STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

November 1, 2004

Mr. Nicholas L. Graf, P.E.
Division Administrator
Attention: Ron Lucas Area Engineer
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, N.C. 27601-1418

Subject: Section 7 Biological Assessment for dwarf wedgemussel (*Alasmidonta heterodon*) for the proposed Clayton Bypass, US 70 from I-40 in Wake County to US 70 Business in Johnston County, Federal Aid Project No. F-60-1 (8), State Project No. 8.T311001, R-2552.

Dear Mr. Lucas:

Please review the attached addendum to the Biological Assessment (BA) for the dwarf wedgemussel as part of the Section 7 Consultation for the Proposed Clayton Bypass (R-2552) in Wake and Johnston Counties. My staff has concluded that the proposed action is "May Affect-Not Likely to Adversely Affect" (Conditional) for the species in question. NCDOT has committed to and implemented the following as conservation measures for the potential impacts to the dwarf wedgemussel: hazardous spill basins, removal of curb and gutter on Ranch Road, extending the controlled access on the AB, B and C sections, water quality monitoring, a seeding and mulching special provision, erosion and sedimentation control inspection and oversight and the use of the newest technologies to increase sediment retention from 70% to 90% in our basins. Also, proposed is the extension of the existing Environmental Sensitive Area (ESA). This extension would increase the existing ESA into the Upper Swift Creek sub-watershed in Wake County and the Little Creek sub-watershed in Johnston County. The extension of the ESA by Wake and Johnston Counties is crucial to getting to the "May Affect-Not Likely to Adversely Affect" conclusion for the dwarf wedgemussel.

Your timely attention to this matter is greatly appreciated. If you need further information, or have questions concerning the attached materials, please contact Jared Gray at 919-715-1422.

Sincerely,

Gregory J. Thorpe, Ph.D., Environmental Management Director
Project Development and Environmental Analysis Branch

cc: Gary Jordan, USFWS Raleigh Office
Eric Alsmeyer, USACE Raleigh Office
Matt Haney, Project Manager
Kristina Solberg, P.E., Project Engineer

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS
1548 MAIL SERVICE CENTER
RALEIGH NC 27699-1548

TELEPHONE: 919-733-3141
FAX: 919-733-9794

WEBSITE: www.NCDOT.ORG

LOCATION:
TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH NC

ADDENDUM TO THE BIOLOGICAL ASSESSMENT

CLAYTON BYPASS

JOHNSTON AND WAKE COUNTY,
NORTH CAROLINA
(R-2552)

PREPARED BY:

THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
RALEIGH, NORTH CAROLINA

NOVEMBER 2004

Tables

Appendices

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1.0 INTRODUCTION

Five federally protected species that are listed as threatened or endangered and protected under the Endangered Species Act of 1973 as amended have been documented to occur within the region of the proposed Clayton Bypass (R-2552). The Tar River spinymussel (*Elliptio steinstansana*), dwarf wedgemussel (*Alasmidonta heterodon*), bald eagle (*Haliaeetus leucocephalus*), red-cockaded woodpecker (*Picoides borealis*), and Michaux's sumac (*Rhus michauxii*) have been identified within either Wake or Johnston Counties. This Addendum to the Biological Assessment (BA) is provided to satisfy the North Carolina Department of Transportation (NCDOT) and Federal Highway Administration (FHWA) obligations under Section 7 of the Endangered Species Act. This BA addresses project-related concerns with possible direct, indirect and cumulative impacts to these species. This BA follows the Final Environmental Impact Statement (FEIS), which was produced in June 8, 1998 and describes natural resource issues associated with the project in greater detail (NCDOT 1998).

1.1 Project Description and History

The NCDOT proposes to provide a bypass of existing U.S. 70 from I-40 in Wake County to U.S. 70 Business in Johnston County southeast of the Town of Clayton, a distance of approximately 10 miles (16 kilometers). The proposed improvements would provide a minimum four-lane divided facility with full control of access on new location bypassing the Town of Clayton. Interchanges are proposed with I-40, NC 42, SR 1560 (Ranch Road), and U.S. 70 Business. The project's western terminus ties into an interchange with I-40, which may possibly be shared with the tie-in to the future Raleigh Outer Loop. For the purpose of this report, the area being studied for the proposed road improvements is referred to as the project study area.

The history of the project is listed in Table 1.

Table 1. Project Activity/History

Action	**Date**
NCDOT Transportation Improvement Program	December 1990
Notice of Intent to Prepare an EIS	June 1991
Citizens Informational Workshop	October 10, 1991 & February 27, 1992
DEIS completed and signed	July 1994
Corridor Public Hearing	October 24, 1994
A preferred alternative (Alternative III) selected	January 1995
Alternative III corridor to be Studied in Detail completed	July 1995
Biological Assessment submitted to United States Fish and Wildlife Service (USFWS)	September 23, 1997

Table 1. Project Activity/History (continued)

Action	Date
Addendum to the Biological Assessment submitted to the (USFWS)	December 5, 1997
USFWS Biological Opinion: May Affect, Not Likely to Adversely Affect.	December 17,1997
Final Environmental Impact Study was completed and signed	June 8, 1998
Additional Mussel Surveys in Project Study area	Summer 2002 and 2003
2A/4A signed concurrence	February 17, 2004
4B Meeting with the Agencies	April 21, 2004
4C Meeting with the Agencies	August 18, 2004

2.0 NATURAL RESOURCE SUMMARY

This section is intended to give a brief summary of the natural resources within the proposed project study area. More detailed descriptions of the natural resources associated with this project are available in the project FEIS (NCDOT 1998).

2.1 Physical Characteristics

The project study area is in the east-central part of North Carolina, in the Piedmont Physiographic Province, and includes portions of both Wake and Johnston counties. The project study area is within the boundary of the Neuse River Basin. The landscape in the region is characterized by gently rolling topography containing rounded uplands with a few nearly level interstream divides. Geologically, this region is described as weathered Piedmont igneous and slate belt rocks (bedrock) overlain by much younger Coastal Plain sediments. Piedmont soils typically occupy the steeper slopes where erosion has occurred, while the coastal plain sediments are present within interstream divides.

Wake County has a land area of 532,478 acres (215,487 hectares [ha]), or about 832 square miles (2,238 square km). The parts of the county that lie north of Raleigh are rolling to hilly and contain major drainageways that are bordered by steep slopes. Elevation ranges from 160 to 540 feet (49 to 165 m) above mean sea level (MSL). The Neuse River and its tributaries drain about 80 percent of the county, but tributaries of the Cape Fear River drain the southwestern part (USDA Soil Conservation Service 1970).

