLE	S105764580	FRIENDLY FARE GROCERY (NO FILE	RT. 3 HWY 152	28115	IMD
MOORESVILLE	U001198154	WILLIAM C. WALLER	RT 3 BOX 264	28115	UST
MOORESVILLE	U001200151	KEN F. SMITH'S GROCERY	RT 3 BOX 196	28115	UST
MOORESVILLE	U001436126	MRS. R.E. BUMGARDNER	ROUTE 4, BOX 580	28115	UST
MOORESVILLE	U001436123	SHINN'S STORE	ROUTE 5, BOX 336	28115	UST
MOORESVILLE	U001437238	TRADING POST	RT 6 BOX 127	28115	UST
MOORESVILLE	U003146050	LARRY HUDSON / TRADING POST	ROUTE 6, BOX 127	28115	UST
MOORESVILLE	1004745496	MOTORSPORTS FABRICATION	RT 8 HWY 150 W	28115	RCRA-SQG, FINDS
MOORESVILLE	1004745602	BEN HESS MOTOR SPORTS LTD	RT 8 BOX 530 HWY 150	28115	RCRA-SQG, FINDS
MOORESVILLE	U001435810	SLOAN C. BROTHERTON	ROUTE 8, BOX 357	28115	UST
MOORESVILLE	S105548366	KEENER - GOODSON PROPERTY	ACADEMY / CENTER ST		IMD, LUST
MOORESVILLE	S105764504	CARISBROOK IND.	201 N. CHURCH ST. MOORES.		IMD, LUST

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM STANDARD RECORDS

NPL: National Priority List
Source: EPA
Telephone: N/A
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 12/14/04
Date Made Active at EDR: 02/03/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 02/01/05
Elapsed ASTM days: 2
Date of Last EDR Contact: 02/01/05

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 6
Telephone: 214-655-6659

EPA Region 8
Telephone: 303-312-6774

Proposed NPL: Proposed National Priority List Sites
Source: EPA
Telephone: N/A

Date of Government Version: 12/14/04
Date Made Active at EDR: 02/03/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 02/01/05
Elapsed ASTM days: 2
Date of Last EDR Contact: 02/01/05

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 02/15/05
Date Made Active at EDR: 04/06/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 03/22/05
Elapsed ASTM days: 15
Date of Last EDR Contact: 03/22/05

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 03/22/05
Date Made Active at EDR: 04/06/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 04/01/05
Elapsed ASTM days: 5
Date of Last EDR Contact: 04/01/05

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 12/15/04
Date Made Active at EDR: 02/25/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 01/07/05
Elapsed ASTM days: 49
Date of Last EDR Contact: 03/07/05

RCRA: Resource Conservation and Recovery Act Information
Source: EPA
Telephone: 800-424-9346
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS). The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month. Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month. Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month. Transporters are individuals or entities that move hazardous waste from the generator off-site to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 03/13/05
Date Made Active at EDR: 04/25/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 03/23/05
Elapsed ASTM days: 33
Date of Last EDR Contact: 03/23/05

ERNS: Emergency Response Notification System
Source: National Response Center, United States Coast Guard
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/04
Date Made Active at EDR: 03/24/05
Database Release Frequency: Annually

Date of Data Arrival at EDR: 01/27/05
Elapsed ASTM days: 56
Date of Last EDR Contact: 04/25/05

FEDERAL ASTM SUPPLEMENTAL RECORDS

BRS: Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/01/01
Database Release Frequency: Biennially

Date of Last EDR Contact: 04/15/05
Date of Next Scheduled EDR Contact: 06/13/05

CONSENT: Superfund (CERCLA) Consent Decrees
Source: Department of Justice, Consent Decree Library
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 12/14/04
Database Release Frequency: Varies

Date of Last EDR Contact: 04/26/05
Date of Next Scheduled EDR Contact: 07/25/05

ROD: Records Of Decision
Source: EPA
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 01/10/05
Database Release Frequency: Annually

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

DELISTED NPL: National Priority List Deletions
Source: EPA
Telephone: N/A
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 12/14/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 02/01/05
Date of Next Scheduled EDR Contact: 05/02/05

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 01/12/05
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4555
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 11/16/04
Database Release Frequency: Annually

Date of Last EDR Contact: 04/19/05
Date of Next Scheduled EDR Contact: 07/18/05

MLTS: Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 01/12/05
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

MINES: Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 11/15/04
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 03/30/05
Date of Next Scheduled EDR Contact: 06/27/05

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 202-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 02/22/05
Date of Next Scheduled EDR Contact: 05/23/05

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-564-3887
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 12/21/04
Database Release Frequency: Annually

Date of Last EDR Contact: 02/23/05
Date of Next Scheduled EDR Contact: 05/09/05

DOD: Department of Defense Sites
Source: USGS
Telephone: 703-692-8801
This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 10/01/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/08/05
Date of Next Scheduled EDR Contact: 05/09/05

UMTRA: Uranium Mill Tailings Sites
Source: Department of Energy
Telephone: 505-845-0011
Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized. In 1978, 24 inactive uranium mill tailings sites in Oregon, Idaho, Wyoming, Utah, Colorado, New Mexico, Texas, North Dakota, South Dakota, Pennsylvania, and on Navajo and Hopi tribal lands, were targeted for cleanup by the Department of Energy.

Date of Government Version: 12/29/04
Database Release Frequency: Varies

Date of Last EDR Contact: 03/22/05
Date of Next Scheduled EDR Contact: 06/20/05

ODI: Open Dump Inventory
Source: Environmental Protection Agency
Telephone: 800-424-9346
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/85
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 05/23/95
Date of Next Scheduled EDR Contact: N/A

FUDS: Formerly Used Defense Sites
Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/03
Database Release Frequency: Varies

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

INDIAN RESERV: Indian Reservations
Source: USGS
Telephone: 202-208-3710
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 10/01/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/08/05
Date of Next Scheduled EDR Contact: 05/09/05

US ENG CONTROLS: Engineering Controls Sites List
Source: Environmental Protection Agency
Telephone: 703-603-8867
A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 01/10/05
Database Release Frequency: Varies

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 03/07/05
Date of Next Scheduled EDR Contact: 06/06/05

TRIS: Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-566-0250
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/02
Database Release Frequency: Annually

Date of Last EDR Contact: 03/22/05
Date of Next Scheduled EDR Contact: 06/20/05

TSCA: Toxic Substances Control Act
Source: EPA
Telephone: 202-260-5521
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 01/01/05
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 04/05/05
Date of Next Scheduled EDR Contact: 06/06/05

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA
Telephone: 202-566-1667

Date of Government Version: 04/13/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 03/21/05
Date of Next Scheduled EDR Contact: 06/20/05

SSTS: Section 7 Tracking Systems
Source: EPA
Telephone: 202-564-5008
Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/03
Database Release Frequency: Annually
Date of Last EDR Contact: 04/19/05
Date of Next Scheduled EDR Contact: 07/18/05

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 09/13/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 03/21/05
Date of Next Scheduled EDR Contact: 06/20/05

STATE OF NORTH CAROLINA ASTM STANDARD RECORDS

SHWS: Inactive Hazardous Sites Inventory
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801
State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 04/12/05
Date Made Active at EDR: 04/25/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 04/12/05
Elapsed ASTM days: 13
Date of Last EDR Contact: 04/11/05

SWF/LF: List of Solid Waste Facilities
Source: Department of Environment and Natural Resources
Telephone: 919-733-0692
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 02/17/05
Date Made Active at EDR: 03/29/05
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/17/05
Elapsed ASTM days: 40
Date of Last EDR Contact: 04/25/05

LUST: Regional UST Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1308
This database contains information obtained from the Regional Offices. It provides a more detailed explanation of current and historic activity for individual sites, as well as what was previously found in the Incident Management Database. Sites in this database with Incident Numbers are considered LUSTs.

Date of Government Version: 03/04/05
Date Made Active at EDR: 04/06/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 03/08/05
Elapsed ASTM days: 29
Date of Last EDR Contact: 03/08/05

UST: Petroleum Underground Storage Tank Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1308
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 02/25/05
Date Made Active at EDR: 04/07/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 03/08/05
Elapsed ASTM days: 30
Date of Last EDR Contact: 03/08/05

OLI: Old Landfill Inventory
Source: Department of Environment & Natural Resources
Telephone: 919-733-4996
Old landfill inventory location information. (Does not include no further action sites and other agency lead sites).

Date of Government Version: 01/06/05
Date Made Active at EDR: 03/16/05
Database Release Frequency: Varies
Date of Data Arrival at EDR: 01/28/05
Elapsed ASTM days: 47
Date of Last EDR Contact: 04/28/05

VCP: Responsible Party Voluntary Action Sites
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996

Date of Government Version: 04/12/05
Date Made Active at EDR: 04/25/05
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 04/12/05
Elapsed ASTM days: 13
Date of Last EDR Contact: 04/11/05

INDIAN UST: Underground Storage Tanks on Indian Land
Source: EPA Region 4
Telephone: 404-562-9424

Date of Government Version: 03/03/05
Date Made Active at EDR: 04/19/05
Database Release Frequency: Varies
Date of Data Arrival at EDR: 03/18/05
Elapsed ASTM days: 32
Date of Last EDR Contact: 02/15/05

INDIAN LUST: Leaking Underground Storage Tanks on Indian Land
Source: EPA Region 4
Telephone: 404-562-8677
LUSTs on Indian land in Florida, Minnesota, Mississippi and North Carolina.

Date of Government Version: 03/01/05
Date Made Active at EDR: 04/19/05
Database Release Frequency: Varies
Date of Data Arrival at EDR: 03/18/05
Elapsed ASTM days: 32
Date of Last EDR Contact: 02/15/05

STATE OF NORTH CAROLINA ASTM SUPPLEMENTAL RECORDS

HSDS: Hazardous Substance Disposal Site
Source: North Carolina Center for Geographic Information and Analysis
Telephone: 919-733-2090
Locations of uncontrolled and unregulated hazardous waste sites. The file includes sites on the National Priority List as well as those on the state priority list.

Date of Government Version: 06/21/95
Database Release Frequency: Biennially
Date of Last EDR Contact: 02/28/05
Date of Next Scheduled EDR Contact: 05/30/05

AST: AST Database
Source: Department of Environment and Natural Resources
Telephone: 919-715-6183
Facilities with aboveground storage tanks that have a capacity greater than 21,000 gallons.

Date of Government Version: 01/14/05
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 04/18/05
Date of Next Scheduled EDR Contact: 07/18/05

LUST TRUST: State Trust Fund Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1315
This database contains information about claims against the State Trust Funds for reimbursements for expenses incurred while remediating Leaking USTs.

Date of Government Version: 03/11/05
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/08/05
Date of Next Scheduled EDR Contact: 05/09/05

DRYCLEANERS: Drycleaning Sites
Source: Department of Environment & Natural Resources
Telephone: 919-733-2801
Potential and known drycleaning sites, active and abandoned, that the Drycleaning Solvent Cleanup Program has knowledge of and entered into this database.

