Mason Farm Wetland/Floodplain Restoration & Stream/buffer Enhancement
Chapel Hill, Orange & Durham Counties, North Carolina

Restoration Plan

July 3, 2008

Prepared for: NCDENR-EEP
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Executive Summary

The Mason Farm Wetland/Floodplain Restoration & Stream Buffer Enhancement project is located within the Mason Farm Biological Reserve (MFBR) and is owned by the University of North Carolina at Chapel Hill. The proposed project includes the restoration of 17.5 acres of wetlands, the preservation of 8 acres of existing wetlands, and the enhancement of 7 acres of riparian floodplain. An easement has been granted by the University for the approximately 34-acre project site. The site is located within the floodplain of Morgan Creek, which, except for 10-year or greater storm events, has been disconnected from the natural floodwaters by a man-made berm. Of the 34 acres, approximately seven are classified as wetlands. Of the remaining 27 acres, approximately 17.5 are impacted wetlands and the remainder is upland floodplain. The area to be restored is an old agricultural field undergoing succession on the eastern half of the site and a plantation of poplars and Chinese tulip trees in the western half of the site that was once a research project.

The goals of the restoration plan focus on improving water quality and ecological functions for Morgan Creek and the Jordan Lake watershed through the following:

- Increased overbank flooding to promote wetland habitats.
- Attenuation of floodwater sediments and nutrients within the floodplain.
- Retention of floodwaters thereby reducing downstream flooding.
- Reduced stormwater flow bank shear stress on Morgan Creek thereby improving localized bank and channel stabilization.

The goals will be obtained through the following project-specific objectives, with the primary means to reaching these objectives being to breach the man-made berm along Morgan Creek:

- Increase the frequency of floodplain flooding to approximately 2.5 times/year
- Restore wetland hydrology to 17.5 acres of impacted wetlands
- Preserve an existing 8-acre wetland
- Re-establish native wetland and riparian plant communities
- Treat and remove non-native invasive plant species
- Preserve 3200 linear feet of riparian buffer on the south bank of Morgan Creek

This effort is consistent with the Morgan and Little Creeks Local Watershed Plan developed by EEP in September 2004, where the stated goal is “to improve and protect watershed functions and prevent functional losses within the Morgan and Little Creeks Watershed Planning Area”.

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1.0 Introduction

In September 2004, the North Carolina Ecosystem Enhancement Program (EEP) published the Morgan and Little Creeks Local Watershed Plan (LWP). The main goal of the LWP is "to improve and protect watershed functions and prevent functional losses within the Morgan and Little Creeks Watershed Planning Area". In accordance with this effort, EEP is performing wetland/floodplain restoration and stream buffer enhancement on the 36.5-acre Mason Farm Mitigation Site in Orange and Durham Counties, NC. The site is part of the Mason Farm Biological Reserve (MFBR) and is owned by the University of North Carolina at Chapel Hill (UNC). EEP has an agreement with UNC to place a permanent conservation easement on the site.

The project site is within the floodplain of Morgan Creek. An approximately 3,800-foot long berm was constructed in the 1940's and runs along the south bank of the creek to control flooding. While the berm, in conjunction with several drainage ditches, created conditions suitable for agriculture, it resulted in loss of the ecological functions of the floodplain and wetlands, as floodwaters now reach the project site only once a decade. There are approximately 17.5-acres of soil within the study area that show evidence of historically supporting wetland hydrology. There is also an 8-acre remnant of the previous functioning wetland at the eastern most extent of the project site. This area receives backwater flooding from Morgan Creek, which is the result of beaver colonizing the creek just downstream of the project site.

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1.1 Directions to Project Site

The project site is a part of the North Carolina Botanical Gardens (NCBG), a unit of the University of North Carolina at Chapel Hill. Located within MFBR southeast of the NCBG's Main Visitor Site, the site is accessed by permit only. Permits are available

through the Botanical Garden main office. Mr. Johnny Randall is the Assistant Director for Conservation for the Botanical Garden.

From Raleigh: take I-40 west to Exit 273, Hwy 54, towards Chapel Hill. At the intersection of Highway 54 and Highway 15-501, Fordham Boulevard, take 15-501 south/Highway 54 west. At the first traffic light, Mason Farm Road, take a left. Follow Mason Farm Road for approximately .65 miles. Turn right into the parking lot for the A.E. Finley Golf Course. Drive around the edge of the parking lot and past the driving range. Once past the driving range, the main road turns to the left and becomes gravel. At this point there is a break in the brick wall along the right side of the road where a dirt road begins. This dirt road goes to the right, towards the sewage plant, and to the left into MFBR. Follow the dirt road to the left, paralleling the north side of Morgan Creek. Within one mile there is an intersection. Turn right and follow the road south over a concrete ford that crosses Morgan Creek and heads back into the project site. There is a small parking lot on the south side of the creek. Past the parking lot the road continues past a gate into MFBR. Stay to the left at the Y-intersection located approximately 750 feet past the parking lot. Turn left approximately 600 feet east of the intersection on to an existing gravel road that bisects the project site.

1.2 USGS Hydrologic Unit Code

The United States Geological Survey (USGS) uses a multi-tiered system to divide and sub-divide the country's watersheds into successively smaller hydrological units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of various numbers of digits depending on the level of classification within the hydrologic unit system. Under the USGS system, the Cape Fear River Basin contains seven 8-digit hydrologic units (New, Haw, Deep, Upper Cape Fear, Lower Cape Fear, Northeast Cape Fear, and Black). The Mason Farm Project Site is located in the Haw River Basin, HUC 03030002 (USGS 2005).

The 8-digit units are further sub-divided into smaller 14-digit hydrologic units that are used for smaller scale planning. The project Site is located in the 14-digit HUC 03030002060080. EEP has included this 14-digit HUC as a targeted local watershed (TLW). TLW's exhibit the need and opportunity for stream and wetland restoration to benefit water quality, aquatic habitat, and other vital watershed functions.

1.3 NC DWQ River Basin Designations

The North Carolina Division of Water Quality (NCDWQ) uses a two-tiered system to divide the state into watershed units. The state is divided into seventeen major river basins with each basin further subdivided into sub-basins (NCDWQ 6-digit sub-basins). The project area is located within sub-basin 03-06-06 of the Cape Fear River Basin (DWQ 2000). This area is part of USGS Hydrologic Unit 03030002 of the South Atlantic/Gulf Region. This river basin covers 9,393 square miles and at least portions of 24 counties (DWQ 2000).

1.4 Project Vicinity Map

The project site is located within MFBR, a 367-acre property within both Orange and Durham Counties. The project study area is approximately 34 acres that runs parallel and south of Morgan creek. The project site begins east of the existing ford on Morgan Creek and the reserve parking area and continues east approximately 3,000 linear feet. The project vicinity maps are included in Section 9.0, Figures 1 and 1A.

2.0 Watershed Characterization

2.1 Drainage Area

The drainage area for the project site is approximately 41.73 square miles at the downstream limit of the project where the berms along both sides of Morgan Creek become smaller and eventually disappear. The drainage area at the upstream limit of the project is approximately 41.4 square miles.

The watershed boundary begins north of the headwaters of Morgan Creek, just over five (5) miles northwest of Carrboro. The watershed boundary generally follows Morgan Creek in a south-southeast direction until Morgan Creek reaches University Lake. The watershed is narrower by the headwaters of Morgan Creek and widens out as Morgan Creek enters University Lake. Downstream of University Lake, Morgan Creek flows generally eastward until it reaches the Durham/Orange County Line, where it turns south and flows into Jordan Lake. The watershed boundary follows Morgan Creek generally eastward, narrowing as it gets closer to the county line.

The northern and western portions of the watershed are rural with a significant amount of farm land. As Morgan Creek reaches University Lake towards the Towns of Carrboro and Chapel Hill, the watershed becomes more urbanized. East of University Lake, the northern portion of the watershed is still primarily urban and drains the southern part of the Town of Chapel Hill and the University of North Carolina at Chapel Hill. The southern portion of the watershed in this area is still relatively rural but is experiencing a recent increase in new housing, especially along Highway 15/501. Land use in the easternmost portion of the watershed where the project site is located includes the A.E. Finley Golf Course, a sewage treatment plant, NCBG, and residential neighborhoods. The Morgan Creek watershed is shown in Section 9.0, Figure 2.

2.2 Surface Water Classification

Best Usage Classifications are ranks assigned to surface waters by the NCDWQ in accordance with *Procedures for Assignment of Water Quality Standards* (15A NCAC 2B .0100) and *Classifications and Water Quality Standards Applicable to the Surface Waters of North Carolina* (15A NCAC 2B .0200). These classifications serve to protect water quality by governing the uses of the water resource.

Morgan Creek (DWQ Stream Index Number 16-41-2-8) and an unnamed tributary are the two perennial streams within the project area. The NCDWQ Stream Classification Forms can be found in Appendix 3. DWQ classifies Morgan Creek as WS-IV; NSW. WS-IV waters are generally located within moderately to highly developed watersheds. The

NSW classification denotes nutrient sensitive waters that need additional nutrient management. According to the NCDWQ 303(d) list, this portion of Morgan Creek is classified as Impaired for Aquatic Life because fecal coliform bacteria levels were exceeded. The Mason Farm and Carolina Meadows Waste Water Treatment Plants (WWTP) point source discharge to Morgan Creek and have had significant permit violations for fecal coliform bacteria during the last two years of assessment. The violations at Mason Farm occurred during plant upgrades and are not ongoing (NCDWQ 2005). The project site is also located within the Jordan Lake water supply watershed. NCDWQ is currently developing total maximum daily loads (TMDLs) for phosphorus and nitrogen for Jordan Lake.

2.3 Physiography, Geology and Soils

The study site is located within the flood plain of Morgan Creek in the Piedmont physiographic region of North Carolina. The Piedmont is the area between the mountains to the west and the coastal plain to the east and ranges in elevation from approximately 300 feet to 1,500 feet. The average elevation within the project site is below 300 feet. Slopes within the project site are relatively flat and range from 0 to 2 percent.

Within the Piedmont, major types of bedrock determine the soil system. These soil systems are the felsic crystalline terrains composed of granite, gneiss, mica gneiss and schist, the Carolina Slate Belt composed of bedded argillites, felsic volcanics and mafic volcanics and fine-grained schists, the Triassic Basin composed of Triassic mudstones, sandstones, shales and conglomerates, and the mixed mafic and felsic rock, which is a very complex area of granites, diorites, gabbros, and other rocks occurring in an intimate spatial association (Daniels et al, 1999). The watershed for the project site contains the first three of the four major soil systems in the Piedmont: the felsic crystalline terrains, the Carolina Slate Belt, and the Triassic basins.

The site is within the Triassic basin, which is an area of lower elevation, ranging from 230 to 420 feet, overlying easily erodible sedimentary rock. The upland areas are dissected by waterways, and the floodplains are wide with meandering stream and rivers.

The majority of the watershed consists of Slate Belt and Triassic Basin soils. General soil types within the Slate Belt (Georgeville, Herndon, Tatum, Goldston Soil Series) are gently sloping and well drained with a silt loam and slaty silt loam surface layer, and subsoil ranging from clay loam, silty clay, silty clay loam, and clay. General soil types in the Triassic Basin (White Store, Creedmoor Soil Series) are strongly sloping, moderately well drained with a loam and fine sandy loam surface layer and clay loam, clay, silty clay, silty clay loam, and sandy clay loam subsoil.

2.4 Historical Land Use and Development Trends

MFBR was donated to the University of North Carolina at Chapel Hill in 1894 by bequest of Mary Elizabeth Morgan Mason, one of the last descendants of the Morgan family who had settled in the southeast corner of Orange County in the 1740s. The Project Area has likely been cleared since colonial times. The earliest record of the berm dates to between the 1940's and 50's. It is likely that Morgan Creek was moved in

conjunction with the berm construction. Several drainage ditches were also constructed in an effort to drain the site for agricultural use. The berm and ditches have been continuously maintained. Portions of the project area have also been utilized as a field laboratory for UNC-Chapel Hill, though presently there is no active research or crop production. Today the area is administered by the NCBG as both a natural area and biological field station (North Carolina Botanical Garden website, 2006).

The berm and ditches effectively altered the site hydrology to allow it to be used for agriculture and/or pasture. Removing the native vegetation, altering the hydrology, and continual soil management (plowing, ditching) has effectively negated the ecological benefits of an active wetland/floodplain. The objectives of this project are expected to result in the restoration of these ecological benefits.

The population of Orange County has grown by 173% from 1950 to 1990. As of 1990 57.4 % of county residents lived within the municipal limits of four of the county's towns: Carrboro, Chapel Hill, Hillsborough and Mebane. Within these municipalities residential development has largely been focused in Chapel Hill, which has accounted for 64% of all residences built in municipal portions of the county between 1950 and 1990. The percentages for Carrboro, Hillsborough, and the Orange County portion of Mebane, are 28%, 7% and 0.69% respectively (Shaping Orange County's Future [SOCF] Task Force [Task Force], 2000).

The annual population growth rate is projected to be 1.45% between 1998 and 2030. In 2030, an estimated 178,740 persons will live in the county. In the next 30 years, it is projected under current patterns that two thirds as much land will be developed as has been developed from the time of European settlement to the present day. If current trends continue, an estimated 46% of land in the county will be developed by 2030, compared to 28% in 1998. If the trend in prime forest loss from 1988 to 1996 continues (a reduction of 1,000 acres per year), by 2030 there would be less than 47,000 acres of prime forests left, or about 52% of the 90,000 acres existing in 1988. Prime forest is defined as hardwood or mixed hardwood forests at least 40 acres in size that are undisturbed, or only slightly disturbed by human activity (Task Force, 2000).

The Morgan and Little Creeks Local Watershed Plan prepared by the NCDWQ Ecological Enhancement Program (NCEEP) September 2004, discusses the need for the improvement of watershed functions. The report states "factors contributing to this decline in functional health downstream include increased imperviousness, disturbance of the overall forest cover, the degree of riparian buffer disturbance and the amount of encroachment into floodplain areas." "Future development threatens to increase imperviousness in the rural headwater and currently forested areas of the watershed." The trends of the watershed effect the stability of Morgan Creek and flood flows within the project area.

2.5 Endangered/Threatened Species

Some populations of fauna and flora have been, or are, in the process of decline due to either natural forces or their inability to coexist with humans. Federal law [under

provisions of Section 7 of the Endangered Species Act of 1973, as amended (ESA)] requires that any action likely to adversely affect a species classified as federally protected is subject to review by the USFWS. Other species may receive additional protection under the state Endangered Species Act of 1987, and the North Carolina Plant Protection and Conservation Act of 1979.

A search of the North Carolina Natural Heritage Program (NCNHP) database of rare plants, animals, and natural areas was conducted on January 19, 2006. One record, from the 1950's, of the gold-banded skipper (*Autochton cellus*) was found within the MFBR. This species is ranked as Significantly Rare (SR) for Orange County, North Carolina. Currently the gold-banded skipper is not federally protected. No threatened and endangered species or federally designated habitats were found within 1 mile (1.6 kilometers) of the project site.

According to the North Carolina Wildlife Resources Commission (NCWRC) there are records for the bald eagle and the four-toed salamander (*Hemidactylium scutatum*) near the project site. The four-toed salamander has no federal protection status and is a species of Special Concern in the Orange County, North Carolina. See Appendix III.

As of February 25, 2003, the USFWS had identified four Endangered (E) species as potentially occurring in Orange County (Table 1). As of February 11, 2003 the USFWS had identified two Endangered species, one Threatened species, and 12 Federal Species of Concern (FSC) as potentially occurring in Durham County (Table 2). The site was traversed to determine if any suitable habitat existed for these species.

Table 1: Federally Threatened and Endangered Species Orange County, North Carolina (02/25/2003)

Common Name	Scientific Name	Status
Red-cockaded woodpecker	*Picoides borealis*	Endangered**
Dwarf wedgemussel	*Alasmidonta heterodon*	Endangered
Michaux's sumac	*Rhus michauxii*	Endangered
Smooth coneflower	*Echinacea laevigata*	Endangered*

* Historic Record: the species was last observed in the county more than 50 years ago.
** Obscure Record: the date and/or location of observation is uncertain.

Table 2: Federally Threatened and Endangered Species Durham County, North Carolina (02/11/2003)

Common Name	Scientific Name	Status
Bald Eagle	*Haliaeetus leucocephalus*	Threatened*
Michaux's sumac	*Rhus michauxii*	Endangered
Smooth coneflower	*Echinacea laevigata*	Endangered*

* Historic Record: the species was last observed in the county more than 50 years ago.

Red-cockaded woodpecker (*Picoides borealis*)

Family: Picoidae
Endangered
Date Listed: October 13, 1970

The red-cockaded woodpecker (RCW) is 7.1 to 7.9 inches (18-20 centimeters) long with a wingspan of 13.8 to 15.0 inches (35-38 centimeters). It is identified by plumage that is entirely black and white except for small red streaks on the sides of the nape of the male. The back of the RCW is black and white horizontal stripes and it has a large white cheek patch surrounded by a black cap, nape, and throat. Its diet is composed mainly of insects, including ants, beetles, wood-boring insects, caterpillars, and corn earworms, if available. About 16 to 18 percent of the diet includes seasonal wild fruit (USFWS, 2000).

The RCW is found in open pine forests in the southeastern United States. The RCW is unique among woodpeckers because it nests exclusively in living pine trees. The RCW uses open old growth stands of southern pines, particularly longleaf pine (*Pinus palustris*), for foraging and nesting habitat. Slash, pond, or loblolly pines (*Pinus elliottii, P. serotina, and P. taeda*, respectively) will also be utilized if longleaf is not available.

A forested stand must contain at least 50% pine and lack a thick understory. These birds excavate nests in pines greater than 60 years old within pine stands at least 30 years of age. The foraging range of the RCW may extend 200 hectares (500 acres) and must be contiguous with suitable nesting sites. In good, well stocked pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres (32-51 hectares).

Living pines infected with red-heart disease (*Formes pini*) are often selected for cavity excavation because the inner heartwood is usually weakened. Cavities are located from 12 to 100 feet (3.6 to 30.3 meters) above ground level and below live branches. These trees can be identified by "candles", large encrustations of running sap that surrounds the nest. Clusters consist of one to many of these candle trees. The RCW lays its eggs in April, May, and June; the eggs hatch approximately 38 days later. Most often, the parent birds and some of their male offspring from previous years form a family unit called a group. Commonly, these groups are comprised of three to five birds. Rearing the young

birds becomes a shared responsibility of the group. However, a single pair can breed successfully without the benefit of the helpers.

BIOLOGICAL CONCLUSION NO EFFECT

No suitable habitat in the form of old-growth pine dominated communities for RCW occurs within the project area. Based on NCNHP records, this species has not been documented to occur within 1 mile (1.6 kilometer) of the study area. Consequently, the proposed stream restoration will have "No Effect" on red-cockaded woodpeckers.

Dwarf wedge mussel (*Alasmidonta heterodon*)

Family: Unionidae
Endangered
Date Listed: March 14, 1990

The dwarf-wedge mussel is relatively small, rarely exceeding 1.5 inches in length. The shell's outer surface (periostracum) is usually brown or yellowish brown in color, with faint green rays that are most noticeable in young specimens. Unlike some mussel species, the male and female shells differ slightly, with the female being wider to allow greater space for egg development. A distinguishing characteristic of this mussel is its dentition pattern; the right valve possesses two lateral teeth, while the left valve has only one. This trait is opposite of all other North American species having lateral teeth (Clark 1981).

The dwarf wedge mussel is limited in distribution to the Tar and Neuse River basins where it inhabits creeks and rivers with slow to moderate current and a sand, gravel, or muddy bottom. Toxic effects from industrial, domestic and agricultural pollution are the primary threats to this mussel's survival (USFWS 1993).

BIOLOGICAL CONCLUSION NO EFFECT

The dwarf wedgemussel is not known to occur in the Cape Fear River Basin. Based on NCNHP records, this species has not been documented to occur within 1 mile (1.6 kilometer) of the study area. Consequently, the proposed wetland restoration and will have "No Effect" on this species.

Michaux's sumac (*Rhus michauxii*)

Family: Anacardiaceae
Endangered
Date Listed: September 28, 1989

Michaux's sumac, a densely hairy shrub with erect stems 1 to 3 feet (0.3 to 0.9 meters) in height, grows in sandy or rocky open woods in association with basic soils. Michaux's sumac has compound leaves which are narrowly winged at the base, dull on the top, and

veiny and slightly hairy on the bottom. Each leaf is finely toothed on its edges. Most plants are unisexual; however, more recent observations have revealed plants with both male and female flowers on one plant. The flowers are small, borne in a terminal, erect, dense cluster, and colored greenish yellow to white. Flowering usually occurs from June to July; while the fruit, a red drupe, is produced through the months of August to October.

Michaux's sumac survives best in areas that are open due to some form of disturbance such as roadside rights-of way, artificially maintained clearings, or in areas with periodic fires. It was once found in Georgia, South Carolina, and North Carolina but now only has viable populations North Carolina. Just four plants still survive in one county (down from five counties) in Georgia. In South Carolina, two populations of the plant were historically known; now, the plant is considered extirpated from that State. Currently, the plant survives in the following North Carolina Counties: Richmond; Hoke; Scotland; Franklin; Davie; Robeson; and Wake. It has been eliminated from Durham, Moore, Orange, Randolph, Wilson, Lincoln, and Mecklenburg counties. Of the 15 existing populations in North Carolina, nine have less than 100 plants each, and three of these have less than a dozen plants each (USFWS 1993).

BIOLOGICAL CONCLUSION NO EFFECT

Michaux's sumac is known historically from Orange County, but is considered to have been extirpated from the county. Based on NCNHP records, this species has not been documented to occur within 1 mile (1.6 kilometer) of the study area. Consequently, the proposed wetland restoration will have "No Effect" on Michaux's sumac.

Smooth coneflower (*Echinacea laevigata*)

Family: Asteraceae
Endangered
Date Listed: October 8, 1992

Smooth coneflower is a rhizomatous perennial herb that grows up to 4.9 feet (1.5 meters) tall. The stem is smooth. Basal leaves are smooth to slightly rough and are the largest, reaching 7.9 inches (20 centimeters) in length and 2.9 inches (7.5 centimeters) in width. They have long stems, and are elliptical to broadly lanceolate, tapering to the base. Mid-stem leaves have shorter stems or no stems and are smaller in size than the basal leaves. Flower heads are usually solitary with drooping petals light pink to purplish in color and 1.9 to 3.1 inches (5 to 8 centimeters) long. Flowering occurs from May through July.

Smooth coneflower is usually found in open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium- and calcium-rich soils associated with limestone (in Virginia), gabbro (in North Carolina and Virginia), diabase (in North Carolina and South Carolina), and marble (in South Carolina and Georgia). Smooth coneflower is found in areas with abundant sunlight and few

competitors which are usually associated with periodic disturbances such as fire (USFWS 1995).

BIOLOGICAL CONCLUSION NO EFFECT

No suitable habitat for smooth coneflower occurs within the project area. Based on NCNHP records, this species has not been documented to occur within 1 mile (1.6 kilometer) of the study area. Consequently, the proposed wetland restoration will have "No Effect" on smooth coneflowers.

Bald eagle (*Haliaeetus leucocephalus*)

Status: Threatened (proposed for delisting)
Family: Accipitridae
Listed: March 11, 1967

The bald eagle is a large raptor. The characteristic adult plumage consists of a white head and tail with a dark brown body. Juvenile eagles are completely dark brown and do not fully develop the majestic white head and tail until the fifth or sixth year. Fish are the primary food source but bald eagles will also take a variety of birds, mammals, and turtles (both live and as carrion) when fish are not readily available. Adults average about 3 feet (0.9 meters) from head to tail, weigh approximately 10 to 12 pounds (4.5 to 5.4 kilograms) and have a wingspread that can reach 7 feet (2.1 meters). Generally, female bald eagles are somewhat larger than the males (USFWS 1992a).

BIOLOGICAL CONCLUSION NO EFFECT

No suitable habitat for the bald eagle occurs within the project area. Based on NCNHP records, this species has not been documented to occur within 1 mile (1.6 kilometer) of the study area. Consequently, the proposed stream restoration will have "No Effect" on the bald eagle.

2.5.1 Federal Designated Critical Habitat

Letters were sent to United States Fish and Wildlife Service (USFWS) and the North Carolina Wildlife Resource Commission (NCWRC) on January 5, 2006, requesting information concerning endangered species and any other wildlife matters at the project site (Appendix III). Additionally, a search of the North Carolina Natural Heritage Program (NCNHP) database of rare plants, animals and natural areas conducted on January 19, 2006, revealed no records of federally designated habitat. No response was received from USFWS within 30 days of mailing. A response was received NCWRC stating there was records for the threatened bald eagle and state special concern four toed-salamander (*Hemidactylium scutatum*) near the project site. NCWRC does not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

2.6 Cultural Resources

Five areas within the MFBR may be eligible for inclusion in the National Register of Historic Places (see Appendix 10). Only two of these sites are within the project site and neither will be impacted or disturbed by the restoration activities.

2.7 Potential Constraints

2.7.1 Property Ownership and Boundary

The project site is part of the Mason Farm Biological Reserve (MFBR), and is owned by the State of North Carolina and managed by the North Carolina Botanical Gardens and the University of North Carolina at Chapel Hill. The MFBR is approximately 367 acres of forests and fields that protects natural areas and supports academic research and public education. The North Carolina Ecosystem Enhancement Program is currently in discussions on language and location for a proposed conservation easement that will contain the entire project site.

2.7.2 Site Access

Right of Entry to the project site will be provided through MFBR, which has public access. Access to the site, as described in Section 1.1, is through the parking lot of the A.E. Finley Golf Course. The only way to get to the side of the stream to the project site is to cross the ford over Morgan Creek. This will not likely present any problems for construction vehicles.

2.7.3 Utilities

There are no utilities in the project area.

2.7.4 FEMA/Hydrologic Trespass

The Federal Emergency Management Agency (FEMA) regulates Morgan Creek floodwater elevations. Floodway limits have been established by FEMA on Morgan Creek to the Durham/Orange County line, which includes one half of the study site and the area in which the berm has been constructed. Typically, land disturbing activities within a FEMA regulated floodway are permitted only with a detailed analysis showing that no rise in the 100 year floodplain or floodway will occur due to these activities. The entire project site is located within the 100-year floodplain of Morgan Creek. The floodplain and floodway limits of Morgan Creek are shown on the Floodplain Restoration Overall Plan included in Section 9, Figure 6. Discussions have been held with Ms. Sue Burke the Floodplain administrator for the Town of Chapel Hill regarding the five planned berm openings. The existing berm is overtopped by the 10-year storm event. No impacts to the 100 year floodplain will occur in the model cross sections with the construction of these openings. Therefore no impacts will occur in the regulated flood hazard elevations. A letter to Ms. Burke regarding these discussions and conclusions are included in Appendix 9. The project is located on state owned land and therefore the floodplain development permit will be issued by the effective floodplain administrator, Mr. Bert Neily with the State Construction Office. A floodplain development application has been completed for this project. This correspondence is included in Appendix 9.

The United States Army Corps of Engineers (COE) has a flowage easement for Jordan Lake that extends within the project site. The flowage easement is a line originally established on the land contour elevation of 245 feet above mean sea level (msl). This easement and elevation represent the height to which the COE may raise the elevation of the backwater of B. Everett Jordan Lake. The flowage easement encompasses a set area that represents an available volume of water storage behind the Jordan Lake dam. The COE maintains this easement with the condition that no permanent fill is allowed. Mr. Michael Hozy with the B. Everett Jordan Lake Operations Center stated that the highest elevation the lake had ever been raised to was 236 feet above mean sea level (msl). The COE flowage easement is shown on the Floodplain Restoration Overall Plan included in Section 9, Figure 6. No permanent fill will be placed within this flowage easement.

3.0 Project Site Streams (Existing Conditions)

The headwaters of Morgan Creek begin approximately 5 miles northwest of the Town of Carrboro. The majority of Morgan Creek is located within the Carolina Slate Belt, but the project area is within the Triassic Basin. Streams within the slate belt or the felsic crystalline terrain have narrow valleys and flood plains that widen abruptly upon entering the Triassic Basin (Daniels et al, 1999). The portion of Morgan Creek adjacent to the study site is within the Triassic Basin and has a characteristic wide floodplain.

The project site is within the 100-year floodplain of Morgan Creek. A berm approximately 3,800 feet long was constructed along the south and north bank of the creek in the 1940's to reduce the frequency of flooding (the berm contains the 10-year flood events). The area was then used for agriculture. The berm varies in distance from the stream top of bank between 30 and 60 feet. The berm at its present height was most likely created to control flooding on what is now the project site resulting in the loss of the ecological functions of the floodplain and wetlands. The stream banks as well as the berm itself are well-vegetated. A remnant of the previous functioning wetland is the area 7 acres in size at the eastern most extent onsite along the berm. This area receives backwater flooding from Morgan Creek and has many beaver occupying the wetland.

The description of the stream is important in understanding the overbank flooding that will occur and stormwater volumes that will enter through the proposed berm openings. **NOTE: No stream work is proposed for this project.**

3.1 Channel Classification

Morgan Creek is classified as a C5 stream with an identifiable low flow channel width of 45-55 feet within the average bankfull width of 178 feet adjacent to the project area. The bankfull width extends beyond the low flow channel to the constructed berm. The "C" stream types are located in narrow to wide valleys, constructed from alluvial deposition. They have a well-developed floodplain that is slightly entrenched, are relatively sinuous with a channel slope of 2% or less and a bedform morphology indicative of a ripple/pool configuration. The "5" in the classification describes the channel further as a sand bed stream. (Rosgen, 1996). Morgan creek has been cut off from its access to the wide valley floodplain by the manmade berm.

Average data collected from field cross sections on Morgan Creek resulted in the following values:

Table 3: Characteristics of Morgan Creek within the Project Area

Parameter	Measurement
Bankfull Width	178 feet
Bankfull Cross-sectional area	623 square feet
Bankfull Mean Depth (area/width)	3.5 feet
Bankfull Maximum depth	7.5 feet
Width/Depth Ratio	51
Slope	.05%

3.2 Discharge

A United States Geological Survey (USGS) stream gauge identified as number 02097517 Morgan Creek near Chapel Hill, North Carolina, is located approximately one thousand (1,000) feet upstream of the project site on Morgan Creek and has been in operation for twenty two (22) years. From this data stream flows for storm events were determined for various return periods.

Cross-sections were measured at the gauge station and at several locations along Morgan Creek. From this data, bankfull was determined to be 1,300 cfs. Additionally the minimum event that will overtop Morgan Creek was determined to be approximately 1000 cfs.

A natural levee extends along the length of Morgan Creek. This levee in the project area creates a depression between it and the berm. Water is able to flow into the depression through elevation changes in the levee. The proposed berm openings will be at the elevation of this depression and existing berm toe with no earthwork extending any closer to the creek. Floodwaters will reach the project site after construction through the depression and then into the berm 'breaks'. Floodwaters will flow through the openings with a frequency of occurrence of two to two and one half times per year with a flow in Morgan Creek of approximately six hundred (600) cfs.

3.3 Channel Stability Assessment

Within the project limits Morgan Creek has a sandy bottom and a defined ripple/pool sequence. The stream is generally stable except for one area where the stream has over widened and a center bar has developed. The banks are generally well vegetated and stable within the project limits. There are areas along the banks where trees have fallen in the channel creating local areas of bank erosion. Woody debris is present within the channel at various locations along the stream length. A significant blockage of debris is located just downstream of the project area that is currently producing an approximate one foot rise in the water upstream of the blockage within the lower half of the project area. Beavers are in this area of the stream and below the project site.

4.0 Project Site Existing Conditions

4.1 Floodwaters

The berm contains the 10-year storm (peak flow of approximately 3,400 cfs). However, storm waters can, and do, backup into the project area from eastern edge of the project site (through the existing 8-acre wetland) where the berm ends. This back water flooding is the result of recent beaver colonization of Morgan Creek just downstream of the project site. The attached groundwater graphs reflect the colonization sometime in Fall 2006 as there is a marked increase in hydrology from Spring 2006 to Spring 2007.

The 100-year storm limits, as provided by the Federal Emergency Management Agency (FEMA), extend well into the Mason Farm Reserve property (Figure 6).

4.2 Vegetation

Plant community classifications follow those presented by Schafale and Weakley (1990) where possible (Figure 5). The dominant flora observed, or likely to occur, in each community are described and discussed. Scientific nomenclature and the common names (when applicable) are provided. Plant taxonomy typically follows Radford et al. (1968), Petrides et.al. (1998), and Niering et.al. (2001). All subsequent references to the same organism will include the common name only. Published range distributions and habitat analysis are used in estimating flora expected to be present within the project area. The vegetation community types and locations are shown on Figure 3-B in Section 6.0 Figures.

4.2.1 Piedmont/ Mountain Levee Forest

This community is located along wooded sections of the berm (levee) of Morgan Creek. The canopy consists of hackberry (*Celtis laevigata*), sweet gum (*Liquidambar styraciflua*), box elder (*Acer negundo*), American elm (*Ulmus americana*), water oak (*Quercus nigra*), green ash (*Fraxinus pennsylvanica*), black willow (*Salix nigra*), red maple (*Acer rubrum*), and sycamore (*Platanus occidentalis*). Sub-canopy and shrub species include black cherry (*Prunus serrotina*), box elder (*Acer negundo*), possumhaw viburnum (*Viburnum nudum*), elderberry (*Sambucus canadensis*), buckthorn (*Rhamnus* sp.), polkweed (*Phytolacca americana*), and painted buckeye (*Aesculus sylvatica*). The herbaceous layer is composed of blackberry (*Rubus* sp.), poison ivy (*Toxicodendron radicans*), American bittersweet (*Celastrus scandens*), catbrier (*Smilax rotundifolia*), and muscadine grape (*Vitis rotundifolia*). Invasive exotic species that are sporadic throughout this community include the Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), kudzu (*Pueraria montana*), and Japanese stiltgrass (*Microstegium vimineum*).

4.2.2 Piedmont/Mountain Bottomland Forest

This vegetative community is described in Schafale and Weakley (1990) as occurring in the floodplains of streams in the Piedmont and lower elevation mountain zones. This community is located on the eastern side of the project study area (Figure 5). The canopy species include black willow, green ash, box elder, sycamore, yellow poplar (*Liriodendron tulipifera*), and red maple. Sub-canopy and shrub species present are the

black willow, green ash, box elder, possumhaw viburnum, elderberry, red chokeberry (*Aronia arbutifolia*), buckthorn, red elm (*Ulmus rubra*), and Chinese privet. The herbaceous layer consists of Pennsylvania smartweed (*Polygonum pennsylvanicum*), arrowhead (*Sagittaria latifolia*), green arrow arum (*Peltandra viginica*), lizard's tail (*Saururus cernuus*), spotted jewelweed (*Impatiens capensis*) Japanese stiltweed, bullrush (*Scirpus cyperinus*), soft rush (*Juncus effusus*), and goldenrod (*Solidago* sp.). The primary invasive exotic species is parrot feather (*Myriophyllum aquaticum*).

4.2.3 Fallow Field/Disturbed Community

The fallow field/disturbed community is an old agricultural field undergoing succession. It is located on the southern side of the berm along the southern side of Morgan Creek (Figure 5). The plant community consists of immature canopy species such as loblolly pine (*Pinus taeda*), sycamore, yellow poplar, sweet gum, box elder, Eastern red cedar (*Juniperus virginiana*), sweet gum, red maple, and green ash. The shrub layer is composed of possumhaw viburnum buckthorn, and blackberry. The herbaceous layer consists of broomsedge (*Andropogon glomeratus)*, rush, sedges, fescue (*Festuca* sp.), corn salad (*Valerianella olitoria*), summer grape, poison ivy, goldenrod (*Solidago* sp.) and milkweed (*Asclepias* sp.). The invasive exotic species include multiflora rose, Chinese privet and Japanese honeysuckle.

4.2.4 Poplar Plantation

A plantation of poplars (*Liriodendron tulipifera*) and the exotic Chinese tulip tree (*Liriodendron chinense*) is located east of the parking area south of Morgan Creek, and north of the pedestrian trail (Figure 5). Other exotic species planted within this area include Manchurian catalpa (*Catalpa bungei*), Japanese persimmon (*Diospyros kaki*.), Japanese hackberry (*Celtis sinensis*), and Steward oak (*Quercus stewardii*). These species were planted as part of a research study and are currently scheduled to be removed. They are not considered invasive. Volunteer canopy and subcanopy species observed within this community include green ash, sycamore, willow oak (*Quercus phellos*), sweet gum, Eastern red cedar, elderberry (*Sambucus canadensis*), black cherry, winged elm (*Ulmus alata*), black willow, and box elder. The shrub layer consists of silky dogwood (*Cornus ammomum,*), buckthorn (*Rhamus* sp.), and blackberry. The herbaceous layer consists of poison ivy (*Toxicodendron radicans*), summer grape (*Vitis aestivalis*), false nettle, (*Boehmeria cylindrica*), rushes, sedges, Indian strawberry (*Duchesnea indica*), and smartweed (*Polygonum* sp.). The invasive exotic species include autumn olive (*Eleaegnus umbellata*), Chinese privet, multflora rose (*Rosa multiflora*), Japanese honeysuckle, and Japanese stiltgrass.

4.3 Jurisdictional Wetlands

The project site contains many areas of micro-relief where there is a clear vegetation and hydrological distinction between the "micro-highs" and "micro-lows". The "micro-lows" typically contain more hydrophytic vegetation and soils saturated closer to the surface than the "micro-highs". These areas are sporadically interspersed throughout the site with the "micro-lows" becoming more dominant towards the eastern edge of the project where it becomes a jurisdictional wetland. Though this transition is very gradual, there is a shallow drainage feature that seemed best to designate the transition from upland to

wetlands. This feature is the wetlands western edge boundary. The north edge is the berm, the east edge Morgan Creek, and the south edge a drainage ditch. The wetland totals approximately eight acres.

4.4 Hydrological Characterization

4.4.1 Surface Water Modeling at Restoration Site

See Section 6.1.1

4.4.2 Hydrologic Budget for Restoration Site

The hydrologic budget is detailed in Section 6.1.2 and included in Appendix 12.

4.5 Soil Characteristics

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding, for long enough periods during the growing season to develop anaerobic conditions in the upper part and which can also support the growth and regeneration of hydrophytic vegetation (Gregory, 2000). Hydric soils are one of three required parameters (hydrology, soils, and vegetation) that must be present in order to make a positive jurisdictional wetland determination (Environmental Laboratory, 1987). Detailed soil-mapping, consisting of numerous auger borings and six backhoe pits concentrating on the micro-reliefs, was performed. In addition, a backhoe trench was dug from a micro-high area into a micro-low area. The morphological results are as follows:

- The majority of the study area, including the “micro-highs” and “micro-lows”, does not meet the morphological parameters required for hydric soils.
- There was no visible change in the soil from the micro-highs to the micro-lows.
- The seasonal high water table generally becomes shallower starting from the parking area and moving downstream into the jurisdictional wetland.

Many floodplain soils in North Carolina, such as those mapped within the project area, are relatively young in development and are classed as Inceptisols. It is the experience of the investigator (Michael Wood, NCLSS) that occasionally soils in these landscape positions may have, or did have before the altering of the hydrology (i.e. berming and ditching), a hydrologic regime that would classify as “wetland hydrology”, yet have not developed the morphological indicators that would classify it as “hydric soil”. It is the opinion of the investigator that the phenomenon has occurred at the project site. Some of the other site factors that lead to this conclusion are:

- A relatively static groundwater table that remains relatively close to the soil surface due to being geographically positioned such that it receives a nearly continuous groundwater flow from surrounding uplands
- Proximity to the headwaters of Jordan Lake which controls the regional groundwater table and is another factor in causing the relatively static groundwater table
- A nearly continuous groundwater flow that impedes formation of anaerobic conditions and hence development of redoximorphic features

- Low chroma coarsely textured alluvial parent material in the surface horizon that tends to mask the finer redoximorphic features.

The years (150+) of soil disturbance coupled with the altered hydrology, has likely resulted in the masking and/or fading of the redoximorphic features in the soil profile.

Whether the soil morphology would ever have met the current hydric soil criteria or if the redoximorphic features have become altered such that they no longer meet the morphological criteria, is not possible to determine. However, by evaluating the entire study area, it is possible to make a relative comparison of the extent of the historic hydrology based upon percent changes in redoximorphic features and/or other morphological or physical features. As such, a set of parameters specific to the project site, were established to identify the limits of what is believed to have historically been "hydric soil". The first set of parameters was used to delineate soils that likely met the hydrologic criteria for 12.5% of the growing season and are grouped as Soil Unit 1 and totals approximately 11 acres:

- Soil depletions of chroma 3 or less that constitute at least 20% of the matrix within 12" of the surface accompanied by soil concentrations such that the redoximorphic features collectively composed at least 40% of the matrix color
- Soft masses of iron/manganese within 20 inches of the soil surface (not always present)

Additional areas were identified that were deemed to be marginally hydric, in that they are more likely to meet the hydrologic wetland criteria for 5-12.5% of the growing season. These delineations were based on the following criteria and are referred to as Soil Unit 2 and total approximately 6.5 acres:

- Soil depletions of chroma 3 or less that constitute at least 10% of the matrix within 12" of the surface accompanied by soil concentrations such that the redoximorphic features collectively composed at least 30% of the matrix color

The remaining 11 acres of soil were deemed to be upland floodplain soils and were grouped as Soil Unit 3. Representative soil profiles for the different Soil Units are provided below and locations shown in Figure 3-A.