Johnston County consists of 510,138 acres (206,446 ha), or about 797 square miles (2,064 square km). This total includes 1,075 acres (435 ha) of bodies of water larger than 40 acres (16 ha). About half of this acreage is used as farmland. Elevation ranges from 75 feet (23 m) above sea level, where the Neuse River leaves the County at the Wayne County line, to more than 370 feet

(113 m) above MSL at the North Carolina University Experiment Station, which is near the Wake County line. The Neuse River and its numerous tributaries meander through Johnston County, with some of the tributaries having headwaters outside of the county. Johnston County almost entirely drains into the Neuse River (USDA Soil Conservation Service 1994).

2.2 Water Resources

The Neuse River Basin originates in central North Carolina in the Piedmont and extends through the Coastal Plain, stretching from Person and Orange Counties in the west to Carteret County in the east. The basin encompasses 6,192 square miles (16,031 square km) in 19 counties. There are approximately 3,293 square miles (8,529 square km) of freshwater streams in the basin, 328,700 acres (133,020 ha) classified as salt waters, and thousands of freshwater impoundments. It is the third-largest river basin in North Carolina.

Swift Creek is within the Neuse River Subbasin 02 as assigned by the North Carolina Department of Environment Health and Natural Resources (DEHNR), Division of Water Quality (DWQ) section, formerly known as the Division of Environmental Management (DEM). Swift Creek originates in western Wake County near the town of Cary, and flows in a general southward direction before joining the Neuse River just south of the town of Smithfield in central Johnston County. Total stream length is approximately 38 miles. Two water-supply lakes (Lake Wheeler and Lake Benson) for the city of Raleigh are formed by Swift Creek. Swift Creek drains an area of approximately 156 square miles before joining Middle Creek, 1 mile upstream of the confluence with the Neuse River (NCDEHNR-DEM 1992).

Swift Creek is characterized as slow moving, with a streambed gradient of 4.7 feet per mile. The channel in the project area is typically U-shaped, 30-40 feet wide and at least 1-3 feet deep. The substrate is highly variable throughout its course ranging from silt to sandy-gravel to cobble. The banks are mostly gently sloping, although some areas exhibit fairly steep topography. Largely, Lake Wheeler and Lake Benson control stream flow of Swift Creek. Below Lake Benson, average stream flow is estimated at 98 cubic feet per second (cfs). Following storm events flows of 800 cfs are possible (NCDEHNR-DEM 1992). There is no minimum flow release required for either Lake Wheeler or Lake Benson. During drought periods Swift Creek becomes stagnant, with a 7Q10 flow rate of 1.3 cfs. The 7Q10 are statistically the lowest 7-day average flow occurring in a 10-year period, and are used by the DWQ as the low flow criteria at which water quality standards must be maintained.

The predominant land usage in the Swift Creek watershed below Lake Benson is rural-agricultural, consisting of "rural" subdivisions of 1 acre lots, cropland and woodland. This portion of the watershed, which lies mostly in Johnston County has experienced considerable economic growth in recent years which is expected to continue.

2.2.1. Surface Water Characteristics

The majority of the streams crossed by the proposed project can be characterized as naturally meandering streams that exhibit run, riffle and pool habitats. In most cases stream profiles that occur along existing roadways that are a part of project study area differ upstream and downstream. There were 39 jurisdictional streams identified in the project study area.

2.2.2. Water Quality

The North Carolina Department of Environment and Natural Resources (NCDENR) measures and monitors water quality in North Carolina streams using several different methodologies. One method is to assign a best usage classification to each water body of the river basins of North Carolina that is appropriate for the best intended uses of that particular water body (e.g. aquatic life support, swimming, etc). The best usage classification for the water bodies occurring in the project study area range from C NSW to WS-II NSW (HQW).

WS-II waters are protected as water supplies that are generally in predominantly undeveloped watersheds. Local programs to control non-point-source and stormwater discharges of pollution are required with WS designations. These waters are suitable for all Class C uses. Class C designates waters suitable for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Class C imposes a minimum standard of protection for all waters of North Carolina. WS-I and WS-II waters are considered HQWs (High-Quality Waters), or waters rated as excellent based on biological and physical/chemical characteristics.

The supplemental classification of NSW denotes Nutrient-Sensitive Waters, which require additional nutrient management because of their susceptibility to excessive growth of microscopic and macroscopic vegetation. It is recommended that Design Standards for Sensitive Watershed Sedimentation Control Guidelines be implemented in addition to the standard Best Management Practices.

In addition to best usage classification, the DWQ has initiated a basinwide approach to water-quality management for the state's 17 river basins (NCDENR-DWQ 2001). The basinwide approach allows for more intensive sampling of biological, chemical and physical data that can be used in basinwide assessment and planning. Likewise, benthic macroinvertebrates are intensively sampled for specific river basins. Biodiversity information was collected and is available for five of the water bodies that may be affected by the proposed project. All of these streams received a biological classification of Good-Fair (Support Threatened) (Table 2). Non-point-source pollution was recognized as the one of the primary sources of degradation. Field assessment of most of the creeks in the project study area revealed moderate signs of sedimentation, but no major degradation was otherwise apparent.

Table 2. Water Resources Classification and Macroinvertebrate Sampling Stations (Bioclassification) on Project Study Area Streams.

Stream Crossing	*DWQ index*	*DWQ Date*	*DWQ class*	*Bioclassification Date*	*Bioclassification Rating*
Swift Creek (Streams AA1b, AA3 - AA5, AA9-AA11, AA14-AA15, AA17-AA18, AB9, AB11, B1-B2, B4	27-43-8	05/01/88	C NSW	1995-2000 1995-2000	Good-Fair Good
White Oak Creek (Streams AB1-AB2, AB4 – AB6, AB 8)	27-43-11	05/01/88	C NSW	N/A	N/A
Little Creek (Streams B5-B9, B11-B12- B14, B16, C1, C4, C5)	27-43-12	05/01/88	C NSW	1995-2000	Fair
Cooper Branch (Stream C6)	27-43-13	05/01/88	C NSW	N/A	N/A
Reedy Branch (Streams C10, C12, C14)	27-43-14	05/01/88	C NSW	N/A	N/A

2.2.3. Point-Source Discharges

Point source discharge is defined as discharges that enter surface waters through a pipe, ditch, or other well-defined point of discharge. These include municipal (city and county) and industrial wastewater treatment facilities, small domestic discharging treatment systems (schools, commercial offices, subdivisions and individual residents), and stormwater systems from large urban areas, and industrial sites. The primary substances and compounds associated with point source discharge include, nutrients, oxygen demanding wastes and toxic substances such as chlorine, ammonia and metals.

Under Section 301 of the Clean Water Act of 1977 (CWA) discharge of pollutants into surface waters is prohibited without a permit by the Environmental Protection Agency (EPA). Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permitting program, which delegates permitting authority to qualifying states. In North Carolina, the DWQ of the DEHNR is responsible for permitting and enforcement of the NPDES program. A total of seven facilities have been issued discharge permits for the Swift Creek watershed (Table 3).