Date of Government Version: 11/12/04
Database Release Frequency: Varies

Date of Last EDR Contact: 04/18/05
Date of Next Scheduled EDR Contact: 07/18/05

IMD: Incident Management Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-3221
Groundwater and/or soil contamination incidents

Date of Government Version: 06/15/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/27/05
Date of Next Scheduled EDR Contact: 07/25/05

EDR PROPRIETARY HISTORICAL DATABASES

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

Disclaimer Provided by Real Property Scan, Inc.

The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

BROWNFIELDS DATABASES

Brownfields: Brownfields Projects Inventory
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996
A brownfield site is an abandoned, idled, or underused property where the threat of environmental contamination has hindered its redevelopment. All of the sites in the inventory are working toward a brownfield agreement for cleanup and liabitliy control.

Date of Government Version: 09/30/04
Database Release Frequency: Varies

Date of Last EDR Contact: 02/04/05
Date of Next Scheduled EDR Contact: 05/02/05

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

VCP: Responsible Party Voluntary Action Sites
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996

Date of Government Version: 04/12/05
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 04/11/05
Date of Next Scheduled EDR Contact: 07/11/05

INST CONTROL: No Further Action Sites With Land Use Restrictions Monitoring
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801

Date of Government Version: 04/12/05
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/11/05
Date of Next Scheduled EDR Contact: 07/11/05

US BROWNFIELDS: A Listing of Brownfields Sites
Source: Environmental Protection Agency
Telephone: 202-566-2777
Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: 01/10/05
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 03/14/05
Date of Next Scheduled EDR Contact: 06/13/05

US INST CONTROL: Sites with Institutional Controls
Source: Environmental Protection Agency
Telephone: 703-603-8867
A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 01/10/05
Database Release Frequency: Varies

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Electric Power Transmission Line Data
Source: PennWell Corporation
Telephone: (800) 823-6277
This map includes information copyrighted by PennWell Corporation. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Facility List
Source: Department of Health & Human Services
Telephone: 919-662-4499

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 from the U.S. Fish and Wildlife Service.

STREET AND ADDRESS INFORMATION

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

DYE BRANCH
GLENWOOD MEMORIAL PARK
MOORESVILLE, NC 28115

TARGET PROPERTY COORDINATES

Latitude (North):	35.576199 - 35° 34' 34.3"
Longitude (West):	80.812500 - 80° 48' 45.0"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	516989.3
UTM Y (Meters):	3936761.5
Elevation:	834 ft. above sea level

EDR's GeoCheck Physical Setting Source Addendum has been developed to assist the environmental professional with the collection of physical setting source information in accordance with ASTM 1527-00, Section 7.2.3. Section 7.2.3 requires that a current USGS 7.5 Minute Topographic Map (or equivalent, such as the USGS Digital Elevation Model) be reviewed. It also requires that one or more additional physical setting sources be sought when (1) conditions have been identified in which hazardous substances or petroleum products are likely to migrate to or from the property, and (2) more information than is provided in the current USGS 7.5 Minute Topographic Map (or equivalent) is generally obtained, pursuant to local good commercial or customary practice, to assess the impact of migration of recognized environmental conditions in connection with the property. Such additional physical setting sources generally include information about the topographic, hydrologic, hydrogeologic, and geologic characteristics of a site, and wells in the area.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata. EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

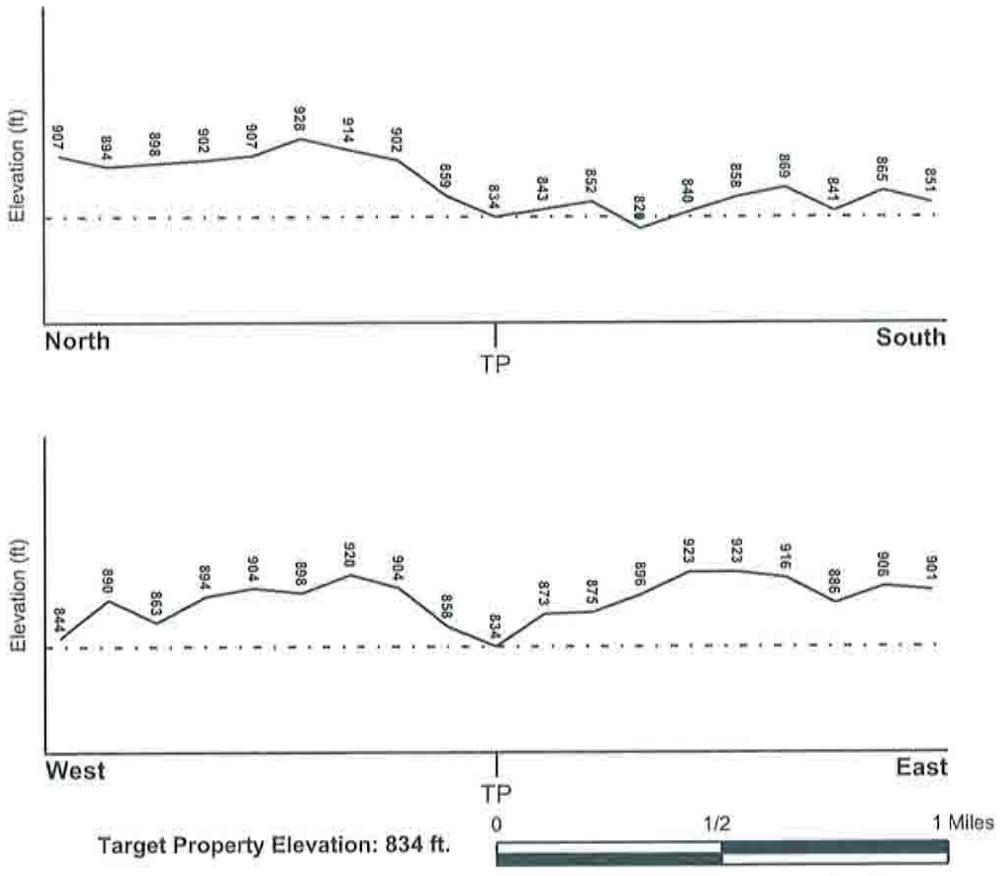
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

USGS Topographic Map:	35080-E7 MOORESVILLE, NC
General Topographic Gradient:	General SSE
Source:	USGS 7.5 min quad index

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
IREDELL, NC	Not Available

Flood Plain Panel at Target Property: Not Reported

Additional Panels in search area: Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
MOORESVILLE	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Paleozoic
System:	Ordovian
Series:	Lower Paleozoic granitic rocks
Code:	Pzg1 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Plutonic and Intrusive Rocks

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	CECIL
Soil Surface Texture:	sandy clay loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	HIGH
Depth to Bedrock Min:	> 60 inches
Depth to Bedrock Max:	> 60 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	7 inches	sandy clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 2.00 Min: 0.60	Max: 6.50 Min: 4.50
2	7 inches	11 inches	sandy clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 2.00 Min: 0.60	Max: 5.50 Min: 4.50
3	11 inches	50 inches	clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit 50% or more), Elastic silt.	Max: 2.00 Min: 0.60	Max: 5.50 Min: 4.50
4	50 inches	75 inches	variable	Not reported	Not reported	Max: 0.00 Min: 0.00	Max: 0.00 Min: 0.00

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: sandy loam
loam
clay loam
silt loam
very channery - silt loam
gravelly - sandy loam

Surficial Soil Types: sandy loam
loam
clay loam
silt loam
very channery - silt loam
gravelly - sandy loam

Shallow Soil Types: silt loam
sandy clay
clay
silty clay loam
very channery - silt loam
loam

Deeper Soil Types: weathered bedrock
fine sandy loam
silty clay loam
unweathered bedrock
sandy clay loam

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

ADDITIONAL ENVIRONMENTAL RECORD SOURCES

According to ASTM E 1527-00, Section 7.2.2, "one or more additional state or local sources of environmental records may be checked, in the discretion of the environmental professional, to enhance and supplement federal and state sources... Factors to consider in determining which local or additional state records, if any, should be checked include (1) whether they are reasonably ascertainable, (2) whether they are sufficiently useful, accurate, and complete in light of the objective of the records review (see 7.1.1), and (3) whether they are obtained, pursuant to local, good commercial or customary practice." One of the record sources listed in Section 7.2.2 is water well information. Water well information can be used to assist the environmental professional in assessing sources that may impact groundwater flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
3	USGS2259828	1/2 - 1 Mile North
4	USGS2259832	1/2 - 1 Mile NNE
5	USGS2259834	1/2 - 1 Mile NNE
6	USGS2259836	1/2 - 1 Mile NNW

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

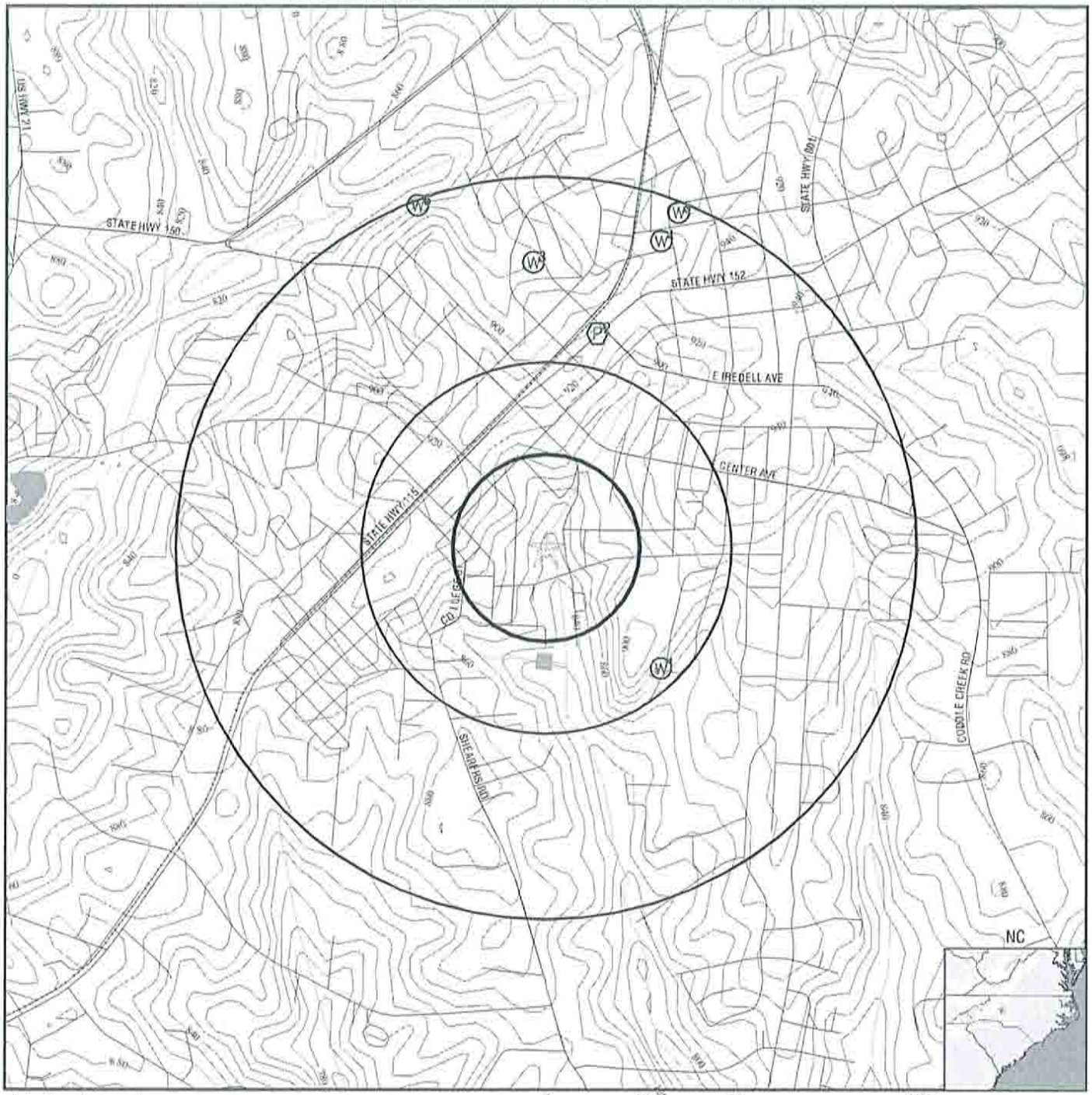
MAP ID	WELL ID	LOCATION FROM TP
2	NC0149414	1/2 - 1 Mile NNE