4.5.1 Profile Description

Table 4: Soil Unit Profiles

Horizon Name	Depth	Soil Color	Texture/Structure
Soil Unit 1:			
Ap	0-7	10YR5/6 Few (2%) fine, prominent 10YR 6/2 depletions	sandy loam/weak fine granular
Bt1	7-11	7.5 YR 4/6 Many (40%) fine, prominent 10YR 6/2 depletions Common (15%) fine distinct 5YR 5/8 concentrations	clay loam/weak fine subangular blocky
Bt2	11-15	7.5 YR 4/6 Many (45%) fine, prominent	clay loam/ moderate, medium subangular

		10YR 6/2 depletions Common (15%) fine distinct 5YR 5/8 concentrations	blocky
Btg	15-25	10YR 6/2 Common (15%) fine, distinct 10YR 4/4 and common (15%) fine prominent 5YR 4/6 concentrations	Sandy clay loam/moderate medium subangular blocky
Cg	25-54	5BG 4/1 Many (45%) fine prominent 5YR 5/8 concentrations	Sandy clay/ massive
Soil Unit 2:			
Ap	0-6	10YR 5/4	sandy loam/weak fine granular
Bw1	6-18	10YR 5/4 Common(15%), fine, faint 10YR 5/3 depletions Common (15%), fine, distinct 10YR 5/6 concentrations	sandy loam/weak fine subangular blocky
Bw2	18-22	10YR 6/6 Few (2%), fine, prominent 10YR 6/2 depletions Few (2%), fine, distinct 10YR 6/8 concentrations	sandy loam/ weak fine subangular blocky
Bw3	22-28	10YR 6/6 Common (15%) fine, prominent 10YR 6/2 depeltions Common (15%) fine, faint 7.5YR 5/6 concentrations	sandy loam/weak fine subangular blocky
Cg1	28-32	10YR 6/1 Many (40%) medium, prominent 10YR 5/6 concentrations	sandy clay loam/massive
Cg2	32-48	10YR 6/1 Many (30%) fine, prominent 10YR 5.6 concentrations	clay loam/massive
Soil Unit 3:			
A	0-3	10YR 5/3	sandy loam/weak fine granular
Bt1	3-15	10YR 5/4	sandy clay loam/weak fine subangular blocky
Bt2	15-24	10YR 6/4 Common (10%) fine distinct 10YR 6/2 depletions	loam/weak fine granular
Cg1	24-40+	10YR 5/2	sandy loam/sg

4.5.2 Taxonomic Classification

Two major Soil Units were mapped by NRCS as occurring in the project site and are shown in Figure 3. The majority of the site is mapped as Chewacla and Wehadkee soils (mapping unit Ch) and a small area in the poplar forest is mapped as Congaree silt loam (mapping unit Cp). The borings and soil pits confirmed that the majority of the project area is dominated by variations of the Chewacla and Wehadkee soil series, which form from alluvial parent material. The area of the Congaree was not observed, however, this section did exhibit less soil development than the Chewacla and Wehadkee soils observed on the remainder of the site.

5.0 Reference Wetland

5.1 Reference Wetland

5.1.1 Reference Wetland

Upstream of the project site on the northern bank of Morgan Creek within the floodplain in an area that receives frequent flooding, a small wetland area was found that was deemed suitable for a reference. It is in recently deposited soils and has a mix of bottomland hardwood species with an herbaceous layer of hydrophytic plants. A RDS groundwater monitoring gauge was installed in July 2007 and a routine wetland determination form was completed for the site (See Appendix 8).

5.1.2 Hydrology of Reference Wetland

A groundwater gauge was installed on July 11, 2007 and was last downloaded May 15, 2008. The growing season for Durham County is April 11 to October 28. Due to drought conditions, the water table was very low during the growing season of 2007 resulting in a very low water table. The graph displays the water table recharging as the autumn season transitions into the winter (Appendix 6).

5.2 Soil Characterization

The soils in this area are alluvial and relatively young such that they have not developed many diagnostic horizons and are therefore classed as inceptisols. The soils meet hydric Field Indicator F3 which states:

> A layer at least 15 cm (6 in) thick with a depleted matrix that has 60% or more chroma 2 or less starting within 25cm (10 in) of the soil surface.

5.2.1 Taxonomic Classification

The soils in the reference wetland are the Wehadkee series, which are very deep, poorly drained, and very poorly drained soils on floodplains along streams that drain from the mountains and piedmont. They are formed in loamy sediments. Slopes range from 0 to 2 percent. The taxonomic classification is a fine-loamy, mixed, active nonacid, thermic fluaquentic endoaquept.

5.2.2 Profile Description

Table 5: Reference Wetland Soil Profile Description

Depth (inches)	Horizon	Matrix	Redox Concentrations	Depletions	Soil Texture
0-2	A	2.5Y 5/2	20% - 7.5YR 4/6	20% - 10YR 6/2	Silty clay loam
2-28	Btg1	7.5YR 4/3	40% - 7.5YR 4/3	60% - 2.5Y 6/2	Silty clay loam
28-48	Btg2	2.5Y 6/1	70% - 2.5Y 6/1	20% - 7.5YR 4/3 10% - 7.5YR 5/6	Clay loam

5.3 Plant Community Characterization

5.3.1 Community Description

This wetland is located upstream of the project area on the north side of Morgan Creek between the toe of slope and a natural levee adjacent the creek. It is a linear depression consisting mainly of an herbaceous layer with few canopy species present within the actual wetland boundaries. The herbaceous layer is composed of Pennsylvania smartweed (*Polygonum pennsylvanicum*), netted chain fern (*Woodwardia aereolata*), sensitive fern (*Onoclea sensibilis*), clearweed (*Pilea pumila*), marsh fleabane (*Pluchea camphorata*), false nettle (*Boehmeria cylindrica*), arrow arum (*Peltandra virginica*), rush (*Juncus effusus*), and dayflower (*Commelina diffusa*). The canopy layer includes tulip poplar (*Liriodendron tulipifera*), hackberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanicum*), and box elder (*Acer negundo*).

5.3.2 Basal Area

The reference wetland is basically devoid of canopy trees. As such, basal area is not addressed.

6.0 Project Site Restoration Plan

6.1 Restoration Project Goals and Objectives

The goal of the restoration plan is to improve water quality and ecological functions for Morgan Creek and the Jordan Lake watershed by reconnecting Morgan Creek to its natural floodplain by breaching the berm at five locations, thus allowing floodwaters to access the project site an average of 2.5 times per year. This action is anticipated to restore the natural hydrology of the study site and specifically, the hydrology of 17.5 acres of impacted wetlands. The project will also preserve approximately 3,200 linear feet of stream buffer along the south embankment of Morgan Creek.

6.1.1 Berm Openings Design

The restoration plan includes the placement of five openings in the existing berm to allow stormwater from storm events that overtop the banks of Morgan Creek to flow into the previously inaccessible floodplain within the project area. The berm openings were located at stable locations in reference to Morgan Creek. The existing berm is located 30 to 60 feet from the top of the banks of Morgan Creek. The openings were modeled as lateral openings in the HEC-RAS computer model and discharges were generated from each opening to reflect the volume of water applied to the fields. A second HEC-RAS model was then generated in the floodplain beyond the berm using the peak discharges

flowing through the openings to predict the extent of the flooding with in the MFBR. This second model approximated maximum storm water levels within the existing parking lot and the frequency and duration of flooding in the Big Oak Woods (BOW). Increased flooding into the BOW natural area was controlled in order to avoid potential detrimental impacts due to excessive flooding.

The berm openings were placed at locations with stable stream banks, floodplains, and stream pattern. The stream banks of Morgan Creek were reviewed upstream and downstream of each proposed opening for stability. Locations with wide and consistent floodplain widths from the top of Morgan Creek stream bank to the toe of the existing berm were selected for stability. Stream bank stability included a visual review of Morgan Creek banks looking for areas that were not actively eroding. The position along the stream pattern was also taken into consideration. Locations at stream bends under higher stresses during storm events were not considered. Additionally, areas in the stream with current debris and blockages or center bars were not considered. Wide floodplain widths, from the top bank of Morgan Creek to the toe of the existing berm, with good vegetation in the form of mature trees were selected. The berm opening elevations are shown on the cross sections located in Appendix 9. The openings will connect the existing floodplain elevation on the north side of the berm with the floodplain elevation on the south side. Floodwater is expected to flow through the openings on average two and one half times per year.

A COE Water Surface Profile model (HEC-RAS) preliminary analysis was performed on Morgan Creek between the field surveyed cross sections and the USGS Stream Gauge Station. This model was completed for storm events equal to and less than the 10-year storm event. In the analysis it was determined that the 10-year storm event and lower return periods are contained within the existing berm. Storm events larger than the 10-year event overtopped the berm. Five lateral weirs were entered into the water surface profile model with dimensions and at locations shown in Figures 7 and 6, respectively, to simulate the proposed breaches. The results of this analysis produced peak discharges that could be expected to flow from Morgan Creek through each berm opening and onto the project area floodplain. This analysis was completed for a stream bank overtopping storm event, bankfull, 2-year, 3-yr, 4-yr, 5-yr, and 10-yr storm events.

A second HEC-RAS model was developed to predict the stormwater extent of influence within the project site for the peak volume that would be discharged by all five openings. This preliminary model was based on cross sections developed using field-surveyed data. Five cross sections were surveyed starting at the berm and continuing across the floodplain to the south. A total of 8,150 linear feet of cross section line was surveyed. The five cross sections covered a length through the floodplain, from east to west, of 2,200 linear feet and a width from, north to south, which ranged from 2,500 feet at the eastern end of the project near the Big Oak Woods to a 600 foot width near the parking lot. The vertical elevations for the sections were based on a benchmark established on site by a Registered Land surveyor based on vertical datum, NAVD 29.

Normal depth was used as the starting boundary condition for the model and peak discharges from the openings were added together as cumulative discharges downstream without consideration of peak timing through the opening to create a conservative model. The maximum flow limits for the 5, 2, and bankfull storm events extended into the northeast portion of the Big Oak Woods as shown on the restoration plan.

Surveyed section #5 at the surveyed floodplain downstream limit and furthest to the east in the field was evaluated to determine the rate of discharges of stormwater out of the floodplain. A rating curve was developed for this section relating discharge to elevation. The rating curve showed that for flows greater than elevation 242 the section has the capacity to discharge approximately 1200 cfs/ft of depth. Below the elevation of 242 the discharge dropped to an average flow of approximately 33cfs/ft of depth. Therefore flows above elevation 242 are estimated to drain within one hour for storm events with a return period of five years and less. It is estimated that the water stored below elevation 242 will take approximately 15 additional hours to drain out of the Big Oak Woods area based on surface water flow. Therefore no adverse impacts will occur to the BOW natural area.

Historical storm event data was reviewed and five storm events were selected to determine the volume of water moving through Morgan Creek during selected storm events. These storm events were within the two to five year storm return period range. The storm volume versus peak discharges were plotted to establish a linear relationship. Based on this analysis, the peak backwater expected on the fields from the berm openings are predicted to not inundate the existing parking lot for storm events smaller than a 5-year return period.

Waste soils from the berm area will be disposed on site outside of the FEMA floodway and COE Flowage Easement as shown on Figure 7.

6.1.2 Groundwater Modeling - DrainMod

DrainMod was developed to simulate the performance of agricultural drainage and water table control systems on sites with shallow water table conditions (Skaggs, 1980). The model was subsequently modified to perform water table analyses by recording the number of events wherein the water table meets certain criteria of depth and duration, usually for wetland studies. Model results are analyzed to determine if wetland criteria are satisfied for sufficient duration during the growing season of most years. Through this methodology, DrainMod can be used to characterize water table elevations under current conditions and then to predict groundwater levels with increased water discharges. Simulation parameters include the threshold water table depth, required duration of high water tables, and beginning and ending dates of the monitoring period.

Wetland Restoration Analysis. DrainMod was developed primarily for use in broad, relatively flat landforms, such as delta regions or coastal plains. However, it can also be used to in other regions, provided they are relatively flat, through manipulation of the inputs to match actual observed site data.

To this end, nine groundwater gauges were installed, seven of which are within the restoration area. (Note: gauge 9 was installed in the "poplar forest" in 2007 and therefore did not contain enough data for evaluation). From these gauges, actual site data was used to calibrate the model. Upon reviewing the groundwater data, gauge 4 was chosen to calibrate the model, as it appears to provide "average" groundwater data when compared to the other gauges.

The initial intent was to use gauge 4 data from January 2006-April 2007 for calibration. However, beavers began constructing dams downstream of the project site in the late spring/ early fall of 2006 which altered the hydrologic regime of the site, especially the eastern portion which is the existing wetland. Attempting to replicate such unsystematic site conditions violates the basic assumptions of the model.. Further compounding the situation is the relatively static water table (discussed in Section 4.3). As a result, it was not possible to calibrate the model to be a reliable predictor of depth to soil saturation.

Though the model can't be used to model specific depths to soil saturation, it can be used as general water (hydrologic) balance. One of hydrologic parameters is the infiltration rate. As such, it allows for a comparison of infiltration for existing conditions versus post-construction, as shown in Table 5.

Table 6 Comparison of Infiltration (in/yr)

Year	Existing	Post-Construction
1971	33.4	50.3
1972	33.5	48.1
1973	34.9	50.7
1974	33.4	49.8
1975	30.6	46.2
1976	33.2	46.6
1977	32.9	47.7
1978	33.2	48.4
1979	35.6	55.2
1980	28.8	42.0
1981	27.2	37.8
1982	29.6	44.5
1983	33.2	54.2
1984	31.3	47.3
1985	26.2	38.4
1986	30.8	39.9
1987	31.7	48.6
1988	29.5	39.7
1989	38.6	53.5
1990	31.2	41.6
1991	28.3	40.6
1992	30.1	40.8
1993	22.8	34.3
1994	28.3	39.7
Average	**31.2**	**45.2**

Restoring the floodwaters will result in an approximately 45% increase in the amount of infiltration within the study area.

6.1.3 Wetland/Floodplain Restoration

The project is designed to restore floodwaters to the entire site, not just the wetlands. The benefits of restoring the wetlands and the floodplain include:

- Attenuation of floodwater sediments and nutrients
- Retention of floodwaters thereby reducing downstream flooding
- Reduced stormwater flows promote bank and channel stabilization
- Increased overbank flooding restores wetland habitats

6.1.3.1. Restoration Vegetation

The restored wetland/floodplain will be planted with canopy and understory plant species typical of a piedmont bottomland hardwood forest. Herbaceous vegetation will not be planted with the anticipation of present native species and volunteers giving rise from the seedbank. Within the poplar plantation the trees planted for research purposes will be removed but native trees such as green ash, elms, and box elder will remain. See Table 7 below for a list of tree and shrub species that will be planted within the 24 acre restored floodplain area. The restoration planting plan is shown in Figure 8.

Table 7. Planting Plan Species List

Botanical Name	Common Name
Liriodendron tulipifera	yellow poplar
Fraxinus pennsylvanica	green ash
Quercus falcata var. pagodaefolia	pagoda oak
Carya ovata	shagbark hickory
Celtis laevigata	hackberry
Carpinus caroliniana	ironwood
Lindera benzoin	spice bush
Viburnum dentatum	arrowwood
Calycanthus floridus	sweet shrub
Vaccinium corymbosum	highbush blackberry
Sambucus canadensis	elderberry
Alnus serrulata	tag alder
Ilex decidua	deciduous holly
Aesculus sylvatica	painted buckeye
Asimina triloba	common pawpaw
Cornus ammomum	silky dogwood
Amelanchier arborea	downy serviceberry

6.1.3.2. Site Invasive Species Management

A variety of plant species inhabit the project study area. While the majority of those species are native to the region, there are six invasive exotic plant species: Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa*

multiflora), Russian olive (*Elaeagnus angustifolia*), Japanese stiltgrass (*Microstegium vimineum*), and kudzu (*Pueraria montana*). Invasive exotic species management strategies will be conducted throughout the restoration site. Manual or mechanical removal of invasive exotic plants should always be considered as the first method of control where feasible. However, for most of these species, it is anticipated that an herbicide treatment will also be required. The specification for each species will be addressed in the Project Manual.

Chinese privet: This shrub was introduced from China and Europe in the early to mid 1800's and used as an ornamental shrub and has spread throughout and invaded woodlands in the southeastern United States. This aggressive thicket forming shrub can out-compete native vegetation and become the dominant shrub layer of an invaded habitat resulting in a lower species composition and an alteration in the natural community structure. It can shade out the herbaceous layer of the community it inhabits. This evergreen shrub is shade tolerant and colonizes by root and stump sprouts and the seeds are spread widely by wildlife. It has commonly been used as a hedge and has escaped and invaded adjacent areas to form dense thickets. Control efforts during early stages of colonization have a higher potential for successful management.

Japanese Honeysuckle: Japanese honeysuckle occurs as dense infestations along forest margins, rights-of-ways, and under canopies. This vine is shade tolerant and spreads from a large root stock, rooting at vine nodes; seeds are dispersed by animals.

Japanese stiltgrass: This species is native to Asia and was introduced into the United States around 1919. This plant is believed to have accidentally escaped after being used as packaging material for porcelain products. Japanese stiltgrass can be found in a wide variety of habitats that include moist ground of open woods, floodplain forests, wetlands, uplands, fields, thickets, paths, clearings, roadsides, ditches, and utility corridors. It invades disturbed areas and displaces native plants. It is tolerant to various light intensities and moisture regimes. This plant is a colonial species that spreads by rooting where stem nodes touch the ground. It only reproduces by seeds, which may be dispersed by water during heavy rain events, humans (seeds attached to clothing or footwear), or moved in contaminated hay and soils. Though stiltgrass is present, it is not anticipated to pose a problem in restoring the vegetation, and therefore will not be targeted in the Project Manual. If it at some later point it proves to be negatively impacting the establishment of native plants, it will be addressed at that time.

Kudzu: This semi-woody vine native to Asia, was introduced in the early 1900s and has spread throughout the southeastern United States. Until 1953, this vine was planted as a forage crop and used for erosion control. The twining and trailing growth habit of this plant can form dense infestations covering the ground, debris, shrubs, and trees. It has a wide range of habitats such as agricultural areas, disturbed areas, natural and planted forests, grasslands, riparian zones, shrublands, and urban areas. It colonizes through vine rooting at the nodes, and seeds are dispersed by wind, animals, and water.

Multiflora rose: This shrub thrives in sunny locations and well drained soils. It forms dense thickets that out-compete native herbaceous and shrub species. The seeds are bird and mammal dispersed. Due to bird dispersal, multiflora rose can colonize gaps in late-successional forests. It may not be a long-term threat in mature forests and may likely be shaded out by surrounding trees and shade tolerant shrubs.

Russian olive: This shrub is a fast growing weedy ornamental. It is tolerant to shade, drought, and salt, and is spread by animal dispersed seeds. It occurs in both the open and under forest shade.

Areas of the restoration site that are currently vegetated with native, non-invasive species will not be disturbed outside the limits of necessary construction activities. Succession in these areas should be allowed to proceed naturally. In areas where exotic species are located, removal will be specified in the Project Manual.

7.0 Performance Criteria

7.1 Wetlands/Floodplains

Performance criteria and monitoring protocol will follow EEP's most recent Site Mitigation Plan outline. Monitoring provides an accounting of ecosystem processes to ensure that functioning wetlands are established, which is one of the project objectives. Performance of a mitigation project is assessed by comparing monitored data from mitigation sites relative to undisturbed, reference wetland habitats. The intensity of monitoring varies with the degree of disturbance at the project site (White 1991) and the probability of successfully achieving targeted wetland functions. The monitoring program at MFBR will measure and evaluate structural and functional parameters of each project component of the mitigation effort. Pressure transducers will be installed at two berm openings to record stormwater flows through the proposed openings.

7.1.1 Hydrology

The project is expected to help to restore the hydrology to its historic regime. As noted in Section 4.3, Soil Unit 1 is expected to be restored to at least 12.5% soil saturation of the growing season and Soil Unit 2 from 5-12.5% of the growing season. Restoring the floodwaters to the mitigation site will obviously result in longer periods of soil saturation. However, while the site is expected to flood approximately 2.5 times per year, due to the unpredictability of storm events, based upon models this will have little effect on the specific wetland criteria thresholds. It will however, result in approximately 14 inches of floodwaters now being retained and treated on the site. Therefore, a hydrologic success criterion will be based upon successful flooding of the mitigation site 2.5 times per year over the monitoring period and soil saturation for Soil Unit 1 for at least 12.5% of the growing season and Soil Unit 2 for at least 5% of the growing season.

As noted in Section 5.0, a reference wetland has been established to serve as an alternative hydrologic success criterion in the event that unforeseen circumstances arise during the monitoring period (i.e. severe drought). A groundwater gauge has been placed within the wetland and will be downloaded along with the gauges at the study site over the 5-year monitoring period.

7.2 Vegetation

The vegetation monitoring will be conducted according to the Carolina Vegetation Survey (CVS) – EEP protocol Version 4.0. Vegetation monitoring plots will be 100 square meters in size and will be conducted according to the Level I protocol which has a focus of planted stems only. The purpose of this level of monitoring is to determine the pattern of installation of plant material with respect to species, spacing, density, and to monitor the survival and growth of those installed species. The success criteria for the preferred species in the restoration areas will be based on annual and cumulative survival and growth over five (5) years. Survival of preferred species must be at a minimum 320 stems/acre at the end of the three years of monitoring and 260 stems/acre after five years. Five (5) vegetation plots will be established, one below each berm opening.

7.3 Soils

As detailed in Section 4.3, the majority of the wetland restoration section does not meet the morphological criteria of hydric soils as defined in the Field Indicators of Hydric Soils in the United States, Guide for Indentifying and Delineating Hydric Soils, Version 6.0 (USDA 2006). While the goals of the restoration plan is to restore wetland hydrology, the morphological features of the soils are not expected to be visibly altered during the 5-year monitoring period for the same reasons noted in Section 4.3. However, by returning the hydrologic regime to its natural state, the morphological features of the soil are expected to eventually develop.

In addition, the Hydric Soils in the United States, Guide has been supplemented with technical notes, of which Technical Note 11: Technical Standards for Hydric Soils the Guide, acknowledges there are situations where a soil that does not meet the morphological criteria can nonetheless be proven, through in-situ measurements, to be a hydric soil. As such, success in the soils criteria will be assumed by success in the hydrological monitoring.

7.4 Schedule/Reporting

Upon completion of construction, As-Built Plans will be incorporated with the Mitigation Plan to serve as the baseline for future monitoring of vegetation and hydrology. During vegetation monitoring, planted and volunteer stem densities will be measured in addition to the relative abundance and diversity of herbaceous vegetation within the monitoring plots. Species will be listed and identified by wetland indicator status. Planting locations and methods will be completed in the first year Annual Report. Survival, numbers per acre by species, and tree height will be measured at the end of each growing season just prior to leaf fall. Hydrological monitoring will consist of periodic downloading of groundwater and rain gauges on the project site and reference wetland.

Monitoring data will be collected for a period of five years or until all success criteria are achieved, whichever is longer. Annual Reports will be submitted to the EEP prior to the end of each calendar year, documenting plant community conditions within the restoration areas and documenting hydrologic data within these areas and reference plots. The project areas will be photographed from permanent photo stations and changes in any of the above variables will be recorded and included in each annual report.

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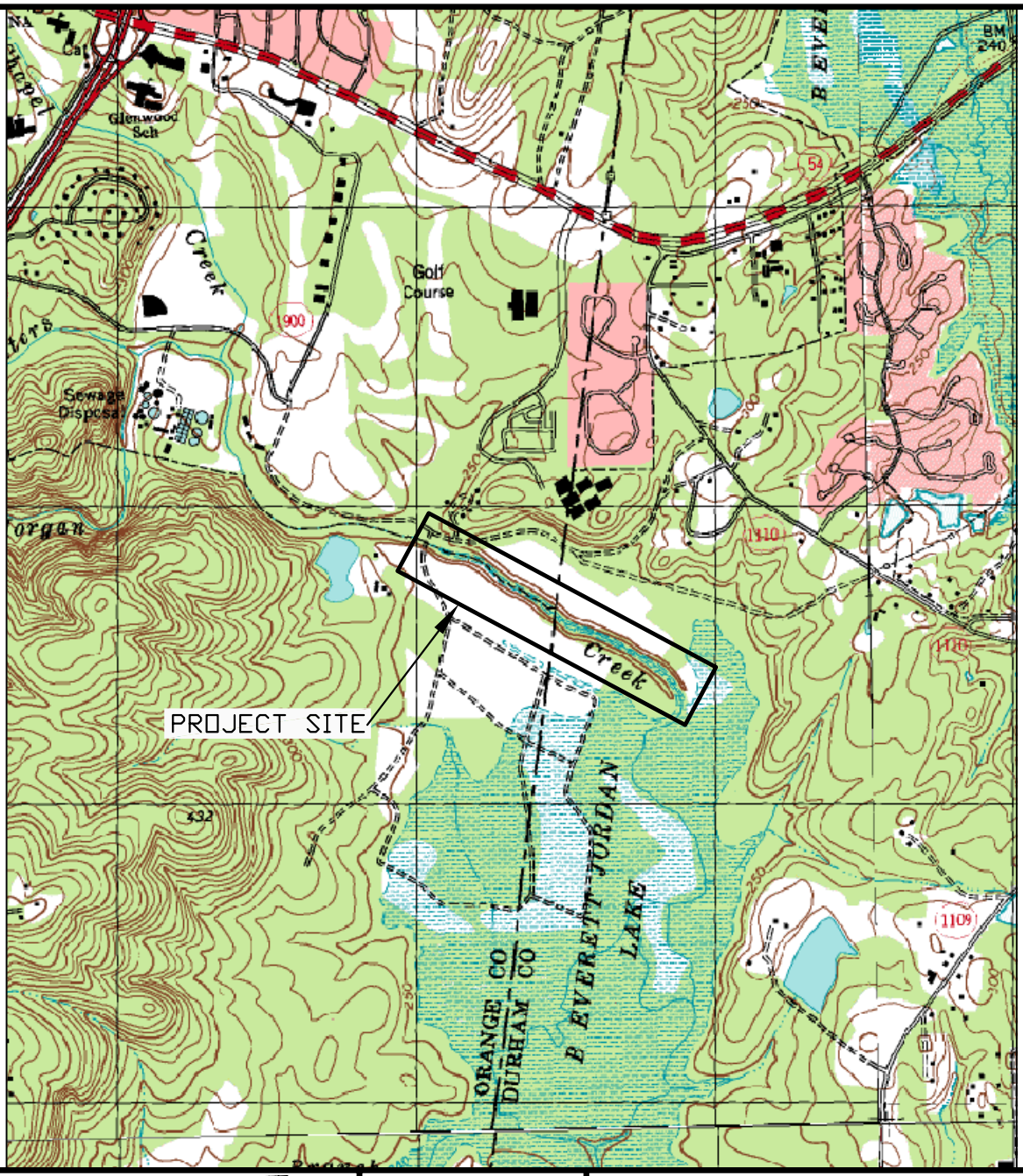
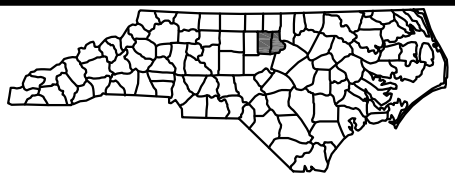
Figures





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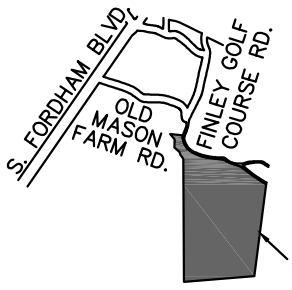

FIGURE 1
RESTORATION SITE
VICINITY MAP

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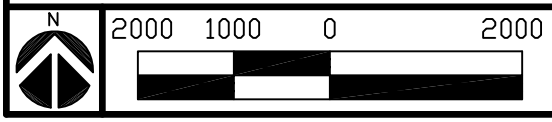

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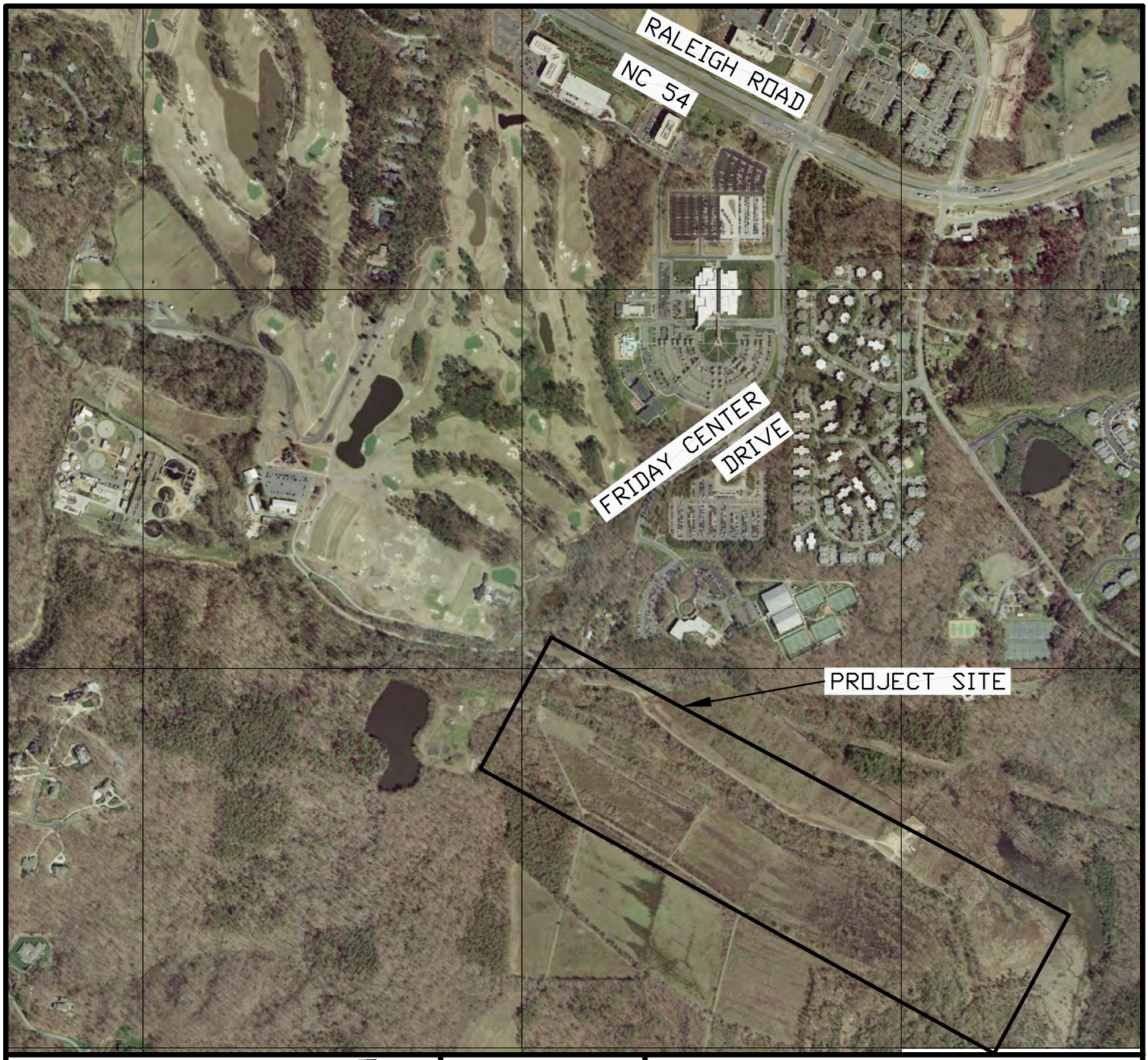

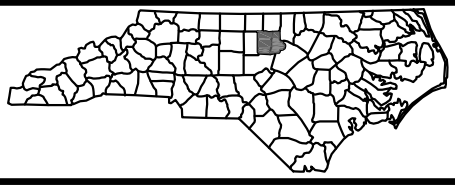

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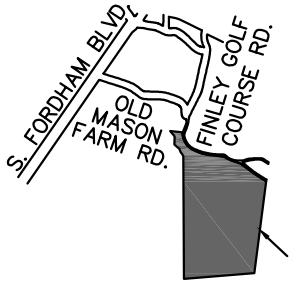

FIGURE 1-A
RESTORATION SITE
AERIAL VICINITY MAP

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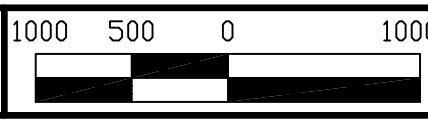

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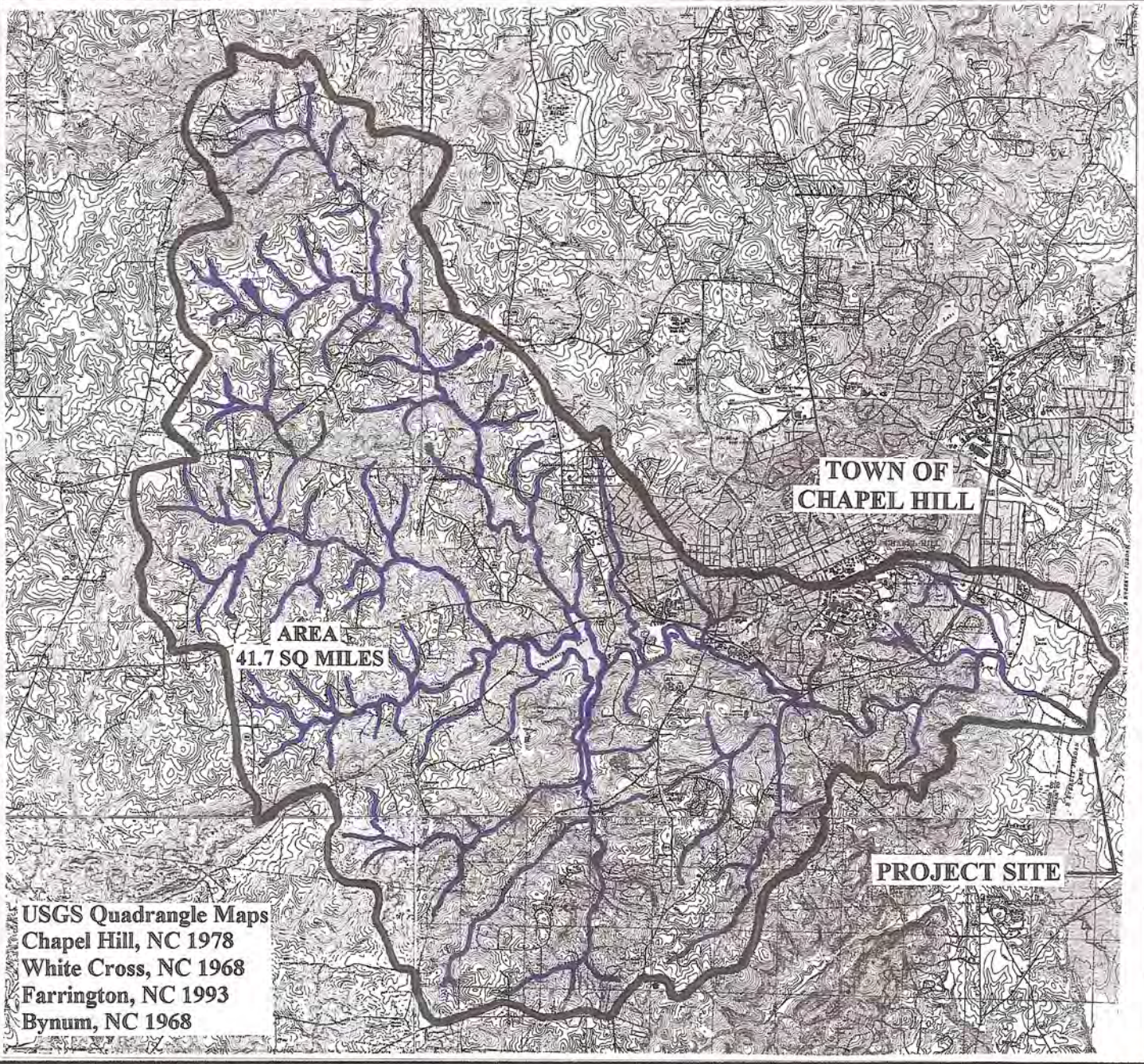

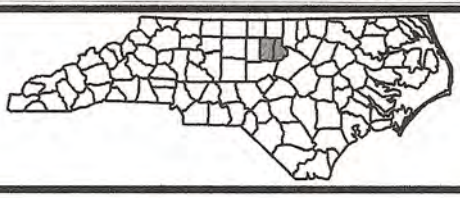

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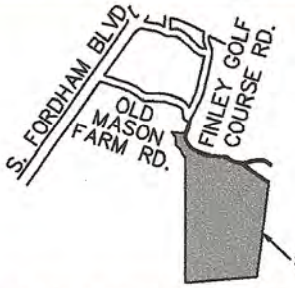

FIGURE 2
RESTORATION SITE
WATERSHED MAP

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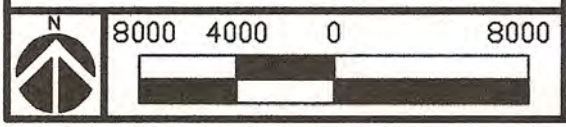

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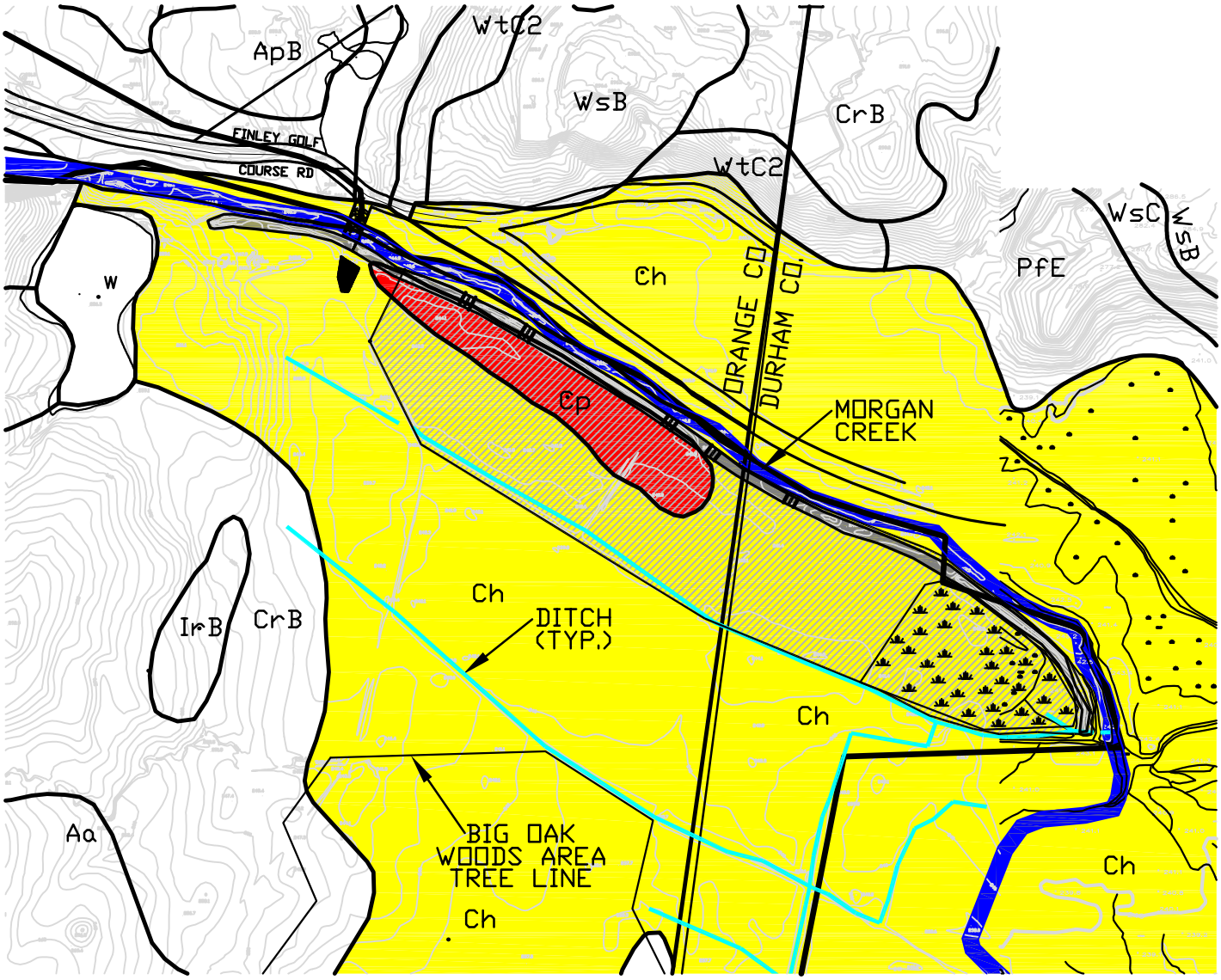
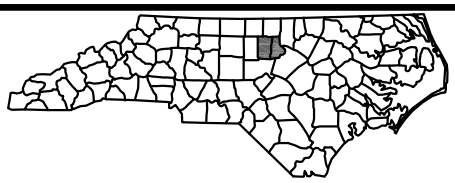