Table 3. NPDES Permits: Swift Creek Watershed

Facility	**Discharge Type**	**Wasteflow (mgd)**
Mill Run	Domestic-Mobile Home Park	0.026
Mount Auburn Training Center	Domestic-Mobile Home Park	0.0024
Pope Industrial Park	Domestic	0.008
Indian Creek Overlook	Domestic-Subdivision	0.112
Heater Utilities-Nottingham WTP	Domestic-Subdivision	Not limited
White Oak Plantation	Municipal	0.5
Clayton Town WTP	Municipal	2.5

2.2.4. Non-point Source Discharges

Non-point source discharge refers to runoff that enters surface waters through stormwater or snowmelt. Many types of land use activities are non-point sources of pollution, including land development, construction activity, animal waste disposal, mining, agriculture and forestry operations, as well as impervious surfaces such as roadways and parking lots.

Land use control (low-density development) and technology-based BMP's are the two most widely used tools for controlling non-point source pollution and protecting the designated best usage of waterbodies. Various non-point source management programs have been developed by a number of agencies to control specific types of non-point source pollution (e.g. forestry, pesticide, urban and construction-related pollution, etc.). Each agency develops BMP's to control a specific type of non-point source pollution.

The Sedimentation and Erosion Control Program (SECP) applies to construction activities, such as roadway construction, and is established and authorized by the Sedimentation Pollution Control Act of 1973. This act delegates administration and enforcement to the Division of Land Resources (DLR) (Land Quality Section) of NCDENR. The SECP requires submission and approval of erosion control plans prior to construction for all projects disturbing one acre or more. DLR conducts on-site inspections to determine compliance with the plan and to evaluate the effectiveness of the BMP's being used. The NCDOT, in cooperation with the DWQ, has developed a sedimentation control program for highway projects that adopts formal BMP's for protection of surface waters. Additional erosion control measures as outlined in Design Standards in Sensitive Watersheds (NCAC T15A: 04B .0024) are implemented by NCDOT for projects within WS-I, or WS-II water supply watersheds, Critical Areas, waters designated for shellfishing, or any waters designated by DWQ as High Quality Waters (HQW's). When crossing an aquatic resource containing a federally listed species, NCDOT has committed to implement erosion control guidelines that go beyond both the standard BMP's, as well as the Design Standards in Sensitive Watersheds, regardless of the DWQ classification. These areas are designated as "Environmentally Sensitive Areas" on the erosion control plans.

2.2.5. Ecological Significance

Swift Creek is known to support several rare freshwater mussel species, including the federally protected dwarf wedgemussel (Table 4), and is considered one of the few streams remaining in the lower Neuse Basin that supports viable populations of many of these species. Conservation of this resource is believed to be critical for future restoration efforts of the lower Neuse River basin. The Carolina madtom (*Notorus furiosus*) and Neuse River waterdog (*Necturus lewisi*) have also been recorded from Swift creek: both species are of Special Concern (SC) in North Carolina (Legrand and Hall 1995).

Table 4. Rare Aquatic Species in Swift Creek

Scientific Name	Common Name	NC Status	Federal Status
Alasmidonta heterodon	Dwarf wedgemussel	E	E
Alasmidonta undulata	Triangle floater	T	~
Elliptio lanceolata	Yellow lance	E	FSC
Elliptio roanokensis	Roanoke slabshell	T	~
Fusconaia masoni	Atlantic pigtoe	E	FSC
Lasmigona subviridus	Green floater	E	FSC
Strophitus undulatus	Creeper	T	~

E, T and FSC denote Endangered, Threatened and Federal Species of Concern, respectively.

The North Carolina Wildlife Resources Commission (NCWRC) has identified Swift Creek and its tributaries from its confluence with Middle Creek in Johnston County to the lake Benson Dam in Wake County, as one of 25 areas in North Carolina that have been formally proposed as aquatic Critical Habitats (PCH). These habitats are considered essential for the continued survival of endangered or threatened aquatic wildlife species. Certain conservation procedures, such as high quality waters designation and protection, are then established by the state agencies (Alderman et al. 1993). Presently the NCWRC is not allowed to designate areas as Critical Habitat: however NCDOT uses the PCH'S for guidance in determine if a project will impact a federally listed aquatic species.

The North Carolina Natural Heritage Program (NCNHP) maintains a database of rare plant and animal species, as well as significant natural areas, for the state of North Carolina. The NHP compiles the DENR priority list of "Natural Heritage Areas" as required by the Nature Preservation Act (NCGS 113A-164 of Article 9). Natural areas (sites) are inventoried and evaluated on the basis of rare plant and animal species, rare or high quality natural communities, and geologic features occurring in the particular site. These sites are rated with regard to national, state and regional significance. That list contains those areas, which should be given priority for protection: however, it does not imply that all of the areas currently receive protection (NCDEHNR 1995). Swift Creek is considered to be of " National Significance".

2.3 Plant Communities

There are 7 distinct biotic communities within the project study area. However, there is often some degree of overlap, or gradation, in which characteristics of two community types are present. Community composition reflects the physiography, topography, moisture regime and current and prior land uses of the area. Many of the forested areas have had limited recent human disturbance and provide diverse habitats for a variety of wildlife species. The habitat complexity (stratification) and the abundance of mast-producing plants provide numerous foraging and shelter opportunities, which results in a rich and diverse faunal community. The biotic communities also provide travel corridors to access adjacent habitats.

There is a mixture of disturbed and natural plant communities within the project study area. These communities include Bottomland Hardwood, Pine Forest, Mixed Hardwood Forest, Oak-Hickory Forests (Dry and Dry-Mesic), Early Successional, Agricultural Fields, Urban/Disturbed Areas

and Maintained Communities, as described in the FEIS. The majority of the project study area consists of the maintained communities and Mixed Hardwood Forest (NCDOT 1998).

3.0 RARE AND PROTECTED SPECIES

Some populations of fauna and flora have declined or are in decline due to natural forces or their inability to coexist with humans. Section 7 of the Endangered Species Act requires the United States Fish and Wildlife Service (USFWS) review of any federal action likely to adversely affect a species classified as federally protected. Other species may receive additional protection under the State Endangered Species Act (1987) and the North Carolina Plant Protection and Conservation Act (1979).

3.1 Federally Protected Species

Plants and animals with federal classifications of Endangered (E), Threatened (T), Proposed Endangered (PE), or Proposed Threatened (PT) are protected under the provisions of Sections 7 and 9 of the ESA. As of February 25, 2003, the USFWS had listed four federally protected species for Wake County and four of those for Johnston County (Table 5). Descriptions of characteristics and habitat requirements for each of the listed species are provided below, along with a biological conclusion concerning potential effects to each species by the proposed project.