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
1	NCWS002110	1/4 - 1/2 Mile SE

PHYSICAL SETTING SOURCE MAP - 01415917.1r



County Boundary
Major Roads
Contour Lines
Earthquake epicenter, Richter 5 or greater
Water Wells
Public Water Supply Wells
Cluster of Multiple Icons

0 1/4 1/2 1 Miles

Groundwater Flow Direction
Indeterminate Groundwater Flow at Location
Groundwater Flow Varies at Location

Wildlife Areas
Natural Areas
Rare & Endangered Species

TARGET PROPERTY:	Dye Branch	CUSTOMER:	Mulkey Inc.
ADDRESS:	Glenwood Memorial Park	CONTACT:	Layna Thrush
CITY/STATE/ZIP:	MOORESVILLE NC 28115	INQUIRY #:	01415917.1r
LAT/LONG:	35.5762 / 80.8125	DATE:	May 06, 2005 1:29 pm

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation

	Database	EDR ID Number
1 **SE** **1/4 - 1/2 Mile** **Higher**	**NC WELLS**	**NCWS002110**

Site Name:	WELL #1		
PWS ID:	0149600	Source code:	S01
City:	MOORESVILLE		
County:	Iredell		
Latitude:	353417.387	Longitude:	804825.169
Availability:	Permanent		
Type:	Ground	Depth:	0
Owner:	JOHN MURRAY		

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2 **NNE** **1/2 - 1 Mile** **Higher**	**FRDS PWS**	**NC0149414**	

PWS ID:	NC0149414	PWS Status:	Active
Date Initiated:	7706	Date Deactivated:	Not Reported
PWS Name:	AMITY LUTH CH MOORESVILLE, NC 28115		
Addressee / Facility:	System Owner/Responsible Party AMITY LUTH CH RT 5 MOORESVILLE, NC 28115		
Addressee / Facility:	System Owner/Responsible Party AMITY LUTH CH RT 5 MOORESVILLE, NC 28115		
Facility Latitude:	35 35 04	Facility Longitude	080 48 37
Facility Latitude:	35 44 15	Facility Longitude	080 46 15
City Served:	MOORESVILLE		
Treatment Class:	Untreated	Population:	00000050

PWS currently has or had major violation(s) or enforcement: Yes

Violations information not reported.

ENFORCEMENT INFORMATION:

System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Regular		
Contaminant:	NITRATE		
Compliance Period:	2002-01-01 - 2002-12-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0316019
Enforcement Date:	2003-02-18	Enf. Action:	State Formal NOV Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Regular		
Contaminant:	NITRATE		
Compliance Period:	2002-01-01 - 2002-12-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0316018
Enforcement Date:	2003-02-18	Enf. Action:	State Public Notif Requested

ENFORCEMENT INFORMATION:

System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Regular		
Contaminant:	NITRATE		
Compliance Period:	2002-01-01 - 2002-12-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0316020
Enforcement Date:	2003-03-03	Enf. Action:	State Compliance Achieved
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2000-04-01 - 2000-06-30	Analytical Value:	0
Violation ID:	0100397	Enforcement ID:	0013593
Enforcement Date:	2000-08-11	Enf. Action:	State Formal NOV Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2000-07-01 - 2000-09-30	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0102540
Enforcement Date:	2000-11-08	Enf. Action:	State Formal NOV Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2002-08-01 - 2002-08-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0305040
Enforcement Date:	2002-10-01	Enf. Action:	State Formal NOV Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2000-04-01 - 2000-06-30	Analytical Value:	0
Violation ID:	0300056	Enforcement ID:	0013592
Enforcement Date:	2000-08-11	Enf. Action:	State Public Notif Requested
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2000-07-01 - 2000-09-30	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0102539
Enforcement Date:	2000-11-08	Enf. Action:	State Public Notif Requested
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2002-08-01 - 2002-08-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0305039
Enforcement Date:	2002-10-01	Enf. Action:	State Public Notif Requested
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2002-08-01 - 2002-08-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0305041
Enforcement Date:	2002-10-18	Enf. Action:	State Public Notif Received
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2000-04-01 - 2000-06-30	Analytical Value:	0
Violation ID:	0006503	Enforcement ID:	0300031
Enforcement Date:	2003-03-31	Enf. Action:	State Compliance Achieved

ENFORCEMENT INFORMATION:

System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2000-07-01 - 2000-09-30	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0300031
Enforcement Date:	2003-03-31	Enf. Action:	State Compliance Achieved
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	2002-08-01 - 2002-08-31	Analytical Value:	0
Violation ID:	0318039	Enforcement ID:	0300031
Enforcement Date:	2003-03-31	Enf. Action:	State Compliance Achieved
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-04-01 - 1999-06-30	Analytical Value:	0000000.000000000
Violation ID:	0000371	Enforcement ID:	9906278
Enforcement Date:	1999-08-12	Enf. Action:	State Public Notif Requested
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-10-01 - 1999-12-31	Analytical Value:	0000000.000000000
Violation ID:	0000371	Enforcement ID:	0006223
Enforcement Date:	2000-02-04	Enf. Action:	State Formal NOV Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-10-01 - 1999-12-31	Analytical Value:	0000000.000000000
Violation ID:	0003413	Enforcement ID:	0006224
Enforcement Date:	2000-02-04	Enf. Action:	State Public Notif Requested
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-10-01 - 1999-12-31	Analytical Value:	0000000.000000000
Violation ID:	0003413	Enforcement ID:	0009904
Enforcement Date:	2000-02-15	Enf. Action:	State Admin Penalty Assessed
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-10-01 - 1999-12-31	Analytical Value:	0000000.000000000
Violation ID:	0003413	Enforcement ID:	0009905
Enforcement Date:	2000-02-15	Enf. Action:	State AO (w/penalty) Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-04-01 - 1999-06-30	Analytical Value:	0000000.000000000
Violation ID:	9909608	Enforcement ID:	9906277
Enforcement Date:	1999-08-12	Enf. Action:	State Formal NOV Issued
System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-04-01 - 1999-06-30	Analytical Value:	0000000.000000000
Violation ID:	9909608	Enforcement ID:	9906278
Enforcement Date:	1999-08-12	Enf. Action:	State Public Notif Requested

ENFORCEMENT INFORMATION:

System Name:	AMITY LUTHERAN CHURCH		
Violation Type:	Monitoring, Routine Major (TCR)		
Contaminant:	COLIFORM (TCR)		
Compliance Period:	1999-04-01 - 1999-06-30	Analytical Value:	0000000.000000000
Violation ID:	9912229	Enforcement ID:	9906277
Enforcement Date:	1999-08-12	Enf. Action:	State Formal NOV Issued

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3
North
1/2 - 1 Mile
Higher

FED USGS **USGS2259828**

Agency cd:	USGS	Site no:	353514080484801
Site name:	IR-113		
Latitude:	353514		
Longitude:	0804848	Dec lat:	35.58735962
Dec lon:	-80.81312796	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	37
State:	37	County:	097
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	Not Reported	Altitude method:	Not Reported
Altitude accuracy:	Not Reported	Altitude datum:	Not Reported
Hydrologic:	Not Reported		
Topographic:	Hillside (slope)		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	EST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported		
Aquifer:	Not Reported		
Well depth:	148.0	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	453709900
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1954-00-00	Ground water data end date:	1954-00-00
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1954	25	

4
NNE
1/2 - 1 Mile
Higher

FED USGS **USGS2259832**

Agency cd:	USGS	Site no:	353517080482601
Site name:	IR-115		
Latitude:	353517		
Longitude:	0804826	Dec lat:	35.58819307
Dec lon:	-80.8070167	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	37
State:	37	County:	097
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	Not Reported	Altitude method:	Not Reported
Altitude accuracy:	Not Reported	Altitude datum:	Not Reported
Hydrologic:	Not Reported		
Topographic:	Hillside (slope)		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	EST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported		
Aquifer:	Not Reported		
Well depth:	400.0	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	453709900
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1954-00-00	Ground water data end date:	1954-00-00
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1954	25	

5
NNE
1/2 - 1 Mile
Higher

FED USGS **USGS2259834**

Agency cd:	USGS	Site no:	353521080482301
Site name:	IR-114		
Latitude:	353521		
Longitude:	0804823	Dec lat:	35.5893042
Dec lon:	-80.80618334	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	37
State:	37	County:	097
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	Not Reported	Altitude method:	Not Reported
Altitude accuracy:	Not Reported	Altitude datum:	Not Reported
Hydrologic:	Not Reported		
Topographic:	Hillside (slope)		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	EST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported		
Aquifer:	Not Reported		
Well depth:	270.0	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	453709900
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1954-00-00	Ground water data end date:	1954-00-00
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1954	25	

6
NNW
1/2 - 1 Mile
Higher

FED USGS **USGS2259836**

Agency cd:	USGS	Site no:	353522080490801
Site name:	IR-112		
Latitude:	353522		
Longitude:	0804908	Dec lat:	35.58958176
Dec lon:	-80.81868363	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	37
State:	37	County:	097
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	Not Reported	Altitude method:	Not Reported
Altitude accuracy:	Not Reported	Altitude datum:	Not Reported
Hydrologic:	Not Reported		
Topographic:	Hillside (slope)		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	EST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported		
Aquifer:	Not Reported		
Well depth:	150.0	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	453709900
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: NC Radon

Radon Test Results

County	Result Type	Total Sites	Avg pCi/L	Range pCi/L
IREDELL	Statistical	52	1.83	-0.80-9.50
IREDELL	Non-Statistical	84	2.27	0.00-9.50

Federal EPA Radon Zone for IREDELL County: 2

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 28115

Number of sites tested: 11

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	1.255 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	4.267 pCi/L	67%	33%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002. 7.5-Minute DEMs correspond to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 from the U.S. Fish and Wildlife Service.