SOILS LEGEND

Ch - CHEWACLA AND WEHADKEE SOILS

Cp - CONGAREE SILT LOAM



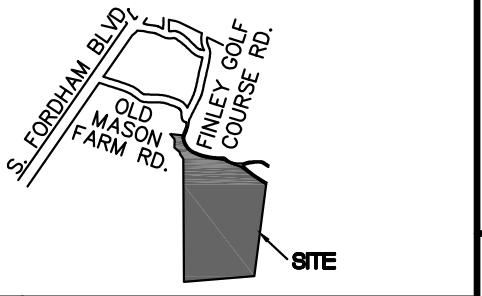


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FIGURE 3
RESTORATION SITE
NRCS SOILS SURVEY

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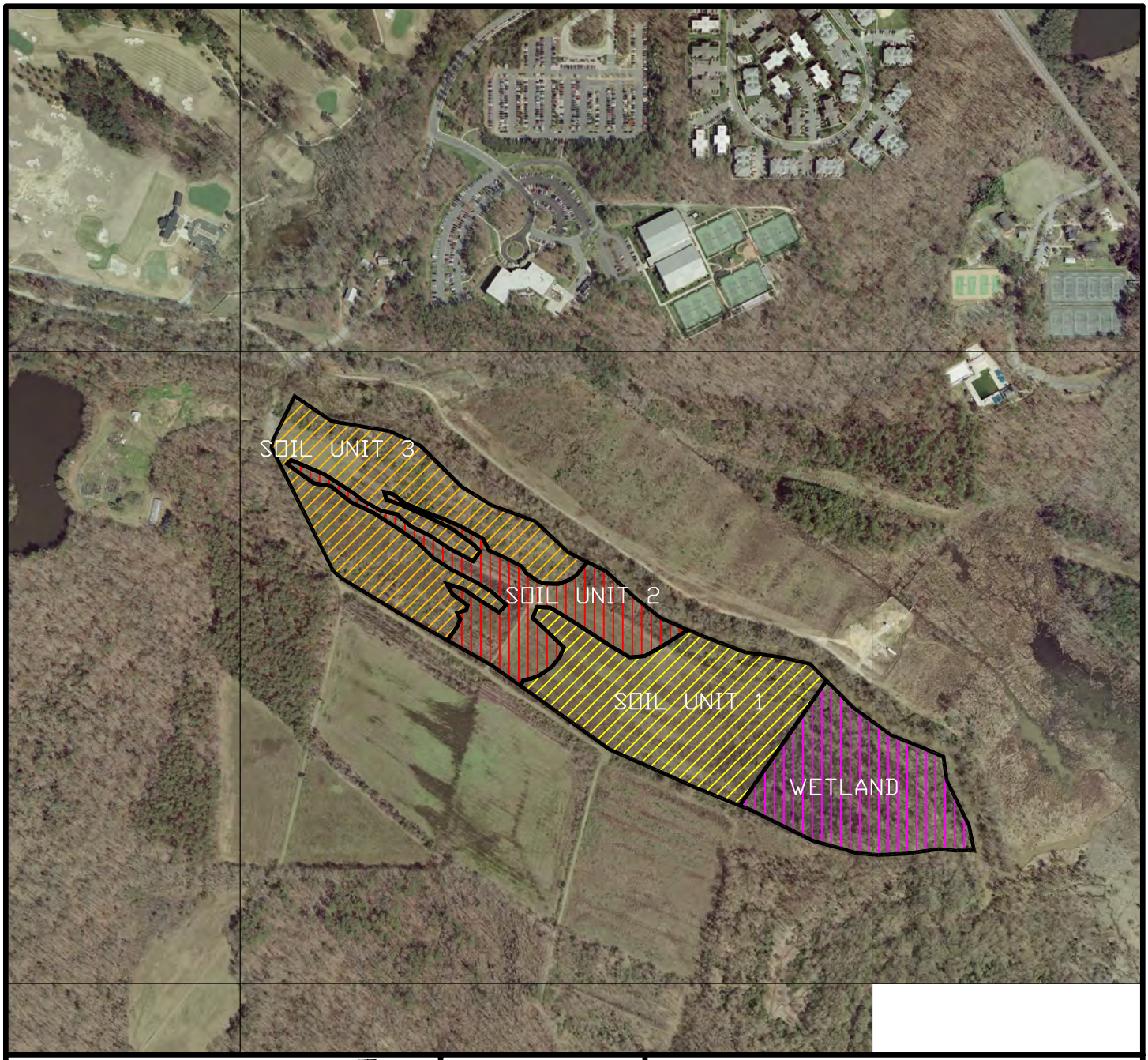

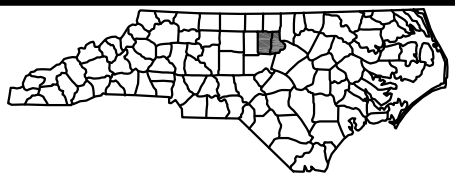

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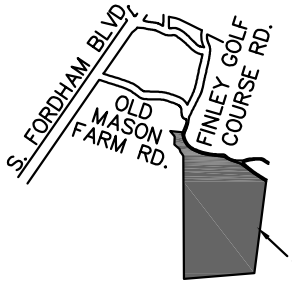

FIGURE 3-A
RESTORATION SITE
FIELD SOILS DELINEATION

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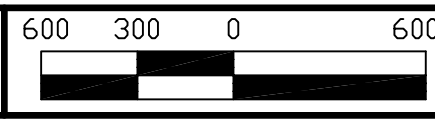

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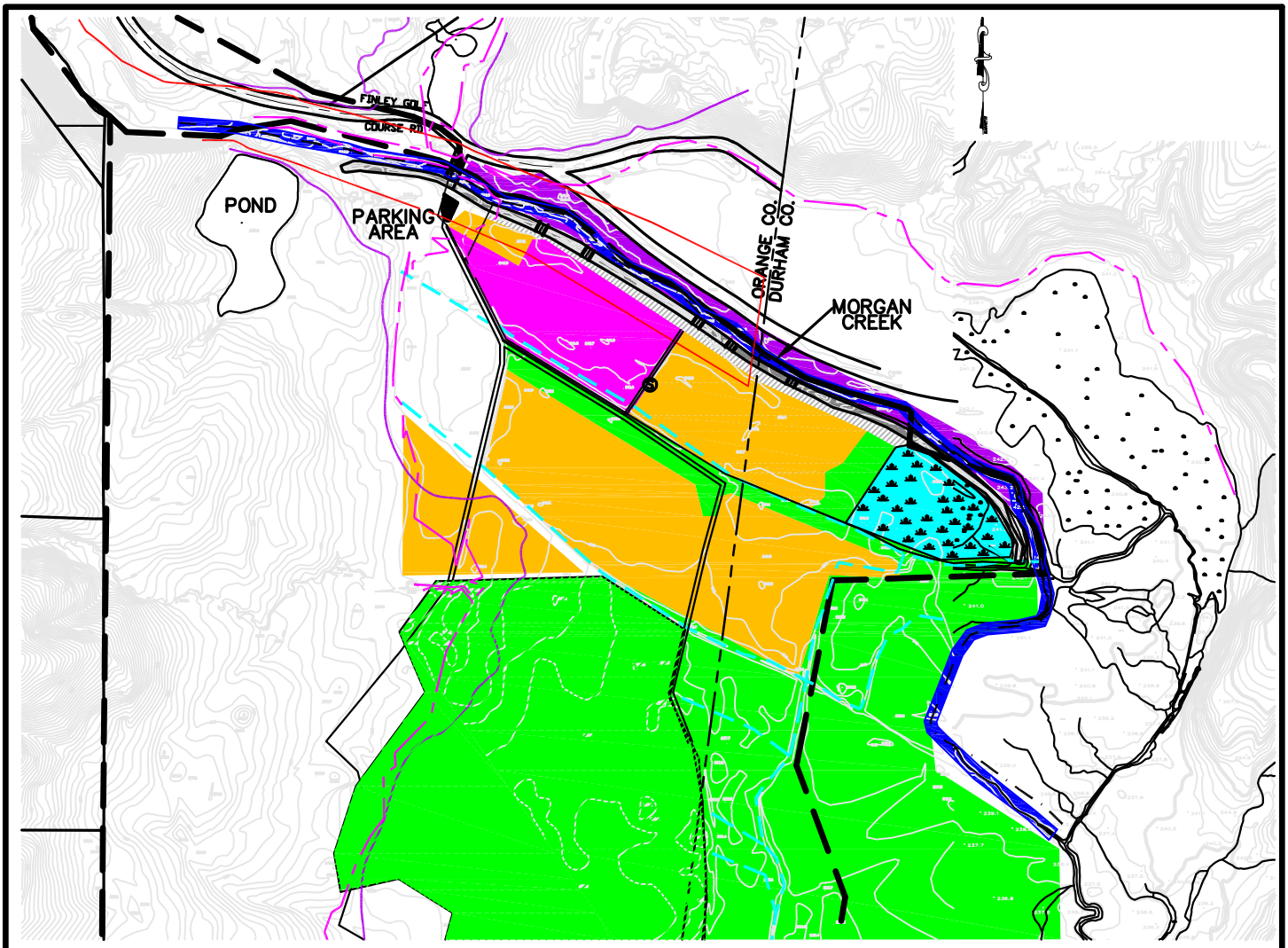
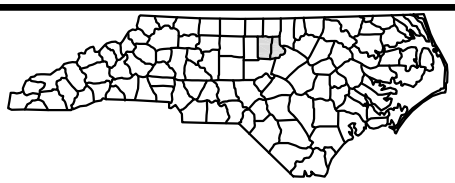


LEGEND

- POPLAR PLANTATION
- FALLOW FIELD
- PIEDMONT BOTTOMLAND FOREST
- REFERENCE WETLAND
- PIEDMONT LEVEE FOREST
- BERM
- MORGAN CREEK
- DITCHES
- LIMITS OF BIG OAK WOODS



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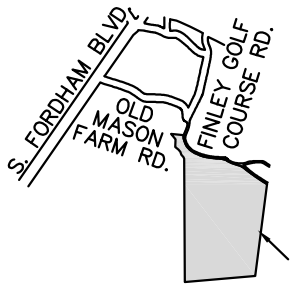

FIGURE 3-B
RESTORATION SITE
VEGETATIVE COMMUNITIES MAP

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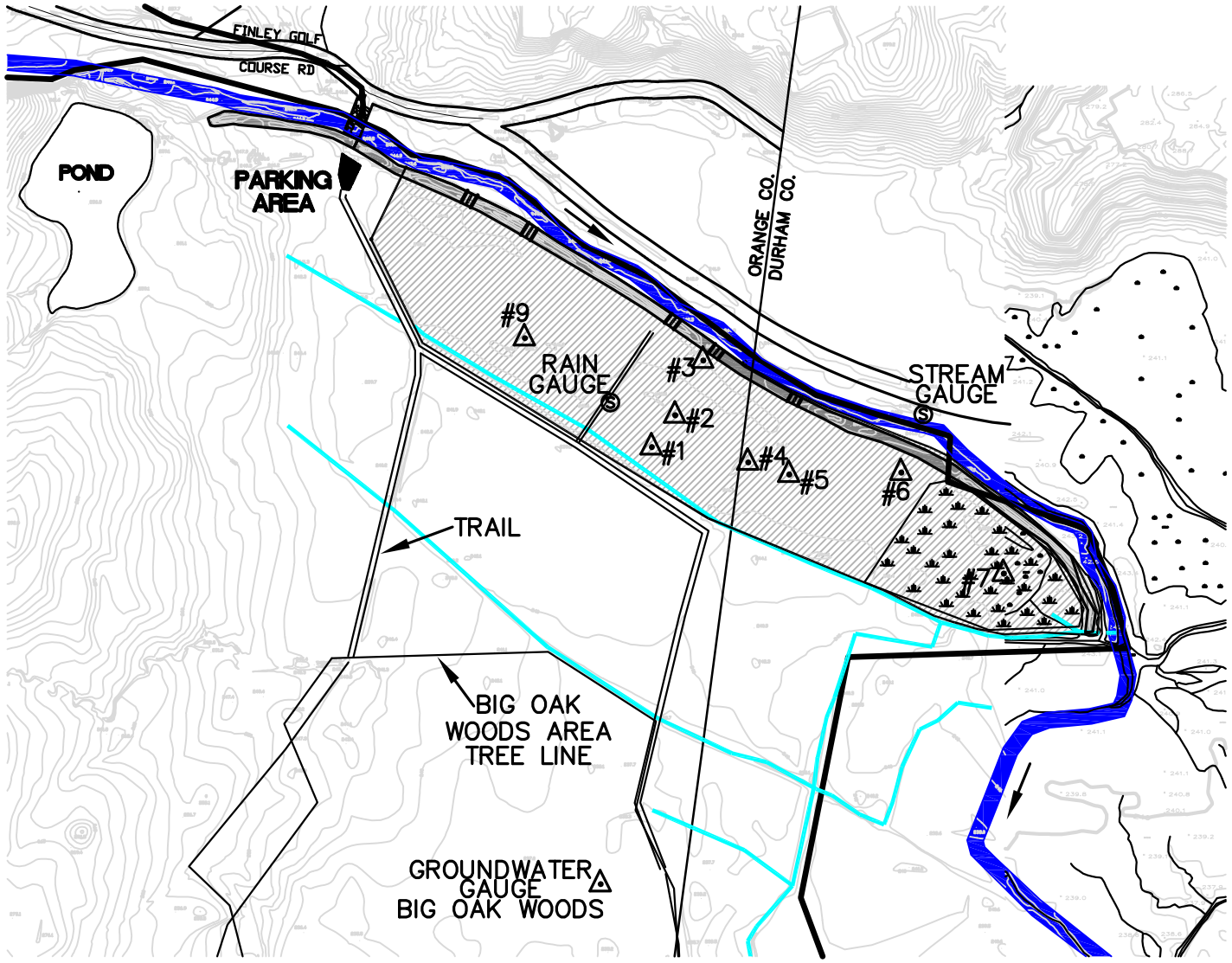
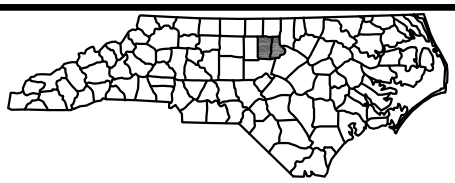


LEGEND

- DITCH
- STREAM
- GROUND WATER GAUGE
- RAIN & STREAM GAUGE



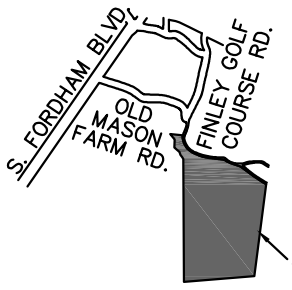


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FIGURE 4
RESTORATION SITE HYDROLOGIC FEATURES AND GAUGE LOCATIONS

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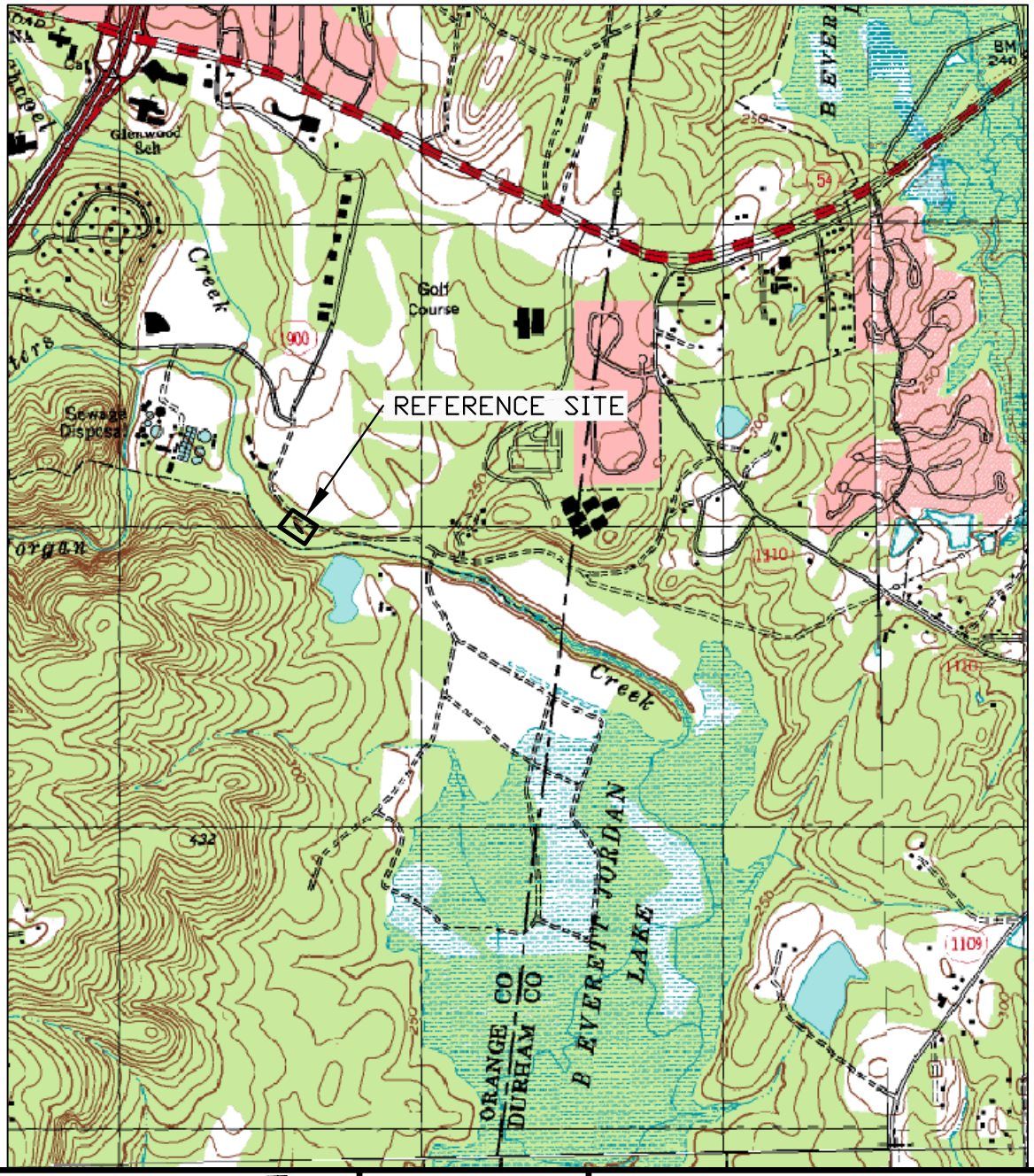
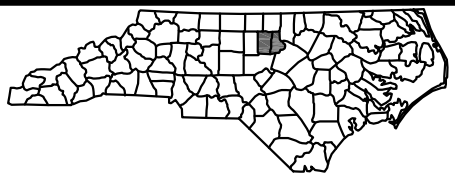




North Carolina – Ecosystem Enhancement Program

Morgan Creek Wetland / Floodplain Restoration
Orange & Durham County, North Carolina
SCO ID #050645601

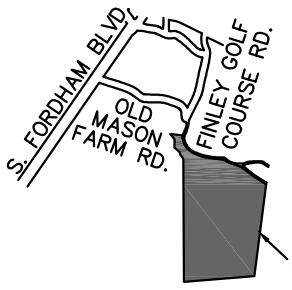
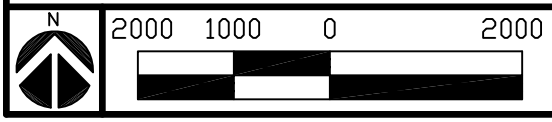


FIGURE 5
REFERENCE SITE
VICINITY MAP

DATE: MAY 18, 2007



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FINLEY GOLF COURSE RD

100 YEAR FEMA FLOODPLAIN

FLOWAGE EASEMENT

OPENING #1

OPENING #2

100 YEAR FEMA FLOODWAY

ORANGE CO./ DURHAM CO.

MORGAN CREEK

OPENING #4

CROSS SECTION 3 MORGAN CREEK

OPENING #5

CROSS SECTION 2 MORGAN CREEK

OPENING #3

EXISTING BERM

PARKING AREA

245.85'

BERM 250.48'

C.S. 1

PARKING LOT ELEV 245.97

244.00'

BEGIN PROJECT

244.19'

243.19'

PROPOSED BERM OPENING (TYP.5)

243.47'

242.23'

EXISTING GRAVEL ROADWAY

RESTORATION AREA 27 ACRES

PRESERVATION AREA 7 ACRES

END PROJECT

POND

C.S. 2

EXCESS SOIL DISPOSAL AREA (APPROXIMATE)

FLOWAGE EASEMENT

100 YEAR FEMA FLOODPLAIN

C.S. 3

241.49'

C.S. 4

C.S. 5

MINIMUM OVERTOPPING FLOW 10 YEAR 15 YEAR

MORGAN CREEK APPROX. LOCATION

OAK

LEGEND

- MORGAN CREEK 100 YEAR FLOODWAY
- MORGAN CREEK 100 YEAR FLOODPLAIN
- COUNTY LINE
- EXISTING DITCHES
- LIMITS OF PEAK FLOODING FROM BERM OPENINGS
- COE FLOWAGE EASEMENT JORDAN LAKE ELEV. 245.0
- PROPERTY BOUNDARY
- EXISTING WETLANDS
- BERM OPENING (NTS)
- CE — CONSERVATION EASEMENT
- STORMWATER FLOW
- BIG OAK WOODS
- MORGAN CREEK
- BERM LOCATION
- PROJECT AREA (34 AC)

300 150 0 300 600 900

SCALE IN FEET

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Ecosystem Enhancement PROGRAM

RESTORATION SITE
MORGAN CREEK WETLAND/ FLOODPLAIN RESTORATION
OVERALL PLAN

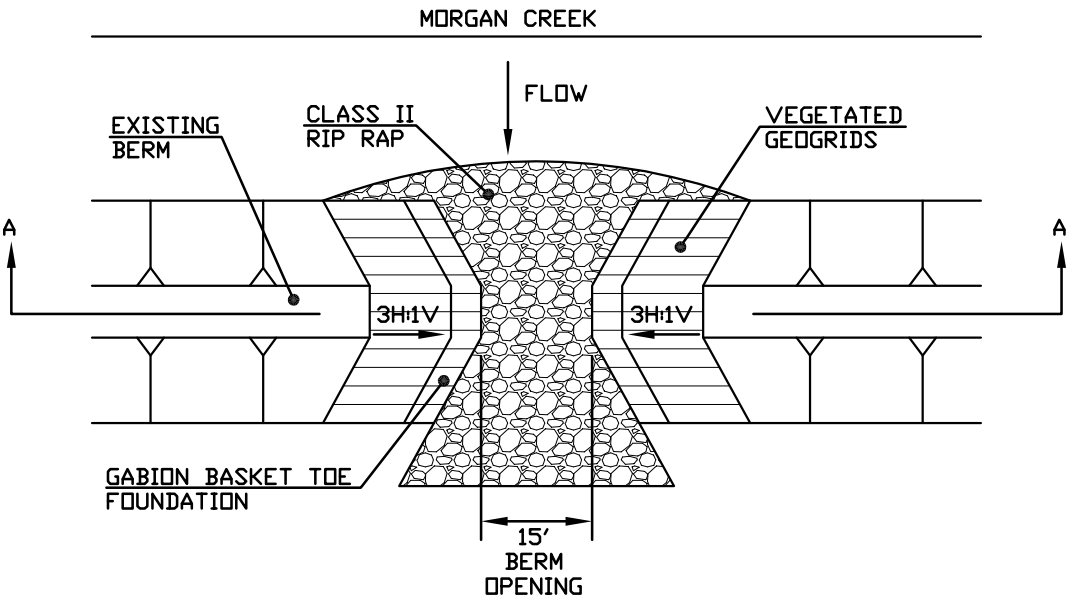
ORANGE/DURHAM COUNTY, NC

DATE: MAY 18, 2007

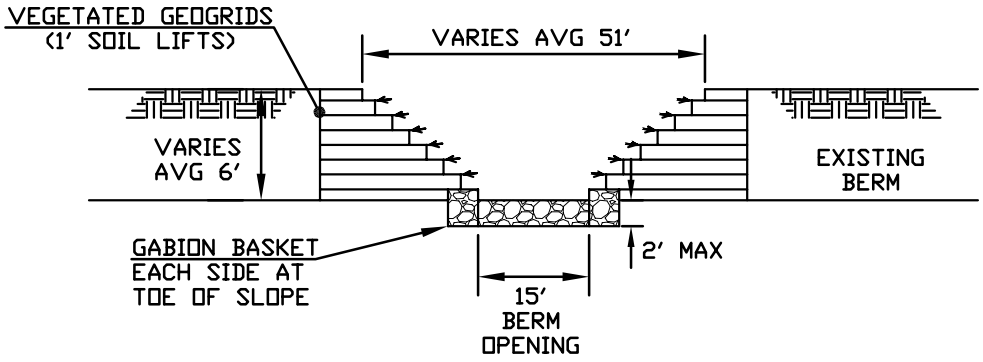
PROJ./DWG. NAME: MASON FARM RESTORATION Exhibit

SCALE: 1"=300'

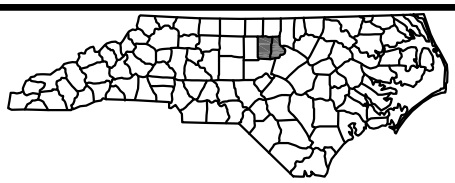
FIGURE 6



PLAN VIEW
(NTS)



SECTION A-A
(NTS)



Ecosystem Enhancement PROGRAM

North Carolina – Ecosystem Enhancement Program

Morgan Creek Wetland / Floodplain Restoration
Orange & Durham County, North Carolina
SCO ID #050645601

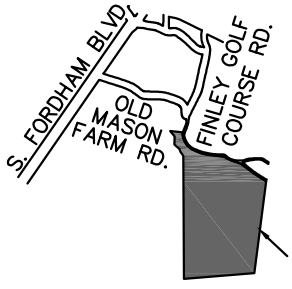


FIGURE 7
TYPICAL BERM OPENING

DATE: MAY 18, 2007

N

NOT TO SCALE

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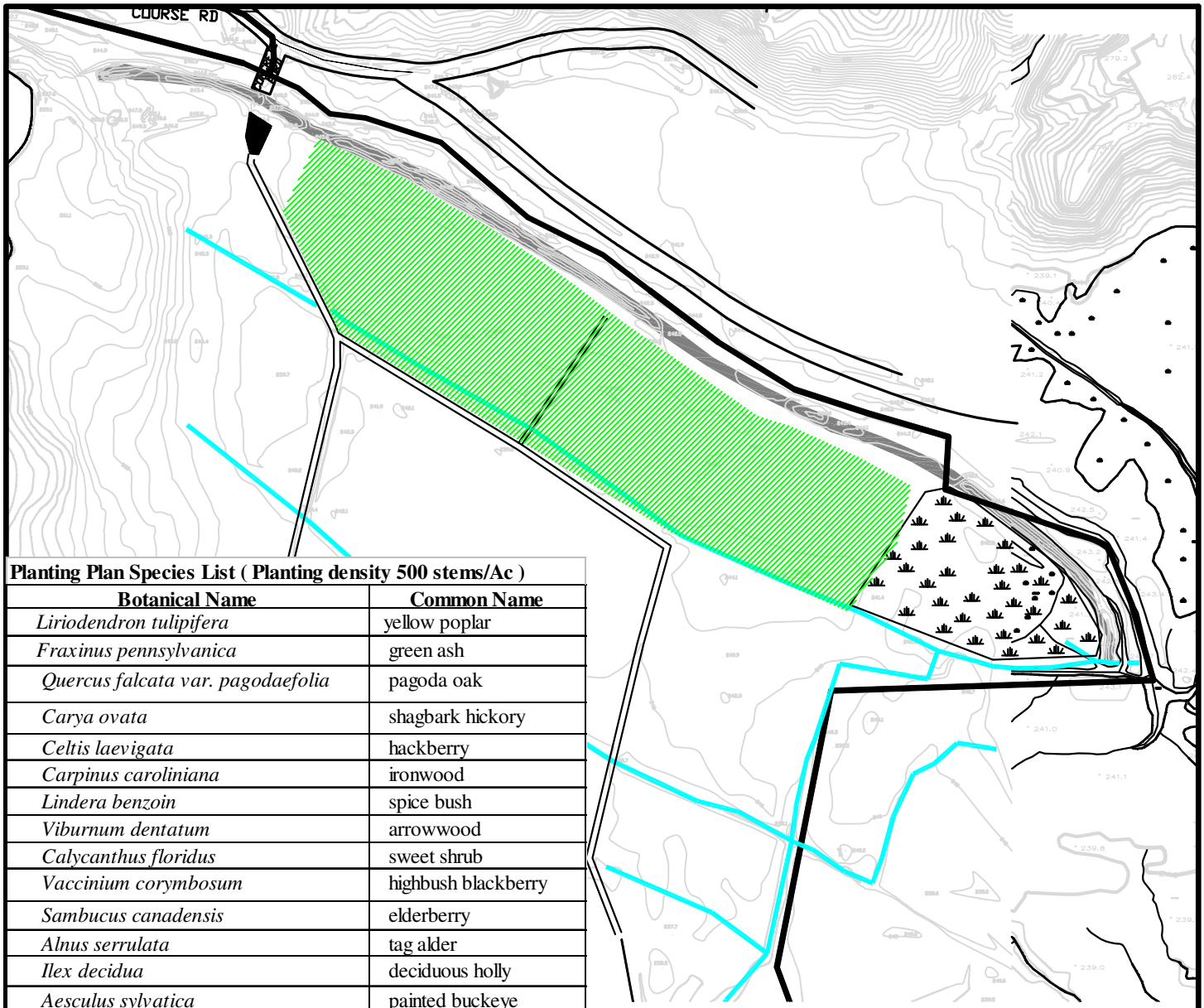
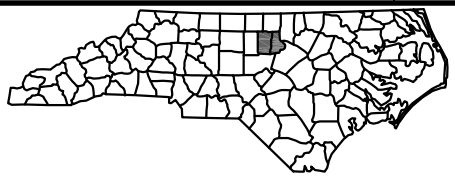


Planting Plan Species List (Planting density 500 stems/Ac)

Botanical Name	Common Name
Liriodendron tulipifera	yellow poplar
Fraxinus pennsylvanica	green ash
Quercus falcata var. pagodaefolia	pagoda oak
Carya ovata	shagbark hickory
Celtis laevigata	hackberry
Carpinus caroliniana	ironwood
Lindera benzoin	spice bush
Viburnum dentatum	arrowwood
Calycanthus floridus	sweet shrub
Vaccinium corymbosum	highbush blackberry
Sambucus canadensis	elderberry
Alnus serrulata	tag alder
Ilex decidua	deciduous holly
Aesculus sylvatica	painted buckeye
Asimina triloba	common pawpaw
Cornus ammomum	silky dogwood
Amelanchier arborea	downy serviceberry

PLANTING LEGEND

PLANTING AREA APPROX 27 ACRES



Ecosystem Enhancement PROGRAM

North Carolina – Ecosystem Enhancement Program

Morgan Creek Wetland / Floodplain Restoration
Orange & Durham County, North Carolina
SCO ID #050645601

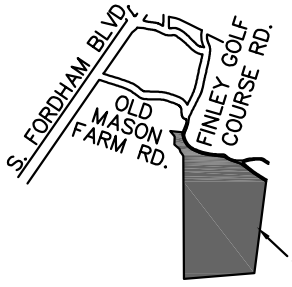
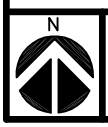
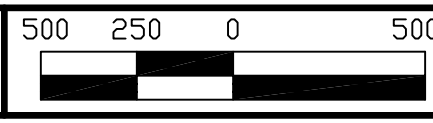


FIGURE 8
RESTORATION SITE PLANTING PLAN

DATE: MAY 18, 2007





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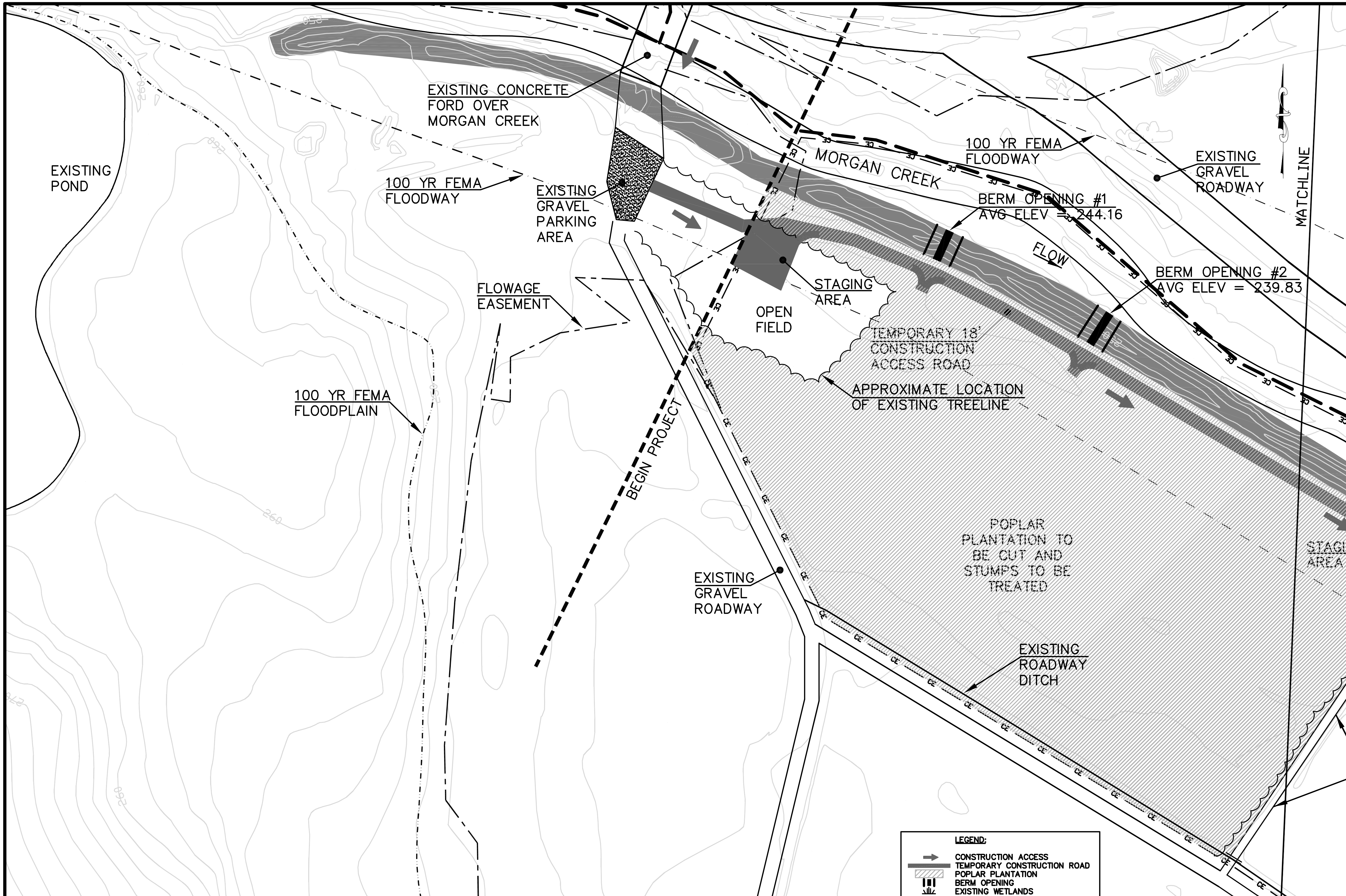

NOTES:

1. CONTRACTOR TO REMOVE TEMPORARY ACCESS ROADS AND WIDENING OF EXISTING ROAD UPON COMPLETION OF PROJECT

LEGEND:

- CONSTRUCTION ACCESS
- TEMPORARY CONSTRUCTION ROAD
- POPLAR PLANTATION
- BERM OPENING
- EXISTING WETLANDS
- TREELINE
- PROPERTY LINE
- CONSERVATION EASEMENT

60 30 0 60 120 180
SCALE IN FEET

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North Carolina – Ecosystem Enhancement Program
Chapel Creek Stream & Buffer Restoration Enhancement and Preservation
Orange County, North Carolina

SEAL: NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 1334 BECKY LYNNE WARD

MASON FARM RESTORATION PLAN

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 10 JULY 2006

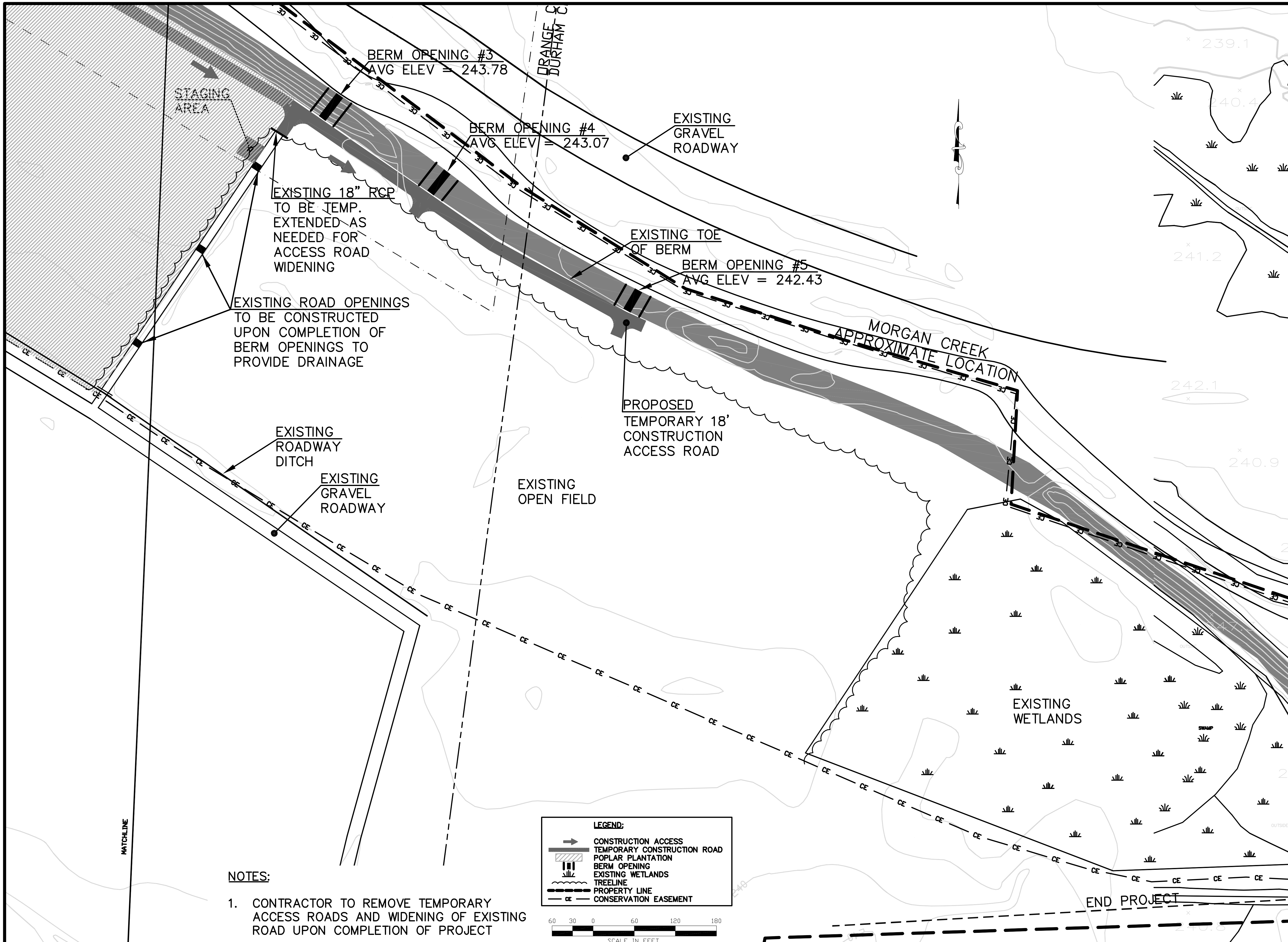
REVISIONS:

PROJECT NAME: Mason Farm

DWG NAME: Construction

SCALE: 1" = 60'

SHEET NO. 1 OF 2



NOTES:

1. CONTRACTOR TO REMOVE TEMPORARY ACCESS ROADS AND WIDENING OF EXISTING ROAD UPON COMPLETION OF PROJECT

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FAX (919) 870-5359

North Carolina - Ecosystem Enhancement Program

Chapel Creek Stream & Buffer Restoration Enhancement and Preservation
Orange County, North Carolina

SEAL:

MASON FARM RESTORATION PLAN

PRELIMINARY NOT FOR CONSTRUCTION

DATE: 10 JULY 2006

REVISIONS:

PROJECT NAME: Mason Farm

DWG NAME: Construction

SCALE: 1' = 60'

SHEET NO.