Table 5. Federally Protected Species for Wake and Johnston Counties

Common Name	Scientific Name	Status	County
Dwarf wedgemussel	*Alasmidonta heterodon*	Endangered	Wake and Johnston
Tar River spinymussel	*Elliptio steinstansana*	Endangered	Johnston
Michaux's sumac	*Rhus michauxii*	Endangered	Wake and Johnston
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Wake and Johnston
Bald eagle	*Haliaeetus leucocephalus*	Threatened (proposed for delisting)	Wake

3.2 Terrestrial Species

3.2.1 Michaux's Sumac

***Rhus michauxii* (Michaux's sumac)**
Status: Endangered
Family: Anacardiaceae
Listed: September 28, 1989

Characteristics

Michaux's sumac is a rhizomatous, densely hairy shrub, with erect stems from 1 to 3 feet (0.3 to 1.0 m) in height. The leaves are divided into 7 to 13 oblong to oblong-lanceolate leaflets on a narrowly winged or wingless rachis. 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.

Distribution and Habitat Requirements

Michaux's sumac is endemic to the inner coastal plain and lower piedmont of Virginia, North Carolina, South Carolina, Georgia and Florida. Only 36 extant populations are known, with 31 in North Carolina, three in Virginia, and two populations in Georgia. Currently, the plant is documented in the following North Carolina counties: Richmond, Hoke, Moore, Scotland, Franklin, Davie, Robeson, and Wake (USFWS 2003).

Michaux's sumac grows in sandy or rocky open woods in association with basic soils. Apparently, this plant survives best in areas where some form of disturbance has provided an open area. At least twelve of the plant's known populations in North Carolina are on highway right-of-way, roadsides, or on the edges of artificially maintained clearings. Two other populations are in areas with periodic fires, and two populations exist on sites undergoing natural succession. One population is situated in a natural opening on the rim of a Carolina bay (USFWS 2003.)

Threats to this Species

The most crucial factor endangering this species is its low reproductive capacity. A low percentage of the plant's remaining populations have both male and female plants. The plant is also threatened by fire suppression and habitat destruction due to residential and industrial development. Because of the proximity of many of the remaining populations to highway, utility, and railroad right-of-ways, the threat of damage from herbicide application exists. These populations may also be at risk from right-of-way maintenance, improvements, or future expansion (USFWS 2003).

Biological Conclusion **No Effect**

Much of the roadside shoulders, successional communities and the Dry-Oak-Hickory Forest communities in the project study area provide potentially suitable habitat for this species. Plant-by-plant surveys were conducted by an Arcadis biologist for NCDOT, within the roadside habitats, successional areas, Disturbed Lands, Dry- Oak-Hickory Forest, at the edge of agriculture fields and pasture along the corridor for the proposed Clayton Bypass in July 2002. No individual population was identified during these surveys. A review of the North Carolina Heritage Program (NCNHP) database indicate no known populations of this species within one mile of the project area. It should be noted that there is only a historic record of plant occurring in Johnston County, where the majority of the project area is located. Based on those surveys and the review of the NCNHP database the proposed Clayton Bypass will have "No Effect" on Michaux's sumac (NCDOT 2003).

3.2.2 Red-cockaded woodpecker

***Picoides borealis* (red-cockaded woodpecker)**
Status: Endangered
Family: Picidae
Listed: October 13, 1970

Characteristics

The red-cockaded woodpecker (RCW) is 7 to 8 inches (18 to 20 cm) long with a wingspan of 14 to 15 inches (35 to 38 cm). There are black and white horizontal stripes on its back, and its cheeks and underparts are white. Its flanks are black streaked. The cap and stripe on the side of the male has a small red spot on each side of the black cap. After the first post- fledgling molt, fledgling males have a red crown patch. This woodpecker's diet is composed mainly of insects, which include ants, beetles, wood-boring insects and caterpillars. About 16 to 18 percent of the diet are seasonal wild fruit (USFWS 2003).

The eggs are laid during April, May, and June with the female utilizing her mate's roosting cavity for a nest. Maximum clutch size is seven eggs with the average being three to five eggs. From egg laying to fledgling requires about 38 days, and then another several weeks are needed before the young become completely independent. Most often, the parent birds and some of their male offspring from previous years form a family unit called a group. A group may include one breeding pair and as many as seven other birds. 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 (USFWS 2003).

Distribution and Habitat Requirements

This bird's range is closely tied to the distribution of southern pines. Historically, the RCW occurred from East Texas and Oklahoma, to Florida, and North to New Jersey. The present distribution is similar, except the species has been extirpated from Missouri, Maryland and New Jersey (USFWS 2003).

The nesting and roosting habitat for RCW is open stands of pine containing trees 60 years old and older. RCW need live, large older pines in which to excavate their cavities. Longleaf pines are

most commonly used, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 30 years old and older with foraging preference for pine trees 10 inches (25 cm) or larger in diameter. In good, moderately stocked, pine habitats, sufficient foraging substrate can be provided on 80 to 125 acres (32 to 51 hectares).

Roosting cavities are excavated in living pines, and usually in those which are infected with a fungus producing what is known as red-heart disease. Ages of cavity trees range from 63 to 300 plus years for longleaf and 62 to 200 plus years for loblolly and other pines. The aggregate of cavity trees is called a cluster and may include 1 to 20 or more cavity trees on 3 to 60 acres (1 to 24 hectares). The average cluster is about 10 acres (4 hectares). Completed cavities in active use have numerous, small resin wells which exude sap. The birds keep the sap flowing apparently as a cavity defense mechanism against snakes and possibly other predators. The territory for a group averages about 200 acres (81 hectares), but observers have reported territories running from a low of around 60 acres (24 hectares), to an upper extreme of more than 600 acres (243 hectares). The expanse of territories is related to both habitat quality and population density (USFWS 2003).

Threats to Species

Clearing of mature pine forests for forestry, agriculture and development, coupled with fire suppression, has contributed to the decline and population fragmentation of this species throughout its range. The rarity of the RCW, along with documented declines in local populations and diminished availability of nesting habitats, lead to the species being listed as Endangered in 1970.

Biological Conclusion: **No Effect**

Typical habitat for the RCW in the form of old-growth pine forests with an open understory is not present in the project study area. There are, however, numerous forested stands that contain pines of sufficient age. Surveys for cavity trees were conducted at various times during the field investigations. This included areas outside (up to one half-mile) of the proposed alternates. No evidence of this species was recorded during these surveys. A review of the NCNHP database indicates no known populations of this species within one mile of the project area. It can be concluded that project construction will have "No Effect" on the red-cockaded woodpecker (NCDOT 2003).

3.2.3 Bald Eagle

***Haliaeetus leucocephalus* (bald eagle)**
Status Threatened (Proposed for delisting)
Family Acciptridae
Listed March 11, 1967

Characteristics

The bald eagle is a large from 27 to 37 inches (69 to 94 cm) in length predatory raptor identified by the large white head in adults and short white tail. The body plumage is dark brown to

chocolate brown in color. Immature birds are brown and irregularly marked with white until their fourth year. In flight, bald eagles can be identified by their flat wing soar. The wingspan of adult eagles ranges from 70 to 90 inches (178 to 229 cm) in width.