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

ADDITIONAL ENVIRONMENTAL RECORD SOURCES

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STATE RECORDS

NC Natural Areas: Significant Natural Heritage Areas
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
A polygon converage identifying sites (terrestrial or aquatic that have particular biodiversity significance. A site's significance may be due to the presenceof rare species, rare or hight quality natural communities, or other important ecological features.

NC Game Lands: Wildlife Resources Commission Game Lands
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
All publicly owned game lands managed by the North Carolina Wildlife Resources Commission and as listed in Hunting and Fishing Maps.

NC Natural Heritage Sites: Natural Heritage Element Occurrence Sites
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
A point coverage identifying locations of rare and endangered species, occurrences of exemplary or unique natural ecosystems (terrestrial or aquatic), and special animal habitats (e.g., colonial waterbird nesting sites).

North Carolina Public Water Supply Wells
Source: Department of Environmental Health
Telephone: 919-715-3243

RADON

State Database: NC Radon
Source: Department of Environment & Natural Resources
Telephone: 919-733-4984
Radon Statistical and Non Statiscal Data

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Cemetery Branch	**Reach:**	Trib (Existing)
Date:	5/26/2005	**Observers:**	Mulkey

Value	Variable	Definition
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872
6	di mm	D50 from [Riffle] or Pavement* — *Choose One
2	d50 mm	D50 from Bar Sample or [Sub Pavement*]
0.0320	Tci	Critical Dimensionless Shear Stress
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment
88.9	mm	Largest Bar Sample Particle in mm
0.29	Di ft	Largest Bar Sample Particle in ft
0.0190	Se ft/ft	Bankfull Water Surface Slope
0.81	dr ft	Bankfulll Mean Depth Required
0.97	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)
de/dr=	1.20	if = 1 / <1 / >1
Choose one:		Stable / aggrading / [Degrading]
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment
0.29	Di ft	Largest Bar Sample Particle
0.97	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)
0.0159	Sr ft/ft	Bankfull Water Surface Slope Required
Se/Sr=	1.20	if = 1 / <1 / >1
Choose one:		Stable / aggrading / [Degrading]
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS
62.4	y lbs/cu ft	Density of water
0.76	R=A/Wp	
6.76	A sq ft	Bankfull Cross-Sectional Area
8.92	Wp	Wetted parameter
0.0190	S ft/ft	Bankfull Water Surface Slope
0.898504	Tc lb/sqr ft	Tc = yRS
88.9	Di mm	Largest Bar Sample Particle (mm)
45-180	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238
0.4-1.2	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Cemetery Branch	**Reach:**	Proposed UT
Date:	5/26/2005	**Observers:**	LT

Value	Variable	Definition
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872
6	di mm	D50 from Riffle or Pavement* *Choose
1.8	d50 mm	D50 from Bar Sample or Sub Pavement* *One*
0.0292	Tci	Critical Dimensionless Shear Stress
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment
88.9	mm	Largest Bar Sample Particle in mm
0.29	Di ft	Largest Bar Sample Particle in ft
0.0190	Se ft/ft	Bankfull Water Surface Slope
0.74	dr ft	Bankfulll Mean Depth Required
0.70	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)
de/dr=	0.95	if = 1 <1 >1
Choose one:		Stable aggrading Degrading
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment
0.29	Di ft	Largest Bar Sample Particle
0.70	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)
0.0201	Sr ft/ft	Bankfull Water Surface Slope Required
Se/Sr=	0.95	if = 1 <1 >1
Choose one:		Stable aggrading Degrading
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS
62.4	y lbs/cu ft	Density of water
0.61	R=A/Wp	
7	A sq ft	Bankfull Cross-Sectional Area
11.4	Wp	Wetted perimeter
0.0190	S ft/ft	Bankfull Water Surface Slope
0.728	Tc lb/sqr ft	Tc = yRS
88.9	Di mm	Largest Bar Sample Particle (mm)
35-150	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238
0.4-1.2	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Reach 3 (Existing)
Date:	5/26/2005	**Observers:**	Mulkey

Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872						
Value	**Variable**	**Definition**				
2.6	di mm	D50 from	Riffle	or	Pavement*	*Choose
2.8	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0890	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
45.7	mm	Largest Bar Sample Particle in mm				
0.15	Di ft	Largest Bar Sample Particle in ft				
0.0110	Se ft/ft	Bankfull Water Surface Slope				
2.00	dr ft	Bankfulll Mean Depth Required				
1.18	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)				
de/dr=	0.59	if = 1	<1		>1	
Choose one:		Stable	aggrading		Degrading	
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.15	Di ft	Largest Bar Sample Particle				
1.18	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)				
0.0187	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	0.59	if = 1	<1		>1	
Choose one:		Stable	aggrading		Degrading	
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
1.02	R=A/Wp					
17.4	A sq ft	Bankfull Cross-Sectional Area				
17.11	Wp	Wetted parameter				
0.0110	S ft/ft	Bankfull Water Surface Slope				
0.698034	Tc lb/sqr ft	Tc = yRS				
45.7	Di mm	Largest Bar Sample Particle (mm)				
43 - 100	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
0.2 - .75	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Proposed Reach 3
Date:	5/26/2005	**Observers:**	LT

Value	Variable	Definition				
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872				
2.6	di mm	D50 from	Riffle	or	Pavement*	*Choose
2.8	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0890	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
45.7	mm	Largest Bar Sample Particle in mm				
0.15	Di ft	Largest Bar Sample Particle in ft				
0.0102	Se ft/ft	Bankfull Water Surface Slope				
2.16	dr ft	Bankfulll Mean Depth Required				
1.90	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
de/dr=	0.88	if = 1	<1			>1
Choose one:		Stable	aggrading			Degrading
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.15	Di ft	Largest Bar Sample Particle				
1.90	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
0.0116	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	0.88	if = 1	<1			>1
Choose one:		Stable	aggrading			Degrading
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
1.07	R=A/Wp					
18.8	A sq ft	Bankfull Cross-Sectional Area				
17.6	Wp	Wetted perimeter				
0.0102	S ft/ft	Bankfull Water Surface Slope				
0.679876	Tc lb/sqr ft	Tc = yRS				
45.7	Di mm	Largest Bar Sample Particle (mm)				
35-120	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
0.2 - 0.75	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Reach 2 (Existing)
Date:	5/26/2005	**Observers:**	Mulkey

Value	Variable	Definition				
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872				
9	di mm	D50 from	Riffle	or	Pavement*	*Choose
2.8	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0301	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
24	mm	Largest Bar Sample Particle in mm				
0.08	Di ft	Largest Bar Sample Particle in ft				
0.0080	Se ft/ft	Bankfull Water Surface Slope				
0.49	dr ft	Bankfulll Mean Depth Required				
1.63	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
de/dr=	3.33	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.08	Di ft	Largest Bar Sample Particle				
1.63	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
0.0024	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	3.33	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
1.26	R=A/Wp					
18.13	A sq ft	Bankfull Cross-Sectional Area				
14.4	Wp	Wetted parameter				
0.0080	S ft/ft	Bankfull Water Surface Slope				
0.628507	Tc lb/sqr ft	Tc = yRS				
24	Di mm	Largest Bar Sample Particle (mm)				
38	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
0.44	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Proposed Reach 2
Date:	6/7/2005	**Observers:**	LT

Value	Variable	Definition				
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872				
9	di mm	D50 from	Riffle	or	Pavement*	*Choose
2.8	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0301	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
45.7	mm	Largest Bar Sample Particle in mm				
0.15	Di ft	Largest Bar Sample Particle in ft				
0.0094	Se ft/ft	Bankfull Water Surface Slope				
0.79	dr ft	Bankfulll Mean Depth Required				
1.24	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
de/dr=	1.57	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.15	Di ft	Largest Bar Sample Particle				
1.24	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
0.0060	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	1.57	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
1.08	R=A/Wp					
20	A sq ft	Bankfull Cross-Sectional Area				
18.58	Wp	Wetted perimeter				
0.0094	S ft/ft	Bankfull Water Surface Slope				
0.633404	Tc lb/sqr ft	Tc = yRS				
45.7	Di mm	Largest Bar Sample Particle (mm)				
30-110	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
.2-.75	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Reach 1 (Existing)
Date:	5/26/2005	**Observers:**	Mulkey

Value	Variable	Definition				
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872				
6	di mm	D50 from	Riffle	or	Pavement*	*Choose
2.8	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0429	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
24	mm	Largest Bar Sample Particle in mm				
0.08	Di ft	Largest Bar Sample Particle in ft				
0.0056	Se ft/ft	Bankfull Water Surface Slope				
1.00	dr ft	Bankfulll Mean Depth Required				
1.58	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
de/dr=	1.59	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.08	Di ft	Largest Bar Sample Particle				
1.58	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
0.0035	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	1.59	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
1.05	R=A/Wp					
19.68	A sq ft	Bankfull Cross-Sectional Area				
18.79	Wp	Wetted parameter				
0.0056	S ft/ft	Bankfull Water Surface Slope				
0.365991	Tc lb/sqr ft	Tc = yRS				
24	Di mm	Largest Bar Sample Particle (mm)				
20-90	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
0.41	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

*Modified Shields Curve data from Rosgen 2001

Entrainment Calculation Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Proposed Reach 1
Date:	6/7/2005	**Observers:**	LT

Value	Variable	Definition				
Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872						
6	di mm	D50 from	Riffle	or	Pavement*	*Choose
2.8	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0429	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
24	mm	Largest Bar Sample Particle in mm				
0.08	Di ft	Largest Bar Sample Particle in ft				
0.0052	Se ft/ft	Bankfull Water Surface Slope				
1.07	dr ft	Bankfulll Mean Depth Required				
1.40	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
de/dr=	1.31	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.08	Di ft	Largest Bar Sample Particle				
1.40	de ft	Bankfull Mean Depth (*From Riffle Cross Section*)				
0.0040	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	1.31	if = 1		<1		>1
Choose one:		Stable		aggrading		Degrading
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
1.21	R=A/Wp					
24.1	A sq ft	Bankfull Cross-Sectional Area				
20	Wp	Wetted perimeter				
0.0052	S ft/ft	Bankfull Water Surface Slope				
0.390998	Tc lb/sqr ft	Tc = yRS				
24	Di mm	Largest Bar Sample Particle (mm)				
15-60	mm*	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
0.1-0.5	lb/ft2*	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