2 OF 2

Appendices

Appendix 1.	Restoration Site Photographs
Appendix 2.	Restoration Site USACE Routine Wetland Determination Data Forms
Appendix 3.	Restoration Site NCDWQ Stream Classification Forms
Appendix 4.	Restoration Site Soils Data
Appendix 5.	Restoration & Reference Site Ground Water Gauge Data
Appendix 6.	Reference Wetland Site Photographs
Appendix 7.	Reference Site USACE Routine Wetland Determinations
Appendix 8.	Morgan Creek USGS Gauge and HEC-RAS
Appendix 9.	Categorical Exclusion and Agency Response Letters
Appendix 10.	USACE Flowage Easement
Appendix 11.	DRAINMOD

Appendix 1: Restoration Site Photographs

Appendix 1 Mason Farms Restoration Site

Photo 1: Facing Northeast across Restoration Site

Photo 2: Facing Southeast across restoration site.

Photo 3: Facing Southwest across poplar plantation.

Photo 4: Facing West across poplar plantation.

Photo 5: Facing East across restoration site.

Photo 6: Facing Northeast across restoration site.

Photo 7: Morgan Creek Looking Downstream

Photo 8: Existing Southern Berm as viewed from the Northern bank of Morgan Creek

Appendix 2: Restoration Site USACE Routine Wetland Determination Data Forms

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

Project/Site: *Mason Farms Mitigation Site*
Applicant/Owner: *Ecosystem Enhancement Program*
Investigator(s): *Alex Adams, Chris Sheats*

Date: *22-Dec*
County: *Orange County*
State: *North Carolina*

Do Normal Circumstances exist on the site? **Yes** No
Is the site significantly disturbed (Atypical Situation)? Yes **No**
Is this area a potential Problem Area? Yes **No**
(If needed, explain on reverse)

Community II *Upland*
Transect ID: *Restoration Site*
Plot ID: *Fallow Field*

VEGETATION

	Dominant Plant Species	Stratum	Indicator
1.	*Fraxinus pennsylvanica*	*tree*	*FACW*
2.	*Liquidambar styraciflua*	*tree*	*FAC+*
3.	*Juniperus viginiana*	*tree*	*FACU-*
4.	*Rubus sp.*	*herb*	
5.	*Acer rubrum*	*tree*	*FAC*
6.	*Juncus effusus*	*herb*	*FACW*
7.	*Rhamnus sp.*	*shrub*	
8.	*Ligustrum sinense*	*shrub*	*FAC*
9.	*Rosa multiflora*	*shrub*	*UPL*
10.	*Pinus taeda*	*tree*	*FAC*
11.			
12.			
13.			
14.			
15.			
16.			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-). *> 50 %*

Remarks:

This fallow field has be disturbed form mowing.
The tree species average 15' in height and are spread sporadically throught the area.
The herbaceous layer is dominated by *Rubus* sp. and *Juncus effusus* in wetter areas.

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: **4** (in.)
Depth to Saturated Soil: **2** (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
X Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
X FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: *Some areas are inundated where the Juncus communities are located.*

SOILS

Map Unit Name
(Series and Phase): *Chewacla*

Drainage Class:

Taxonomy (Subgroup)

Field Observations
Confirm Mapped Type? Yes **No**

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-5"	*Ap*	*7.5YR 4/4*			*Sandyloam, granular*
5-16"	*BW1*	*7.5YR 4/4*	*7.5YR 5/3*	*many faint*	*clay loam, wk-sbk*

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
x Reducing Conditions
___ Gleyed or Low-Chroma Colors

___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks: *Non-hydric*

WETLAND DETERMINATION

Hydrophytic Vegetation Present? **Yes** No
Wetland Hydrology Present? **Yes** No
Hydric Soils Present? Yes **No**

Is this Sampling Point Within a Wetland? Yes **No**

Remarks: *This area is located adjacent to Morgan Creek which has a debris jam located downstream of the site. This may be a reason for the increased hydrology in the area. The water surface elevation at the debris jam is approximately 2 feet higher than directly downstream of the debris jam. The debris jam may be beaver influenced due to a lodge and gnawed trees observed on site.*

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

Project/Site: Mason Farms Mitigation Site Applicant/Owner: Investigator: Chris Sheets, Alex Adams	Date: 12-22-05 County: Orange+Durham State: North Carolina
Do Normal Circumstances Exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: WETLAND Transect ID: WETLAND1 Plot ID: Flag 2 Project Site

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Salix nigra	Canopy		9. Solidago sp.	herb	
2. Fraxinus pennsylvanica	Canopy		10.		
3. Polygonum pennsylvanicum	herb		11.		
4. Scirpus cyperinus	herb		12.		
5. Acer rubrum	Canopy		13.		
6. Sambucus canadensis	Sub-canopy		14.		
7. Viburnum nudum	Sub-canopy		15.		
8. Microstegium vimineum	herb		16.		

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

Remarks: A variety of hydrophitic plants are present within this wetland.

HYDROLOGY

___ Recorded Data (Describe in Remarks): ____ Stream, Lake, or Tide Gauge ____ Aerial Photographs ____ Other ___ No Recorded Data Available	Wetland hydrology Indicators: Primary Indicators: X Inundated X Saturated in Upper 12 Inches X Water Marks X Drift Lines X Sediment Deposits X Drainage Patterns in Wetlands Secondary Indicators (2 or more required): X Oxidized Root Channels in Upper 12" X Water-Stained Leaves ____ Local Soil Survey Data X FAC-Neutral Test ____ Other (Explain in Remarks)
Field Observations: Depth of Surface Water: _____(in.) Depth to Free Water in Pit: 2" (in.) Depth to Saturated Soil: 1" (in.)	

Remarks: Beaver do exist on site and are believed to be a cause for increased hydrology on site. Some areas are inundated as deep as 3 feet.

SOILS

Map Unit Name
(Series and Phase): Wahadkee

Drainage Class: _____

Taxonomy (Subgroup): _____

Field Observations
Confirm Mapped Type? Yes No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6"	A	10YR 5/2	10YR 4/4	Many distinct	SL, GR
6-18"	Bw	10YR 5/2	10YR 5/3	Many prominent	sicl, weak sbk

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- X Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer 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: Soil is extremely variable, the description represents most common conditions. Non-hydric inclusions present.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks: The hydrology within this wetland has been influenced by a beaver dam on Morgan Creek downstream.

Appendix 3: Restoration Site NCDWQ Stream Classification Forms

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

Date: 1-23-06	**Project:** Mason Farms	**Latitude:** 35.888567
Evaluator: Chris Sheats	**Site:** Morgan Creek	**Longitude:** -79.013468
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 41.5	**County:** Orange and Durham Counties	**Other** *e.g. Quad Name:* Chapel Hill, NC

A. Geomorphology (Subtotal = 23)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	← (2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	1	2	(3)
9[a] Natural levees	0	1	(2)	3
10. Headcuts	0	1	2	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = (3)	

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

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

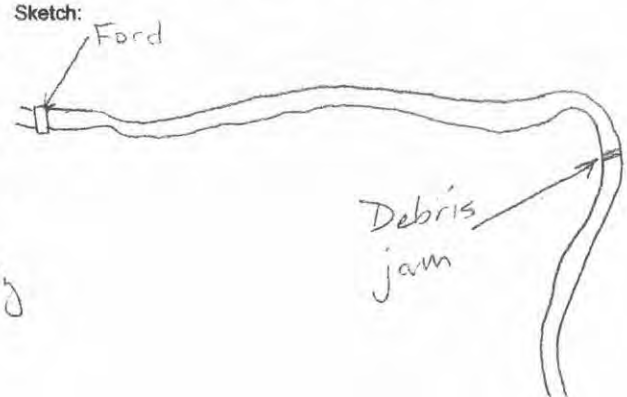
C. Biology (Subtotal = 10.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	(0.5) →	1	1.5
23. Bivalves	0	(1)	2	3
24. Fish	0	0.5	1	(1.5)
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	← (1)	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = (0)			

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

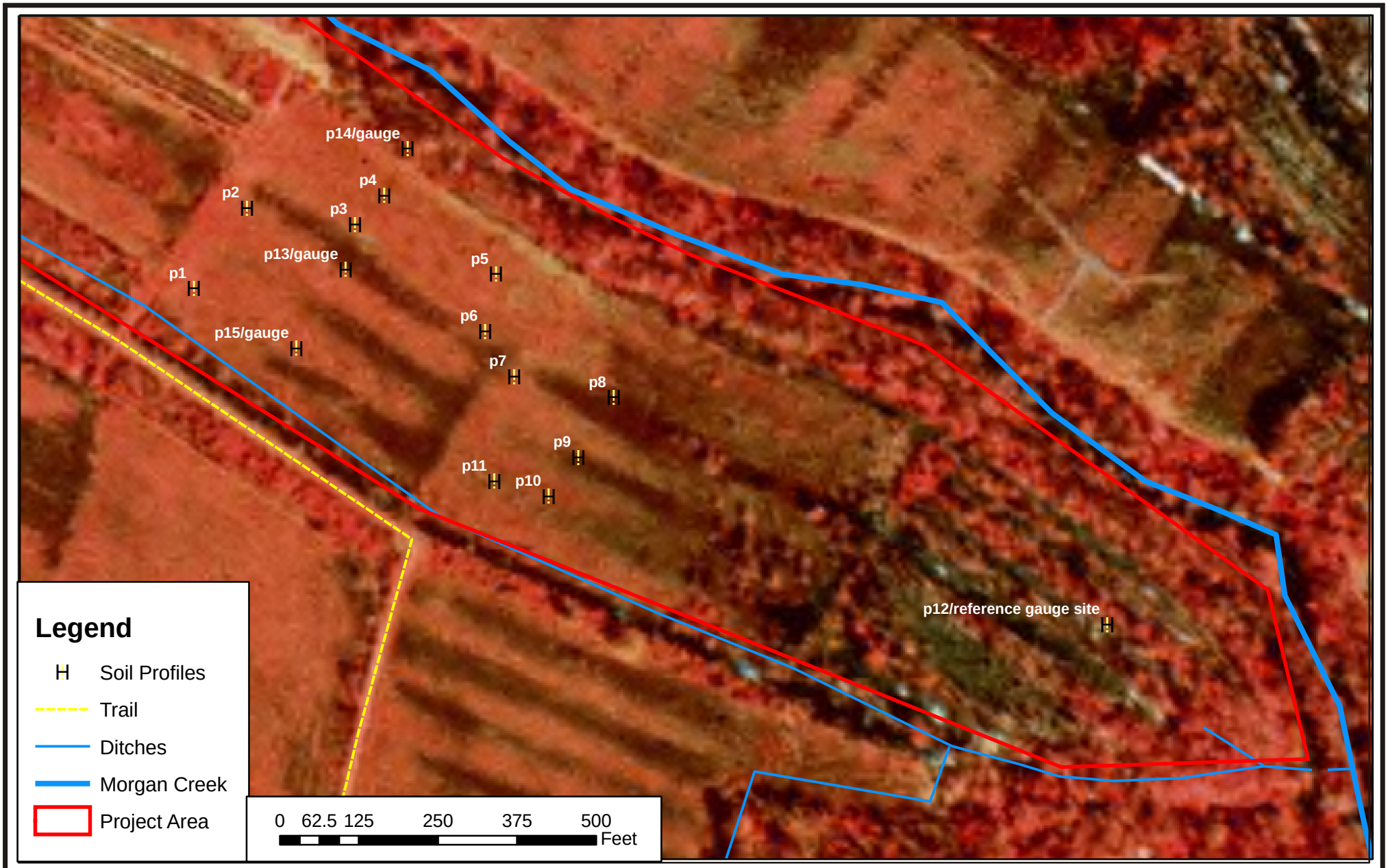
Notes: (use back side of this form for additional notes.)

A debris jam is located downstream of the southward meander on Morgan Creek. The dam may be beaver influenced and has raised the water table on Mason Farms Mitigatin Site. The water surface elevation drops approximately 2 feet downstream of the debris jam.

Sketch:



Appendix 4: Restoration Site Soils Data



The Catena Group

Client: Ecosystem Enhancement Program

Mason Farms Wetland and Stream Mitigation Project

Orange and Durham Counties, North Carolina

Date: May 2006

Scale: As Shown

Job No.:

Figure 1

Project: Mason Farm **County:** Orange

Described by: Michael Wood & Alex Adams **Date:** 11-11-05

	Boring # P-1	Boring # P-1	Boring # P-2	Boring #
DEPTH HORIZON I	0-6"	29-32"	0-15"	
COLOR	10YR 5/4	10YR 6/1 - 60%	10YR 4/2	
TEXTURE	SL	SCL	SL	
STRUCTURE	GR	SBK	GR/SG	
CONSISTENCE	FR	FI	VFR	
CONCENTRATIONS	F-1-10YR 5/6-F	10YR 5/6 - 40%	—	
DEPLETIONS	—		—	
DEPTH HORIZON II	6-18"	32-48"	15-28"	
COLOR	10YR 5/3	10YR 6/1 - 70%	10YR 5/4 - 60%	
TEXTURE	SL	C	SCL	
STRUCTURE	SBK-1	SBK	SBK	
CONSISTENCE	FR	FI	FR	
CONCENTRATIONS	C-F-1-10YR 5/6	C F-E-10YR 5/6-35%	10YR 5/8-20%	
DEPLETIONS	—		10YR 6/2-20%	
DEPTH HORIZON III	18-22	48-60"	28-38"	
COLOR	10YR 6/6	Soil Grads	10YR 5/4-50% 10YR 5/6-30%	
TEXTURE	SL	more Reduced	SL/SCL	
STRUCTURE	SBK-1	and coarser	SB/C	
CONSISTENCE	FR	as 4th depth	F	
CONCENTRATIONS	F-1-F-10YR 6/8	90% Gray matrix	soft Mg masses	
DEPLETIONS	F-1-F 10YR 6/2	+ SL/SCL at 60"	10YR 6/2-20%	
DEPTH HORIZON IV	22-28		38-AR	
COLOR	10YR 6/6-70%			
TEXTURE	SL			
STRUCTURE	SBK			
CONSISTENCE	FR			
CONCENTRATIONS	C-F-7.5YR 5/6-15%			
DEPLETIONS	C-F 10YR 6/2			
			38"-Thin ~3" gravel layer	
Ld. Pos.? % slope				
HYDRIC		Non		
Notes:				
INDICATOR:		None		

Project: Mason Farm **County:** Orange

Described by: Michael Wood & Alex Adams **Date:** 11-1-05

	Boring # 3	Boring # 4	Boring # 5	Boring # 6
DEPTH HORIZON I	0-3"	0-16"	0-14	0-11
COLOR	10YR 5/3	10YR 4/4	10YR 4/4	10YR 6/2
TEXTURE	SL	SL	SL	SCL
STRUCTURE	GR	GR	GR	SBLC
CONSISTENCE	~~GR~~ FR	FR	FR	FR
CONCENTRATIONS	—	—		40% 10YR 4/4
DEPLETIONS	—	—	F F- 10YR 6/2	—
DEPTH HORIZON II	3-15"	16-24"	14-32	11-26
COLOR	10YR 6/2	10YR 4/4	10YR 5/4	10YR 4/3
TEXTURE	SCL	SL	L/CL	LS
STRUCTURE	SBLC	SBK	SBLC	SG
CONSISTENCE	FR	FR	FR	FR
CONCENTRATIONS	C-P-10YR 5/6	—	C 10YR 4/6	30% 10YR 4/4
DEPLETIONS		F-F 10YR 6/2	C 10YR 6/2	
DEPTH HORIZON III	15-24	24-37"		
COLOR	10YR 5/6	10YR 4/4		
TEXTURE	L	SL		
STRUCTURE	M	M		
CONSISTENCE	FR	FR		
CONCENTRATIONS	—	many soft		
DEPLETIONS	Few 10YR 6/2	masses		
DEPTH HORIZON IV	24-46"			
COLOR	10YR 5/4			
TEXTURE	SL			
STRUCTURE	M			
CONSISTENCE	FR			
CONCENTRATIONS	—			
DEPLETIONS	—			
	many soft massy			
Ld. Pos.? % slope				
HYDRIC	Hydric	Non	Non	Hydric
Notes:	H_2O at 15"	H_2O at 22"	H_2O at 24"	H_2O at 16"
INDICATOR:				

628-230-7126

Project: Mason Farm **County:** Orange

Described by: Michael Wood & Alex Adams **Date:** 11-1-05

	Boring # 7	Boring # 8	Boring # 9	Boring # 10
DEPTH HORIZON I	0 - 15"	0 - 16	0 - 5	0 - 4
COLOR	10YR 4/4	10YR 5/2	10YR 5/3	10YR 5/2
TEXTURE	SL	CL	SCL	SCL
STRUCTURE	GR	SBK	GR	GR
CONSISTENCE	FR	FR	FR	FR
CONCENTRATIONS	—	common O.R 10YR 5/6	common O.R 10YR 5/6 - 30% →	
DEPLETIONS	—	—	10YR 6/2 - 10% →	
DEPTH HORIZON II	15 - 31	16 - 21	5 - 13	4 - 14"
COLOR	10YR 4/4	10YR 4/4 - 60%	10YR 5/3	10YR 5/2
TEXTURE	SCL	CL	SL	SiL
STRUCTURE	SBK	SBK	SBK	SBK
CONSISTENCE	FR	FR	FR	FR
CONCENTRATIONS	15% 10YR 3/6	10YR 3/6 - 20%	10YR 5/6	10YR 5/6
DEPLETIONS	20% 10YR 5/2	10YR 5/2 - 20%	10YR 6/2	
DEPTH HORIZON III	31 - 35	21 - 48	13 - 24+	
COLOR	10YR 4/4	10YR 4/4 60%	10YR 3/4	
TEXTURE	LS	C	L	
STRUCTURE	M/SG	SBK	SBK	
CONSISTENCE	FR	FR	FR	
CONCENTRATIONS	—	10YR 3/6 20%	—	
DEPLETIONS	—	10YR 6/2 20%		
		many salt masses	10YR 5/2 - 30%	
DEPTH HORIZON IV	35-48+	48-60+		
COLOR	mixed - Saturated	10YR 6/1 - 50%		
TEXTURE	Clay	C		
STRUCTURE	M	M		
CONSISTENCE	FR			
CONCENTRATIONS	Present	10YR 4/3 - 20%		
DEPLETIONS	Present	—		
Ld. Pos.? % slope				
HYDRIC	Non Hydric	Hydric	Non Hydric	Hydric
Notes:	H_2O at 32"	H_2O at 22"	—	
INDICATOR:				

Project: Mason Farm **County:** Orange

Described by: Michael Wood & Alex Adams **Date:** 11-11-05 Well Location

	Boring # 11	Boring # Ref-12	Boring # Ref-13	Boring # -13
DEPTH HORIZON I	0-11	0-14	47-60	0-14
COLOR	10YR 4/4	10YR 5/2	2.5Y 5/2	10YR 4/4
TEXTURE	SL	L	SL	SL
STRUCTURE	GR	GR	M-SG	GR
CONSISTENCE	FR	FR	FR	FR
CONCENTRATIONS	-	5YR 4/6 - 2.5%		
DEPLETIONS	-	-		
DEPTH HORIZON II	11-24+	14-B2"		14-21
COLOR	10YR 5/3	10YR 4/4		2.5Y 6/3
TEXTURE	SL	L		SCL
STRUCTURE	SBK	~~10YR~~ SBK		SBK
CONSISTENCE	FR	FR		FR
CONCENTRATIONS	-	5YR 4/6 -		10YR 3/2 - Mg masses
DEPLETIONS	- C 10YR 6/2			C 10YR 6/2
				Many Mg - Soft Masses
				Pockets of fine textured
DEPTH HORIZON III	24-30+	B2-40		21-27
COLOR	10YR 4/4	2.5Y 5/2		10YR 5/3
TEXTURE	SCL	SC		CL
STRUCTURE	SBK	SBK		SBK
CONSISTENCE	FR	FR		FR
CONCENTRATIONS	many 10YR Soft masses	10YR 4/4 - Many		Common O.R. 10YR 3/3 - Soft Many
DEPLETIONS	-			10YR 5/2 - C
		10YR 3/1 - Streaky		
DEPTH HORIZON IV		40-47		27-33
COLOR		2.5Y 5/2		10YR 4/3
TEXTURE		CL		CL
STRUCTURE		SBK		SBK
CONSISTENCE		FR		FR
CONCENTRATIONS		2.5Y 4/4 - Many		O.R. - throughout
DEPLETIONS				10YR 5/2
Ld. Pos.? % slope				
HYDRIC	Non Hydric			
Notes:		Roots to 48"	Gravel - 55-60"	
INDICATOR:		H_2O @ 12"		

Project: Mason Farm **County:** Orange

Described by: Michael Wood & Alex Adams **Date:** 11-11-05

	Boring # 13 well Count	Boring #	Boring #	Boring #
DEPTH HORIZON I	33- ~~68~~			
COLOR	10YR 5/2			
TEXTURE	CL			
STRUCTURE	SBlC			
CONSISTENCE	FR			
CONCENTRATIONS	< 10YR 5/3 - Comm 0.2			
DEPLETIONS	—			
	Breaking to m			
	SB Structure at 60			
DEPTH HORIZON II				
COLOR				
TEXTURE				
STRUCTURE				
CONSISTENCE				
CONCENTRATIONS				
DEPLETIONS				
DEPTH HORIZON III				
COLOR				
TEXTURE				
STRUCTURE				
CONSISTENCE				
CONCENTRATIONS				
DEPLETIONS				
DEPTH HORIZON IV				
COLOR				
TEXTURE				
STRUCTURE				
CONSISTENCE				
CONCENTRATIONS				
DEPLETIONS				
Ld. Pos.? % slope				
HYDRIC				
Notes:	H2O at 33"			
INDICATOR:				

Project: Mason Farm

County: Orange

Described by: [redacted] Steven J. Mellin #1254

Date: 11/23/05

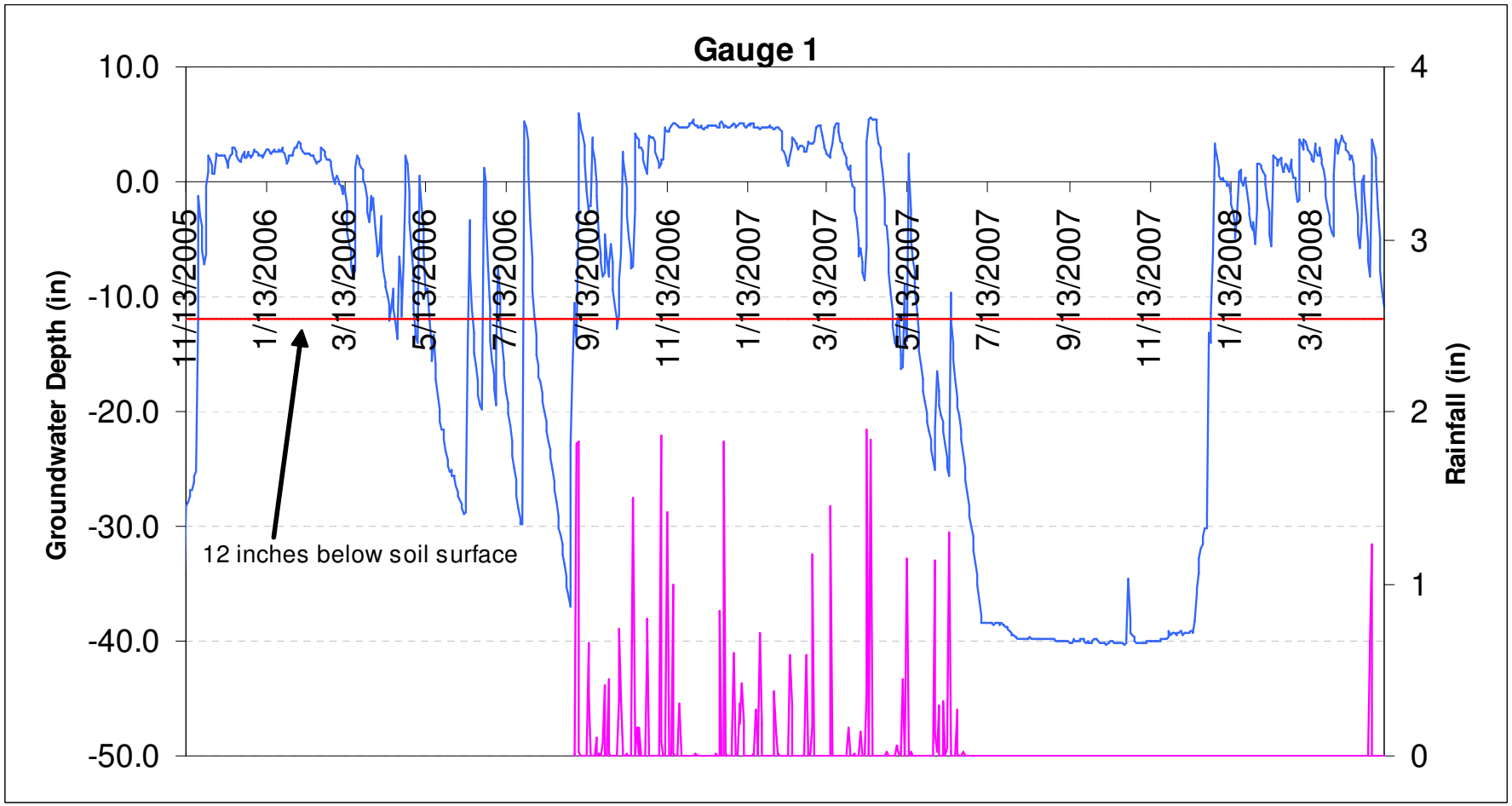
	Boring # 1000	Boring # cont?	Boring # 1001	Boring #
DEPTH HORIZON I	0 - 7		0-4	
COLOR	10 YR 5/6		10 YR 5/3	
TEXTURE	L		SiL	
STRUCTURE	1 f sbk		1 f sbk	
CONSISTENCE	FR / Stic Sty		FR / Stic Sty	
CONCENTRATIONS	-		5 YR 5/6 (C,D)	
DEPLETIONS	few fc. + 10YR 6/2			
DEPTH HORIZON II	7- 11	15 - 25	4 - 13	
COLOR	7.5 YR 4/6	10 YR 6/2	10 YR 6/2	
TEXTURE	CL	SCL	SiL / L	
STRUCTURE	2 m sbk	M / 2m sbk	2 m sbk	
CONSISTENCE	F: / Stic Sty	Fi	Fi	
CONCENTRATIONS	5 YR 5/8 (C,D)	10 YR 4/4 A	5YR 4/6 (M. P)	
DEPLETIONS	10YR 6/2 (C,D)	5 YR 4/6	7.5 YR 4/6	
DEPTH HORIZON III	11 - 15	25 - 54	15 - 28	
COLOR	7.5 YR 4/6	Gleyed	10 YR 6/1	
TEXTURE	CL	SC	CL	
STRUCTURE	2 m sbk	M	M	
CONSISTENCE	Fi / Stic Sty	F: / V. plast	Fi	
CONCENTRATIONS	5 YR 5/8 (C,D)	5 YR 5/8 Strong	5 YR 4/6 Strong	
DEPLETIONS	10 YR 4/2 (M, P)	-	10 YR 4/6 (C,D)	
DEPTH HORIZON IV		54 + (60")	28 - 50	
COLOR		10 YR 6/2	10 GYR 5/1	
TEXTURE		Sand (coarse)	Clay	
STRUCTURE		M	M	
CONSISTENCE		VFR	Fi	
CONCENTRATIONS		-	-	
DEPLETIONS		-	-	
			Sand @ 50" +	
			Gleyed	
Ld. Pos.? % slope				
HYDRIC		✓	✓	
Notes:		Next to creek		
INDICATOR:				

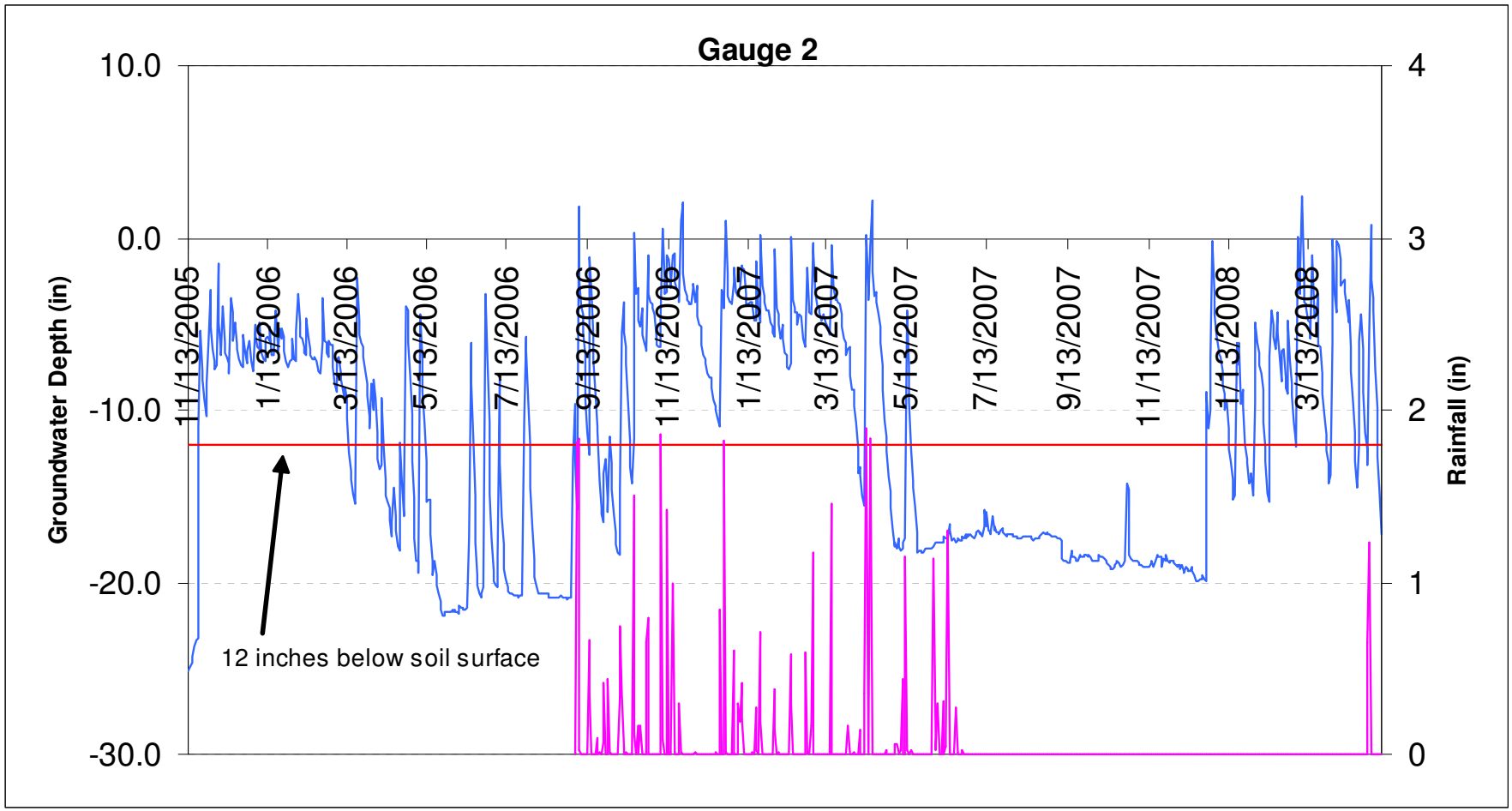
Project: Mason Farm **County:** Orange

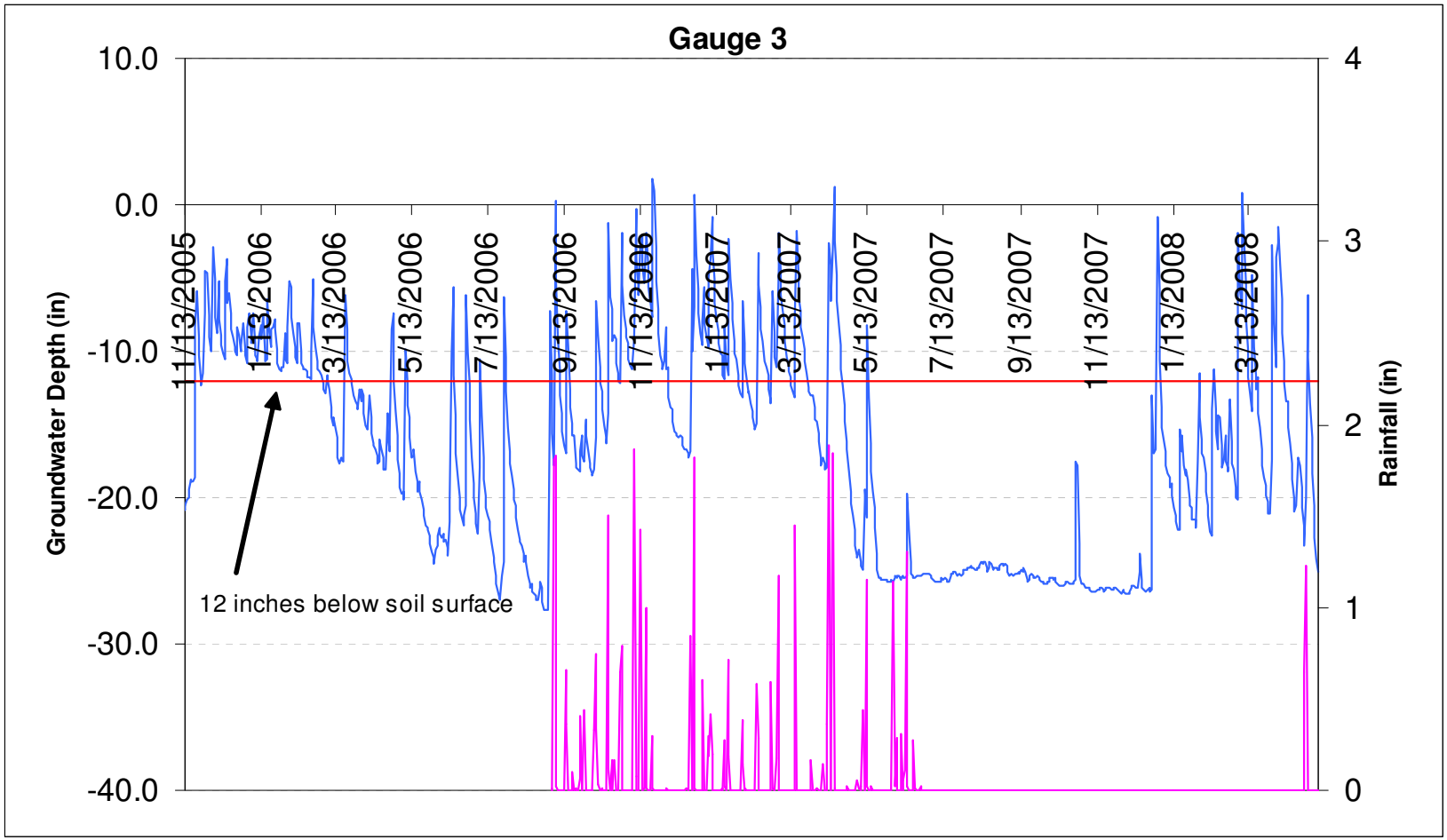
Described by: Michael Wood & Alex Adams **Date:** 11-23-05

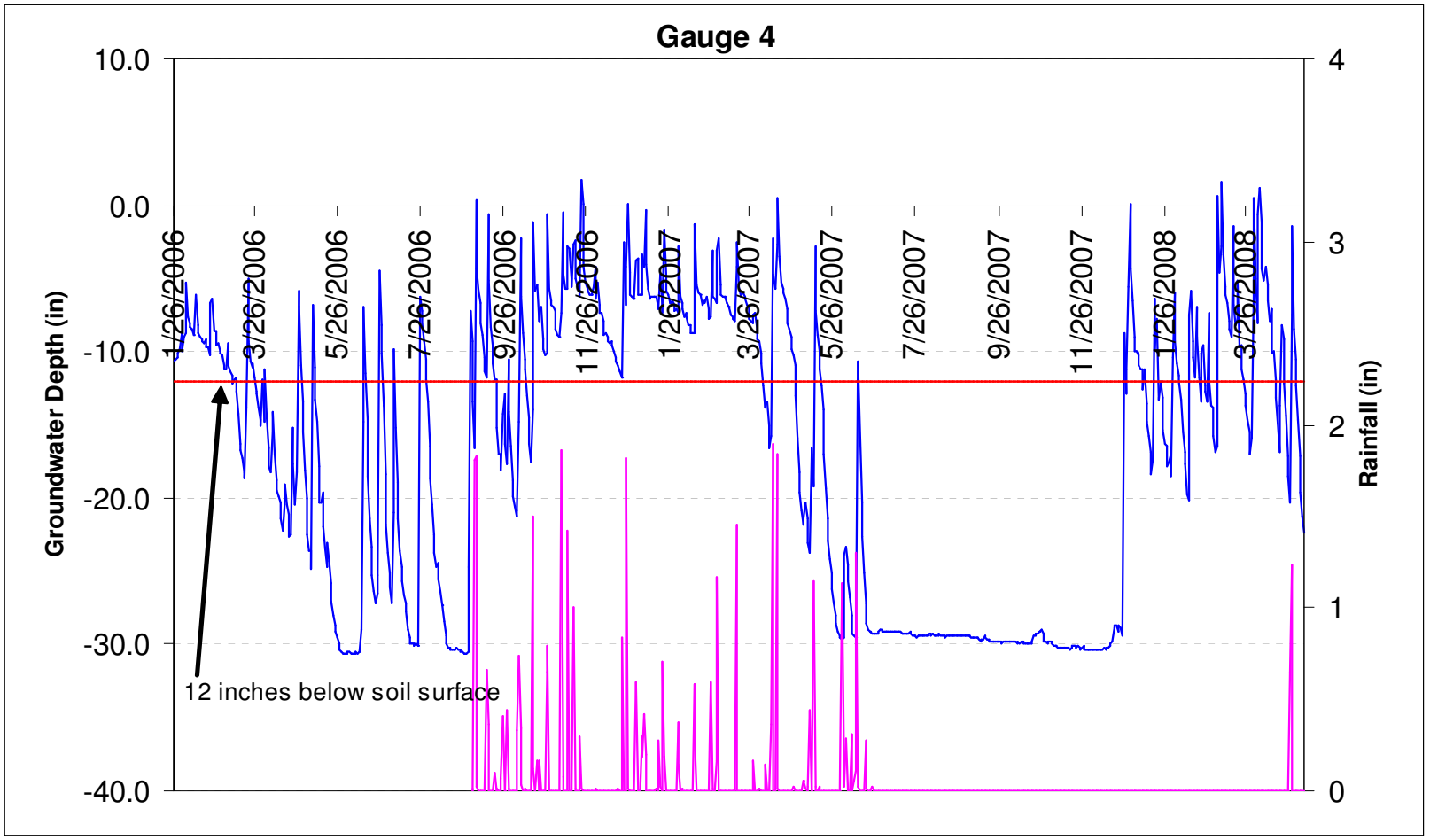
	Boring # P-15	Boring # P-16	Boring #	Boring #
DEPTH HORIZON I	0-7	0-24		
COLOR	7.5YR 5/3	10YR 4/6		
TEXTURE	SL	SL		
STRUCTURE	SBK	SBK		
CONSISTENCE	FR	FR		
CONCENTRATIONS	30% 10YR 4/4	—		
DEPLETIONS		—		
DEPTH HORIZON II	7-18	24-50		
COLOR	10YR 6/2	NP Recovery		
TEXTURE	SL	After 3		
STRUCTURE	wk SBK	Attempts		
CONSISTENCE	FR			
CONCENTRATIONS	40% 7.5YR 4/4			
DEPLETIONS				
5% soft masses				
DEPTH HORIZON III	18-24			
COLOR	10YR 4/2			
TEXTURE	SCL			
STRUCTURE	wk SBK			
CONSISTENCE	FR			
CONCENTRATIONS	15% 7.5YR 4/4			
DEPLETIONS	30% soft masses			
DEPTH HORIZON IV	34-44			
COLOR	7.5YR 6/1			
TEXTURE	SiCL			
STRUCTURE	SBK			
CONSISTENCE	FI			
CONCENTRATIONS	25% 7.5YR 4/4			
DEPLETIONS	—			
Ld. Pos.? % slope	FP -2%	FP		
HYDRIC		Non Hydric		
Notes:	Junkas			
INDICATOR:				