Eagles nest close (within 1 mile [1.6 km) to large expanses of water usually in the largest dominant tree of an old-growth stand. Nests constructed in marine environments have been shown to be more successful than nests on lakes and reservoirs (Stocek and Pearce 1981). The nests may measure 6 feet (2 m) across and often as deep. Nests are often used for many years and may increase in size as the birds continue to add to it.

In the southeast United States, nesting activity usually begins in early September, with breeding taking place in December or January. Usually two eggs are laid, which are incubated for 35 days. The young remain in the nest at least 10 weeks, although parental care may extend 4 to 6 weeks after fledging. Studies of post-fledging movements in the southeastern nesting eagles demonstrate extensive northward migration.

Distribution and Habitat Requirements

These large, predatory birds are found in North America from Florida to Alaska. It is a common breeder in southeastern coastal Alaska (Robards and Hodges 1977) and is found in lesser numbers throughout Canada and the United States (DeGraaf et al. 1980). Historically, the bald eagle was a common nesting species throughout the coastal plain of the Southeast, as well as along major lakes and rivers (USFWS 1989).

Bald eagles consume a wide range of food items, as prey, or carrion. Fish is considered to be the major staple of bald eagles (DeGraaf et al. 1980). However, prey selection is determined largely by availability (Peterson 1986). Cline and Clarke (1981) found bald eagles in the Chesapeake to feed on 45 species of birds, 12 species of fish, 11 species of mammals and five species of turtles. Bald eagle nesting density is dependent of prey availability, which is a function of habitat size. Birds nesting on smaller water bodies may require other nearby lakes for additional foraging areas (Peterson 1986).

Threats to Species

Habitat alterations and hunting related to human encroachment from the time of European settlement of North America resulted in a slow eagle population decline (Peterson 1986, Tucker 1994). The most dramatic declines in eagle populations are attributed to environmental contaminants. Organo-chlorine compounds (DDT and its metabolites) inhibited calcium deposition, which resulted in eggshell thinning and ultimately, reduced reproductive success (Hickey and Anderson 1968, Tucker 1994).

As a result of various conservation measures and increased public concern, mortality of eagles from shooting has steadily declined since the 1960s, and the use of DDT in the US was banned in 1972 (USFWS 1989, Tucker 1994), a slow recovery of eagle productivity has occurred. The increase in human population in coastal areas, and the associated habitat alterations, as well as disturbance is currently the major threat to the recovery of the bald eagle.

Biological Conclusion: **No Effect**

No water bodies large enough to support this species occur within 0.5 mile (0.8 km) of the project study area. A review of the NCNHP database indicates no known populations of this species within one mile of the project area. It can be concluded that construction of this project will not impact the bald eagle (NCDOT 2003).

3.3 Aquatic Species

3.3.1 Tar River spinymussel

Elliptio steinstansana **(Tar River spinymussel)**
Status: Endangered
Listed: July 29, 1985

Characteristics

The Tar River spinymussel (TSM) grows to a maximum length of 2.4 inches (60 mm). Short spines are arranged in a radial row anterior to the posterior ridge on one valve and symmetrical to the other valve. The shell is generally smooth in texture, with as many as 12 spines that project perpendicularly from the surface and curve slightly ventrally. However, adult specimens tend to lose their spines as they mature (USFWS 1992c). Its shiny periostricum, parallel pseudocardinal teeth, and the linear ridges on the inside surface of the shell distinguish the TSM.

Little is known about the reproductive biology of the TSM (USFWS 1992a). Nearly all-freshwater mussel species have similar reproductive strategies, which involves a larval stage (glochidium) that becomes a temporary obligatory parasite on a fish. Many mussel species have specific fish hosts that must be present to complete their life cycle.

Distribution and Habitat Requirements

Previously, this mussel was believed to be endemic to the Tar River system, currently occurring in relatively short stretches of the Tar River and three creeks (Shocco, Sandy/Swift and Little Fishing) in the Tar drainage. Historically the TSM was collected in the Tar River from near Louisburg in Franklin County to Falkland in Pitt County (approximately 78 river miles). Clarke (1983) located TSM only in a 12-mile (19.3-km) stretch of the Tar River in Edgecombe County. In 1998, the TSM was found in the Little River of the Neuse River Basin. The preferred habitat of the TSM in Swift Creek was described as relatively fast-flowing, well-oxygenated, circumneutral pH water in sites prone to significant swings in water velocity, with a substrate of relatively silt-free loose gravel and/or coarse sand (USFWS 2003).

Range-wide Threats to Mussel Species

The cumulative effects of several factors, including sedimentation, point and non-point discharges and stream modifications (impoundments, channelization etc.) have contributed to the decline of these species throughout their respective ranges. Siltation resulting from improper erosion control of various land uses, including agriculture, forestry, and development activities

has been recognized as a major contributing factor to degradation of mussel populations (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and directly smothering mussels (Ellis 1936; Marking and Bills 1979). Sediment accumulations of less than 1 inch have been shown to cause high mortality in most mussel species (Ellis 1936).

Biological Conclusion: **May Affect, Not Likely to Adversely Affect**

Swift Creek does provide habitat for the TSM and its associate species. John Alderman, NCWRC, The Catena Group (Environmental Consultant) and NCDOT have conducted surveys several times over the years but the TSM has never been found. The associate species, the yellow lance (*Elliptio lanceolata*), was once one of the more common mussels in Swift Creek. (pers. comm. Tim Savidge). NCDOT and the Catena Group did a comprehensive survey for TSM as well as dwarf wedgemussel in 2002 and 2003. No individual population was identified during these surveys. A review of the NCNHP database indicates no known populations of this species within one mile of the project area. It should be noted that the only record of TSM occurring in Johnston County was from the Little River, which is not affected by this project. Habitat does exist and associate species due occur in Swift Creek, but based numerous surveys and the review of the NCNHP database the proposed Clayton By-Pass "May Affect, Not Likely to Adversely Affect" the Tar River spinymussel.

3.3.1 Dwarf wedgemussel

Alasmidonta heterodon **(dwarf wedgemussel)**
Status: Endangered
Family: Unionidae
Listed: March 14, 1990

Characteristics

The specific epithet, "heterodon", refers to the chief distinguishing characteristic of the dwarf wedgemussel (DWM) (*Alasmidonta heterodon*), which is the only North American freshwater mussel that consistently has two lateral teeth on the right valve and only one on the left (Fuller 1977). All other laterally dentate freshwater mussels in North America normally have two lateral teeth on the left valve and one on the right. The DWM is generally small, with a shell length ranging between 1.0 inch to 1.5 inches (25 mm to 38 mm). The largest specimen ever recorded was 2.2 inches (56.5 mm) long, taken from the Ashuelot River in New Hampshire (Clarke 1981). The periostricum is generally olive green to dark brown and the nacre bluish to silvery white, turning to cream or salmon colored toward the umbonal cavities. Sexual dimorphisim occurs in DWM, with the females having a swollen region on the posterior slope, while the males are generally flattened.