*Modified Shields Curve data from Rosgen 2001

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Existing Reach 1
Date:	5/26/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	19.68 sq ft	Bankfull Mean Depth (Dbkf)	1.58 ft
Bankfull Width (Wbkf)	12.47 ft	Wetted Parameter (WP)	15.63 ft
D84 (Riffle or pavement)	11 mm	D84 (mm/304.8)	0.04 ft
Bankfull Slope (S)	0.0056 ft/ft	Hydraulic Radius (R)	1.26 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	39.50 ft/ft
Bankfull Maximum Depth	2.2 ft.	R/D84 (use D84 in ft)	31.48 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.6 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.025
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	5.19 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.48 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	5.42 ft/s

Mannings n by StreamType		
Stream type		E4
Mannings n	(Red Book: p187; Blue :p237)	0.032
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.05 ft/s

Continuity Equation	
Qbkf (cfs) original curve or stream gage hydraulic geometry	63.75 cfs
Velocity (u=Q/A) or from stream gage hydraulic geometry	3.24 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.22583012
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.056340489
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	5.68 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Proposed Reach 1
Date:	6/7/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	24.1 sq ft	Bankfull Mean Depth (Dbkf)	1.40 ft
Bankfull Width (Wbkf)	17.2 ft	Wetted Perimeter (WP)	20.00 ft
D84 (Riffle or pavement)	11 mm	D84 (mm/304.8)	0.04 ft
Bankfull Slope (S)	0.0052 ft/ft	Hydraulic Radius (R)	1.20 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	35.03 ft/ft
Bankfull Maximum Depth	2.1 ft.	R/D84 (use D84 in ft)	30.12 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.4 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.026
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.67 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.45 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	5.06 ft/s

Mannings n by StreamType		
Stream type		C4
Mannings n	(Red Book: p187; Blue :p237)	0.018
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	6.74 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	63.75 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	2.65 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.22
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.06
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	5.30 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Existing Reach 2
Date:	5/26/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	18.13 sq ft	Bankfull Mean Depth (Dbkf)	1.63 ft
Bankfull Width (Wbkf)	11.15 ft	Wetted Parameter (WP)	14.40 ft
D84 (Riffle or pavement)	11 mm	D84 (mm/304.8)	0.04 ft
Bankfull Slope (S)	0.008 ft/ft	Hydraulic Radius (R)	1.26 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	40.65 ft/ft
Bankfull Maximum Depth	2.81 ft.	R/D84 (use D84 in ft)	31.47 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.8 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.025
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	6.20 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.57 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	6.47 ft/s

Mannings n by StreamType		
Stream type		E4
Mannings n	(Red Book: p187; Blue :p237)	0.032
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.84 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	63.75 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.52 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	14.28317587
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.054574553
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	6.89 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Proposed Reach 2
Date:	6/7/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	20 sq ft	Bankfull Mean Depth (Dbkf)	1.24 ft
Bankfull Width (Wbkf)	16.1 ft	Wetted Perimeter (WP)	18.58 ft
D84 (Riffle or pavement)	11 mm	D84 (mm/304.8)	0.04 ft
Bankfull Slope (S)	0.00943 ft/ft	Hydraulic Radius (R)	1.08 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	31.06 ft/ft
Bankfull Maximum Depth	1.8 ft.	R/D84 (use D84 in ft)	26.90 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.026
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	5.83 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.57 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	6.28 ft/s

Mannings n by StreamType		
Stream type		C4
Mannings n	(Red Book: p187; Blue :p237)	0.018
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	8.42 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	63.75 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.19 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.04572737
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.060592412
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	6.57 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Existing Reach 3
Date:	5/26/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	17.4 sq ft	Bankfull Mean Depth (Dbkf)	1.18 ft
Bankfull Width (Wbkf)	14.75 ft	Wetted Parameter (WP)	17.11 ft
D84 (Riffle or pavement)	8.5 mm	D84 (mm/304.8)	0.03 ft
Bankfull Slope (S)	0.011 ft/ft	Hydraulic Radius (R)	1.02 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	39.33 ft/ft
Bankfull Maximum Depth	1.71 ft.	R/D84 (use D84 in ft)	33.90 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.6 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.026
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	6.06 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.60 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	6.93 ft/s

Mannings n by StreamType		
Stream type		G5
Mannings n	(Red Book: p187; Blue :p237)	0.038
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.15 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	63.67 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.66 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.06747857
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.05490575
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	7.24 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Dye Branch	**Reach:**	Proposed Reach 3
Date:	5/26/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	18.8 sq ft	Bankfull Mean Depth (Dbkf)	1.30 ft
Bankfull Width (Wbkf)	15 ft	Wetted Perimeter (WP)	17.60 ft
D84 (Riffle or pavement)	8.5 mm	D84 (mm/304.8)	0.03 ft
Bankfull Slope (S)	0.01017 ft/ft	Hydraulic Radius (R)	1.07 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	43.33 ft/ft
Bankfull Maximum Depth	1.9 ft.	R/D84 (use D84 in ft)	35.61 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.8 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.026
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	6.02 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.59 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	6.90 ft/s

Mannings n by StreamType		
Stream type		C4
Mannings n	(Red Book: p187; Blue :p237)	0.018
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	8.70 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	63.67 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.39 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.30016481
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.053421182
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	7.24 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Cemetery Branch	**Reach:**	Existing Trib
Date:	5/26/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	6.76 sq ft	Bankfull Mean Depth (Dbkf)	0.97 ft
Bankfull Width (Wbkf)	6.98 ft	Wetted Parameter (WP)	8.92 ft
D84 (Riffle or pavement)	10.5 mm	D84 (mm/304.8)	0.03 ft
Bankfull Slope (S)	0.019 ft/ft	Hydraulic Radius (R)	0.76 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	32.33 ft/ft
Bankfull Maximum Depth	1.52 ft.	R/D84 (use D84 in ft)	25.26 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.2 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.026
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	6.55 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.68 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	7.37 ft/s

Mannings n by StreamType		
Stream type		G4
Mannings n	(Red Book: p187; Blue :p237)	0.038
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.48 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	52.13 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	7.71 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.81125574
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.060749818
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	7.81 ft/s

Velocity Comparison Form

Project:	Dye Branch Stream Restoration	**Location:**	Mooresville, NC
Stream:	Cemetery Branch	**Reach:**	Proposed UT
Date:	5/26/2005	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	7 sq ft	Bankfull Mean Depth (Dbkf)	0.7 ft
Bankfull Width (Wbkf)	10 ft	Wetted Perimeter (WP)	11.4 ft
D84 (Riffle or pavement)	10.5 mm	D84 (mm/304.8)	0.03 ft
Bankfull Slope (S)	0.019 ft/ft	Hydraulic Radius (R)	0.61 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	23.33 ft/ft
Bankfull Maximum Depth	1.1 ft.	R/D84 (use D84 in ft)	20.47 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	10.5 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.027
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	5.48 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.61 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	6.31 ft/s

Mannings n by StreamType		
Stream type		C4
Mannings n	(Red Book: p187; Blue :p237)	0.018
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	8.22 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	52.13 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	7.45 ft/s

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.32992238
Friction Factor - f	1/f^1/2 = 2.03 log (aR/(D84*3.5))	0.06780208
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	6.66 ft/s

50 0 100

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
DYE BRANCH STREAM RESTORATION	2

PROPOSED PROFILES

MULKEY ENGINEERS & CONSULTANTS

DYE BRANCH

McLELLAND AVE.

AVG. BANKFULL SLOPE = 0.51%

PROPOSED BANKFULL

NATURAL GROUND

6.5' X 5' ELLIPTICAL CMP

AVG. BANKFULL SLOPE = 0.94%

835 830 825 820

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00

DYE BRANCH

CABARRUS AVE.

NATURAL GROUND

AVG. BANKFULL SLOPE = 0.94%

PROPOSED BANKFULL

60" CMP

AVG. BANKFULL SLOPE = 1.02%

820 815 810 805 800

15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00

DYE BRANCH

PROPOSED BANKFULL

AVG. BANKFUL SLOPE = 1.02%

NATURAL GROUND

805 800

30+00 31+00 32+00 33+00 34+00 35+00 36+00

CEMETERY BRANCH

AVG. BANKFULL SLOPE = 1.90%

PROPOSED BANKFULL

NATURAL GROUND

421 RCP

835 830 825 820

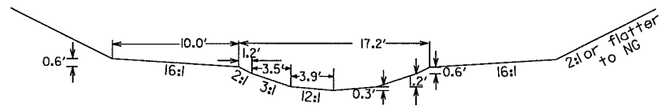
0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00

$$$$SYSTIME$$$$
$$$$DWGNAME$$$$

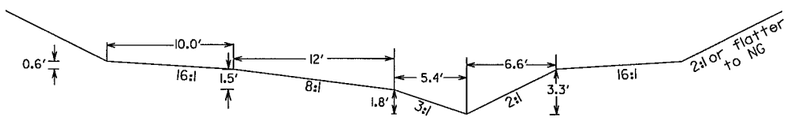
TYPICALS
NOT TO SCALE

PROJECT ENGINEER	PROJECT REFERENCE NO.	SHEET NO.
	DYE BRANCH STREAM RESTORATION	2C
	TYPICALS	
	MULKEY ENGINEERS & CONSULTANTS	

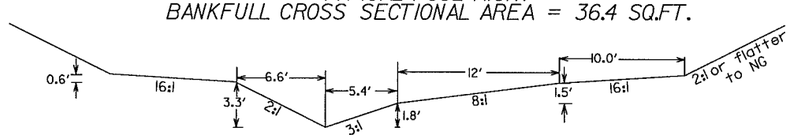
DYE BRANCH - UPPER REACH (0+00 to 9+25)



TYPICAL RIFFLE
BANKFULL CROSS SECTIONAL AREA = 24.1 SQ.FT.

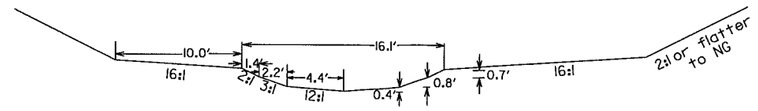


TYPICAL POOL RIGHT
BANKFULL CROSS SECTIONAL AREA = 36.4 SQ.FT.

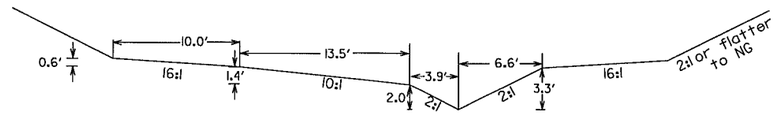


TYPICAL POOL LEFT
BANKFULL CROSS SECTIONAL AREA = 36.4 SQ.FT.

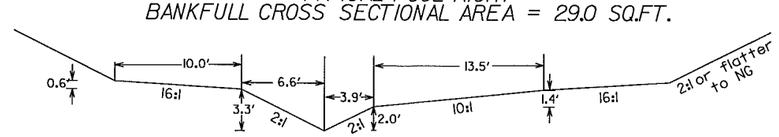
DYE BRANCH - MIDDLE REACH (9+25 to 26+85)



TYPICAL RIFFLE
BANKFULL CROSS SECTIONAL AREA = 20.0 SQ.FT.