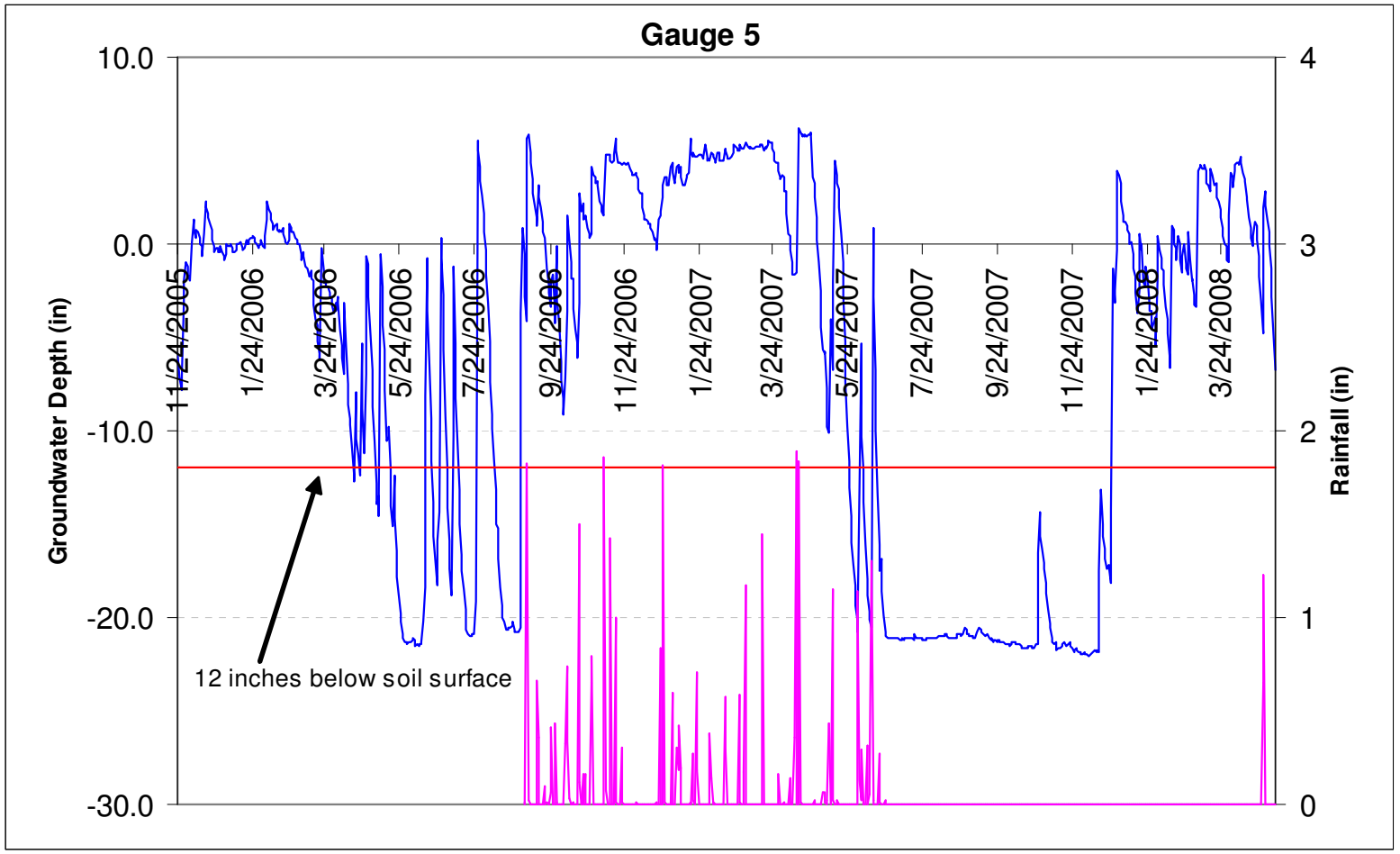
Appendix 5: Restoration & Reference Site Ground Water Gauge Data

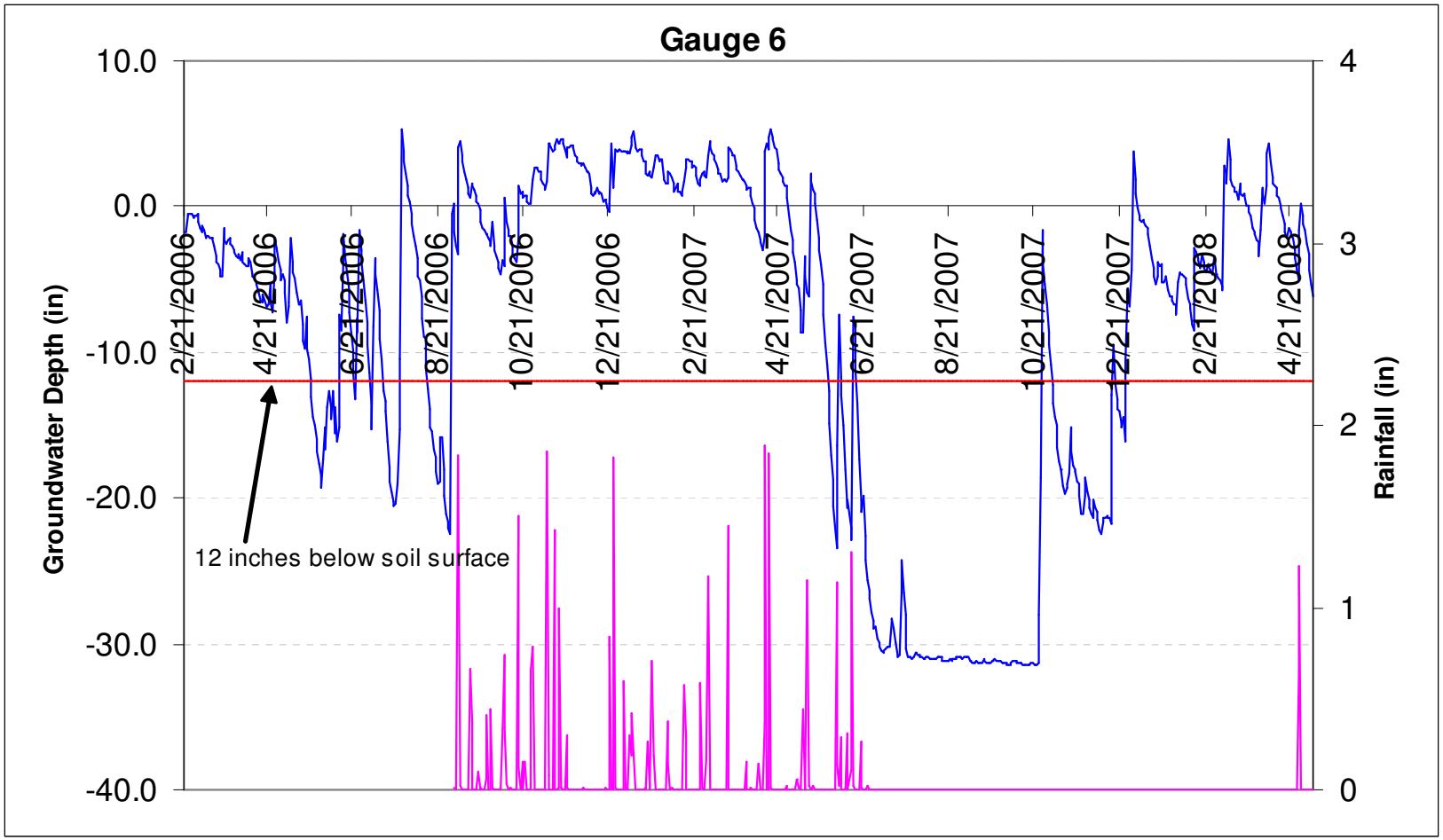

Gauge 1
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
4
3
2
1
0
11/13/2005
1/13/2006
3/13/2006
5/13/2006
7/13/2006
9/13/2006
11/13/2006
1/13/2007
3/13/2007
5/13/2007
7/13/2007
9/13/2007
11/13/2007
1/13/2008
3/13/2008
12 inches below soil surface

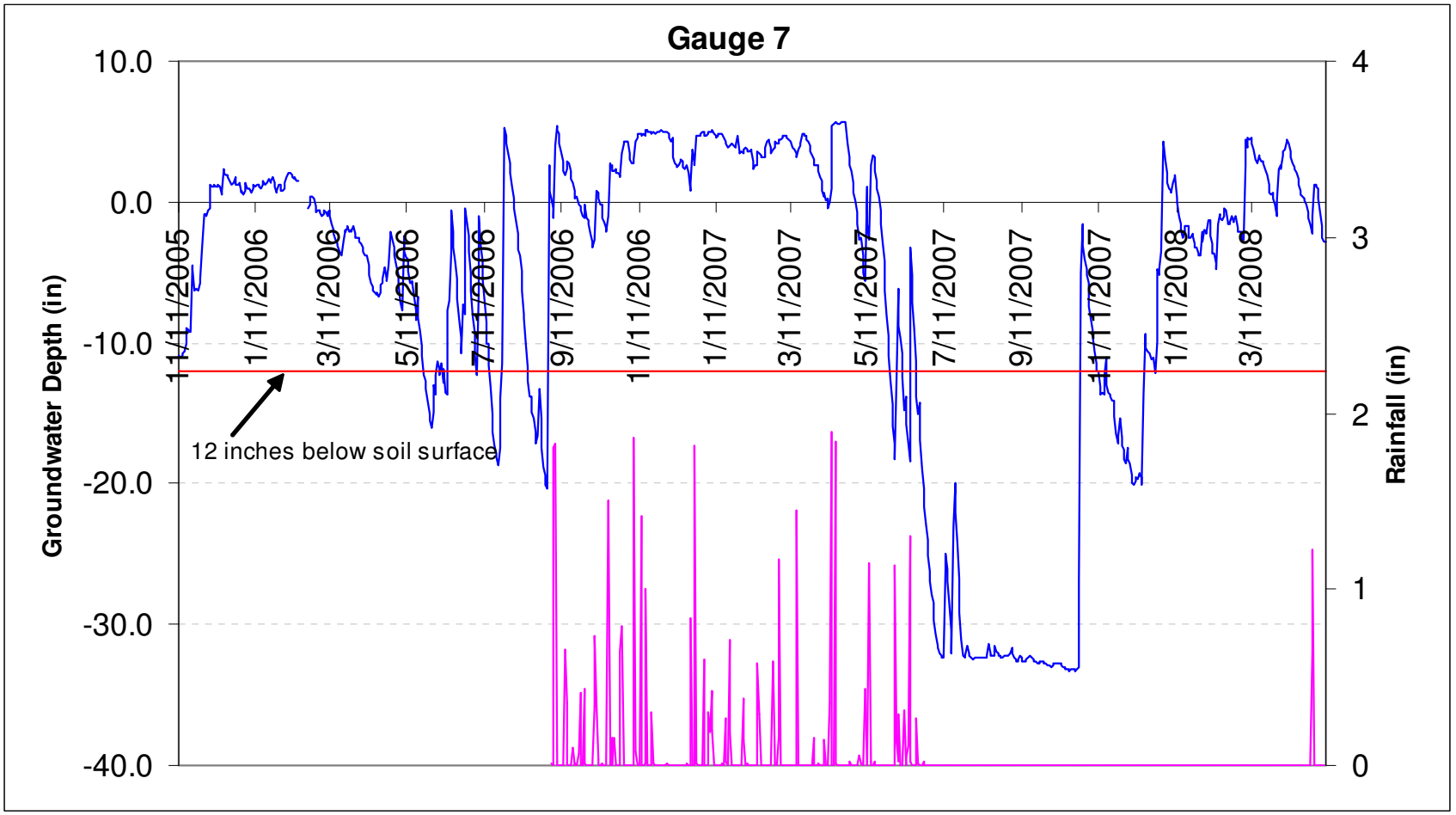

Gauge 2
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
4
3
2
1
0
11/13/2005
1/13/2006
3/13/2006
5/13/2006
7/13/2006
9/13/2006
11/13/2006
1/13/2007
3/13/2007
5/13/2007
7/13/2007
9/13/2007
11/13/2007
1/13/2008
3/13/2008
12 inches below soil surface

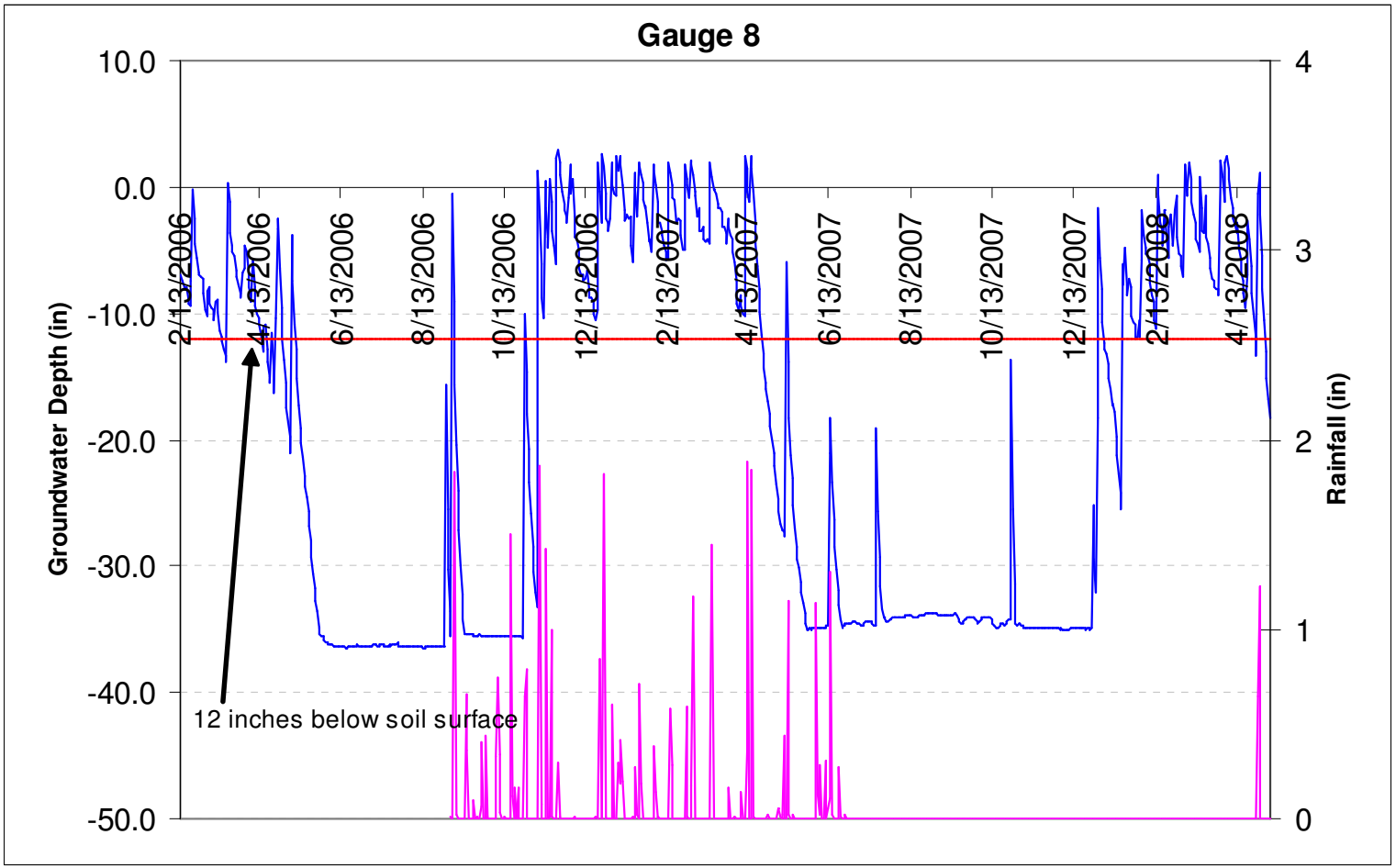

Gauge 3
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
4
3
2
1
0
11/13/2005
1/13/2006
3/13/2006
5/13/2006
7/13/2006
9/13/2006
11/13/2006
1/13/2007
3/13/2007
5/13/2007
7/13/2007
9/13/2007
11/13/2007
1/13/2008
3/13/2008
12 inches below soil surface

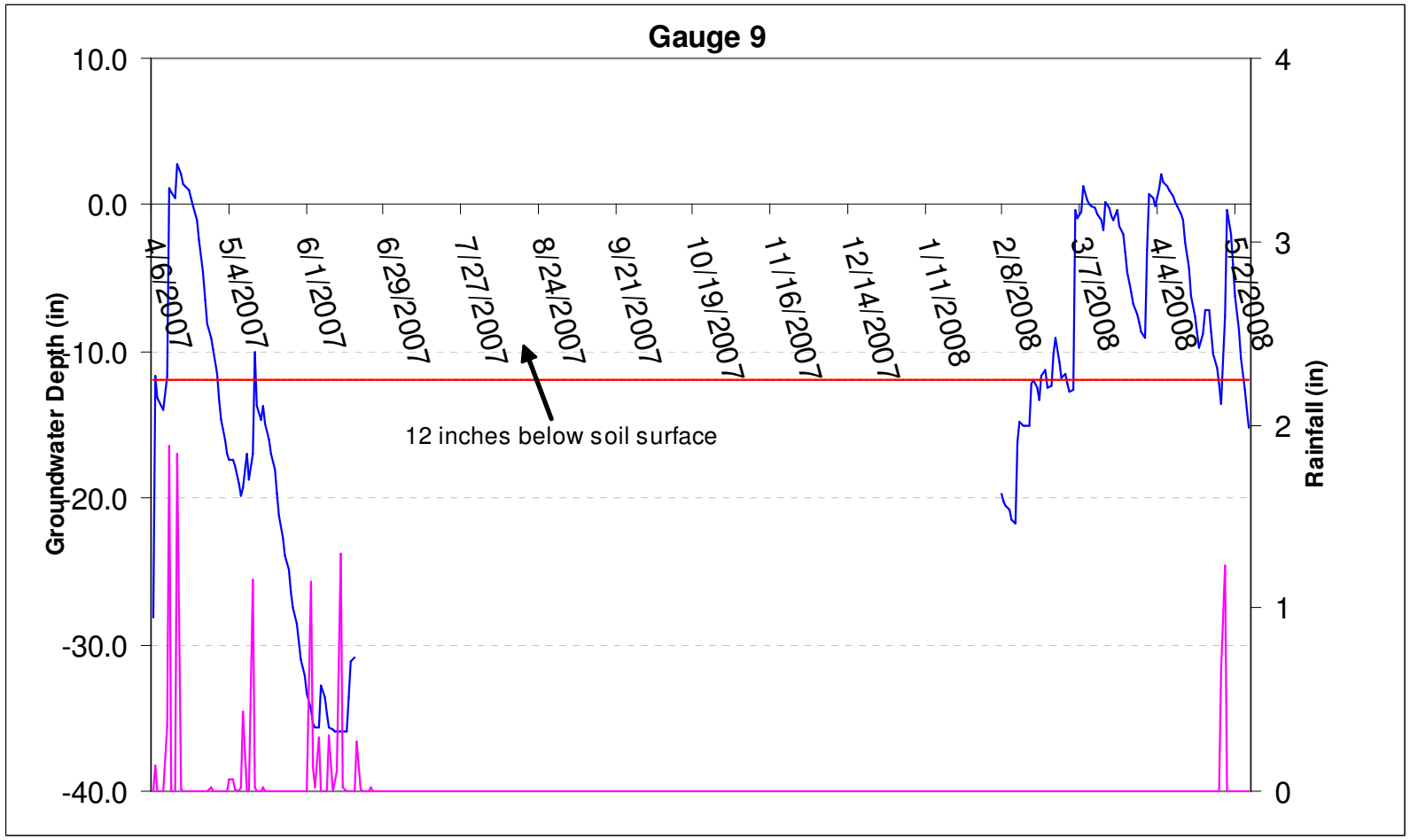

Gauge 4
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
4
3
2
1
0
1/26/2006
3/26/2006
5/26/2006
7/26/2006
9/26/2006
11/26/2006
1/26/2007
3/26/2007
5/26/2007
7/26/2007
9/26/2007
11/26/2007
1/26/2008
3/26/2008
12 inches below soil surface

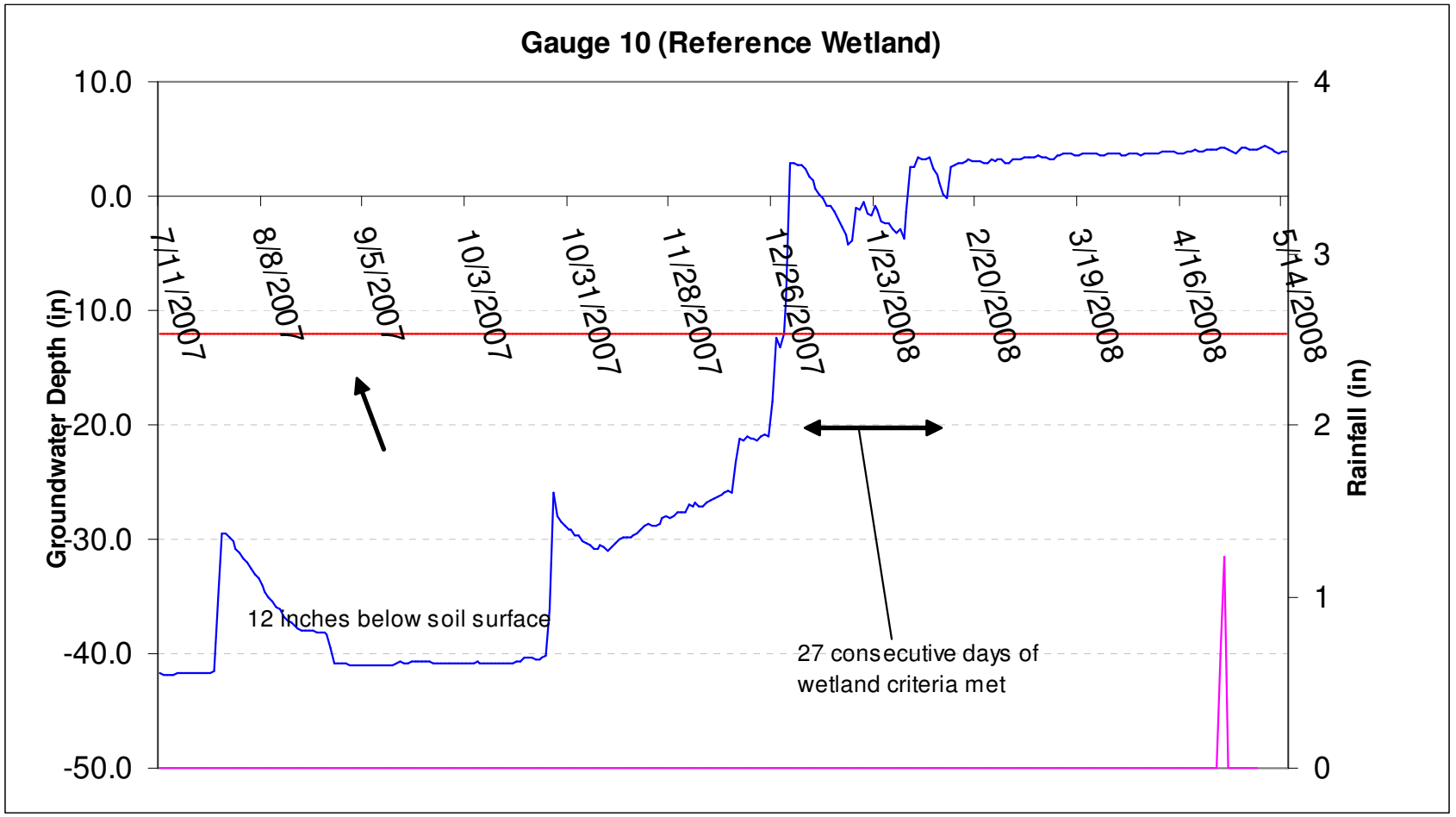

Gauge 5
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
4
3
2
1
0
11/24/2005
1/24/2006
3/24/2006
5/24/2006
7/24/2006
9/24/2006
11/24/2006
1/24/2007
3/24/2007
5/24/2007
7/24/2007
9/24/2007
11/24/2007
1/24/2008
3/24/2008
12 inches below soil surface


Gauge 6
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
4
3
2
1
0
2/21/2006
4/21/2006
6/21/2006
8/21/2006
10/21/2006
12/21/2006
2/21/2007
4/21/2007
6/21/2007
8/21/2007
10/21/2007
12/21/2007
2/21/2008
4/21/2008
12 inches below soil surface


Gauge 7
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
4
3
2
1
0
11/11/2005
1/11/2006
3/11/2006
5/11/2006
7/11/2006
9/11/2006
11/11/2006
1/11/2007
3/11/2007
5/11/2007
7/11/2007
9/11/2007
11/11/2007
1/11/2008
3/11/2008
12 inches below soil surface


Gauge 8
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
4
3
2
1
0
2/13/2006
4/13/2006
6/13/2006
8/13/2006
10/13/2006
12/13/2006
2/13/2007
4/13/2007
6/13/2007
8/13/2007
10/13/2007
12/13/2007
2/13/2008
4/13/2008
12 inches below soil surface


Gauge 9
10.0
0.0
-10.0
-20.0
-30.0
-40.0
4
3
2
1
0
Groundwater Depth (in)
Rainfall (in)
4/6/2007
5/4/2007
6/1/2007
6/29/2007
7/27/2007
8/24/2007
9/21/2007
10/19/2007
11/16/2007
12/14/2007
1/11/2008
2/8/2008
3/7/2008
4/4/2008
5/2/2008
12 inches below soil surface


Gauge 10 (Reference Wetland)
Groundwater Depth (in)
Rainfall (in)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
4
3
2
1
0
7/11/2007
8/8/2007
9/5/2007
10/3/2007
10/31/2007
11/28/2007
12/26/2007
1/23/2008
2/20/2008
3/19/2008
4/16/2008
5/14/2008
12 inches below soil surface
27 consecutive days of
wetland criteria met

Appendix 6: Reference Wetland Site Photographs

Photo 1. View facing northwest with Morgan Creek to the left.

Photo 2. View facing southeast direction with Morgan Creek to the right. A small green ash tree (*Fraxinus pennsylvanica*) can be seen on the left in the foreground.

Photo 3. View facing southeast with Morgan Creek to the right. Pennsylvania smartweed (*Polygonum pennsylvanicum*) is the dominant herbaceous species in this wetland.

\

Photo 4. The large tulip poplar tree (*Liriodendron tulipifera*) in the center of the picture is actually a dead snag allowing for more sunlight creating optimal conditions for a thriving herbaceous wetland community.

Appendix 7: Reference Site USACE Routine Wetland Determination Data Forms

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

Project / Site: Mason Farms **Applicant / Owner:** EEP **Investigator:** Chris Skeats, Mike Callahan	**Date:** 2/13/08 **County:** Orange **State:** NC
Do normal circumstances exist on the site? Yes ✓ No ___ **Is the site significantly disturbed (Atypical situation)?** Yes ___ No ✓ **Is the area a potential problem area?** Yes ___ No ✓ **(explain on reverse if needed)**	**Community ID:** Reference **Transect ID:** Wetland **Plot ID:** Wetland flag 3

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Polygonum pennsylvanicum	herb.	FACW	9. Pilea pumila	herb	FACW
2. Pluchea camphorata	herb	FACW	10. Fraxinus pennsylvanica	canopy	FACW
3. Liriodendron tulipifera	canopy	FAC	11. Commelina diffusa	herb	FACW
4. Boehmeria cylindrica	herb	FACW+	12. Juncus effusus	herb	FACW+
5. Woodwardia areolata	herb	OBL	13. Peltandra virginica	herb	OBL
6. Acer negundo	Canopy	FACW	14.		
7. Celtis laevigata	Canopy	FAC	15.		
8. Onoclea sensibilis	herb	FACW	16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). ___

Remarks:
This wetland is open with few canopy trees. One large dead tulip poplar marks the center of this linear wetland depression

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ **No Recorded Data Available**

Field Observations:

Depth of Surface Water: ___ (in.)

Depth to Free Water in Pit: 9 (in.)

Depth to Saturated Soil: ___ (in.)

Wetland Hydrology Indicators

Primary Indicators:
- ✓ Inundated
- ✓ Saturated in Upper 12"
- ✓ Water Marks
- ___ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators:
- ✓ Oxidized Roots Channels in Upper 12"
- ✓ Water-Stained Leaves
- ___ Local Soil Survey Data
- ✓ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name
(Series and Phase): _____ **Drainage Class:** _____

Taxonomy (Subgroup): _____ **Confirm Mapped Type? Yes___ No___**

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2	A	2.5Y 5/2	7.5YR 4/6	common/prominent	silty clay loam
2-12+	Bg1	7.5YR 4/3	7.5YR 6/2	common/faint	silty clay loam

Hydric Soil Indicators:

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

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes** ✓	**No** ___	**Is the Sampling Point**	
Wetland Hydrology Present?	**Yes** ✓	**No** ___	**Within a Wetland?**	**Yes** ✓ **No** ___
Hydric Soils Present?	**Yes** ✓	**No** ___		

Remarks:

Appendix 8: Morgan Creek USGS Stream Gauge And HECRAS Data

Water Resources

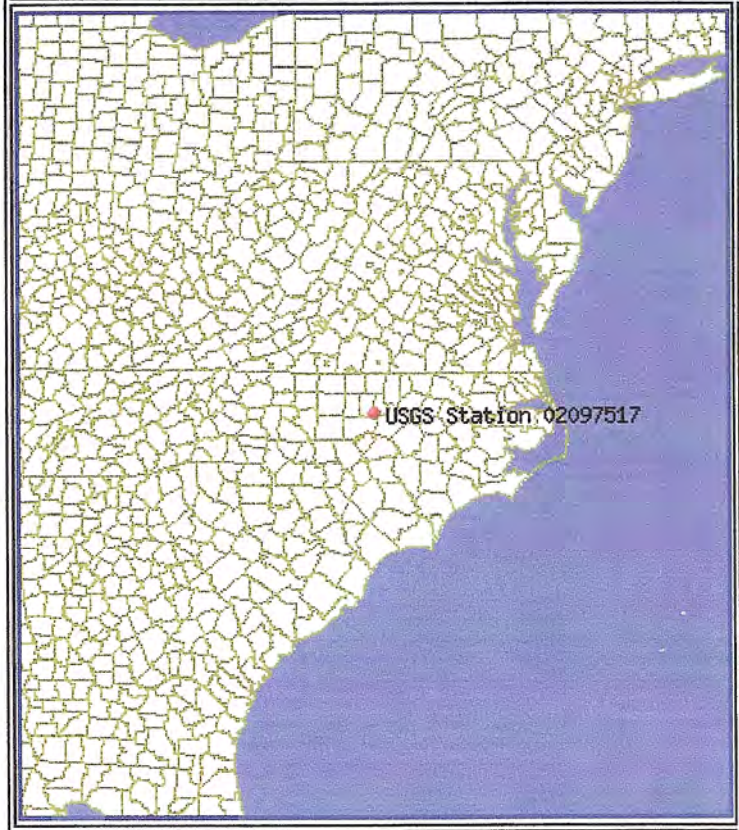
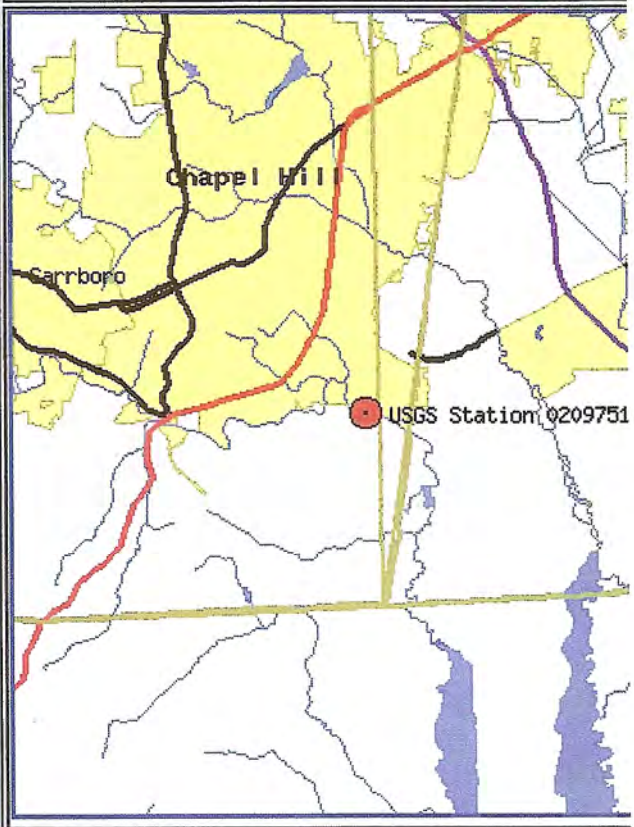
Data Category: Site Information | Geographic Area: United States | go

Site Map for the Nation

USGS 02097517 MORGAN CREEK NEAR CHAPEL HILL, NC

Available data for this site: site map | GO

Orange County, North Carolina
Hydrologic Unit Code 03030002
Latitude 35°53'36", Longitude 79°01'11" NAD83
Drainage area 41.00 square miles
Gage datum 239.02 feet above sea level NGVD29

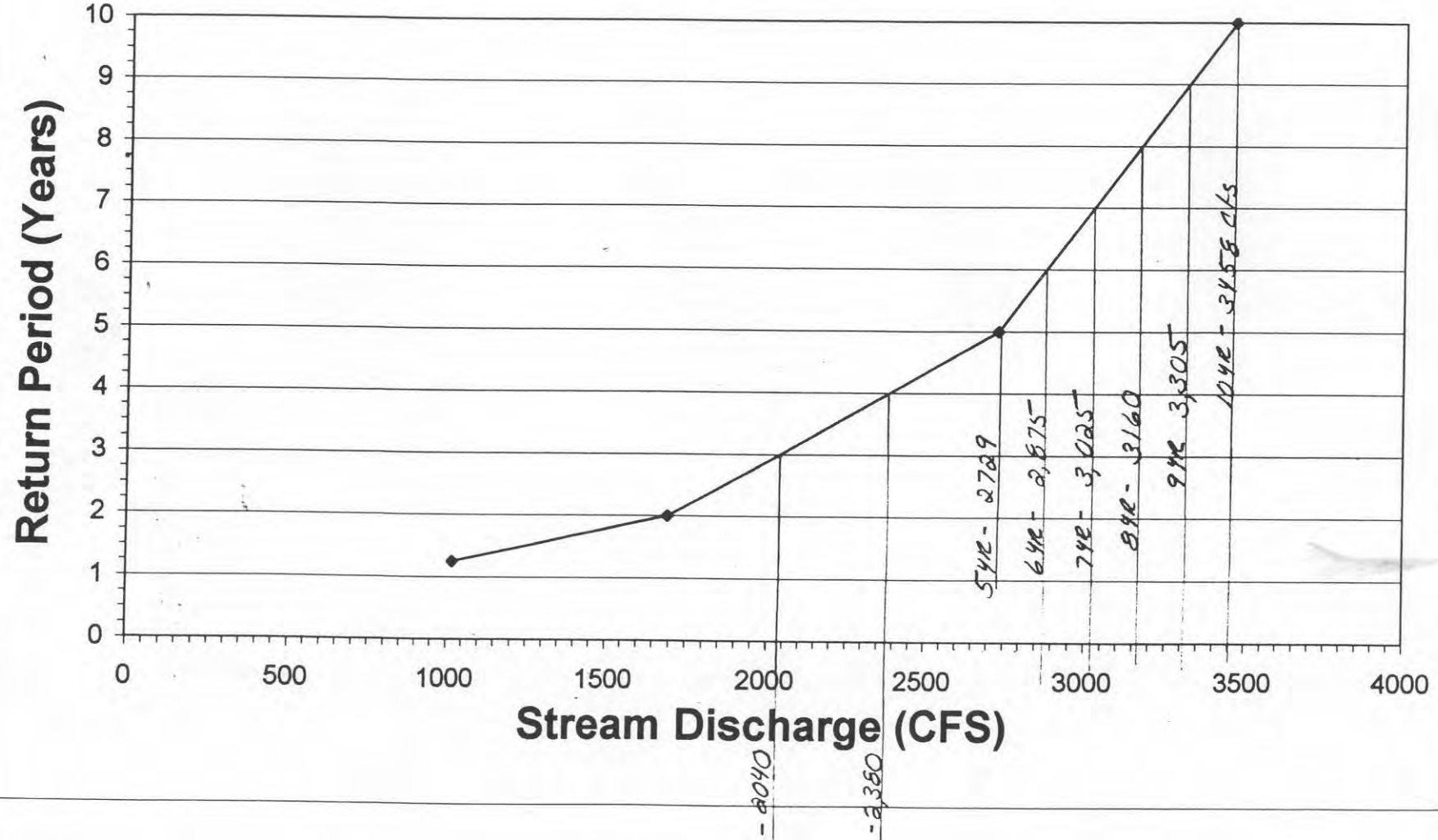
Location of the site in USA.	Site map.
	
	ZOOM IN 2X, 4X, 6X, 8X, or ZOOM OUT 2X 6X. 8X.

Maps are generated by US Census Bureau TIGER Mapping Service.

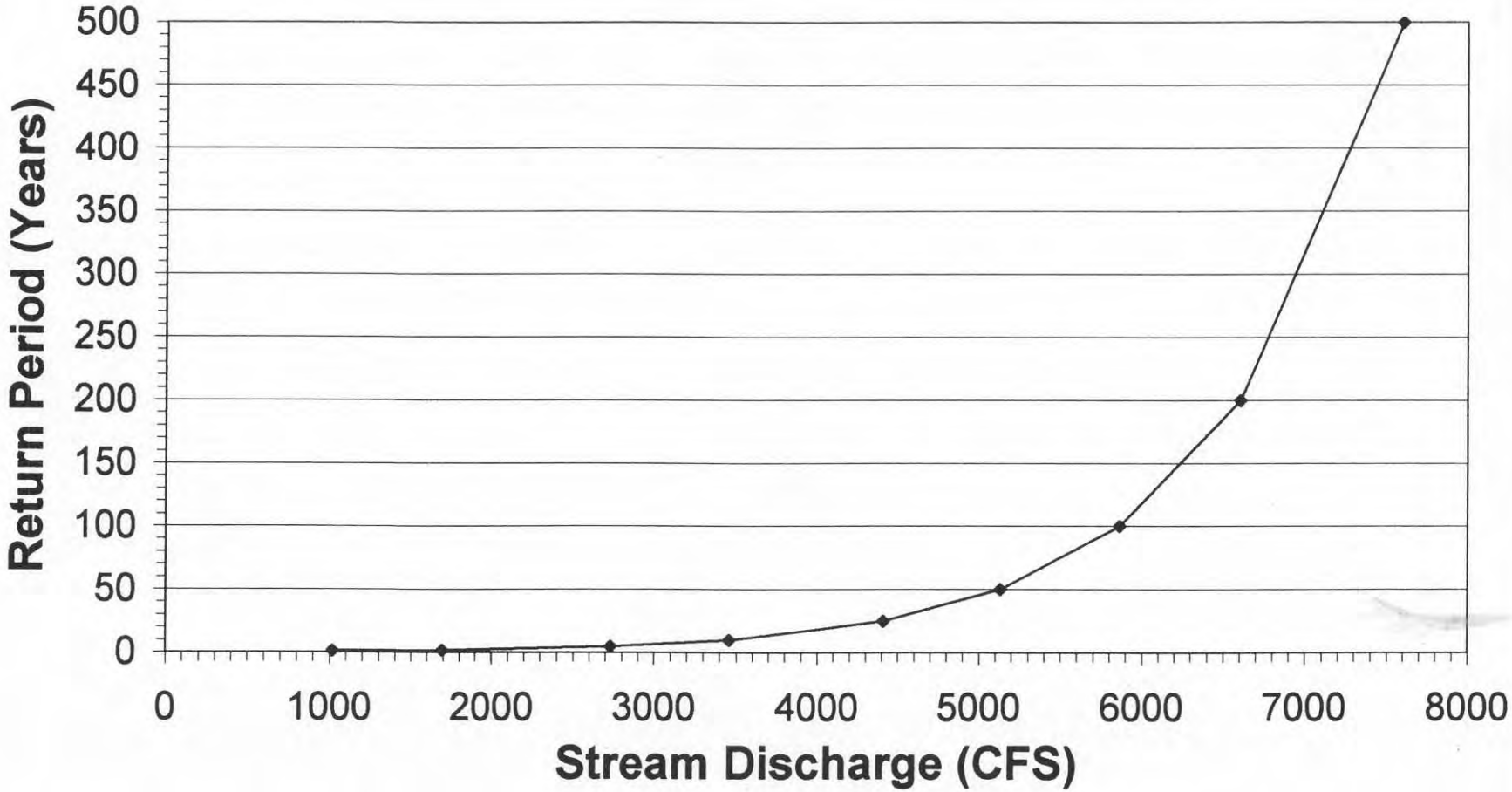
Questions about data Water Webserver Team
Feedback on this website NWISWeb Support Team
NWIS Site Inventory for USA: Site Map
http://waterdata.usgs.gov/nwis/nwismap?