This species is considered to be a long-term brooder, with gravid females reportedly observed in the fall months. Like other freshwater mussels, this species' eggs are fertilized in the female as sperm and are taken in through their siphons as they respire. The eggs develop with the female's gills into larvae (glochidia). The females later release the glochidia, which then attaches to the gills or fins of a specific host fish species. Based on anecdotal evidence, such as dates when

gravid females are present or absent, it appears that release of glochidia occurs primarily in April in North Carolina (Michaelson and Neves 1993). Recent research has confirmed at least three potential fish host species for the dwarf wedgemussel to be the tessellated *darter (Etheostoma olmstedi*), Johnny darter (*E. nigrum*), and mottled sculpin (*Cottus bairdii*) (Michaelson 1993).

Distribution and Habitat Requirements

The historic range of the DWM was confined to Atlantic slope drainages from the Peticodiac River in New Brunswick, Canada, south to the Neuse River, North Carolina. Occurrence records from at least 70 locations, encompassing 15 major drainages, in 11 states and 1 Canadian Province existed (USFWS 1993b). It is currently believed to have been extirpated from all but 36 localities, 14 of them in North Carolina (USFWS 1997). Strayer et al. (1996) conducted range-wide assessments of remaining DWM populations, and assigned a population status, to each of the populations. The status rating is based on range size, number of individuals and evidence of reproduction, seven of the 20 populations assessed are considered "poor", and two others are considered "poor to fair" and "fair to poor" respectively. Swift Creek received a "good" status rating. The USFWS also considered Swift Creek to contain a "good" population of DWM (USFWS 1993). The USFWS has come out with new range wide data for DWM in 2002. They have records from 10 states and 54 localities where DWM occur. Out of those 54 sites there are 9 possibilities of extirpation, of which, 7 are located in North Carolina. Swift Creek was extensively surveyed in 2002 and 2003 by NCDOT and one old individual in the stream was found. While conducting surveys for the proposed project NCDOT biologist discovered a new population in Little Creek where 2 live individuals were observed.

The DWM inhabits creeks and rivers of varying sizes (down to approximately 6 feet [2 m] wide), with slow to moderate flow. A variety of preferred substrates have been described, from coarse sand to firm, muddy sand to gravel (USFWS 1993b). In North Carolina the DWM often occurs within submerged root mats along stable streambanks (John Alderman, pers. comm.). The wide range of substrate types used by this species suggests that the stability of the substrate is likely as the composition.

Range-wide Threats to Mussel Species

The cumulative effects of several factors, including sedimentation, point and non-point discharges and stream modifications (impoundments, channelization etc.) have contributed to the decline of these species throughout their respective ranges. Siltation resulting from improper erosion control of various land uses, including agriculture, forestry, and development activities has been recognized as a major contributing factor to degradation of mussel populations (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and directly smothering mussels (Ellis 1936; Marking and Bills 1979). Sediment accumulations of less than 1 inch (2.5 cm) have been shown to cause high mortality in most mussel species (Ellis 1936).

3.3.2.1 Effects to the Recovery Plan

The 1993-recovery plan for DWM has two main objectives:

Objective 1, Criterion A stated: "Populations of *A. heterodon* in the mainstem Connecticut River, Ashuelot River, Neversink River, upper Tar River, Little River, Swift Creek (Neuse system), and Turkey Creek, as well as populations in at least six other rivers (or creeks) representative of the species' range, must be shown to be viable."

Objective 2 contains two criteria for removing DWM from the Federal list of endangered species:

B. "At least ten of the rivers or creeks referred to in criterion A must support a viable population widely enough dispersed within its habitat such that a single adverse event in a given river would be unlikely to result in the total loss of that river's population." Four of these populations were to be south of Pennsylvania.

C. "All populations referred to in criteria A and B must be protected from present and foreseeable anthropogenic and natural threats that could interfere with their survival."

Of the seven waterways specifically targeted in the recovery plan for long-term viability, four are in North Carolina: the upper Tar River, the Little River, Swift Creek and Turkey Creek. The recovery plan requires that populations representative of the DWM's range must be shown to be viable. Since North Carolina contains the southernmost occurrences of DWM, viable populations in NC will be an important part of the species' recovery.

However, with the exception of streams in the upper Tar River system, most populations of DWM in North Carolina are currently very precarious; only a handful of mussels are found during surveys. This means from the 25 streams containing DWM that only eight had five or more found during the surveys. In addition, many of the populations are very fragmented, separated by uninhabitable areas or dams, which block genetic flow. Seven North Carolina sites where DWM were known to occur may have been extirpated since the 1990's. The remaining North Carolina sites, including Swift Creek, the Little River and Turkey Creek, which were specifically targeted in the recovery plan, have populations described as "small" (USFWS table, 2002).

- Only two live DWM were found in a 5-mile stretch of Swift Creek in 1998. Other information pertaining to viability of this population can be found in the "Threats to Species" section of this BA (USFWS table, 2002).

- In the newly discovered population in Little Creek, only two DWM were found when the system was surveyed in the summer 2003.

- In Turkey Creek, 18 DWM were found in 1997. Turkey Creek is dammed at Buckhorn Reservoir, which effectively isolates this population from any others.

- More mussels are consistently found in the Upper Tar River. However, the Tar River is dammed south of Rocky Mount at the Tar River Reservoir. This effectively separates upper Tar populations from those in Shocco and Fishing Creek.

It may not be possible to achieve a viable population in Swift Creek, given the low numbers of DWM found there, whether the Clayton Bypass is built or not. The proposed bypass will make recovery of the species more difficult, due to possible direct and indirect impacts to the Swift Creek sub-basin. However, implementation of the conservation measures proposed for the Clayton Bypass, such as the protection of riparian buffers, will protect and possibly help to recover the DWM population in Swift Creek.

3.3.2.2 Threats to Species (Particularly the Swift Creek Population)

The cumulative effects of several factors, including sedimentation, point and non-point discharge, stream modification (impoundments, channelization etc.) have contributed to the decline of this species throughout its range, as well as within Swift Creek. The expected extent of DWM habitat in Swift Creek has declined from 21 miles (33 km.) in 1991 to 9 miles (15 km.) in 1996 (John Alderman, pers. comm.). The USFWS (1993b) recognized eleven major threats to the DWM population in Swift Creek (Table 6). These threats are not ranked in any order with regard to potential or severity.