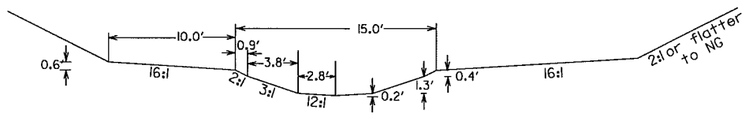


TYPICAL POOL RIGHT
BANKFULL CROSS SECTIONAL AREA = 29.0 SQ.FT.

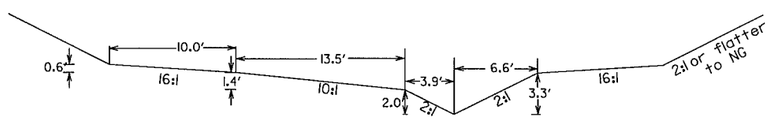


TYPICAL POOL LEFT
BANKFULL CROSS SECTIONAL AREA = 29.0 SQ.FT.

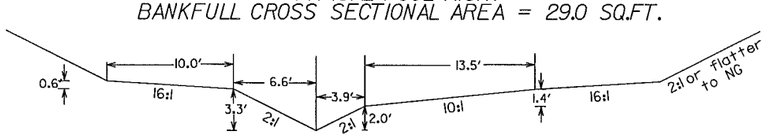
DYE BRANCH - LOWER REACH (26+85 to 37+70)



TYPICAL RIFFLE
BANKFULL CROSS SECTIONAL AREA = 18.8 SQ.FT.

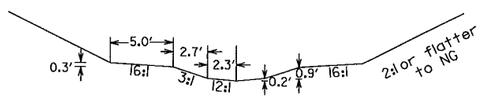


TYPICAL POOL RIGHT
BANKFULL CROSS SECTIONAL AREA = 29.0 SQ.FT.

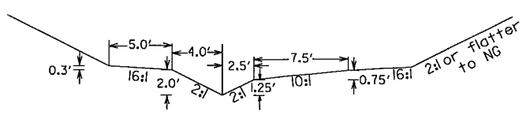


TYPICAL POOL LEFT
BANKFULL CROSS SECTIONAL AREA = 29.0 SQ.FT.

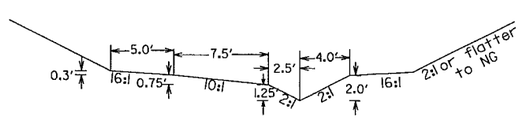
CEMETERY TRIBUTARY



TYPICAL RIFFLE
BANKFULL CROSS SECTIONAL AREA = 7.0 SQ.FT.



TYPICAL POOL RIGHT
BANKFULL CROSS SECTIONAL AREA = 10.3 SQ.FT.



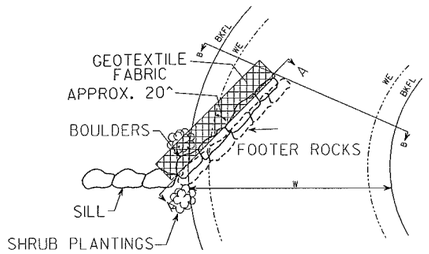
TYPICAL POOL LEFT
BANKFULL CROSS SECTIONAL AREA = 10.3 SQ.FT.

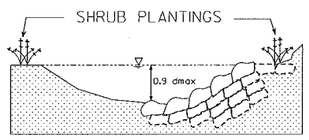
DETAILS
NOT TO SCALE

PROJECT ENGINEER	PROJECT REFERENCE NO.	SHEET NO.
	DYE BRANCH STREAM RESTORATION	2D
INCOMPLETE PLANS DO NOT USE FOR CONSTRUCTION	***DETAILS***	

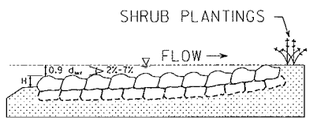
MULKEY
ENGINEERS & CONSULTANTS
PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

ROCK VANE DETAILS



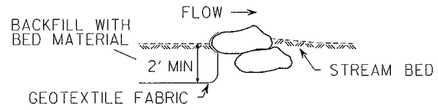


SECTION B-B



SECTION A-A

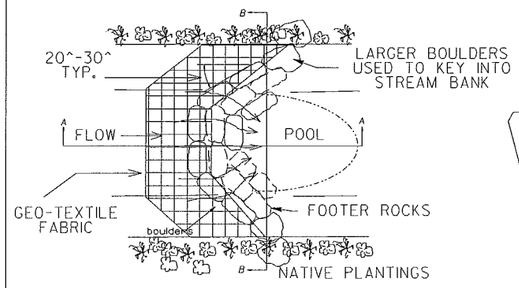
NOTES:
1. BOULDERS SHOULD BE NATIVE QUARRIED ROCK OR LOCALLY SHOT ROCK, ANGULAR AND OBLONG WITH THE FOLLOWING DIMENSION:
2. AVERAGE SIZE IS 4'X3'X2' (APPROX. 3600 LB)
3. ROCKS SHOULD FIT TIGHTLY WITH MINIMAL SPACES.
4. FOOTER ROCKS SHOULD BE A MINIMUM OF 3 TIMES 'H' IN GRAVEL BED STREAMS.
5. GEOTEXTILE FABRIC SHOULD BE PLACED ON UPSTREAM SIDE OF BOULDERS. FABRIC SHOULD BE OVERLAIN ON EXPOSED BOULDERS AND BURIED TO A MINIMUM DEPTH OF 2 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD EXTEND UPSTREAM A MINIMUM LENGTH OF OF 6 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD BE BACKFILLED WITH 3" STONE.
6. H = MIN. OF 0.3'



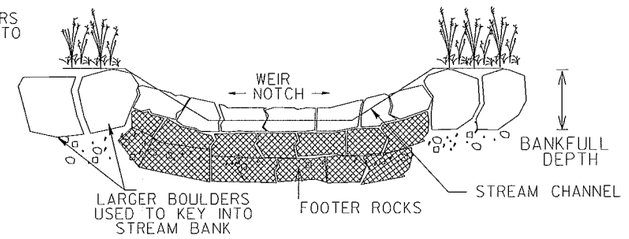
DETAIL OF GEOTEXTILE FABRIC

CROSS VANE DETAILS

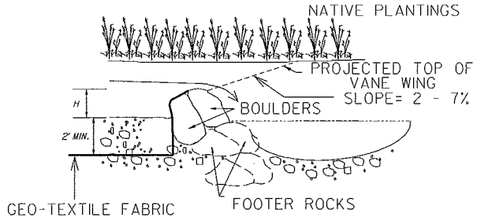
PLAN VIEW



SECTION B-B



SECTION A-A



NOTES:
1. BOULDERS SHOULD BE NATIVE QUARRIED ROCK OR LOCALLY SHOT ROCK, ANGULAR AND OBLONG WITH THE FOLLOWING DIMENSION:
2. AVERAGE SIZE IS 4'X3'X2' (APPROX. 3600 LB)**
3. ROCKS SHOULD FIT TIGHTLY WITH MINIMAL SPACES.
4. FOOTER ROCKS SHOULD BE A MINIMUM OF 3 TIMES 'H' IN GRAVEL BED STREAMS.
5. GEOTEXTILE FABRIC SHOULD BE PLACED ON UPSTREAM SIDE OF BOULDERS. FABRIC SHOULD BE OVERLAIN ON EXPOSED BOULDERS AND BURIED TO A MINIMUM DEPTH OF 2 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD EXTEND UPSTREAM A MINIMUM LENGTH OF OF 6 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD BE BACKFILLED WITH 3" STONE.
6. H = MIN. OF 0.3'

**DYE BRANCH MAIN CHANNEL. STRUCTURES ON CEMETERY BRANCH AVERAGE SIZE IS 2'X2'X1'

$DATE$ $TIME$ $FILE$

DETAILS
NOT TO SCALE

PROJECT ENGINEER	PROJECT REFERENCE NO.	SHEET NO.
INCOMPLETE PLANS DO NOT USE FOR CONSTRUCTION	DYE BRANCH STREAM RESTORATION	2E
	DETAILS	

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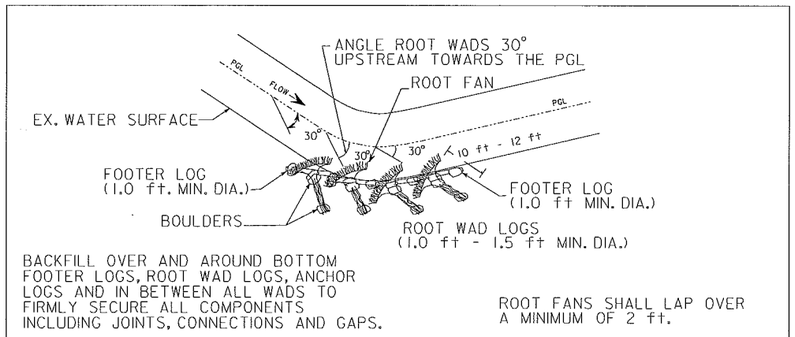
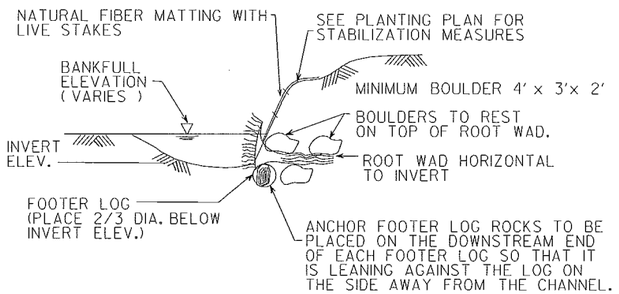
ROOTWAD DETAILS



BACKFILL OVER AND AROUND BOTTOM FOOTER LOGS, ROOT WAD LOGS, ANCHOR LOGS AND IN BETWEEN ALL WADS TO FIRMLY SECURE ALL COMPONENTS INCLUDING JOINTS, CONNECTIONS AND GAPS.

ROOT FANS SHALL LAP OVER A MINIMUM OF 2 ft.