Top
Explanation of terms

Storm Return Period Vs. Morgan Creek Discharge



Storm Return Period Vs. Morgan Creek Discharge

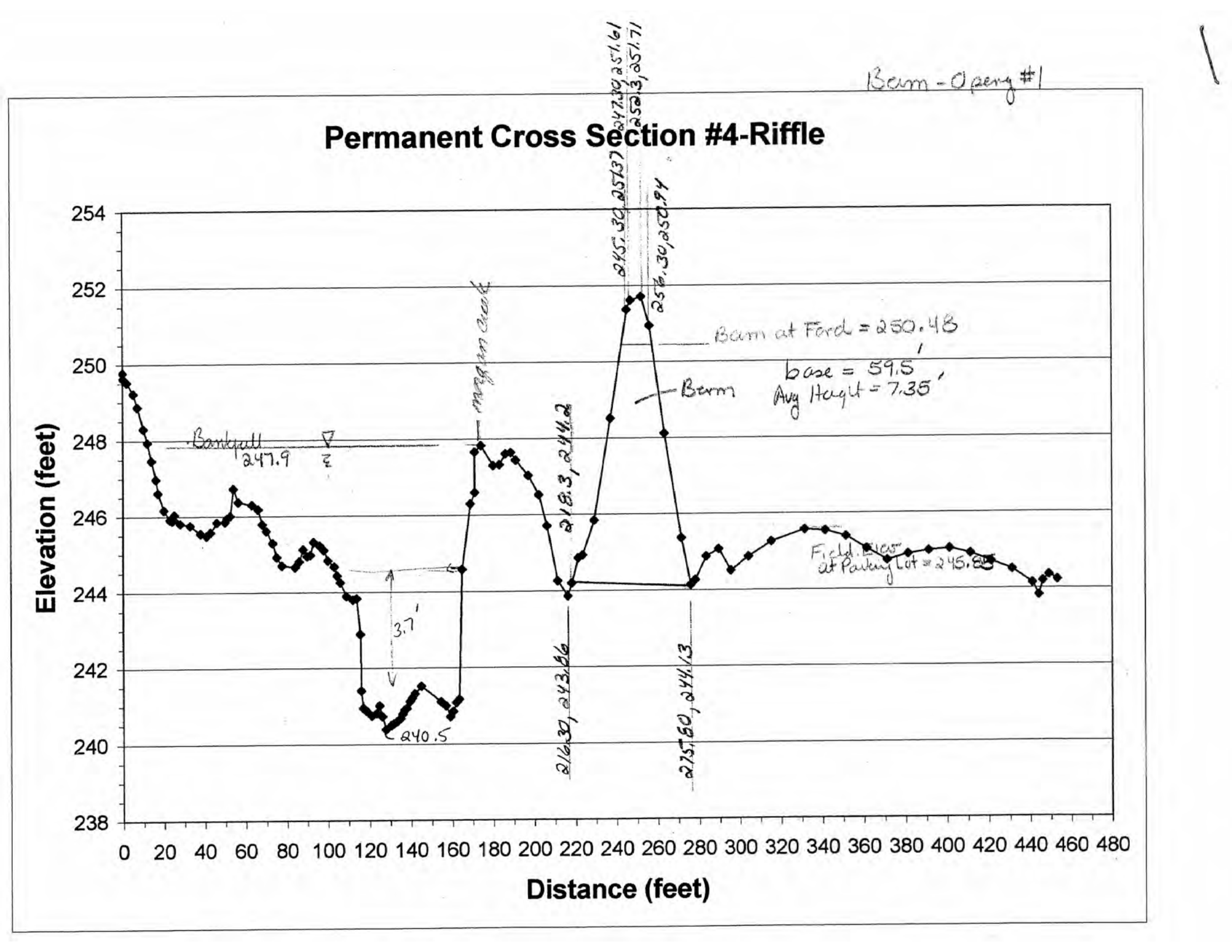


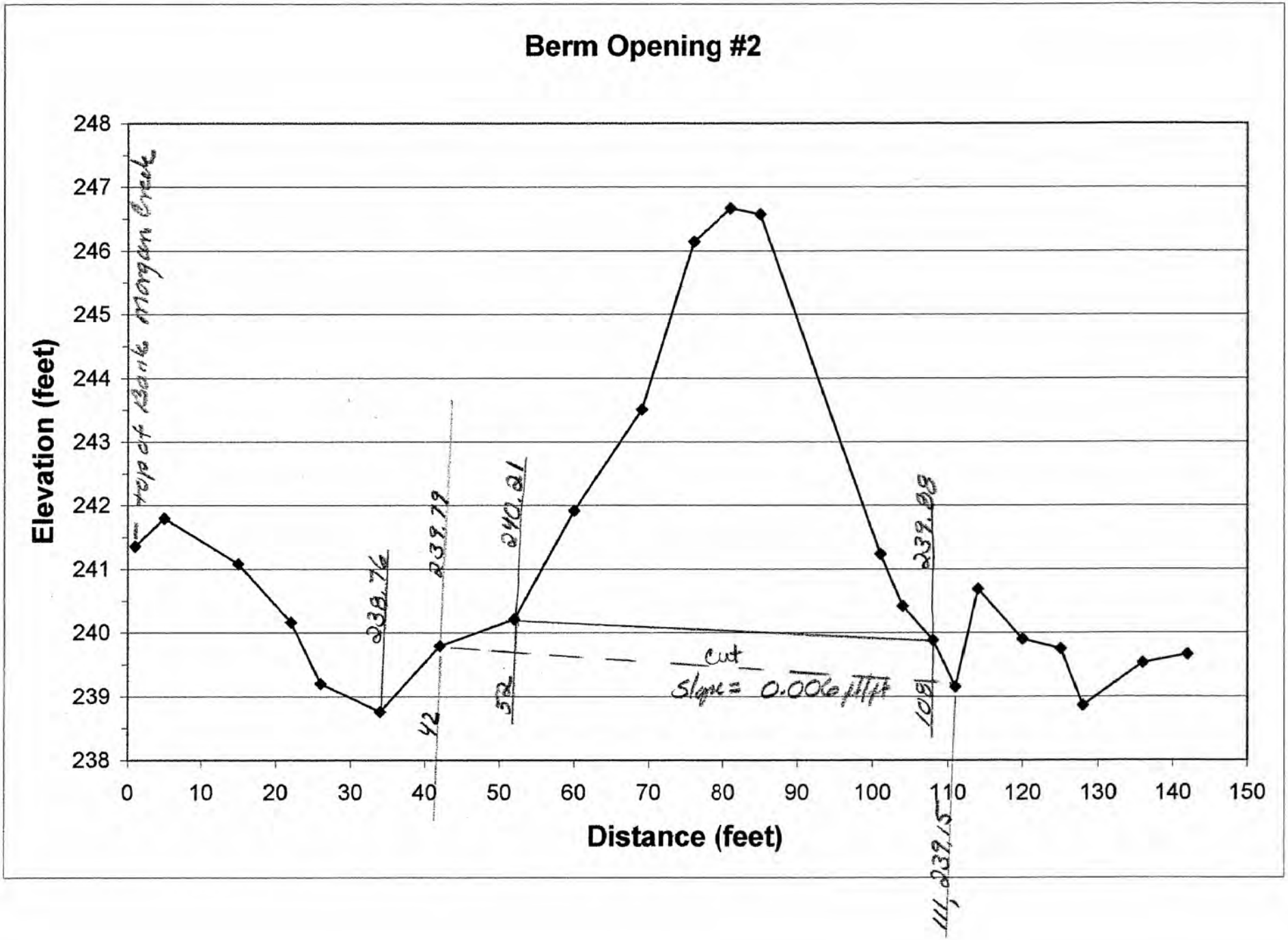
MORGAN CREEK
Stream Flow Data vs. Return Period

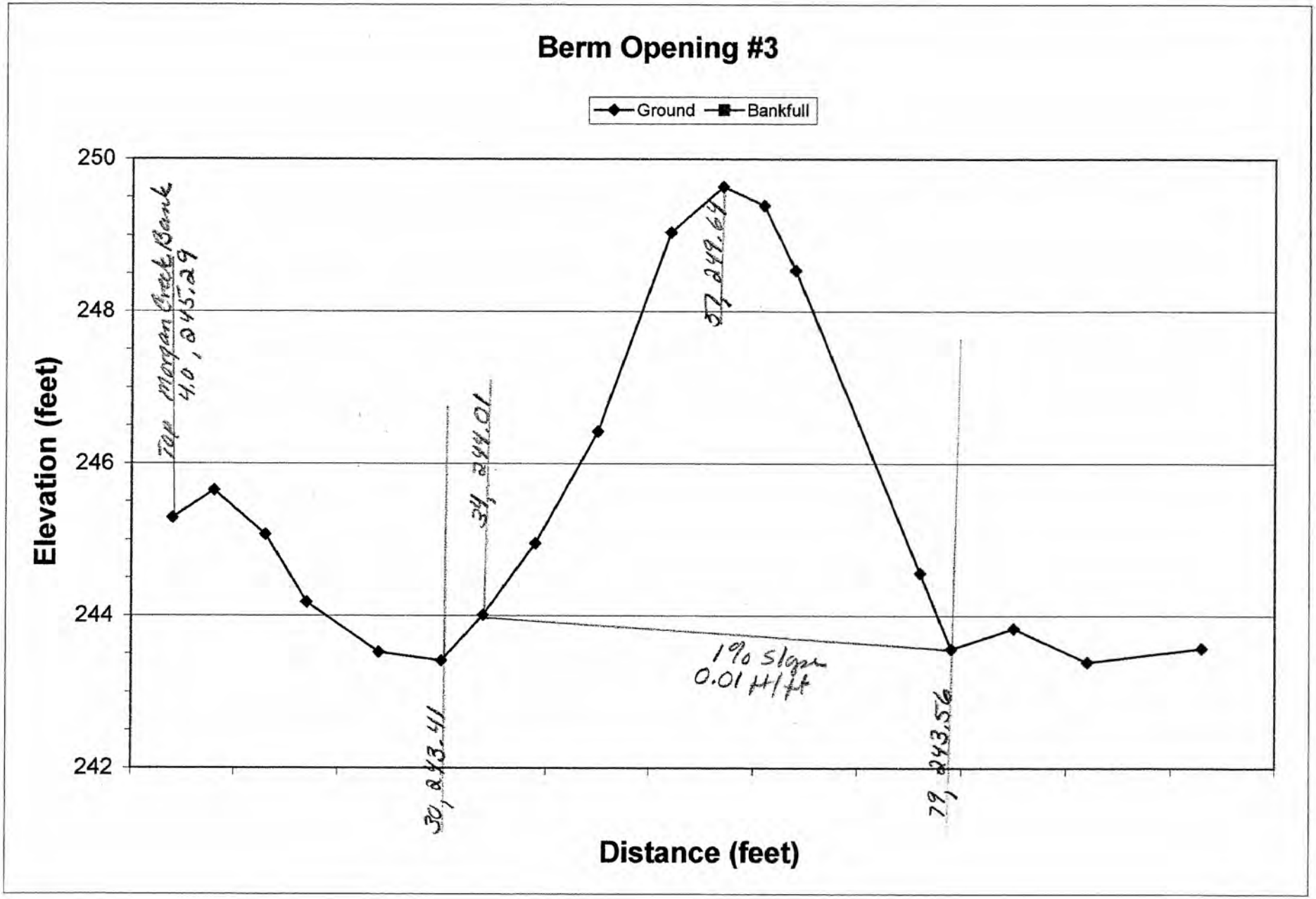
Return Period Year	Peak Flow (cfs)
Minimum Overbank	1,000
Bankfull	1,300
2	1,695
5	2,730
10	3,458
25	4,408
50	5,130
100	5,860
200	6,601
500	7,599

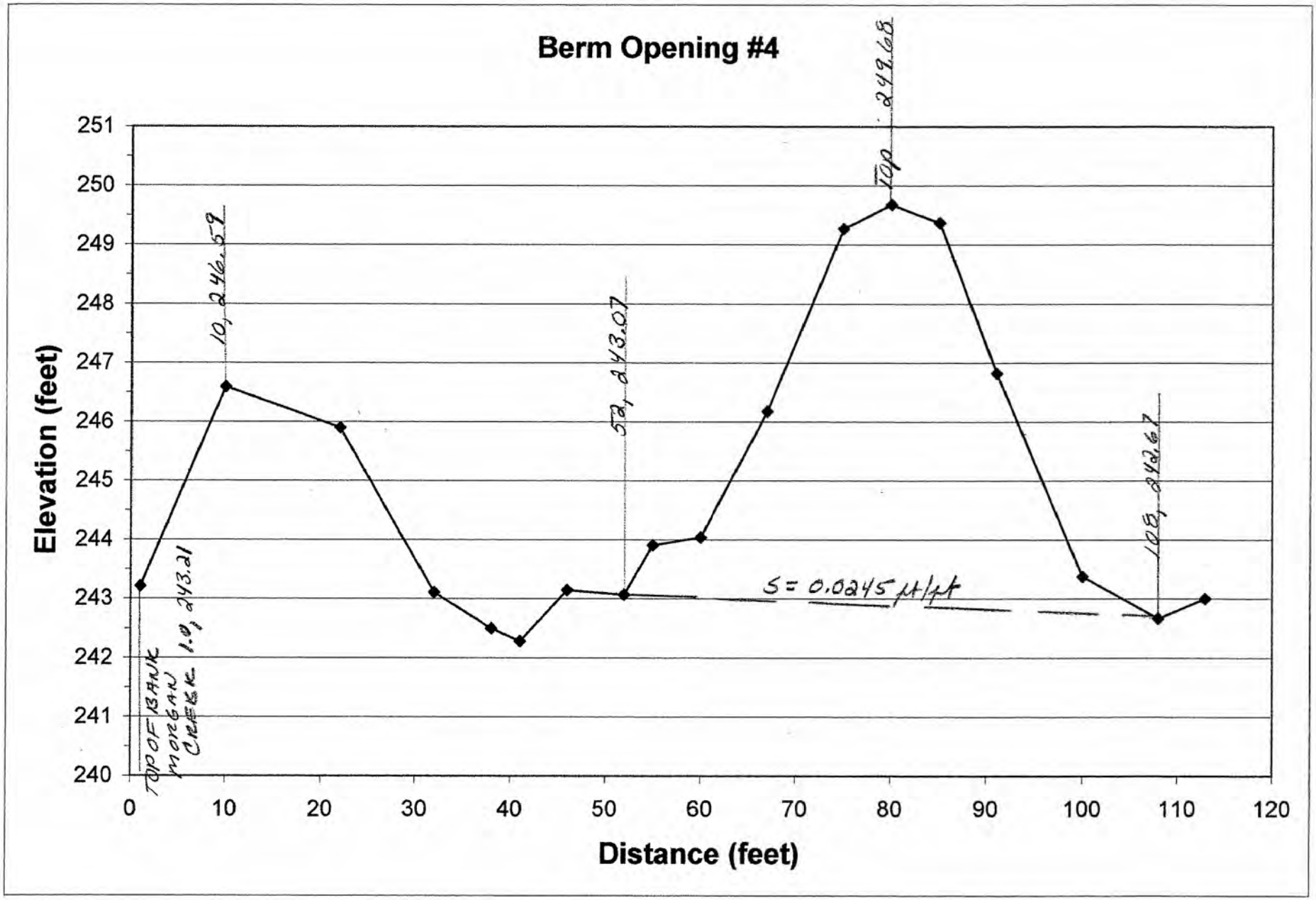
* Note: Stream flow data based on Log Person analysis of USGS Stream Gauge 02097517 Morgan Creek Near Chapel Hill, NC

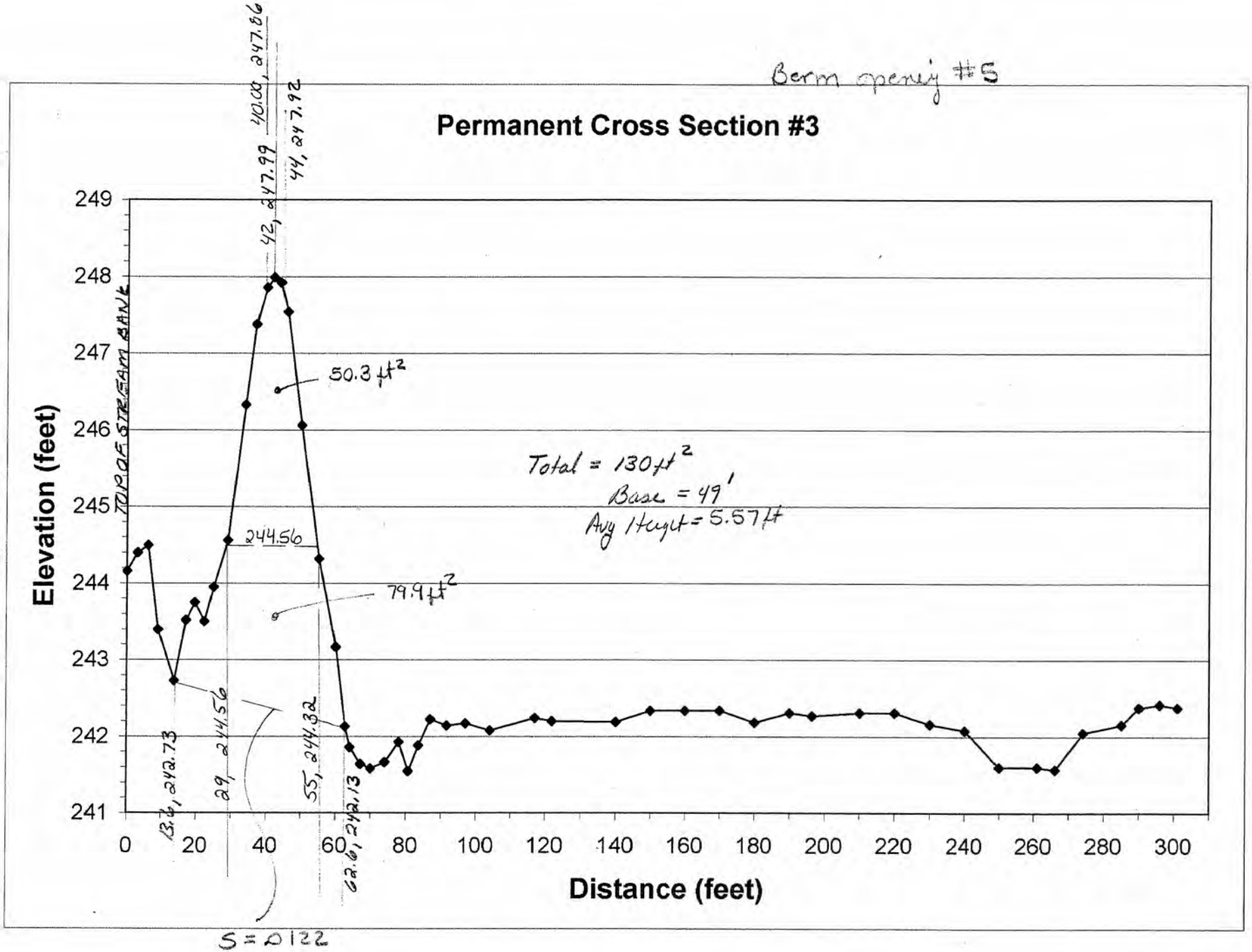
Berm - Opening #1



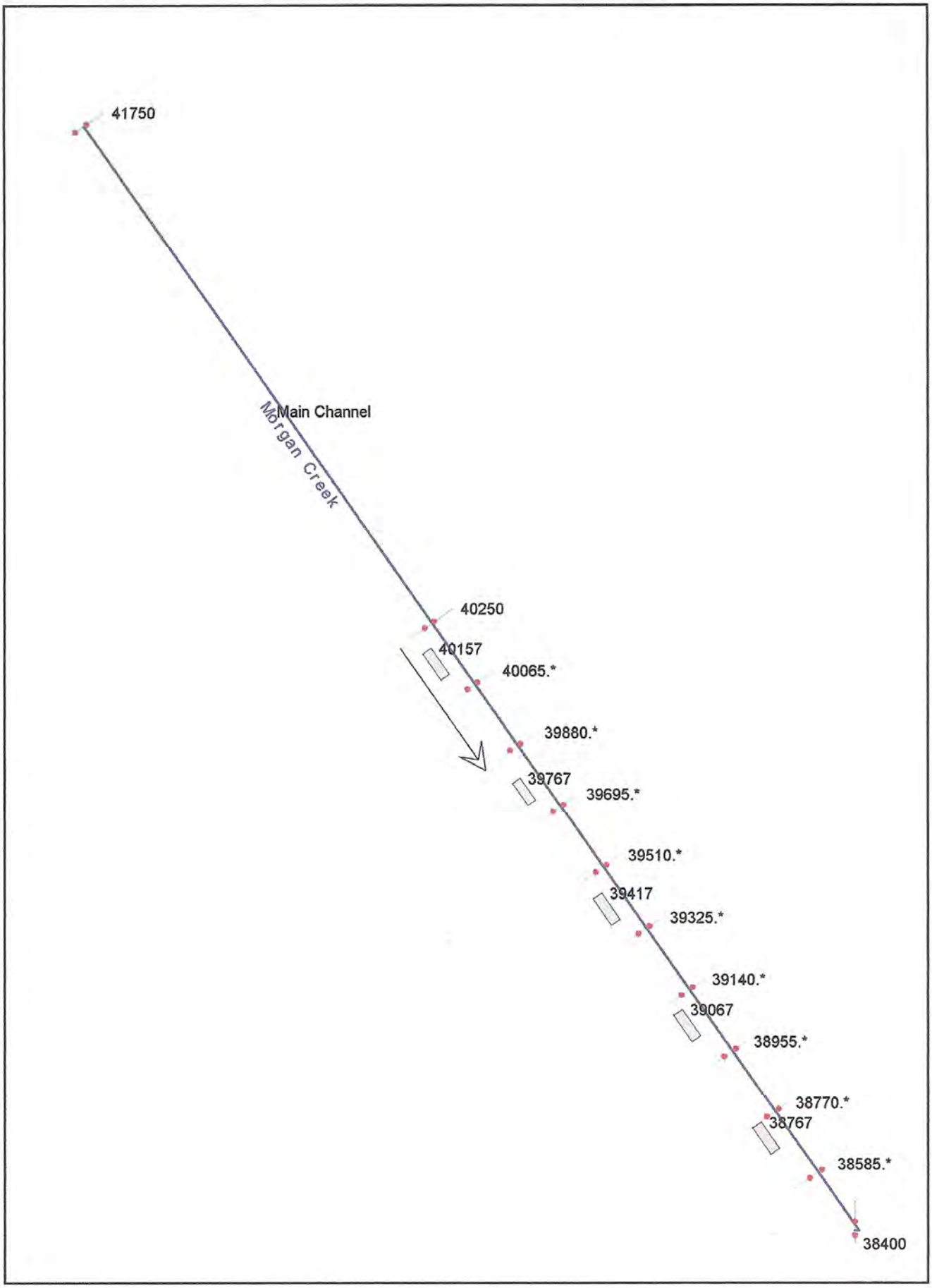

Berm Opening #2
Elevation (feet)
Distance (feet)
248
247
246
245
244
243
242
241
240
239
238
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Top of Bank Morgan Creek
238.76
238.79
240.21
232.83
42
52
101
111, 232.15
cut
Slope = 0.006 ft/ft

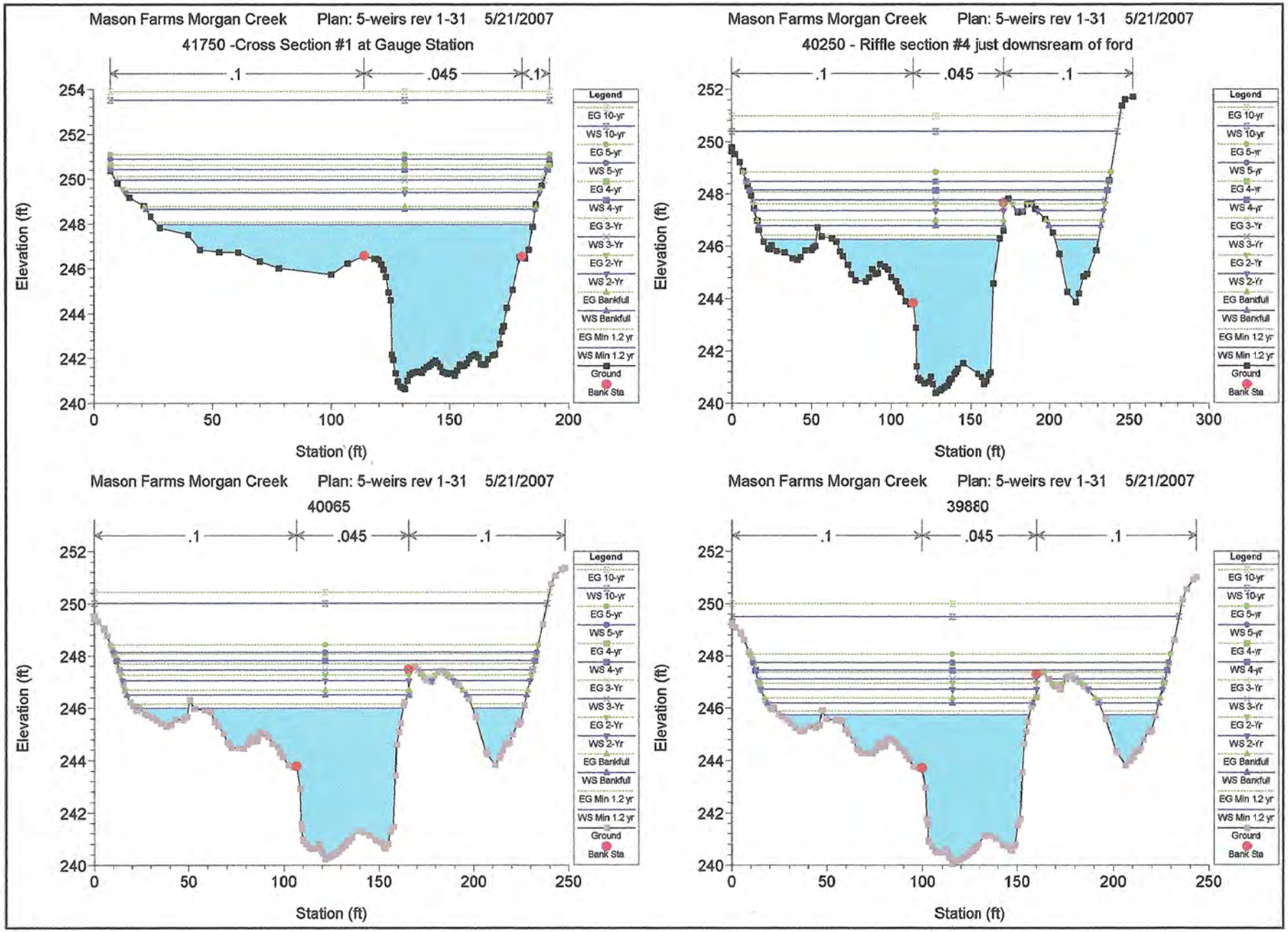

Berm Opening #3
Ground
Bankfull
250
248
246
244
242
Elevation (feet)
Distance (feet)
Top Morgan Creek Bank
41.0, 245.29
37, 249.64
34, 244.01
30, 243.41
79, 243.56
1% slope
0.01 ft/ft

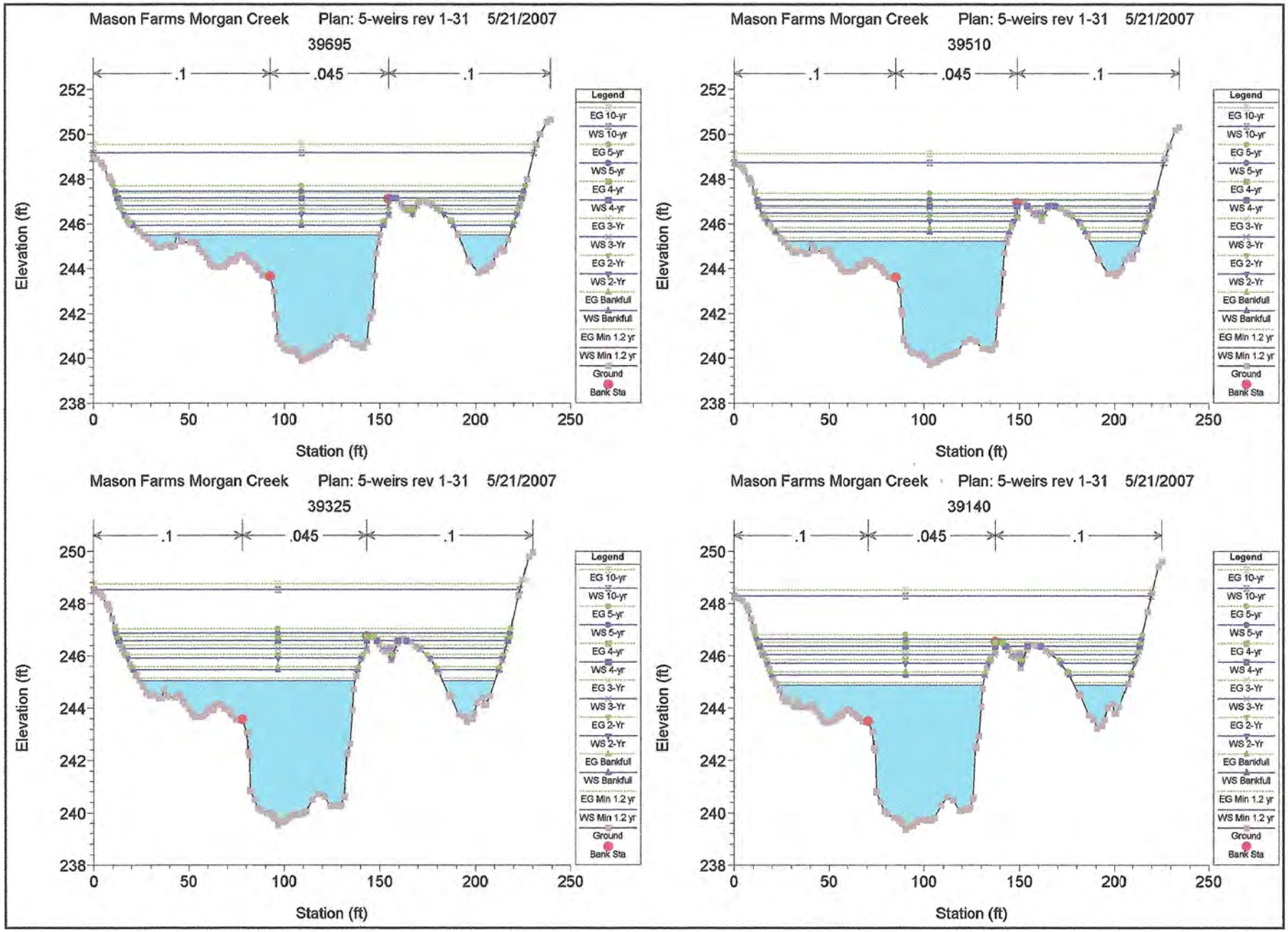

Berm Opening #4
Elevation (feet)
Distance (feet)
251
250
249
248
247
246
245
244
243
242
241
240
0
10
20
30
40
50
60
70
80
90
100
110
120
TOP OF BANK MORGAN CREEK 1.0, 243.21
10, 246.59
52, 243.07
Top 249.68
108, 242.67
S = 0.0245 ft/ft

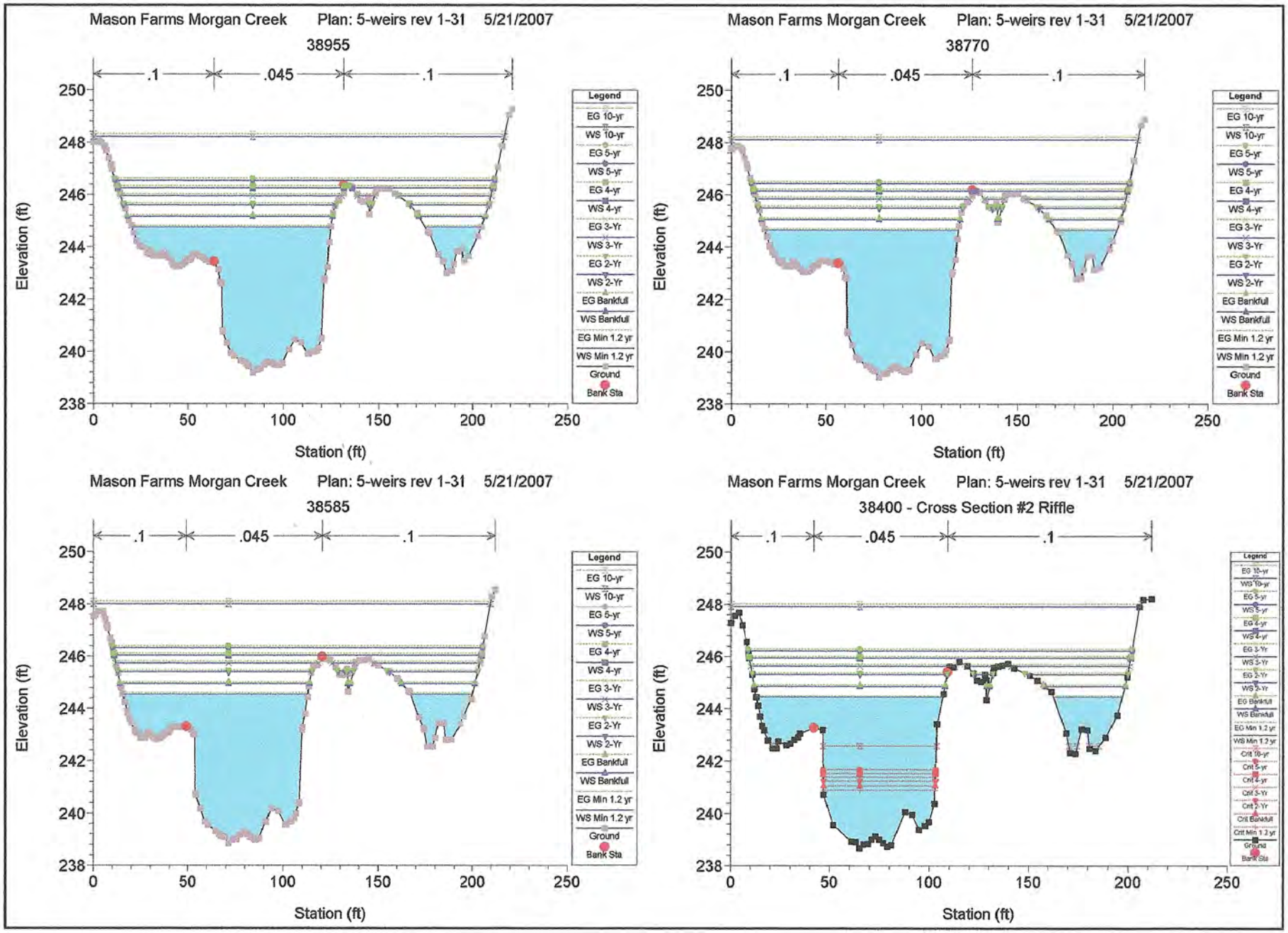

Berm opening #5
Permanent Cross Section #3
Elevation (feet)
Distance (feet)
TOP OF STREAM BANK
42, 247.99
40.00, 247.66
44, 247.92
50.3 ft²
Total = 130 ft²
Base = 49'
Avg Height = 5.57 ft
244.56
79.9 ft²
13.4, 242.73
29, 244.56
55, 244.32
62.6, 242.13
S = 0.122
249
248
247
246
245
244
243
242
241
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300

Morgan Creek Lateral Structures




Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
41750 -Cross Section #1 at Gauge Station
.1
.045
.1
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-Yr
WS 3-Yr
EG 2-Yr
WS 2-Yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
40250 - Riffle section #4 just downsream of ford
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
40065
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
39880


Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
39695
.1
.045
.1
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-Yr
WS 3-Yr
EG 2-Yr
WS 2-Yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
39510
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
39325
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
39140


Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
38955
.1
.045
.1
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-Yr
WS 3-Yr
EG 2-Yr
WS 2-Yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
38770
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
38585
Mason Farms Morgan Creek Plan: 5-weirs rev 1-31 5/21/2007
38400 - Cross Section #2 Riffle

HEC-RAS Plan: 5-weir rev River: Morgan Creek Reach: Main Channel

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	41750	Min 1.2 yr	1000.00	240.63	247.95		248.06	0.000831	2.73	469.97	158.07	0.21
Main Channel	41750	Bankfull	1300.00	240.63	248.65		248.77	0.000856	3.01	581.48	163.96	0.22
Main Channel	41750	2-Yr	1694.00	240.63	249.38		249.54	0.000916	3.37	705.78	174.49	0.23
Main Channel	41750	3-Yr	2040.00	240.63	249.94		250.12	0.000961	3.65	805.68	180.33	0.24
Main Channel	41750	4-yr	2380.00	240.63	250.43		250.63	0.001007	3.90	893.83	184.14	0.25
Main Channel	41750	5-yr	2729.00	240.63	250.88		251.10	0.001051	4.14	976.86	185.00	0.26
Main Channel	41750	10-yr	5360.00	240.63	253.51		253.89	0.001329	5.62	1464.60	185.00	0.30
Main Channel	40250	Min 1.2 yr	1000.00	240.39	246.25		246.42	0.001496	3.48	384.15	164.96	0.28
Main Channel	40250	Bankfull	1300.00	240.39	246.78		246.99	0.001740	3.91	479.54	187.11	0.30
Main Channel	40250	2-Yr	1694.00	240.39	247.34		247.60	0.001929	4.39	588.14	201.94	0.32
Main Channel	40250	3-Yr	2040.00	240.39	247.77		248.06	0.002096	4.78	677.12	220.71	0.34
Main Channel	40250	4-yr	2380.00	240.39	248.13		248.46	0.002213	5.11	758.87	225.23	0.35
Main Channel	40250	5-yr	2729.00	240.39	248.46		248.83	0.002333	5.42	834.41	228.02	0.37
Main Channel	40250	10-yr	5360.00	240.39	250.38		250.97	0.003066	7.33	1286.66	242.52	0.44
Main Channel	40157		Lat Struct									
Main Channel	40065.*	Min 1.2 yr	931.22	240.22	245.99		246.15	0.001363	3.29	369.87	164.64	0.27
Main Channel	40065.*	Bankfull	1174.53	240.22	246.50		246.68	0.001521	3.61	457.36	180.34	0.28
Main Channel	40065.*	2-Yr	1487.94	240.22	247.05		247.26	0.001601	3.94	559.72	191.50	0.30
Main Channel	40065.*	3-Yr	1760.76	240.22	247.46		247.69	0.001697	4.24	642.06	213.12	0.31
Main Channel	40065.*	4-yr	2027.72	240.22	247.82		248.07	0.001748	4.47	720.34	220.53	0.31
Main Channel	40065.*	5-yr	2302.25	240.22	248.14		248.42	0.001809	4.70	792.48	223.21	0.32
Main Channel	40065.*	10-yr	4336.61	240.22	250.01		250.44	0.002193	6.11	1226.31	238.62	0.37
Main Channel	39880.*	Min 1.2 yr	931.22	240.04	245.73		245.89	0.001435	3.34	356.17	156.32	0.27
Main Channel	39880.*	Bankfull	1174.53	240.04	246.20		246.39	0.001611	3.70	432.82	170.79	0.29
Main Channel	39880.*	2-Yr	1487.94	240.04	246.72		246.95	0.001782	4.07	525.83	183.83	0.31
Main Channel	39880.*	3-Yr	1760.76	240.04	247.10		247.36	0.001887	4.37	600.04	201.74	0.32
Main Channel	39880.*	4-yr	2027.72	240.04	247.44		247.72	0.001999	4.66	669.79	215.66	0.33
Main Channel	39880.*	5-yr	2302.25	240.04	247.75		248.06	0.002078	4.92	736.61	217.93	0.34
Main Channel	39880.*	10-yr	4336.61	240.04	249.50		249.99	0.002606	6.48	1132.78	234.31	0.40
Main Channel	39767		Lat Struct									
Main Channel	39695.*	Min 1.2 yr	881.91	239.87	245.48		245.63	0.001332	3.19	346.80	150.40	0.26
Main Channel	39695.*	Bankfull	1087.43	239.87	245.93		246.10	0.001447	3.48	416.52	161.68	0.28
Main Channel	39695.*	2-Yr	1346.07	239.87	246.43		246.63	0.001578	3.76	501.52	176.94	0.29
Main Channel	39695.*	3-Yr	1568.08	239.87	246.81		247.02	0.001620	3.98	571.44	193.86	0.30