Table 6. Major Threats to Dwarf Wedgemussel Populations in Swift Creek

Threat	Source
1	Point-source pollution
2	Non-point source chemical pollution
3	Sedimentation from forestry operations
4	Sedimentation from agriculture
5	Competition from exotic species
6	Food resource modification via forest overstory removal
7	Discharge rate modifications
8	Population density too low to allow successful reproduction
9	Population fragmentation
10	Residential, highway, or industrial development
11	Toxic spill associated with highway runoff

With the exception of the Neversink River population in New York, which has an estimated population of over 80,000 mussels, all of the other populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable to extirpation from a single catastrophic event or activity (Strayer et al. 1996). Catastrophic events may consist of natural events such as flooding, or drought as well as human influenced events such as toxic spills associated with highways or railroads (NCDOT 1998).

Siltation resulting from improper erosion control of various land usage, including agricultural, forestry and development activities has been recognized as a major contributing factor to degradation of mussel populations (USFWS 1996). Siltation has been documented to be

extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants and by direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than 1 inch have been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of DWM, because of accelerated sedimentation and erosion (Smith 1981). Agriculture and continuing development in the watershed has led to significant sedimentation problems within Swift Creek (NCDOT 1998).

Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Small subdivision treatment plants are located in the Swift Creek watershed and a large (8.0 MGD) package plant for the city of Garner is proposed on Swift Creek (NPDES 1995, NCDEM 1992). Goudreau et al. (1988) found that recovery of mussel populations might not occur for up to two miles below points of chlorinated sewage effluent. In early August of 1997 approximately 552,000 gallons of untreated sewage spilled into the Swift Creek subbasin. Impacts to the DWM from this incident have not been determined at this time (NCDOT 1998).

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992 a, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes with aquatic community composition. These changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for glochidia (Fuller 1974). Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for naiads (mussels) in the world, is now at the bottom of Wilson Reservoir and covered with 19 feet of muck (USFWS 1992). Large portions of all of the river basins within the DWM's range have been impounded and this is believed to be a major factor contributing to the species decline (Master 1986, USFWS 1993). The DWM has not been found in Swift Creek upstream of Lakes Benson and Wheeler. The flow rate in the portion of Swift Creek that contains the DWM population is controlled by these lakes, and is often extremely low.

The introduction of exotic species such as the Asiatic clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The Asiatic clam is now established in most of the major river systems in the United States (Fuller and Powell 1973), including those streams still supporting surviving populations of the DWM. Concern has been raised over competitive interactions for space, food and oxygen with this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987, Alderman 1995).

3.3.2.3 Project Impacts on Mussel Species

Project-related threats to the DWM can be separated into direct, secondary and cumulative impacts. Direct impacts refer to consequences that are directly attributed to the construction of the project, such as land clearing, stream rechannelization and erosion. Secondary impacts are not direct consequences of the road construction, but result from modifications in access to parcels of land and from modifications in travel time between various areas (Mulligan and Horowitz 1986). They are defined as those impacts that are "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable" (40CFR 1508.8). Secondary land use

impacts have included residential, commercial and industrial developments, or urban sprawl. Cumulative impacts are those that result from "the incremental impacts of an action when added to other past and reasonable foreseeable future actions" (40CFR 1058.7). Potential direct, secondary and cumulative impacts to the DWM population in Swift Creek, which may result from project construction, are discussed here.

3.3.2.4 Direct Impacts

Swift Creek will not be directly crossed with current project design of the Clayton Bypass, however there is potential for project related sedimentation into Swift Creek, particularly in the area of the interchange with I-40 and the Clayton Bypass. Sedimentation is the most serious direct project-related threat to the Swift Creek watershed, and results when areas are exposed from construction and agricultural activities. Studies have shown that during construction activity, there is a direct correlation between the amount of suspended particles in the stream channel with the amount of clearing and grubbing activity, embankment modification, project duration and rainfall (Vanoni 1975, Shirley 1976, Embler and Fletcher 1981). Although sedimentation may be a temporary process during the construction phase of this project, environmental impacts from this process may be long-lived or irreversible. Suspended solids, sedimentation and turbidity result in reduced biodiversity as well as a decline in productivity at all trophic levels (Gilbert 1989).

Land clearing and grubbing activities during project construction may directly result in soil erosion, leading to increased sedimentation and turbidity in nearby streams. These effects may extend downstream for considerable distance, though with decreasing intensity. Not only is sedimentation detrimental to the aquatic ecosystem, but changes in physical characteristics of the stream can also result. Decreased channel conveyance capacity during peak flows result from continued sedimentation, increasing flooding potential and causing streambank scour and erosion. Sedimentation also leads to increased turbidity of the water column, which reduces the aesthetic value of the water resources, as well as causing biological degradation.

Forested tracts of land border the majority of the streams in or adjacent to the project study area. Removal of streamside vegetation will have a negative effect on water quality, which will potentially impact mussel populations. Streamside vegetation is crucial for maintaining streambank stability and controlling erosion, as well as contributing a significant food source to the stream ecosystem. Loss of riparian vegetation can also lead to lower levels of dissolved oxygen in the water because the increase of light incidence to the stream raises water temperatures and promotes algae growth.

Clearing of riparian areas should be minimized to the fullest extent practical to further reduce direct impacts to the species. Additionally NCDOT must implement High Quality Water (HQW) erosion control standards during clearing and grubbing activities as well as during construction, in all areas that drain to Swift Creek, or impact tributaries to Swift Creek.

Strict adherence to HQW standards and the minimization of clearing/grubbing in the Swift Creek watershed will reduce the potential for direct impacts to the DWM population in Swift Creek. The future interchange associated with the Clayton Bypass and the future Southern Wake Expressway has the potential to result in direct impacts to the DWM.

3.3.2.5 Indirect and Cumulative Effects Assessment Summary

This assessment provides an estimate of the indirect effects of the project and the combined or cumulative effects of the project and other past, present, or reasonably foreseeable future development activities. The focus of the assessment is on the project's potential to induce growth and change land use, which could in turn affect natural resources of the study area. Land use changes were predicted for both without the bypass (Scenario 1) and with the bypass (Scenario 2) for the Year 2025. Land uses within the study area were sorted into twelve categories defined by the amount of impervious area and vegetation cover within a tax parcel unit (Appendices, Table 1).

The project area community supports regional employment centers of Raleigh, Durham and RTP (Research Triangle Park). Identifying regional commuting patterns helps to establish where future development is likely to occur. Recent history has shown that increased highway access between Johnston County and the regional employment centers has stimulated growth in Johnston County. To better understand the likely magnitude and probability of project-induced development, a commute study was conducted between the study area and the regional employment center of RTP. Results of the commute study demonstrate the increased access and substantial timesavings the project will provide study area commuters. This improvement to the existing roadway network will also induce development beyond the current commuteshed (NCDOT 2004b).

Due to past development trends and favorable growth potential for the region, the study area would likely experience considerable development regardless of whether or not the project is built. The potential for substantial growth generated by the project would mainly be limited to new interchange catchment areas within the study area. However, locations to the south and east of the study area may also experience development pressure due to increased accessibility to regional employment centers. Project-induced growth is likely to occur in the form of highway-oriented retail and residential development, replacing agricultural and forested/green space areas (NCDOT 2004b).