PLAN VIEW

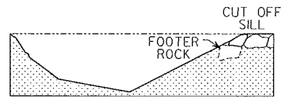


CROSS SECTION VIEW

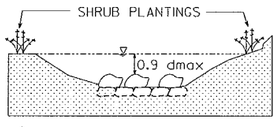
NOTES:

1. A TRENCH SHALL BE DUG ALONG THE TOE OF THE BANK TO A DEPTH OF TOE DIAMETER OF THE FOOTER LOG. A PRUNED FOOTER LOG (MIN. DIA. 12") SHALL BE PLACED AT THE TOE OF THE CHANNEL AND THE ROOTWAD (MIN. BASAL DIA. 12", LENGTH 10-12') SHALL BE PLACED DIRECTLY ABOVE IT. THE ROOT MASS SHALL BE ORIENTED IN SUCH A WAY THAT THE VELOCITY VECTORS OF THE WATER ARE ALIGNED WITH THE TRUNKS LONGITUDINAL AXIS AND WILL INTERSECT THE ROOT MASS AT A 90° ANGLE. THERE SHALL BE NO VOID BETWEEN THE ROOT MASS AND THE BANK ON THE UPSTREAM SIDE OF THE CHANNEL. A BOULDER MAY BE PLACED ON THE DOWNSTREAM SIDE, ON TOP OF, AND ON THE UPSTREAM SIDE BETWEEN THE ROOT MASS AND THE BANK TO PROVIDE EROSION CONTROL AS DIRECTED BY THE DESIGNER. BOULDERS FOR THE ROOTWAD STRUCTURES SHALL BE, 1.75 TONS (APPROX. 4' x 3' x 2') ON DYE BRANCH AS APPROVED BY THE DESIGNER.
2. THE PREFERRED METHOD FOR INSTALLATION OF A ROOTWAD IS TO DRIVE THE SHARPENED TRUNK OF THE ROOTWAD INTO THE STREAMBANK USING AN EXCAVATOR CONTAINING A HYDRAULIC THUMB. IF IT IS DEEMED NOT POSSIBLE TO DRIVE THE TRUNK INTO THE BANK, A TRENCH SHALL BE DUG IN THE BANK AND THE TRUNK SHALL BE PLACED IN THE TRENCH. THE TRENCH SHALL BE BACKFILLED AND COMPACTED.
3. ALL MATERIALS FOR THIS STRUCTURE SHALL BE APPROVED BY THE DESIGNER PRIOR TO INSTALLATION.
4. STATIONING OF ROOTWADS SHALL BE AS SHOWN ON THE PLANS OR AS DIRECTED BY THE DESIGNER. THE ACTUAL NUMBER OF ROOTWADS NECESSARY WILL DEPEND ON THE SIZE OF THE ROOT FAN AND THE ACTUAL CONDITION OF THE SITE AT THE TIME OF CONSTRUCTION.
5. ROOT WADS SHOULD BE FROM NATIVE HARDWOOD TREES WITH SPREADING ROOT SYSTEMS, NO TAP ROOTS.

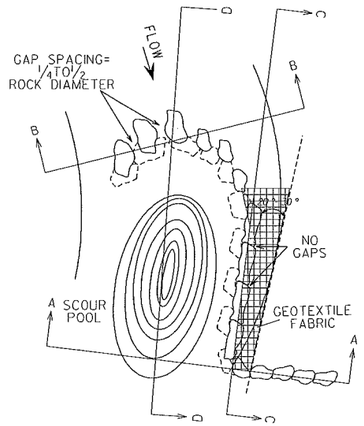
J-HOOK VANE DETAILS

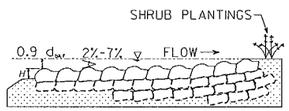


SECTION A-A

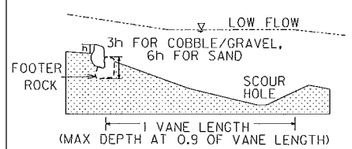


SECTION B-B

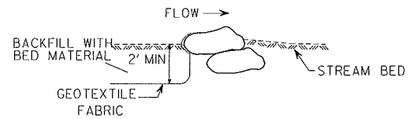




SECTION C-C



SECTION D-D



GEOTEXTILE FABRIC

NOTES:

1. BOULDERS SHOULD BE NATIVE QUARRIED ROCK OR LOCALLY SHOT ROCK, ANGULAR AND OBLONG WITH THE FOLLOWING DIMENSION:
2. AVERAGE SIZE IS 4'X3'X2' (APPROX. 3600 LB)
3. ROCKS SHOULD FIT TIGHTLY WITH MINIMAL SPACES.
4. FOOTER ROCKS SHOULD BE A MINIMUM OF 3 TIMES 'H' IN GRAVEL BED STREAMS.
5. GEOTEXTILE FABRIC SHOULD BE PLACED ON UPSTREAM SIDE OF BOULDERS. FABRIC SHOULD BE OVERLAIN ON EXPOSED BOULDERS AND BURIED TO A MINIMUM DEPTH OF 2 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD EXTEND UPSTREAM A MINIMUM LENGTH OF OF 6 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD BE BACKFILLED WITH 3" STONE.
6. H = MIN. OF 0.3'

DETAILS
NOT TO SCALE

PROJECT ENGINEER	PROJECT REFERENCE NO.	SHEET NO.
INCOMPLETE PLANS DO NOT USE FOR CONSTRUCTION	DYE BRANCH STREAM RESTORATION	2H
	DETAILS	

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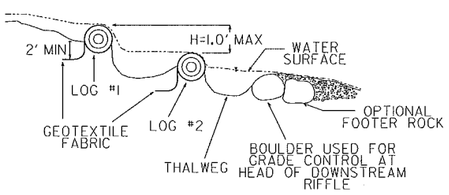
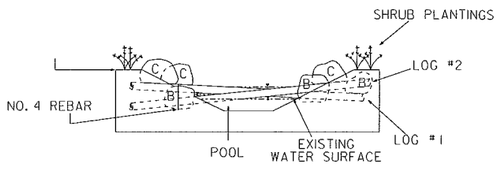
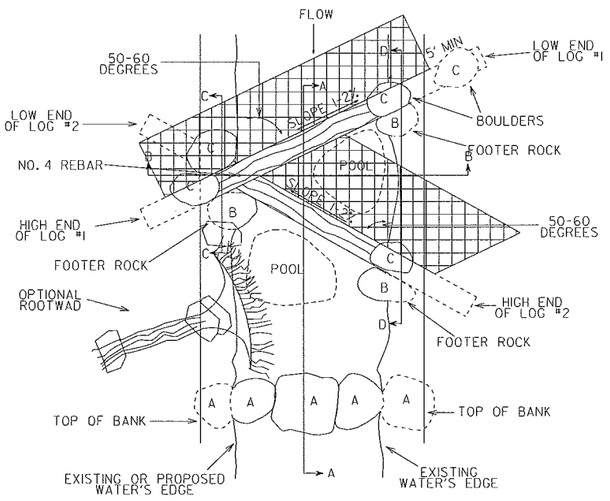
DOUBLE LOG DROP STRUCTURE



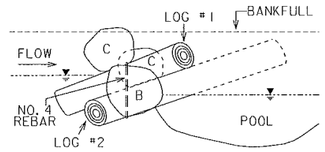
SECTION A-A



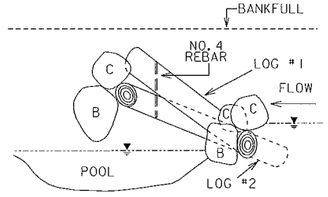
SECTION B-B



PLAN VIEW



SECTION C-C



SECTION D-D

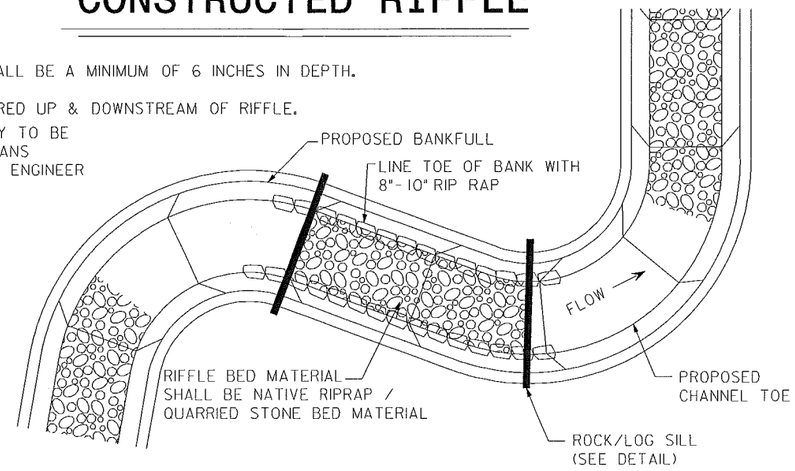
NOTES:

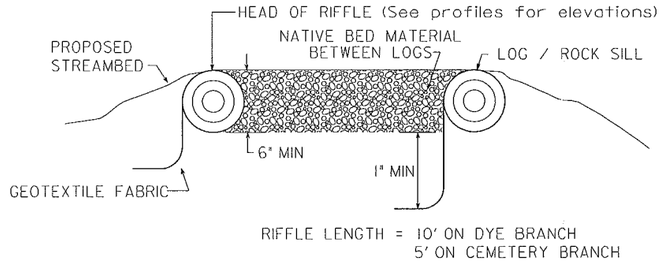
1. LOGS MAY BE NOTCHED TO ALLOW FOR PROPER CONNECTION. THEY SHOULD BE ANCHORED TO ONE ANOTHER VIA NO. 4 REBAR BY DRILLING AND HAMMERING.
2. LOGS SHOULD BE OBTAINED FROM ON-SITE RESOURCES, WHEN APPROPRIATE. THEY SHOULD CONSIST OF NATIVE HARDWOOD MATERIAL, UNLESS DIRECTED OTHERWISE BY ON-SITE ENGINEER. MINIMUM DIAMETER OF LOGS IS 12 INCHES.
3. BOULDERS SHOULD BE NATIVE QUARRIED ROCK, OR LOCAL SHOT ROCK, ANGULAR OR OBLONG WITH THE FOLLOWING DIMENSIONS: 4' x 3' x 2' (1.75 TONS) OR LARGER.
4. GEOTEXTILE FABRIC SHOULD BE PLACED ON UPSTREAM SIDE OF LOGS. FABRIC SHOULD BE ATTACHED TO THE LOGS VIA 1.0 INCH LONG MINIMUM ROOFING NAILS WITH PLASTIC WASHERS SPACED NO GREATER THAN 16 INCHES APART. THE ATTACHMENT POINT SHOULD BE APPROXIMATELY ONE HALF THE HEIGHT OF THE LOG SO THAT IT REMAINS UNSEEN ONCE THE STRUCTURE IS COMPLETED. FABRIC SHOULD BE BURIED TO A MINIMUM DEPTH OF 2.0 FEET, OR AS DIRECTED BY THE ON-SITE ENGINEER. FABRIC SHOULD EXTEND UPSTREAM A MINIMUM LENGTH OF 6.0 FEET, OR AS DIRECTED BY THE ON-SITE ENGINEER. FABRIC SHOULD BE BACKFILLED WITH NATIVE STONE, OR THE APPROPRIATE STREAM BED COMPOSITION, AS DIRECTED BY ON-SITE ENGINEER.
5. H = MIN. OF 0.2", UNLESS DIRECTED OTHERWISE BY ON-SITE ENGINEER. MAX OF 1.0'

CONSTRUCTED RIFFLE

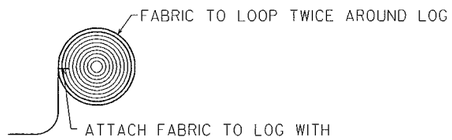
1. RIFFLE BED MATERIAL SHALL BE A MINIMUM OF 6 INCHES IN DEPTH.
2. ROCK OR LOG SILL REQUIRED UP & DOWNSTREAM OF RIFFLE.