HEC-RAS Plan: 5-weir rev River: Morgan Creek Reach: Main Channel (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	39695.*	4-yr	1783.88	239.87	247.13		247.37	0.001682	4.20	636.60	209.17	0.31
Main Channel	39695.*	5-yr	2006.05	239.87	247.44		247.69	0.001719	4.39	700.98	213.77	0.31
Main Channel	39695.*	10-yr	3623.29	239.87	249.16		249.53	0.001977	5.56	1083.15	230.55	0.35
Main Channel	39510.*	Min 1.2 yr	881.91	239.70	245.22		245.38	0.001401	3.23	336.36	144.44	0.27
Main Channel	39510.*	Bankfull	1087.43	239.70	245.64		245.83	0.001543	3.55	398.84	154.24	0.29
Main Channel	39510.*	2-Yr	1346.07	239.70	246.11		246.32	0.001706	3.88	473.69	167.14	0.30
Main Channel	39510.*	3-Yr	1568.08	239.70	246.47		246.71	0.001813	4.11	536.89	183.51	0.31
Main Channel	39510.*	4-yr	1783.88	239.70	246.78		247.04	0.001883	4.34	595.98	198.55	0.32
Main Channel	39510.*	5-yr	2006.05	239.70	247.07		247.35	0.001963	4.57	654.44	209.25	0.33
Main Channel	39510.*	10-yr	3623.29	239.70	248.72		249.13	0.002291	5.82	1010.91	226.45	0.37
Main Channel	39417		Lat Struct									
Main Channel	39325.*	Min 1.2 yr	739.08	239.52	245.04		245.15	0.000975	2.69	336.73	140.48	0.22
Main Channel	39325.*	Bankfull	888.75	239.52	245.45		245.57	0.001023	2.88	396.36	149.39	0.23
Main Channel	39325.*	2-Yr	1073.40	239.52	245.91		246.04	0.001083	3.08	467.43	161.05	0.24
Main Channel	39325.*	3-Yr	1229.66	239.52	246.27		246.41	0.001139	3.22	527.51	178.80	0.25
Main Channel	39325.*	4-yr	1382.33	239.52	246.58		246.73	0.001154	3.36	585.39	194.26	0.25
Main Channel	39325.*	5-yr	1541.37	239.52	246.86		247.03	0.001185	3.52	642.57	206.41	0.26
Main Channel	39325.*	10-yr	2688.28	239.52	248.52		248.75	0.001274	4.32	996.61	223.28	0.28
Main Channel	39140.*	Min 1.2 yr	739.08	239.35	244.86		244.97	0.000963	2.66	338.18	136.99	0.22
Main Channel	39140.*	Bankfull	888.75	239.35	245.26		245.38	0.001016	2.86	394.89	145.31	0.23
Main Channel	39140.*	2-Yr	1073.40	239.35	245.71		245.84	0.001085	3.08	461.93	156.73	0.24
Main Channel	39140.*	3-Yr	1229.66	239.35	246.05		246.20	0.001158	3.23	517.91	174.04	0.25
Main Channel	39140.*	4-yr	1382.33	239.35	246.36		246.51	0.001186	3.37	573.68	188.08	0.26
Main Channel	39140.*	5-yr	1541.37	239.35	246.63		246.80	0.001227	3.54	627.92	202.76	0.26
Main Channel	39140.*	10-yr	2688.28	239.35	248.27		248.51	0.001327	4.36	971.20	219.78	0.28
Main Channel	39067		Lat Struct									
Main Channel	38955.*	Min 1.2 yr	609.25	239.18	244.74		244.81	0.000617	2.13	347.82	134.74	0.18
Main Channel	38955.*	Bankfull	708.19	239.18	245.15		245.22	0.000608	2.22	404.14	143.25	0.18
Main Channel	38955.*	2-Yr	825.73	239.18	245.60		245.67	0.000603	2.31	470.79	155.06	0.18
Main Channel	38955.*	3-Yr	923.14	239.18	245.94		246.02	0.000620	2.37	526.59	174.20	0.18
Main Channel	38955.*	4-yr	1017.37	239.18	246.25		246.33	0.000621	2.44	582.84	193.85	0.18
Main Channel	38955.*	5-yr	1118.94	239.18	246.53		246.61	0.000616	2.51	638.13	200.20	0.19
Main Channel	38955.*	10-yr	1820.13	239.18	248.20		248.30	0.000575	2.88	984.17	216.65	0.19

HEC-RAS Plan: 5-weir rev River: Morgan Creek Reach: Main Channel (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	38770.*	Min 1.2 yr	609.25	239.01	244.64		244.70	0.000579	2.07	358.69	132.73	0.17
Main Channel	38770.*	Bankfull	708.19	239.01	245.04		245.11	0.000572	2.16	414.46	141.84	0.17
Main Channel	38770.*	2-Yr	825.73	239.01	245.49		245.56	0.000566	2.25	480.58	153.27	0.17
Main Channel	38770.*	3-Yr	923.14	239.01	245.83		245.90	0.000589	2.32	535.94	174.41	0.18
Main Channel	38770.*	4-yr	1017.37	239.01	246.14		246.22	0.000596	2.38	592.56	194.17	0.18
Main Channel	38770.*	5-yr	1118.94	239.01	246.42		246.50	0.000588	2.45	647.82	197.89	0.18
Main Channel	38770.*	10-yr	1820.13	239.01	248.10		248.20	0.000554	2.82	990.78	213.17	0.18
Main Channel	38767		Lat Struct									
Main Channel	38585.*	Min 1.2 yr	609.25	238.83	244.54		244.60	0.000540	2.00	370.99	130.42	0.17
Main Channel	38585.*	Bankfull	708.19	238.83	244.94		245.01	0.000536	2.10	425.92	139.87	0.17
Main Channel	38585.*	2-Yr	825.73	238.83	245.39		245.46	0.000532	2.19	491.72	155.60	0.17
Main Channel	38585.*	3-Yr	923.14	238.83	245.73		245.80	0.000560	2.26	546.46	175.07	0.17
Main Channel	38585.*	4-yr	1017.37	238.83	246.03		246.11	0.000569	2.33	603.57	193.99	0.18
Main Channel	38585.*	5-yr	1118.94	238.83	246.31		246.39	0.000562	2.39	658.55	195.52	0.18
Main Channel	38585.*	10-yr	1820.13	238.83	248.00		248.10	0.000532	2.77	997.89	209.50	0.18
Main Channel	38400	Min 1.2 yr	609.25	238.66	244.44	240.89	244.50	0.000500	1.94	384.23	128.39	0.16
Main Channel	38400	Bankfull	708.19	238.66	244.85	241.05	244.91	0.000501	2.03	438.21	137.54	0.16
Main Channel	38400	2-Yr	825.73	238.66	245.30	241.24	245.37	0.000501	2.13	504.00	157.16	0.16
Main Channel	38400	3-Yr	923.14	238.66	245.63	241.38	245.70	0.000501	2.22	558.40	177.15	0.17
Main Channel	38400	4-yr	1017.37	238.66	245.93	241.52	246.01	0.000500	2.30	615.77	191.88	0.17
Main Channel	38400	5-yr	1118.94	238.66	246.22	241.66	246.29	0.000500	2.37	670.18	193.18	0.17
Main Channel	38400	10-yr	1820.13	238.66	247.90	242.57	248.00	0.000500	2.78	1004.69	205.72	0.17

HEC-RAS Plan: 5-weir rev River: Morgan Creek Reach: Main Channel

Reach	River Sta	Profile	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(ofs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Main Channel	40157	Min 1.2 yr	1000.00	68.18	931.22	68.18		22.64	1.30	1.06	245.00	246.35	246.18	246.23	246.07
Main Channel	40157	Bankfull	1300.00	125.33	1174.53	125.33		25.93	1.85	1.44	245.00	246.91	246.70	246.78	246.58
Main Channel	40157	2-Yr	1694.00	205.15	1487.94	205.15		29.49	2.45	1.82	245.00	247.51	247.27	247.36	247.14
Main Channel	40157	3-Yr	2040.00	278.05	1760.76	278.05		32.16	2.89	2.10	245.00	247.96	247.68	247.81	247.55
Main Channel	40157	4-yr	2380.00	350.83	2027.72	350.83		34.49	3.28	2.33	245.00	248.36	248.05	248.19	247.91
Main Channel	40157	5-yr	2729.00	425.30	2302.25	425.30		36.62	3.64	2.54	245.00	248.72	248.38	248.54	248.24
Main Channel	40157	10-yr	5360.00	1018.89	4336.61	1018.89		49.08	5.73	3.71	245.00	250.83	250.28	250.60	250.12
Main Channel	39767	Min 1.2 yr	931.22	48.63	881.91	48.63		17.58	1.28	0.99	244.50	245.79	245.64	245.70	245.55
Main Channel	39767	Bankfull	1174.53	86.23	1087.43	86.23		20.49	1.77	1.30	244.50	246.28	246.09	246.18	246.00
Main Channel	39767	2-Yr	1487.94	140.92	1346.07	140.92		23.73	2.31	1.63	244.50	246.83	246.61	246.71	246.51
Main Channel	39767	3-Yr	1760.76	191.38	1568.08	191.38		26.16	2.72	1.86	244.50	247.23	246.99	247.11	246.89
Main Channel	39767	4-yr	2027.72	242.18	1783.88	242.18		28.29	3.07	2.06	244.50	247.59	247.32	247.46	247.21
Main Channel	39767	5-yr	2302.25	294.92	2006.05	294.92		30.25	3.40	2.24	244.50	247.92	247.63	247.79	247.52
Main Channel	39767	10-yr	4336.61	717.66	3623.29	717.66		41.57	5.29	3.26	244.50	249.81	249.37	249.65	249.25
Main Channel	39417	Min 1.2 yr	881.91	141.32	739.08	141.32		24.94	2.02	1.60	243.25	245.32	245.17	245.22	245.10
Main Channel	39417	Bankfull	1087.43	198.36	888.75	198.36		27.10	2.46	1.89	243.25	245.76	245.59	245.65	245.51
Main Channel	39417	2-Yr	1346.07	272.82	1073.40	272.82		29.50	2.95	2.20	243.25	246.25	246.06	246.13	245.97
Main Channel	39417	3-Yr	1568.08	338.53	1229.66	338.53		31.35	3.32	2.43	243.25	246.63	246.42	246.50	246.33
Main Channel	39417	4-yr	1783.88	401.70	1382.33	401.70		32.97	3.65	2.63	243.25	246.95	246.73	246.82	246.64
Main Channel	39417	5-yr	2006.05	465.14	1541.37	465.14		34.47	3.95	2.81	243.25	247.26	247.01	247.12	246.92
Main Channel	39417	10-yr	3623.29	933.36	2688.28	933.36		43.17	5.71	3.82	243.25	249.03	248.66	248.87	248.58
Main Channel	39067	Min 1.2 yr	739.08	128.08	609.25	128.08		24.68	1.90	1.51	243.00	244.94	244.84	244.88	244.79
Main Channel	39067	Bankfull	888.75	180.17	708.19	180.17		26.80	2.31	1.79	243.00	245.36	245.24	245.29	245.20
Main Channel	39067	2-Yr	1073.40	247.76	825.73	247.76		29.14	2.77	2.08	243.00	245.82	245.69	245.74	245.64
Main Channel	39067	3-Yr	1229.66	306.48	923.14	306.48		30.93	3.11	2.30	243.00	246.17	246.03	246.09	245.98
Main Channel	39067	4-yr	1382.33	365.00	1017.37	365.00		32.55	3.43	2.49	243.00	246.48	246.34	246.40	246.29
Main Channel	39067	5-yr	1541.37	422.70	1118.94	422.70		34.02	3.72	2.66	243.00	246.77	246.61	246.69	246.57
Main Channel	39067	10-yr	2688.28	860.59	1820.13	860.59		42.75	5.42	3.64	243.00	248.48	248.26	248.39	248.23
Main Channel	38767	Min 1.2 yr	609.25	166.10	609.25	166.10		27.85	2.15	1.65	242.50	244.70	244.64	244.65	244.59
Main Channel	38767	Bankfull	708.19	226.78	708.19	226.78		30.32	2.56	1.91	242.50	245.11	245.04	245.06	245.00
Main Channel	38767	2-Yr	825.73	304.84	825.73	304.84		33.05	3.02	2.19	242.50	245.56	245.49	245.52	245.45
Main Channel	38767	3-Yr	923.14	370.52	923.14	370.52		35.07	3.36	2.39	242.50	245.90	245.83	245.86	245.78
Main Channel	38767	4-yr	1017.37	437.00	1017.37	437.00		36.93	3.67	2.57	242.50	246.21	246.14	246.17	246.09
Main Channel	38767	5-yr	1118.94	503.07	1118.94	503.07		38.64	3.95	2.73	242.50	246.50	246.42	246.45	246.37
Main Channel	38767	10-yr	1820.13	1005.85	1820.13	1005.85		48.85	5.65	3.69	242.50	248.20	248.10	248.15	248.05

Plan: 5-weir rev   Morgan Creek   Main Channel RS: 40157   Lat Struct   Profile: Min 1.2 yr

E.G. US. (ft)	246.35	Weir Sta US (ft)	39432.07
W.S. US. (ft)	246.18	Weir Sta DS (ft)	39454.70
E.G. DS (ft)	246.23	Weir Max Depth (ft)	1.30
W.S. DS (ft)	246.07	Weir Avg Depth (ft)	1.06
Q US (cfs)	1000.00	Weir Submerg	0.00
Q Leaving Total (cfs)	68.18	Min El Weir Flow (ft)	245.00
Q DS (cfs)	931.22	Wr Top Wdth (ft)	22.64
Perc Q Leaving	6.88	Q Gate Group (cfs)	
Q Weir (cfs)	68.18	Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)	23.95	Gate Invert (ft)	

Plan: 5-weir rev   Morgan Creek   Main Channel RS: 40157   Lat Struct   Profile: Min 1.2 yr

E.G. US. (ft)	246.35	Weir Sta US (ft)	39432.07
W.S. US. (ft)	246.18	Weir Sta DS (ft)	39454.70
E.G. DS (ft)	246.23	Weir Max Depth (ft)	1.30
W.S. DS (ft)	246.07	Weir Avg Depth (ft)	1.06
Q US (cfs)	1000.00	Weir Submerg	0.00
Q Leaving Total (cfs)	68.18	Min El Weir Flow (ft)	245.00
Q DS (cfs)	931.22	Wr Top Wdth (ft)	22.64
Perc Q Leaving	6.88	Q Gate Group (cfs)	
Q Weir (cfs)	68.18	Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)	23.95	Gate Invert (ft)	

Plan: 5-weir rev   Morgan Creek   Main Channel RS: 40157   Lat Struct   Profile: Min 1.2 yr

E.G. US. (ft)	246.35	Weir Sta US (ft)	39432.07
W.S. US. (ft)	246.18	Weir Sta DS (ft)	39454.70
E.G. DS (ft)	246.23	Weir Max Depth (ft)	1.30
W.S. DS (ft)	246.07	Weir Avg Depth (ft)	1.06
Q US (cfs)	1000.00	Weir Submerg	0.00
Q Leaving Total (cfs)	68.18	Min El Weir Flow (ft)	245.00
Q DS (cfs)	931.22	Wr Top Wdth (ft)	22.64
Perc Q Leaving	6.88	Q Gate Group (cfs)	
Q Weir (cfs)	68.18	Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)	23.95	Gate Invert (ft)	

Plan: 5-weir rev   Morgan Creek   Main Channel RS: 40157   Lat Struct   Profile: Min 1.2 yr

E.G. US. (ft)	246.35	Weir Sta US (ft)	39432.07
W.S. US. (ft)	246.18	Weir Sta DS (ft)	39454.70
E.G. DS (ft)	246.23	Weir Max Depth (ft)	1.30
W.S. DS (ft)	246.07	Weir Avg Depth (ft)	1.06
Q US (cfs)	1000.00	Weir Submerg	0.00
Q Leaving Total (cfs)	68.18	Min El Weir Flow (ft)	245.00
Q DS (cfs)	931.22	Wr Top Wdth (ft)	22.64
Perc Q Leaving	6.88	Q Gate Group (cfs)	

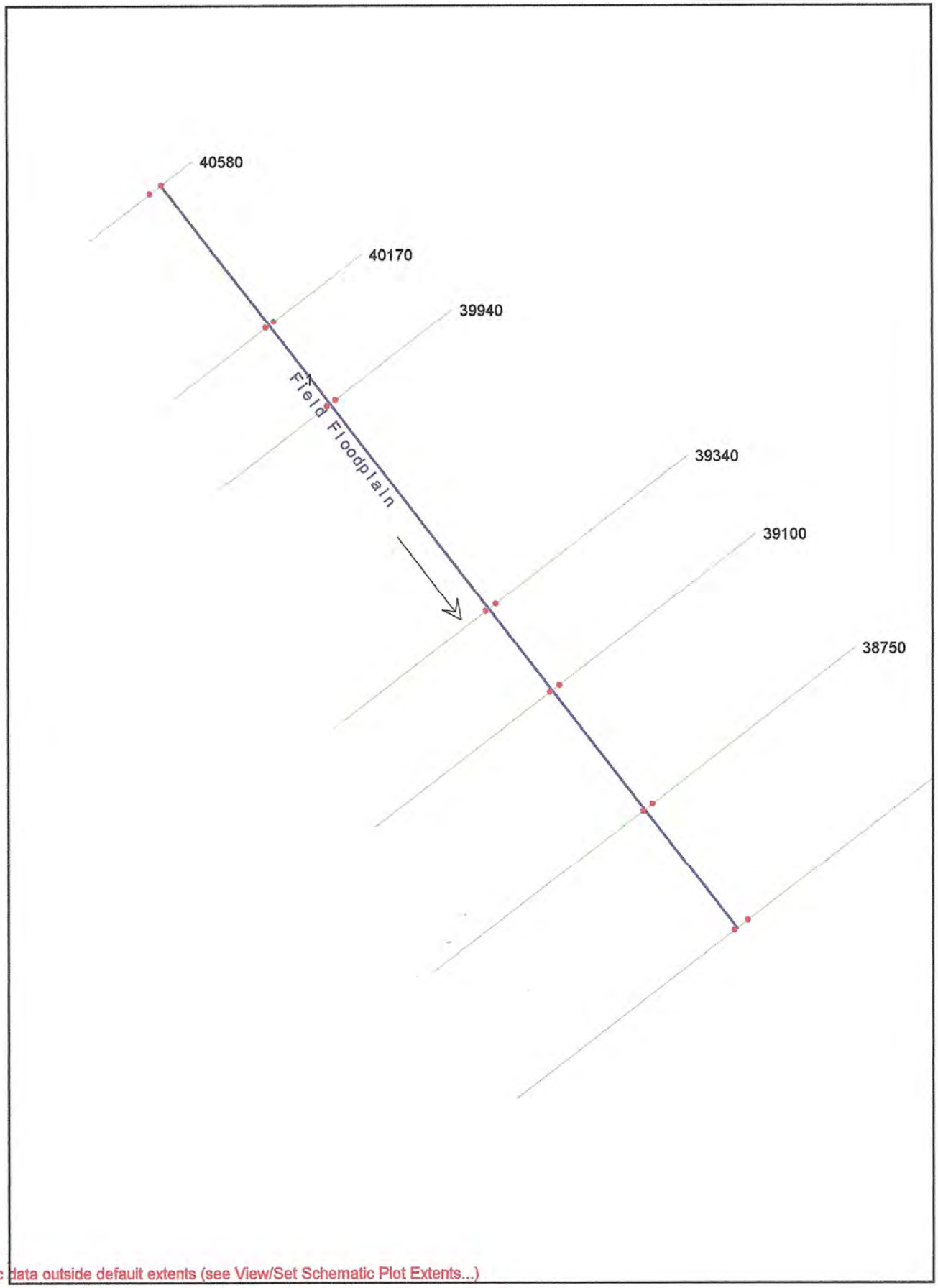
Plan: 5-weir rev Morgan Creek Main Channel RS: 40157 Lat Struct Profile: Min 1.2 yr (Continued)

Q Weir (cfs)	68.18	Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)	23.95	Gate Invert (ft)	

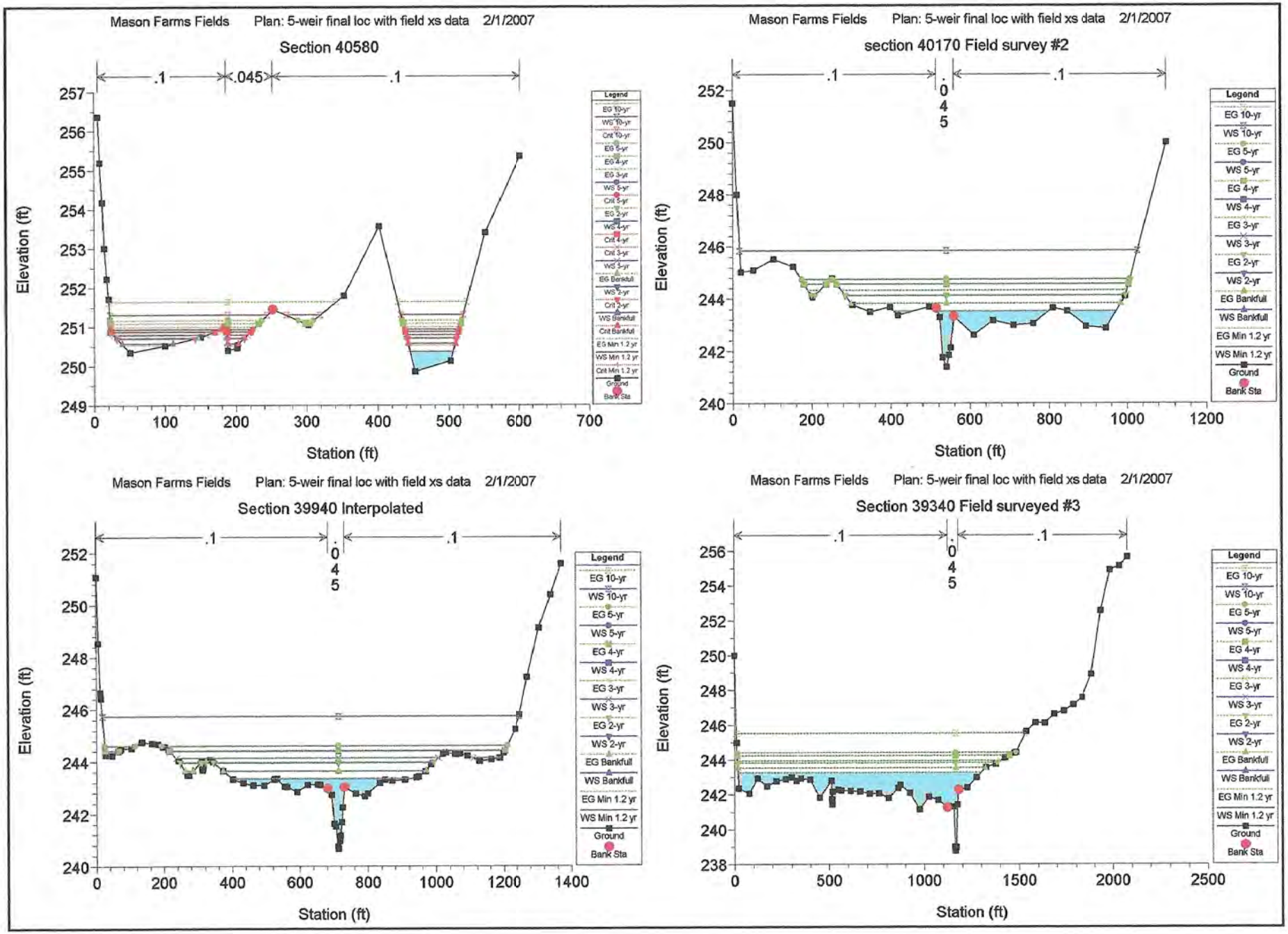
Plan: 5-weir rev Morgan Creek Main Channel RS: 40157 Lat Struct Profile: Min 1.2 yr

E.G. US. (ft)	246.35	Weir Sta US (ft)	39432.07
W.S. US. (ft)	246.18	Weir Sta DS (ft)	39454.70
E.G. DS (ft)	246.23	Weir Max Depth (ft)	1.30
W.S. DS (ft)	246.07	Weir Avg Depth (ft)	1.06
Q US (cfs)	1000.00	Weir Submerg	0.00
Q Leaving Total (cfs)	68.18	Min El Weir Flow (ft)	245.00
Q DS (cfs)	931.22	Wr Top Wdth (ft)	22.64
Perc Q Leaving	6.88	Q Gate Group (cfs)	
Q Weir (cfs)	68.18	Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)	23.95	Gate Invert (ft)	

Field Floodplain



Some schematic data outside default extents (see View/Set Schematic Plot Extents...)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Section 40580
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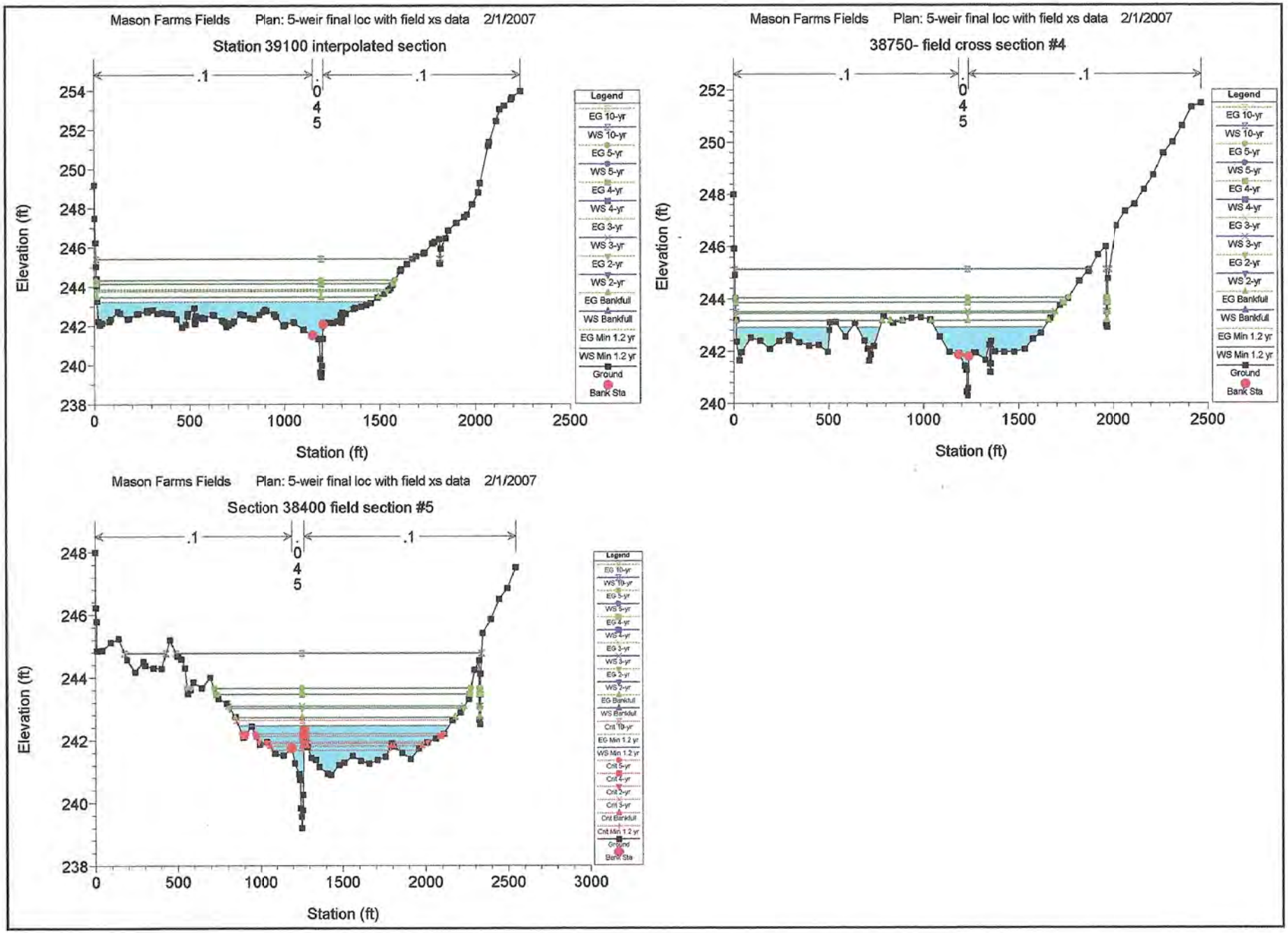
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
Crit 10-yr
EG 5-yr
EG 4-yr
EG 3-yr
WS 5-yr
Crit 5-yr
EG 2-yr
WS 4-yr
Crit 4-yr
Crit 3-yr
WS 3-yr
EG Bankfull
WS 2-yr
Crit 2-yr
WS Bankfull
Crit Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Crit Min 1.2 yr
Ground
Bank Sta
Mason Farms Fields Plan: 5-weir final loc with field xs data 2/1/2007
section 40170 Field survey #2
.1
.045
.1
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-yr
WS 3-yr
EG 2-yr
WS 2-yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta
Mason Farms Fields Plan: 5-weir final loc with field xs data 2/1/2007
Section 39940 Interpolated
.1
.045
.1
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-yr
WS 3-yr
EG 2-yr
WS 2-yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta
Mason Farms Fields Plan: 5-weir final loc with field xs data 2/1/2007
Section 39340 Field surveyed #3
.1
.045
.1
Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-yr
WS 3-yr
EG 2-yr
WS 2-yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta


Mason Farms Fields Plan: 5-weir final loc with field xs data 2/1/2007
Station 39100 interpolated section
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.045
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Elevation (ft)
Station (ft)
Legend
EG 10-yr
WS 10-yr
EG 5-yr
WS 5-yr
EG 4-yr
WS 4-yr
EG 3-yr
WS 3-yr
EG 2-yr
WS 2-yr
EG Bankfull
WS Bankfull
EG Min 1.2 yr
WS Min 1.2 yr
Ground
Bank Sta
Mason Farms Fields Plan: 5-weir final loc with field xs data 2/1/2007
38750- field cross section #4
Mason Farms Fields Plan: 5-weir final loc with field xs data 2/1/2007
Section 38400 field section #5

HEC-RAS Plan: 5-Weir final River: Field Floodplain Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	40580	Min 1.2 yr	68.18	250.40	250.36	250.36	250.53	0.220205		20.24	63.04	0.00
1	40580	Bankfull	125.33	250.40	250.57	250.57	250.72	0.122054	2.84	43.46	154.21	1.43
1	40580	2-yr	205.15	250.40	250.70	250.70	250.88	0.114008	3.74	67.89	204.24	1.49
1	40580	3-yr	278.05	250.40	250.79	250.79	250.99	0.111764	4.27	87.46	232.72	1.53
1	40580	4-yr	350.83	250.40	250.87	250.87	251.08	0.105729	4.61	107.11	255.71	1.53
1	40580	5-yr	425.30	250.40	250.93	250.93	251.16	0.107731	4.99	123.00	270.43	1.57
1	40580	10-yr	1018.89	250.40	251.30	251.30	251.63	0.096698	6.53	236.39	357.34	1.61
1	40170	Min 1.2 yr	68.18	241.39	243.52		243.53	0.000384	0.74	224.23	460.54	0.12
1	40170	Bankfull	125.33	241.39	243.82		243.82	0.000390	0.83	404.61	683.59	0.12
1	40170	2-yr	205.15	241.39	244.13		244.13	0.000344	0.89	620.61	718.38	0.12
1	40170	3-yr	278.05	241.39	244.32		244.32	0.000362	0.97	759.69	752.27	0.12
1	40170	4-yr	350.83	241.39	244.57		244.57	0.000307	0.97	953.23	797.02	0.12
1	40170	5-yr	425.30	241.39	244.75		244.75	0.000302	1.02	1100.61	829.49	0.12
1	40170	10-yr	1018.89	241.39	245.85		245.86	0.000284	1.27	2123.54	1008.80	0.12
1	39940	Min 1.2 yr	116.81	240.66	243.34		243.36	0.001082	1.36	185.72	515.70	0.20
1	39940	Bankfull	211.56	240.66	243.64		243.66	0.001082	1.55	356.06	616.56	0.21
1	39940	2-yr	346.07	240.66	243.96		243.98	0.000994	1.67	571.00	714.10	0.21
1	39940	3-yr	469.43	240.66	244.13		244.16	0.001186	1.92	699.98	842.21	0.23
1	39940	4-yr	593.01	240.66	244.41		244.43	0.000982	1.89	962.11	1023.08	0.21
1	39940	5-yr	720.22	240.66	244.60		244.62	0.000899	1.90	1163.40	1102.28	0.20
1	39940	10-yr	1736.55	240.66	245.73		245.75	0.000621	2.00	2524.64	1227.61	0.18
1	39340	Min 1.2 yr	258.13	238.78	243.26		243.26	0.000101	0.60	1322.45	1282.94	0.07
1	39340	Bankfull	409.92	238.78	243.52		243.52	0.000132	0.73	1666.27	1306.45	0.08
1	39340	2-yr	618.89	238.78	243.82		243.82	0.000163	0.88	2060.76	1369.73	0.09
1	39340	3-yr	807.96	238.78	243.93		243.93	0.000225	1.06	2216.06	1386.25	0.10
1	39340	4-yr	994.71	238.78	244.23		244.23	0.000206	1.07	2637.22	1435.06	0.10
1	39340	5-yr	1185.36	238.78	244.41		244.41	0.000222	1.15	2897.92	1470.07	0.11
1	39340	10-yr	2669.91	238.78	245.51		245.52	0.000286	1.56	4554.93	1521.07	0.13
1	39100	Min 1.2 yr	386.21	239.39	243.20		243.21	0.000375	1.06	1185.62	1443.02	0.13
1	39100	Bankfull	590.09	239.39	243.46		243.47	0.000404	1.19	1560.47	1477.28	0.13
1	39100	2-yr	866.65	239.39	243.75		243.75	0.000431	1.32	1991.05	1523.46	0.14
1	39100	3-yr	1114.44	239.39	243.83		243.84	0.000590	1.58	2123.96	1534.20	0.17
1	39100	4-yr	1359.71	239.39	244.15		244.16	0.000473	1.52	2608.39	1557.17	0.15
1	39100	5-yr	1608.06	239.39	244.32		244.33	0.000488	1.60	2882.12	1567.89	0.16

HEC-RAS Plan: 5-Weir final River: Field Floodplain Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	39100	10-yr	3530.50	239.39	245.41		245.43	0.000550	2.06	4634.06	1664.42	0.17
1	38750	Min 1.2 yr	552.31	240.29	242.90		242.91	0.001998	1.91	861.13	1247.63	0.28
1	38750	Bankfull	816.87	240.29	243.15		243.17	0.001839	2.04	1201.06	1445.63	0.27
1	38750	2-yr	1171.49	240.29	243.44		243.46	0.001683	2.16	1667.67	1678.63	0.27
1	38750	3-yr	1244.53	240.29	243.49		243.51	0.001637	2.17	1754.16	1684.22	0.26
1	38750	4-yr	1796.71	240.29	243.85		243.87	0.001408	2.23	2360.75	1728.99	0.25
1	38750	5-yr	2111.13	240.29	244.03		244.05	0.001348	2.29	2668.61	1758.40	0.25
1	38750	10-yr	4535.50	240.29	245.12		245.15	0.001119	2.63	4657.37	1885.86	0.24
1	38400	Min 1.2 yr	552.31	239.20	242.45	241.68	242.46	0.000900	1.33	1099.80	1273.78	0.19
1	38400	Bankfull	816.87	239.20	242.72	241.81	242.73	0.000902	1.48	1447.75	1336.53	0.19
1	38400	2-yr	1171.49	239.20	243.02	241.93	243.04	0.000901	1.64	1868.97	1422.28	0.20
1	38400	3-yr	1244.53	239.20	243.08	241.89	243.09	0.000902	1.67	1948.58	1435.70	0.20
1	38400	4-yr	1796.71	239.20	243.46	242.13	243.48	0.000900	1.85	2519.48	1540.05	0.20
1	38400	5-yr	2111.13	239.20	243.64	242.20	243.66	0.000900	1.94	2806.19	1584.12	0.21
1	38400	10-yr	4535.50	239.20	244.77	242.63	244.80	0.000900	2.44	4882.40	2103.68	0.22

Appendix 9: Categorical Exclusion and Agency Response Letters

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Mason Farms Wetland Mitigation Site
County Name:	Orange and Durham Counties
EEP Number:	050645601 (State Construction Office ID#)
Project Sponsor:	NC Ecosystem Enhancement Program (EEP)
Project Contact Name:	Perry Suggs
Project Contact Address:	2728 Capital Blvd. Suite 1H8-103 Raleigh, NC 27606
Project Contact E-mail:	perry.sugg@ncmail.net
EEP Project Manager:	Perry Suggs

Project Description

For Official Use Only

Reviewed By:

5-21-06

Date

EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

4-25-07

Date

For Division Administrator
FHWA

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☑ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☐ Yes ☑ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☐ No ☑ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☑ Yes ☐ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☑ No ☐ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☐ Yes ☑ No
2. Does the project require the acquisition of real estate?	☐ Yes ☑ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☐ No ☑ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☐ Yes ☐ No ☑ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☐ Yes ☑ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☑ Yes ☐ No ☐ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☑ No ☐ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☐ Yes ☑ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☐ Yes ☐ No ☑ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☐ Yes ☐ No ☑ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☐ Yes ☑ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

January 5, 2006

Renee Gledhill- Earley
North Carolina State Historic Preservation Office
Mail Service Center 4617
Raleigh, NC 27699-4617

Subject: Mason Farms Wetland and Stream Mitigation Project in Orange County.

Dear Ms. Gledhill-Earley,

The Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential wetland and stream restoration project on the attached site
(USGS site maps with approximate property lines, areas of potential ground disturbance, and locations of and photographs are enclosed).

The Mason Farms Mitigation Site has been identified as a potential site for wetland/floodplain restoration and a stream/buffer enhancement study on the Mason Farms Biological Reserve in Chapel Hill, North Carolina. A major component of the restoration effort is to assess if the partial removal of a berm between Morgan Creek and the study site will increase overbank flooding of the floodplain. The entire stream/ riparian buffer areas, including areas where the berm is removed, will be evaluated for enhancement/ preservation potential.

No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. In addition, the site has been historically disturbed due to maintenance activities such as mowing. Enclosed are current photos of the site.

We ask that you review this site based on the attached information to determine the presence of any historic properties.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Chris Sheats
The Catena Group
8414 Falls of the Neuse Rd., Ste. 204
Raleigh, NC 27615

cc: Perry Sugg
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

January 5, 2006

Shannon Deaton,
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: Mason Farms Wetland and Stream Mitigation Project in Orange County

Dear Ms. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential wetland and stream restoration project on the attached site (USGS site maps with approximate property lines and areas of potential ground disturbance are enclosed).

The Mason Farms Mitigation Site has been identified as a potential site for wetland/floodplain restoration and a stream/buffer enhancement study on the Mason Farms Biological Reserve in Chapel Hill, North Carolina. A major component of the restoration effort is to assess if the partial removal of a berm between Morgan Creek and the study site will increase overbank flooding of the floodplain. The entire stream/ riparian buffer areas, including areas where the berm is removed, will be evaluated for enhancement/ preservation potential.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Chris Sheats
The Catena Group
8414 Falls of the Neuse Rd., Ste. 204
Raleigh, NC 27615

cc: Perry Sugg
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

January 5, 2006

Dale Suiter
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636-3726

Subject: Mason Farms Wetland and Stream Mitigation Project in Orange County.

Dear Mr. Suiter,

The purpose of this letter is to request a list of federally protected species in Orange County as well as any known information for each species in the county. In addition, please review and comment on any possible issues that might emerge with respect to endangered species, and migratory birds from a potential wetland and stream buffer enhancement project on the attached site (USGS site maps with approximate property lines and areas of potential ground disturbance are enclosed).

The Mason Farms Mitigation Site has been identified as a potential site for wetland/floodplain restoration and a stream/buffer enhancement study on the Mason Farms Biological Reserve in Chapel Hill, North Carolina. A major component of the restoration effort is to assess if the partial removal of a berm between Morgan Creek and the study site will increase overbank flooding of the floodplain. The entire stream/ riparian buffer areas, including areas where the berm is removed, will be evaluated for enhancement/ preservation potential.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Chris Sheats
The Catena Group
8414 Falls of the Neuse Rd., Ste. 204
Raleigh, NC 27615

cc: Perry Sugg
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

February 27, 2006

Chris Sheats
The Catena Group
8414 Falls of the Neuse Road, Suite 204
Raleigh, NC 27615

Re: Mason Farms Wetland and Stream Mitigation Project, Durham and Orange Counties, ER 06-0030

Dear Mr. Sheats:

Thank you for your letter of January 5, 2006, concerning the above project. We apologize for the delay in our response.

There are at least nineteen recorded archaeological sites, both Native American and historic period, located within the proposed project boundaries. While some of these sites are disturbed, not all have been evaluated as to their eligibility for the National Register of Historic Places. The information accompanying your letter did not specify the location, type or amount of ground disturbing activities associated with your wetland mitigation project, but it is likely that some of these recorded sites will be affected by the project and will need archaeological investigation.

Please forward plans and specific project information as soon as possible so we may determine which areas will need to be surveyed and which affected sites will need testing to determine their significance.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Peter Sandbeck

cc: Perry Sugg, EEP Project Manager

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

May 16, 2006

Chris Sheats
The Catena Group
8414 Falls of the Neuse Road, Suite 204
Raleigh, NC 27615

Re: Mason Farms Wetland and Stream Mitigation Project, Durham and Orange Counties, ER 06-0030

Dear Mr. Sheats:

Thank you for your letter of March 27, 2006 concerning the above project. We apologize for the delay in our response.

As noted in our letter of February 27, 2006, there are a number of archaeological sites on the Mason Farm property within the project boundaries. Enclosed is a copy of your project map with the site locations added for your information. While many of these sites are not eligible for inclusion in the National Register of Historic Places, five of the sites may be eligible. Archaeological sites 31DH14 and 31DH354 are unassessed, testing has been recommended at 31OR4e, and sites 31OR569** and 31OR570** were evaluated as potentially eligible and recommended for preservation. The last three sites were visited in 2005 during an archaeological survey of the Botanical Gardens.

If any ground disturbing activities are planned at the location of any of these five sites, additional archaeological investigation will be necessary. As this is state-owned property, such investigations must be undertaken after a permit has been issued to the principal investigator under the provisions of the Archaeological Resources Protection Act, NCGS Chapter 70, Article 2. Please contact the Office of State Archaeology for additional information regarding a permit.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

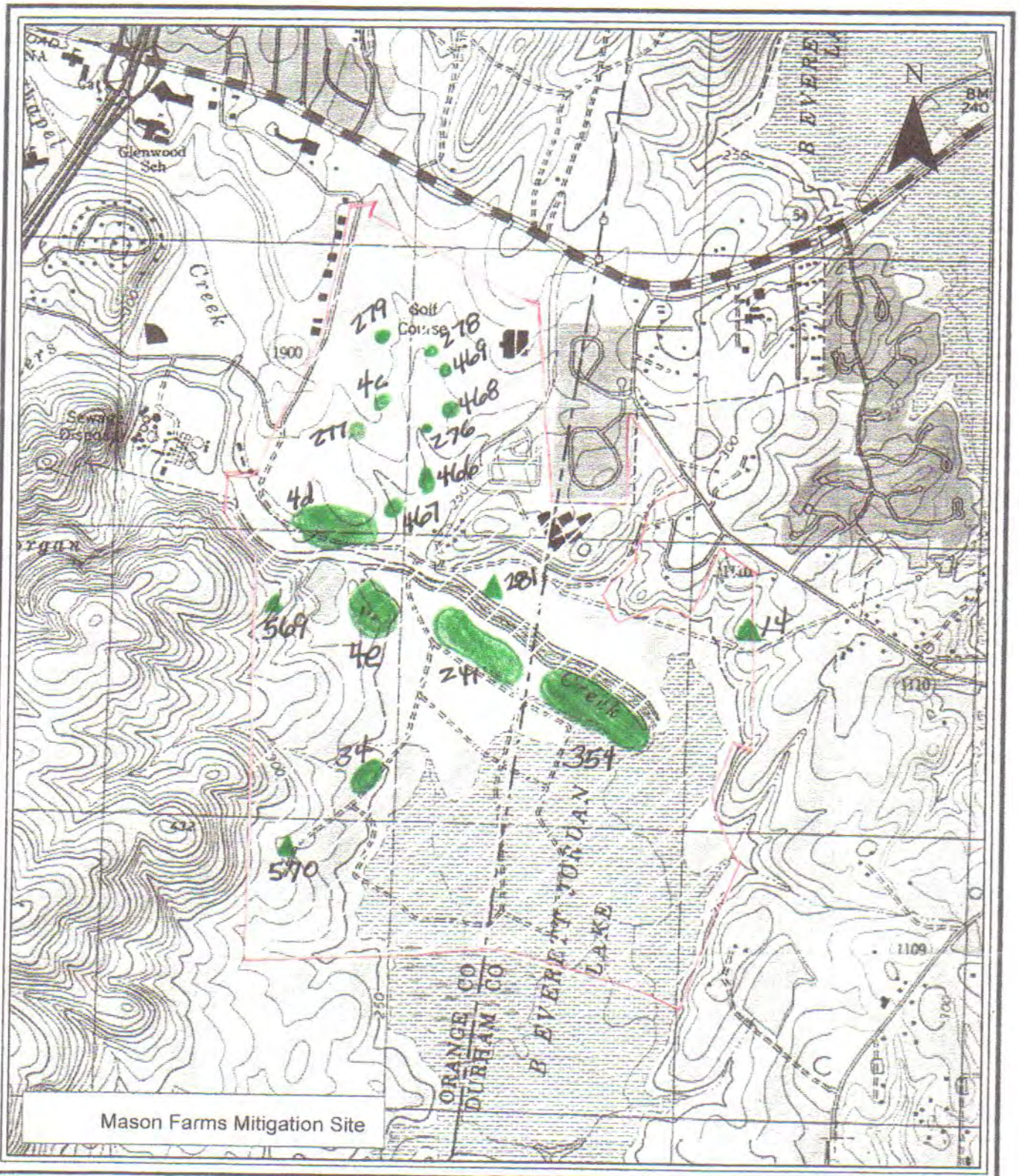
Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

	Location	Mailing Address	Telephone/Fax
ADMINISTRATION	507 N. Blount Street, Raleigh NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-4763/733-8653
RESTORATION	515 N. Blount Street, Raleigh NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-6547/715-4801
SURVEY & PLANNING	515 N. Blount Street, Raleigh, NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-6545/715-4801



The Catena Group

EEP Mason Farms Mitigation Site

Orange and Durham Counties, North Carolina

Date: January 2006

Scale: 0 500 1,000 Feet

Job No.: 4114

Figure 2

North Carolina Wildlife Resources Commission

Richard B. Hamilton, Executive Director

30 January 2006

Mr. Chris Sheats
The Catena Group
8414 Falls of the Neuse Rd., Ste. 204
Raleigh, NC 27615

Subject: Mason Farms Wetland and Stream Mitigation Project, Orange County, North Carolina.

Dear Mr. Sheats:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject document. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d) and North Carolina General Statutes (G.S. 113-131 et seq.).

The North Carolina Ecosystem Enhancement Program is currently investigating a site on the Mason Farms Biological Reserve in Chapel Hill for a wetland/floodplain restoration and stream/buffer enhancement study. The restoration effort will include partial removal of a berm between Morgan Creek and the site and the study will evaluate whether the removal of this berm results in increased overbank flooding. The stream/riparian buffer areas will be evaluated for enhancement/preservation potential.

There are records for the federal and state threatened bald eagle (*Haliaeetus leucocephalus*) and the state special concern four-toed salamander (*Hemidactylium scutatum*) near the project site.

Stream and wetland restoration projects often improve water quality and aquatic habitat. We recommend establishing native, forested buffers in riparian areas to improve terrestrial habitat and provide a travel corridor for wildlife species. Provided measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

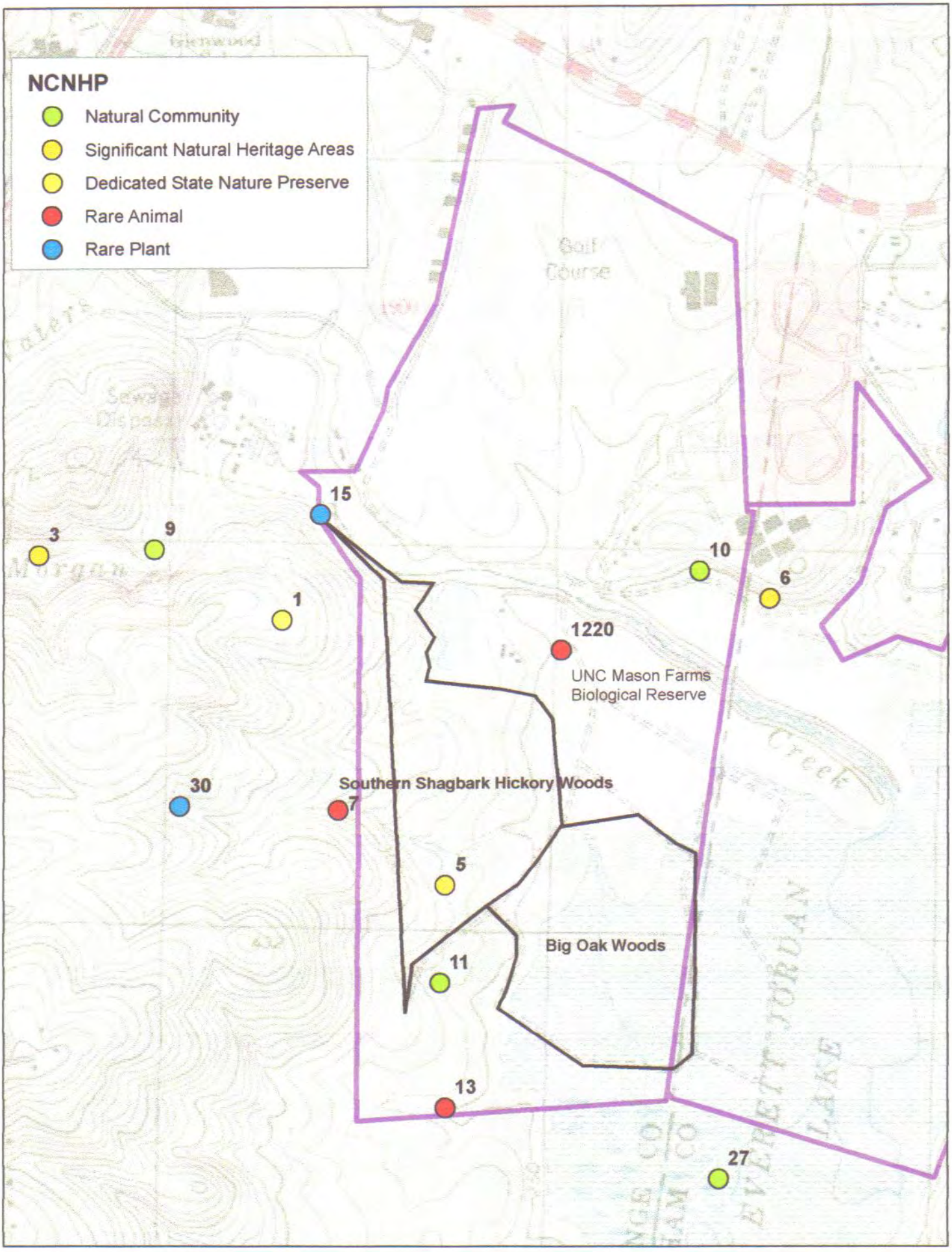
Thank you for the opportunity to review this project. If you require further assistance, please contact our office at (336) 449-7625.

Sincerely,

Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Id	type	record
10	Natural Community	piedmont/low mountain alluvial forest
6	Sig. Nat. Her. Areas	Morgan Creek floodplain forest
27	Natural Community	? not in file
13	rare animal	4-toed salamander
11	Natural Community	Basic Oak Hickory Forest
5	Sig. Nat. Her. Areas	Mason Farm Oak-Hickory Forest
7	rare animal	sharp-shined hawk (1974)
30	rare plant	dichanthelium annulum (a witchgrass) 1898
1	ded. st. nat. pres.	Laurel Hill nature Preserve DNP
1220	rare animal	gold banded skipper (seen in the 50's)
15	rare plant	sweet pinesap (20-30 shoots in ~1988)
3	Sig. Nat. Her. Areas	Morgan Creek Bluffs
9	Natural Community	Piedmont/coastal plain heath bluff


NCNHP
Natural Community
Significant Natural Heritage Areas
Dedicated State Nature Preserve
Rare Animal
Rare Plant
15
3
9
10
6
1
1220
UNC Mason Farms
Biological Reserve
30
Southern Shagbark Hickory Woods
7
5
Big Oak Woods
11
13
27
Golf
Course
Creek
LAKE

Ward Consulting Engineers, P.C.
Engineering Solutions for Civil Design,
Stormwater Management, and Stream/Wetland Restoration

June 11, 2007

Ms. Sue Burke
Town of Chapel Hill, Stormwater Management
209 N. Columbia Street
Chapel Hill, North Carolina 27514

Reference: Morgan Creek Floodplain Restoration Project for NCDWQ Ecosystem Enhancement Program on the University of North Carolina Mason Farm Botanical Reserve

Dear Sue:
I am writing to confirm our conversations and your concurrence of FEMA impacts regarding the proposed project at Mason Farm. As we discussed our proposed project with the Ecosystem Enhancement Program will include the construction of five (5) berm openings through the existing berm that extends from the ford crossing Morgan Creek to approximately 3000 feet downstream along the south bank. The existing berm currently contains storm events that are less than 10 years to Morgan Creek and prevents water from extending into the natural floodplain. The purpose of this project is to provide five openings in the berm that will allow floodwaters to more frequently flood the fields to restore floodplain functions. With the five openings that have been designed the fields are expected to flood with a frequency of 2.5 times per year. With this more frequent flooding we are anticipating the adjacent floodplain to be restored to a riverine wetland state providing additional water quality benefits.

The effective FEMA model does not show the existing berm in the cross sections. This berm may have been considered insignificant to the wide floodplain width and high 100-year storm event water surface elevations in the effective model. Therefore no impacts will occur in the model and to the FEMA effective 100-year effective water surface elevations with the proposed berm openings during the 100-year storm event.

Sincerely,
Ward Consulting Engineers, P.C.

Becky L. Ward

Becky L. Ward, P.E.

8386 Six Forks Road Suite 101, Raleigh NC 27615-5088 Phone: 919-870-0526
Fax: 919-870-5359

Ward Consulting Engineers, P.C.
Engineering Solutions for Civil Design,
Stormwater Management, and Stream/Wetland Restoration

Mr. Herbert Neily
NC Department of Administration
State Construction Office
1307 Mail Service Center
Raleigh, NC 27699-1307

July 3, 2008

Reference: Morgan Creek Floodplain Restoration Project for NCDWQ Ecosystem Enhancement Program on the University of North Carolina Mason Farm Botanical Reserve

Dear Mr. Neily:
I would like to inform you of a project at Mason Farm. Our proposed project with the Ecosystem Enhancement Program will include the construction of five (5) berm openings through the existing berm that extends from the ford crossing Morgan Creek to approximately 3000 feet downstream along the south bank. The existing berm currently contains storm events that are less than a 10-year return period to Morgan Creek and prevents water from extending into the natural floodplain. The purpose of this project is to provide five openings in the berm that will allow floodwaters to more frequently flood the fields to restore floodplain functions. With the five openings that have been designed the fields are expected to flood with a frequency of 2.5 times per year. With this more frequent flooding we are anticipating the adjacent floodplain to be restored to a riverine wetland state providing additional water quality benefits.

The effective FEMA model does not show the existing berm in the cross sections. This berm may have been considered insignificant to the wide floodplain width and high 100-year storm event water surface elevations in the effective model. Therefore no impacts will occur in the model and to the FEMA effective 100-year effective water surface elevations with the proposed berm openings during the 100-year storm event.

I have included for your review the reference maps, restoration maps, HEC-RAS modeling that was completed during our analysis of the berm openings, and Floodplain Development Permit for your review. We have also had discussions with Ms. Sue Burke the Town of Chapel Hill floodplain administrator regarding our project and she concurs that no impacts will occur in the regulated 100-year floodplain water surface elevations. Please let me know if you have any questions or require further information for your review and permit approval.

Sincerely,
Ward Consulting Engineers, P.C.

Becky L. Ward

Becky L. Ward, P.E.

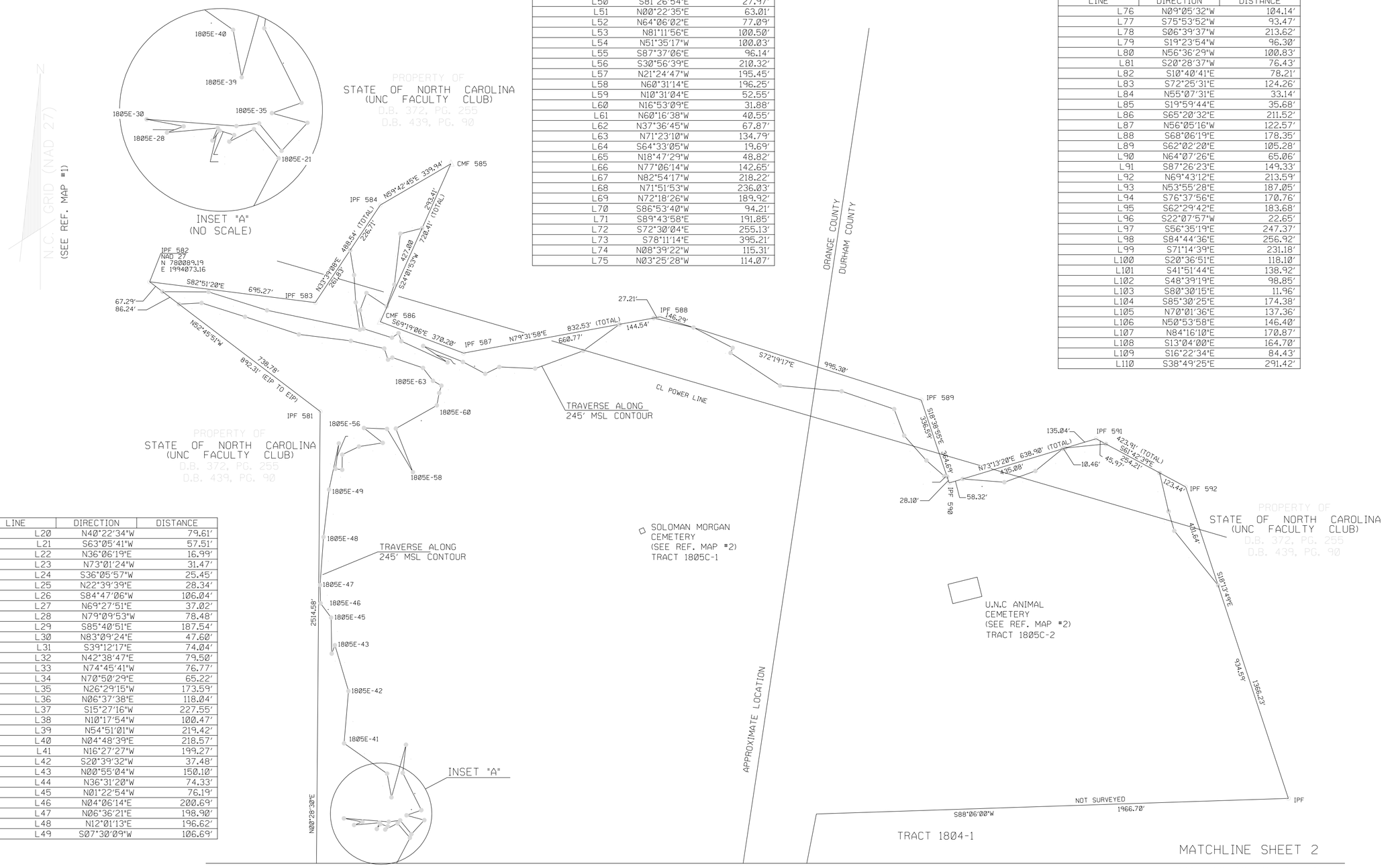
8386 Six Forks Road Suite 101, Raleigh NC 27615-5088
Phone: 919-870-0526
Fax: 919-870-5359

Appendix 10: USACE Flowage Easement

LINE	DIRECTION	DISTANCE
L50	S81°26'54"E	27.97'
L51	N00°22'35"E	63.01'
L52	N64°06'02"E	77.09'
L53	N81°11'56"E	100.50'
L54	N51°35'17"W	100.03'
L55	S87°37'06"E	96.14'
L56	S30°56'39"E	210.32'
L57	N21°24'47"W	195.45'
L58	N60°31'14"E	196.25'
L59	N10°31'04"E	52.55'
L60	N16°53'09"E	31.88'
L61	N60°16'38"W	40.55'
L62	N37°36'45"W	67.87'
L63	N71°23'10"W	134.79'
L64	S64°33'05"W	19.69'
L65	N18°47'29"W	48.82'
L66	N77°06'14"W	142.65'
L67	N82°54'17"W	218.22'
L68	N71°51'53"W	236.03'
L69	N72°18'26"W	189.92'
L70	S86°53'40"W	94.21'
L71	S89°43'58"E	191.85'
L72	S72°30'04"E	255.13'
L73	S78°11'14"E	395.21'
L74	N08°39'22"W	115.31'
L75	N03°25'28"W	114.07'

LINE	DIRECTION	DISTANCE
L76	N09°05'32"W	104.14'
L77	S75°53'52"W	93.47'
L78	S06°39'37"W	213.62'
L79	S19°23'54"W	96.30'
L80	N56°36'29"W	100.83'
L81	S20°28'37"W	76.43'
L82	S10°40'41"E	78.21'
L83	S72°25'31"E	124.26'
L84	N55°07'31"E	33.14'
L85	S19°59'44"E	35.68'
L86	S65°20'32"E	211.52'
L87	N56°05'16"W	122.57'
L88	S68°06'19"E	178.35'
L89	S62°02'20"E	105.28'
L90	N64°07'26"E	65.06'
L91	S87°26'23"E	149.33'
L92	N69°43'12"E	213.59'
L93	N53°55'28"E	187.05'
L94	S76°37'56"E	170.76'
L95	S62°29'42"E	183.68'
L96	S22°07'57"W	22.65'
L97	S56°35'19"E	247.37'
L98	S84°44'36"E	256.92'
L99	S71°14'39"E	231.18'
L100	S20°36'51"E	118.10'
L101	S41°51'44"E	138.92'
L102	S48°39'19"E	98.85'
L103	S80°30'15"E	11.96'
L104	S85°30'25"E	174.38'
L105	N70°01'36"E	137.36'
L106	N50°53'58"E	146.40'
L107	N84°16'10"E	170.87'
L108	S13°04'00"E	164.70'
L109	S16°22'34"E	84.43'
L110	S38°49'25"E	291.42'

LINE	DIRECTION	DISTANCE
L20	N40°22'34"W	79.61'
L21	S63°05'41"W	57.51'
L22	N36°06'19"E	16.99'
L23	N73°01'24"W	31.47'
L24	S36°05'57"W	25.45'
L25	N22°39'39"E	28.34'
L26	S84°47'06"W	106.04'
L27	N69°27'51"E	37.02'
L28	N79°09'53"W	78.48'
L29	S85°40'51"E	187.54'
L30	N83°09'24"E	47.60'
L31	S39°12'17"E	74.04'
L32	N42°38'47"E	79.50'
L33	N74°45'41"W	76.77'
L34	N70°50'29"E	65.22'
L35	N26°29'15"W	173.59'
L36	N06°37'38"E	118.04'
L37	S15°27'16"W	227.55'
L38	N10°17'54"W	100.47'
L39	N54°51'01"W	219.42'
L40	N04°48'39"E	218.57'
L41	N16°27'27"W	199.27'
L42	S20°39'32"W	37.48'
L43	N00°55'04"W	150.10'
L44	N36°31'20"W	74.33'
L45	N01°22'54"W	76.19'
L46	N04°06'14"E	200.69'
L47	N06°36'21"E	198.90'
L48	N12°01'13"E	196.62'
L49	S07°30'09"W	106.69'



DATE	REVISION	INITIAL

McKIM&CREED
ENGINEERS, SURVEYORS, AND PLANNERS
310 EAST JOHNSTON STREET
SMITHFIELD, N.C. 27577
TEL: <919> 934-7154

DATE: _____

SURVEY OF
TRACT 1805-E
JORDAN LAKE PROJECT
FOR
U. S. ARMY CORP OF ENGINEERS
SAVANNAH DISTRICT
SCALE 1" = 300' DECEMBER 08, 1995
CHAPEL HILL TWSP. ORANGE CO. NORTH CAROLINA
TRIANGLE TWSP. DURHAM CO. NORTH CAROLINA

PROJECT # : 0971-0016.0S
PROJ. SVYR : SRW
DRAWN BY : AJB
FIELD BK. : S0171
COMP. FILE : TR1805S1
SHEET # : 2 OF 2

DWG. # : S.1.5.1.114

STATE OF NORTH CAROLINA

COUNTIES OF ORANGE AND DURHAM

0 8611

DEED OF EASEMENT

43

THIS DEED OF EASEMENT, Made and entered into this 24th day of May, 1976, by and between the STATE OF NORTH CAROLINA, a body politic and corporate, hereinafter referred to as Grantor; and the UNITED STATES OF AMERICA, hereinafter referred to as Grantee;

W I T N E S S E T H:

THAT WHEREAS, the University of North Carolina which has control of the property hereinafter described and which has requested and approved the execution of this instrument for the purposes herein specified; and

WHEREAS, the execution of this instrument for and on behalf of the State of North Carolina has been duly approved by the Governor and Council of State at a meeting held in the City of Raleigh, Wake County, North Carolina, on the 2nd day of March, 1976; and

WHEREAS, the Grantor herein is the owner if the land hereinafter described, located in Triangle Township, Durham County and Chapel Hill Township, Orange County, North Carolina, containing approximately 273.37 acres of land and being bound by land now or formerly of the following parties: North by other land of the University of North Carolina at Chapel Hill, east by land of Kendrick Estates Investment Corporation, south by land of Kendrick Estates Investment Corporation and west by other land of the University of North Carolina at Chapel Hill; and

WHEREAS, the parties hereto have mutually agreed to the terms of this deed of easement as hereinafter set forth,

NOW, THEREFORE, for and in consideration of the sum of NINETEEN THOUSAND ONE HUNDRED SEVENTY-FIVE AND NO/100 ($19,175.00) DOLLARS, the receipt of which is hereby acknowledged, Grantor has this day bargained and sold and does hereby grant, bargain, sell, transfer and convey unto

44

Grantee, a permanent flood easement, and the right, privilege and easement occasionally to overflow, flood, and submerge the land hereinafter described which lies below the contour elevation of 245 feet (U.S.C. & G.S. Datum) and to maintain mosquito control in connection with the operation and maintenance of the B. Everett Jordan Dam and Lake Project as authorized by the Act of Congress approved 30 December 1963, together with all right, title and interest in and to the structures and improvements now situate on the land, except the fencing; provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representatives of the United States in charge of the project, and that no alterations to the contour of the land shall be made without such approval; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired.

The land affected by the easement is that portion of the hereinafter described tract which lies below the 245 foot contour elevation (U.S.C. & G.S. Datum) and being that tract of land containing 273.37 acres, more or less lying and being situated in Triangle Township, Durham County and Chapel Hill Township, Orange County, North Carolina, and being more particularly described as follows:

Beginning at the most southwesterly corner of the herein described tract, said corner being in the government acquisition line and on the property line of land of Kendrick Estates Investment Corporation, said corner having a coordinate value of 775,390.77 feet N and 1,994,244.37 feet E; thence from the point of beginning with the government acquisition line through the land of the University of North Carolina at Chapel Hill the following courses: N 42°-59'-33" W 97.00 feet to government monument number 579, said monument having a coordinate value of 755,461.71 feet N and 1,994,178.22 feet E; thence N 20°-21'-58" E 1677.69 feet to government monument number 580, said monument having a coordinate value of 777,034.53 feet N and 1,994,762.08 feet E; thence N 00°-29'-21" E 2514.62 feet to government corner number 581, said corner being an iron pipe having a coordinate value of 779,549.06 feet N and 1,994,783.55 feet E; thence N 52°-45'-11" W 892.42 feet to government corner number 582, said corner being an iron pipe having a coordinate value of 780,089.19 feet N and 1,994,073.16 feet E; thence S 82°-51'-20" E 695.20 feet to government corner number 583, said corner being an iron pipe having a coordinate value of 780,002.73 feet N and 1,994,762.96 feet E; thence N 33°-39'-18" E 488.64 feet to government corner number 584, said corner being an iron pipe having a coordinate value of 780,409.47

feet N and 1,995,033.76 feet E; thence N 59°-41'-19" E 339.92 feet to government monument number 585, said monument having a coordinate value of 780,581.03 feet N and 1,995,327.21 feet E; thence S 24°-01'-26" W 720.44 feet to government monument number 586, said monument having a coordinate value of 779,922.99 feet N and 1,995,033.91 feet E; thence S 69°-20'-07" E 369.92 feet to government corner number 587, said corner being an iron pipe having a coordinate value of 779,792.45 feet N and 1,995,380.03 feet E; thence N 79°-32'-16" E 832.26 feet to government corner number 588, said corner being an iron pipe having a coordinate value of 779,943.58 feet N and 1,996,198.41 feet E; thence S 72°-19'-17" E 1141.80 feet to government corner number 589, said corner being an iron pipe having a coordinate value of 779,596.84 feet N and 1,997,286.33 feet E; thence S 18°-39'-44" E 364.64 feet to government corner number 590, said corner being an iron pipe having a coordinate value of 779,251.37 feet N and 1,997,403.01 feet E; thence N 73°-12'-57" E 638.99 feet to government corner number 591, said corner being an iron pipe having a coordinate value of 779,435.88 feet N and 1,998,014.78 feet E; thence S 61°-42'-53" E 423.98 feet to government corner number 592, said corner being an iron pipe having a coordinate value of 779,234.98 feet N and 1,998,388.14 feet E; thence S 18°-13'-52" E 1366.55 feet to a point in the government acquisition line and on the property line of the land of Kendrick Estates Investment Corporation and land of the herein described tract; thence with land of Kendrick Estates Investment Corporation the following courses: S 88°-06' W 1966.7 feet; thence S 11°-04' W 885.5 feet; thence S 20°-25' E 659.4 feet; thence S 09°-19' W 927.2 feet to a concrete monument; thence S 88°-12' W 2516.9 feet to the point of beginning.

Excluded from the above described is all that land lying above the contour elevation 245 feet, this acreage embraces only that land which lies below contour elevation 245 feet mean sea level and containing 273.37 acres, more or less, having 105.22 acres in Durham County and 168.15 acres in Orange County.

Excepting a cemetery known as the Solomon Morgan Cemetery which has the following description: Beginning at the most southeasterly corner of the herein described tract, said corner being a corner of land of the University of North Carolina at Chapel Hill, said corner being a hub having a coordinate value of 779,038.58 feet N and 1,996,199.66 feet E being N 32°-03' W 1376.3 feet from a corner common to land of Kendrick Estates Investment Corporation and land of the University of North Carolina at Chapel Hill (parent tract), said hub being S 80°-35' W 1300.9 feet from government corner number 590 in the government acquisition line, said government corner being an iron pipe having a coordinate value of 779,251.37 feet N and 1,997,403.01 feet E; thence from the point of beginning through land of the University of North Carolina at Chapel Hill the following courses: N 66°-21' W 16.0 feet to a hub; thence N 23°-39' E 12.0 feet to a hub; thence S 66°-21' E 16.0 feet to a hub; thence S 23°-39' W 12.0 feet to the point of beginning and containing 0.004 acres, more or less.

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Also excepting a cemetery known as the University of North Carolina Animal Cemetery which has the following description: Beginning at the most southwesterly corner of the herein described tract, said corner being a hub having a coordinate value of 778,828.97 feet N and 1,997,398.01 feet E, said corner being a corner of land of the University of North Carolina at Chapel Hill, said corner being N 29°-48' E 1102.8 feet from a corner common to the land of Kendrick Estates Investment Corporation and land of the University of North Carolina at Chapel Hill (parent tract), said corner being S 00°-41' W 422.4 feet from government corner number 590 in the government acquisition line, said government corner being an iron pipe having a coordinate value of 779,251.37 feet N and 1,997,403.01 feet E; thence from the point of beginning through land of the University of North Carolina at Chapel Hill the following courses: N 39°-45' E 152.0 feet to a hub; thence S 50°-15' E 102.0 feet to a hub; thence S 39°-45' W 152.0 feet to a hub; thence N 50°-15' W 102.0 feet to the point of beginning and containing 0.36 acres, more or less.

The above described tract excepting the two cemeteries, contain 168.15 acres in Orange County and 105.22 acres in Durham County for a total of 273.37 acres, more or less.

The land as described as a part of the land conveyed by Mary E. Mason to the University of North Carolina at Chapel Hill by Will dated on the 21st day of July, 1891 and probated on the 20th day of July, 1894 and recorded in Will Book I, Page 43 of the records of Orange County, North Carolina.

The bearings and coordinates shown in the above description are based on the North Carolina Plane Coordinate System.

IN TESTIMONY WHEREOF, the State of North Carolina has caused this instrument to be executed in its name by JAMES E. HOLSHOUSER, JR., Governor, attested by THAD EURE, Secretary of State, and the Great Seal of the State of North Carolina hereto affixed, by virtue of the power and authority aforesaid, the day and year first above written.

STATE OF NORTH CAROLINA

By _____
Governor

ATTEST:

_____
Secretary of State

APPROVED FOR DISPOSITION

_____
Secretary of Administration

APPROVED AS TO FORM:

RUFUS L. EDMISTEN
Attorney General

_____
Associate Attorney

STATE OF NORTH CAROLINA

COUNTY OF WAKE

47

I, SARAH JONES, a Notary Public in and for said County and State, do hereby certify that JAMES E. HOLSHOUSER, JR., Governor of the State of North Carolina, and THAD EURE, Secretary of State of North Carolina, personally came before me this day and being by me duly sworn says each for himself that he knows the Great Seal of the State of North Carolina and that the seal affixed to the foregoing instrument is the Great Seal of the State; that JAMES E. HOLSHOUSER, JR., Governor of Said State, and THAD EURE, Secretary of State, subscribed their names thereto, all by virtue of a resolution of the Council of State; and that said instrument is the act and deed of the State of North Carolina.

IN WITNESS WHEREOF, I have hereunto set my hand and Notarial Seal, this the 23rd day of April, 1976.

Sarah Jones
Notary Public

My Commission Expires:
January 11, 1978.

48

Grantee's Address: Army Corp of Engineers, Cary, N. C.

STATE OF NORTH CAROLINA-ORANGE COUNTY

THE FOREGOING CERTIFICATE(S) OF Sarah Jones

NOTARY PUBLIC OF THE DESIGNATED GOVERNMENTAL UNITS IS (ARE) CERTIFIED TO BE

17th DAY OF May A.D. 19 76

BY: Betty H. Owens
ASSISTANT/DEPUTY REGISTER OF DEEDS

BETTY
REGIST
ORANGE

FILED
BOOK/ROLL 263 PAGE # 64
MAY 27 11 19

OF DEEDS

3rd

BOOK 263 PAGE 646

STATE OF NORTH CAROLINA

COUNTY OF WAKE

47

I, SARAH JONES, a Notary Public in and for said County and State, do hereby certify that JAMES E. HOLSHOUSER, JR., Governor of the State of North Carolina, and THAD EURE, Secretary of State of North Carolina, personally came before me this day and being by me duly sworn says each for himself that he knows the Great Seal of the State of North Carolina and that the seal affixed to the foregoing instrument is the Great Seal of the State; that JAMES E. HOLSHOUSER, JR., Governor of Said State, and THAD EURE, Secretary of State, subscribed their names thereto, all by virtue of a resolution of the Council of State; and that said instrument is the act and deed of the State of North Carolina.

IN WITNESS WHEREOF, I have hereunto set my hand and Notarial Seal, this the 23rd day of April, 1976.

Sarah Jones
Notary Public

My Commission Expires:
January 11, 1978.

48

Grantee's Address: Army Corp of Engineers, Cary, N. C.

State of North Carolina - Durham County

The Foregoing certificate (s) of Sarah Jones
A Notary (Notaries) Public of the Designated Governmental units is (are) certified to be correct.

This the 3 day of June A. D. 19 76.

A. J. Gresham

438 PG 93-9

Appendix 11: DRAINMOD

DrainMod Results – Existing Conditions

MF Cal 0 flood yr

DRAINMOD version 5.1

Mason Farms
Run 1

**********RUN STATISTICS ********** time: 5/28/2007 @ 14:21
input file: C:\Drainmod\INPUTS\MFARMS Calibrated.prj
parameters: subirrigation run and yields not calculated
drain spacing = 5000. cm drain depth = 50.0 cm

YEAR	RAINFALL	INFILTRATION	ET	DRAINAGE	RUNOFF	SEW	TWLOSS	PUMPV
1971	159.72	84.80	62.57	22.85	74.92	73.16	97.81	.00
1972	133.88	84.99	60.26	23.63	48.80	212.31	72.47	.00
1973	134.95	88.64	67.56	21.15	46.41	135.41	67.63	.00
1974	130.58	84.84	62.10	23.14	45.75	248.81	68.93	.00
1975	130.53	77.71	51.45	25.79	52.78	234.61	78.60	.00
1976	117.60	84.45	65.46	19.33	33.19	114.17	52.56	.00
1977	152.86	83.58	59.86	23.54	69.28	147.16	92.86	.00
1978	137.29	84.26	62.95	21.72	53.03	328.72	74.81	.00
1979	156.64	90.46	63.26	27.31	66.18	338.64	93.54	.00
1980	110.74	73.03	47.88	24.96	37.71	117.74	62.71	.00
1981	103.07	69.06	52.77	16.05	34.01	67.76	50.15	.00
1982	127.74	75.16	52.39	22.52	52.50	111.94	75.07	.00
1983	154.64	84.34	55.61	29.15	70.37	179.78	99.56	.00
1984	137.36	79.55	59.57	21.34	57.81	470.46	79.22	.00
1985	114.17	66.50	49.55	16.06	47.68	.00	63.78	.00
1986	102.03	78.20	61.48	16.21	23.84	1.22	40.10	.00
1987	132.97	80.64	57.45	23.21	52.33	84.24	75.61	.00
1988	103.05	74.87	55.20	19.63	28.18	119.06	47.87	.00
1989	175.97	98.00	71.18	26.60	77.97	298.94	104.63	.00
1990	126.95	79.20	64.34	15.27	47.75	198.22	63.12	.00
1991	134.95	71.90	51.98	19.77	63.05	261.21	82.91	.00
1992	111.73	76.51	55.25	21.28	35.23	199.66	56.56	.00
1993	95.15	57.97	38.03	19.88	37.18	69.21	57.09	.00
1994	134.95	71.77	51.98	19.82	63.18	261.21	83.08	.00
AVG	129.98	79.18	57.51	21.67	50.80	178.07	72.53	.00

MF Cal 0 flood wet

---

* DRAINMOD version 5.1 *

* Copyright 1980-99 North Carolina State University *

Mason Farms
Run 1
****

----------RUN STATISTICS ---------- time: 5/28/2007 @ 14:21
input file: C:\Drainmod\INPUTS\MFARMS Calibrated.prj
parameters: subirrigation run and yields not calculated
drain spacing = 5000. cm drain depth = 50.0 cm

D R A I N M O D --- HYDROLOGY EVALUATION
****** INTERIM EXPERIMENTAL RELEASE ******

Number of periods with water table closer than 30.00 cm
for at least 21 days. Counting starts on day
109 and ends on day 292 of each year

YEAR	Number of Periods of 21 days or more with WTD < 30.00 cm	Longest Consecutive Period in Days
1971	0.	20.
1972	1.	28.
1973	0.	18.
1974	1.	38.
1975	1.	42.
1976	1.	34.
1977	1.	23.
1978	0.	18.
1979	1.	45.
1980	0.	19.
1981	0.	18.
1982	0.	18.
1983	1.	21.
1984	0.	16.
1985	1.	24.
1986	0.	19.
1987	1.	42.
1988	1.	24.
1989	1.	33.
1990	0.	18.
1991	1.	31.
1992	1.	30.
1993	0.	12.
1994	1.	31.

Number of Years with at least one period = 14. out of 24 years.

DrainMod Results – Post Construction

MF Cal 2.5+ flood yr

* DRAINMOD version 5.1 *
* Copyright 1980-99 North Carolina State University *

Mason Farms
Run 1

**********RUN STATISTICS ********** time: 6/ 8/2007 @ 10:16
input file: C:\Drainmod\INPUTS\MFARMS Calibrated.prj
parameters: subirrigation run and yields not calculated
drain spacing = 5000. cm drain depth = 50.0 cm

YEAR	RAINFALL	INFILTRATION	ET	DRAINAGE	RUNOFF	SEW	IRR VOL	PUMPV
1971	279.72	127.64	64.19	64.01	152.08	264.51	120.00	.00
1972	253.88	122.17	60.88	60.24	130.83	386.26	120.00	.00
1973	314.95	128.77	67.61	61.16	186.71	276.67	180.00	.00
1974	250.58	126.47	63.85	63.00	124.46	528.59	120.00	.00
1975	190.53	117.25	54.10	62.77	72.83	472.91	60.00	.00
1976	297.60	118.38	67.33	51.33	179.67	340.82	180.00	.00
1977	272.86	121.28	60.36	60.64	151.34	353.08	120.00	.00
1978	257.29	122.95	63.72	59.76	134.58	551.46	120.00	.00
1979	276.64	140.23	64.06	76.29	136.41	579.76	120.00	.00
1980	170.74	106.77	48.25	58.35	63.97	177.08	60.00	.00
1981	283.07	95.89	54.22	41.39	187.19	307.49	180.00	.00
1982	187.74	112.93	52.66	60.07	74.32	184.28	60.00	.00
1983	274.64	137.66	57.08	81.00	137.46	379.02	120.00	.00
1984	317.36	120.23	60.12	61.45	197.13	801.30	180.00	.00
1985	174.17	97.52	52.81	43.84	76.65	52.95	60.00	.00
1986	222.03	101.43	64.80	36.08	120.60	46.85	120.00	.00
1987	312.97	123.39	59.61	63.73	189.57	181.12	180.00	.00
1988	223.05	100.87	57.43	43.52	122.18	288.72	120.00	.00
1989	295.97	135.78	71.92	63.59	160.19	532.54	120.00	.00
1990	246.95	105.70	64.89	41.26	141.25	330.02	120.00	.00
1991	194.95	103.13	53.74	49.08	91.82	420.96	60.00	.00
1992	231.73	103.54	55.86	47.71	128.20	357.37	120.00	.00
1993	155.15	87.01	40.30	46.80	68.14	151.69	60.00	.00
1994	134.95	100.77	52.32	48.32	34.18	382.79	.00	.00
AVG	242.48	114.91	58.84	56.06	127.57	347.84	112.50	.00

MF Cal 2.5+ flood wet

* DRAINMOD version 5.1 *
* Copyright 1980-99 North Carolina State University *

Mason Farms
Run 1
****

----------RUN STATISTICS ---------- time: 6/ 8/2007 @ 10:16
input file: C:\Drainmod\INPUTS\MFARMS Calibrated.prj
parameters: subirrigation run and yields not calculated
drain spacing = 5000. cm drain depth = 50.0 cm

D R A I N M O D --- HYDROLOGY EVALUATION
****** INTERIM EXPERIMENTAL RELEASE ******

Number of periods with water table closer than 30.00 cm
for at least 21 days. Counting starts on day
109 and ends on day 292 of each year

YEAR	Number of Periods of 21 days or more with WTD < 30.00 cm	Longest Consecutive Period in Days
1971	0.	20.
1972	1.	28.
1973	0.	18.
1974	1.	44.
1975	1.	42.
1976	1.	34.
1977	1.	24.
1978	0.	18.
1979	1.	45.
1980	0.	19.
1981	0.	18.
1982	1.	29.
1983	1.	21.
1984	1.	38.
1985	1.	24.
1986	0.	19.
1987	1.	45.
1988	1.	25.
1989	1.	33.
1990	0.	19.
1991	1.	31.
1992	1.	44.
1993	0.	12.
1994	1.	31.

Number of Years with at least one period = 16. out of 24 years.