* RIFFLE BED MATERIAL ONLY TO BE INSTALLED AS SHOWN ON PLANS OR AS DIRECTED BY ON-SITE ENGINEER





FABRIC INSTALLATION



NOTES:

1. SILL TO BE CONSTRUCTED OF BOULDERS 3' X 2' X 1' (MIN. SIZE) OR LOGS WITH A DIAMETER OF 12' MINIMUM.
2. RIFFLE BED MATERIAL TO BE NATIVE BED RIP RAP/ QUARRIED STONE MATERIAL INSTALLED TO A MINIMUM OF 6" IN DEPTH.
3. GEOTEXTILE FABRIC TO USED ON ALL SILLS (ROCK & LOG). IF LOG SILLS ARE USED, FABRIC SHOULD WRAP AROUND LOG A MINIMUM OF 2 TIMES.
4. LOG SILLS SHALL BE ANCHORED AT TOE OF BANKS WITH BOULDERS TO PREVENT FLOATING OF LOG OR SCOUR.
5. TOE OF BANK TO BE LINED WITH 8"-10" RIP RAP.

DETAILS
NOT TO SCALE

PROJECT ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR CONSTRUCTION

PROJECT REFERENCE NO.	SHEET NO.
DYE BRANCH STREAM RESTORATION	2G

DETAILS

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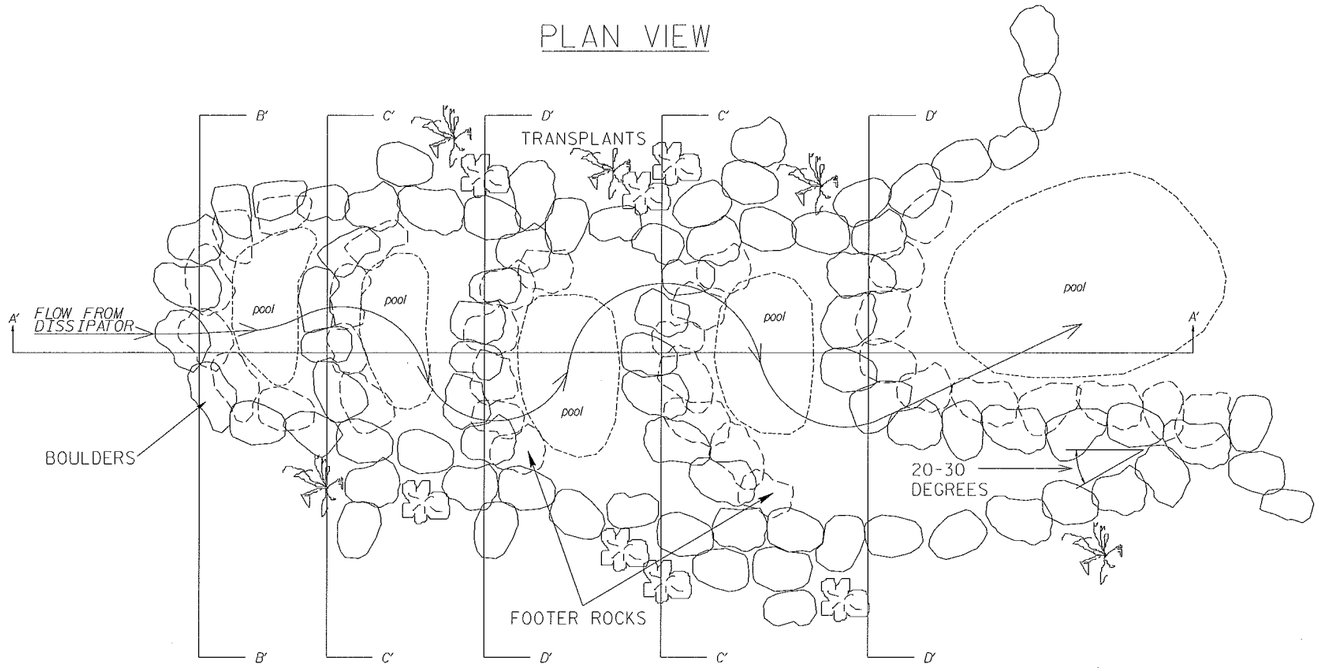
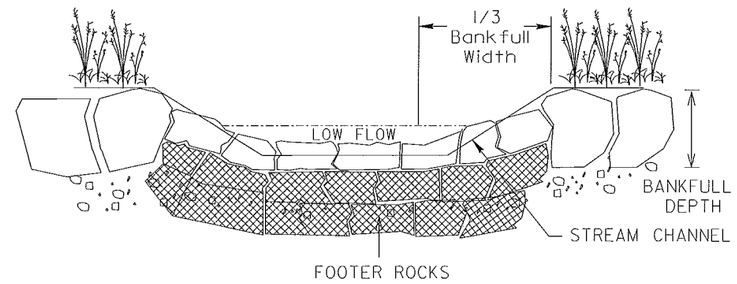
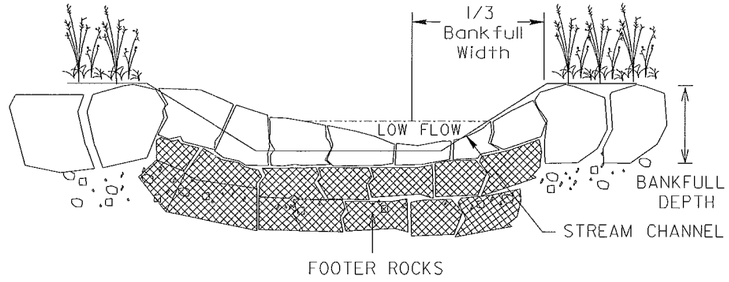
PLAN VIEW



SECTION B-B



SECTION C-C



NOTE: BOULDERS SHOULD BE NATIVE QUARRIED ROCK OR LOCALLY SHOT ROCK, ANGULAR AND OBLONG WITH APPROXIMATE MINIMUM DIMENSIONS OF 4' X 3' X 2' FOR DYE BRANCH.

ROCKS SHOULD FIT TIGHTLY WITH MINIMAL SPACES

FOOTER ROCKS SHOULD BE A MINIMUM OF 6 TIMES 'H' IN SAND BED STREAMS AND 3 TIMES 'H' FOR COBBLE/ GRAVEL BED STREAMS.

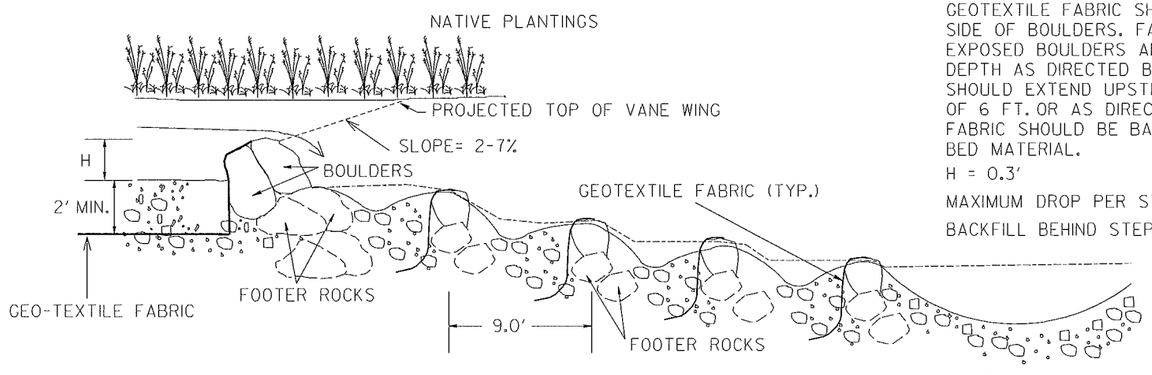
GEOTEXTILE FABRIC SHOULD BE PLACED ON UPSTREAM SIDE OF BOULDERS. FABRIC SHOULD BE OVERLAIN ON EXPOSED BOULDERS AND BURIED TO A MINIMUM DEPTH AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD EXTEND UPSTREAM A MINIMUM LENGTH OF OF 6 FT. OR AS DIRECTED BY ON SITE DESIGNER. FABRIC SHOULD BE BACKFILLED WITH EXISTING BED MATERIAL.

H = 0.3'

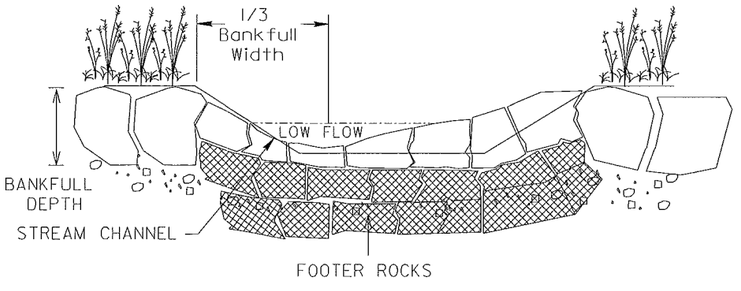
MAXIMUM DROP PER STEP = 1.0'

BACKFILL BEHIND STEPS WITH 3" WASHED STONE

SECTION A-A'



SECTION D-D



STEP POOL DETAIL

Debris in Dye Branch upper reach. Approximately 50 feet downstream of Center Ave.

Old pipe in Dye Branch upper reach. Approximately 80 feet upstream of Mclelland Street culvert.

Existing basketball courts along middle reach of Dye Branch. Proposed area for channel relocation.

Eroded banks along western side of basketball courts. Dye Branch middle reach.

Eroded banks along southern end of basketball courts. Dye Branch middle reach.

Concrete in steam on western side of basketball courts. Dye Branch middle reach looking downstream.

Eroded bank near Cabarrus Street. Dye Branch lower reach.

Eroded bank along last house before project ending boundary. Dye Branch lower reach.

Photo Point 1. View looking downstream from Center Avenue.

Photo Point 2. View looking upstream on Dye Branch from Mclelland Street.

Photo Point 2. View looking downstream on Dye Branch from McLelland Street.

Photo Point 3. View looking north toward the cemetery.

Photo Point 3. View looking south toward the bathrooms in Glenwood Memorial Park.

Photo Point 4. View looking upstream from Cabarrus Avenue.

Photo Point 4. View looking downstream from Cabarrus Avenue.

Photo Point 5. View looking at washout area approximately 50 ft. downstream of Cabarrus Avenue.

Photo Point 6. View looking upstream from lower end of existing Dye Branch.

Photo Point 7. View looking downstream on existing Cemetery Branch near confluence with Dye Branch.

Photo Point 7. View looking upstream on existing Cemetery Branch toward Church Street.

Photo Point 8. View looking southeast toward existing Cemetery Branch.

Photo Point 8. View looking southwest toward existing Cemetery Branch.