In summary, by the Year 2025 and without the project (Scenario 1), the Study Area is anticipated to be subjected to an increase of 13.5 square miles (35 square kilometers) 14.6 percent of development relative to the baseline. By the Year 2025 and with the project (Scenario 2), the Study Area is anticipated to be subjected to an increase of 18.2 square miles (47.1 square kilometers) 19.7 percent of development relative to the baseline (current) condition. As predicted by the Delphi study, only 5.1 percent additional development was attributable to the Clayton Bypass and induced Bypass-related growth (NCDOT 2004b).

3.3.2.6 Indirect and Cumulative Impact Analysis Summary

Nutrient and sediment analyses were performed for the 59,212-acre (92.5-square mile) Study Area inclusive of watershed boundaries that drain to Swift Creek that are likely to be impacted by Clayton Bypass (R-2552) and Bypass-related development in Wake and Johnston Counties, North Carolina. The analysis relied on future land use predictions both without the bypass (Scenario 1) and with the bypass (Scenario 2) for the Year 2025 provided in the Indirect and Cumulative Effects Assessment document prepared by URS Corporation September 2004. The Annualized Agricultural Non-Point Source (AnnAGNPS) pollutant model was used to predict annual

pollutant yields exported from the Study Area for each future scenario. Correction factors for AnnAGNPS output were generated for BMP's and stream generated sediment using Soil and Water Assessment Tool (SWAT) and the Center for Computational Hydroscience and Engineering 1-Dimensional (CCHE1D) models (NCDOT 2004c).

Modeling for Scenario 1 predicted increases over Current Condition of 30.86-percent exported TN, 4.97-percent exported TP, and 31.87-percent exported overland sediment.

Modeling for Scenario 2 predicted increases over Current Condition of 37.69 percent exported TN, 5.15-percent exported TP, and 34.50-percent exported overland sediment.

When comparing the scenarios without the bypass and with the bypass there was a difference in pollutant loading. Those differences in yields are a 6.83-percent increase exported Total Nitrogen (TN), 0.18-percent exported increase Total Phosphorus (TP), and 2.63-percent in exported overland sediment. This suggests that a small increase in pollutant loading is attributable to the Bypass and induced Bypass-related development (Appendices, Table 2).

3.3.2.7 Benefit of Expanded Environmental Sensitive Areas (ESA's)

Supplemental nutrient and sediment analyses were performed for two sub-watersheds, upper Swift Creek and lower Little Creek, proposed to be impacted by the Clayton Bypass (R-2552) in Wake and Johnston Counties. The upper Swift Creek sub-watershed consists of a 24.6 square mile (63.7 square kilometers) area, while the lower Little Creek sub-watershed consists of a 5.2 square mile (13.5 square kilometers) area (NCDOT 2004a).

The analysis relied on future land use predictions both without the bypass (Future No Bypass) and with the bypass (Future Bypass) for the Year 2025 provided in the Indirect and Cumulative Effects Assessment document prepared by URS Corporation September 2004. Two buffer evaluations, Evaluation A and B, were performed with similar land-use change scenarios in order to isolate pollutant-change trends resulting from expanding the existing protected buffer network associated with designated ESA's (Evaluation A) to a more comprehensive preservation network that extends to the nearly the complete limits of both modeled sub-watersheds (Evaluation B). Evaluation A consisted of complete 50-foot buffer coverage (when identified as being extant in Current Condition) along intermittent and perennial streams throughout each modeled sub-watershed, with 100-foot buffers on perennial streams within existing ESA-designated areas. Evaluation B consisted of complete 50-foot buffer coverage (when identified as being extant in Current Condition) along intermittent streams, and 100-foot buffers on perennial streams throughout the area proposed for ESA expansion (NCDOT 2004a).

For the upper Swift Creek sub-watershed, the larger buffers modeled in the Future Bypass Evaluation B are successful at reducing pollutant loading by 15.3 percent for TN, 13.78 percent for TP, and 10.87 percent for overland sediment over the Future Bypass Evaluation A (Appendices, Table 3).

For the lower Little Creek sub-watershed, the larger buffers modeled in Future Bypass Evaluation B are successful at reducing pollutant loading by 9.55 percent for TN, 10.35 percent for TP, and 8.51 percent for overland sediment over the Future Bypass Evaluation A (Appendices, Table 4).

Results indicate that larger buffers provided by the expanded ESA's do have a direct benefit of reducing overland pollutants in both sub-watersheds.

3.3.2.8 Secondary Impacts

Economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990).

Research in North Carolina Piedmont streams has shown that water quality and biota is greatly affected by land use. Streams in urbanized settings have comparatively lower water quality and corresponding lower biotic diversity than streams in forested and agricultural areas (Crawford and Lenat 1989). The Swift Creek watershed is rapidly urbanizing. Wake and Johnston Counties were the two fastest growing counties in North Carolina, between 1990 and 2000, increasing in population by 50.0 and 48.3 percent respectively, compared to the 21.4 percent for the state of North Carolina. By the year 2020, Wake and Johnston Counties are projected to increase in population by 77 and 73 percent respectively, compared to the 36 percent for the state of North Carolina. Two municipalities in the Swift Creek watershed, Clayton and Garner experienced 46.6 percent and 18.6 percent in population increase during this time period (NCDOT 2004b).

The high growth rate exhibited in the project area, particularly in Johnston County, has been attributed to a variety of factors, including employment opportunities in nearby Wake County, affordable housing, private utility companies and public water and sewer (Johnston County Economic Development Administration 1997). As of March 1989, 62% of Johnston County residents worked in Wake County (NCDOT 1996). This is linked to the economies of the Raleigh/Durham metropolitan area, (including Cary and the Research Triangle Park) and the convenient access to these areas via the I-40 and US 70 corridors. A December 09, 1996 statement from the Johnston County Planning Department states that Johnston County is expected to continue growth and this growth will generally occur near the I-40 corridor and along the US 70 corridor.

The proposed Clayton Bypass is part of the transportation system linkage of US-70 to I-40 and the future Raleigh Outer Loop (NCDOT 1996). This transportation system has provided easy access of formerly remote areas within Johnston County, to the Raleigh-Durham metropolitan center. This accessibility to these areas provided by the Transportation system has enhanced the attractiveness of Johnston County to residential development, and accompanying commercial development (restaurants, shopping centers, service stations etc.). The completion of Interstate 40 from the Raleigh Beltline to I-95 (TIP I-10), which involved an interchange at existing NC 42, and NC 210 along with the provision of public water and sewer, has resulted in considerable commercial development adjacent to the interchange. Soon after completion of these interchanges, Johnston County experienced numerous re-zoning requests for uses other than one-acre single family lot development. Based on this experience, the Johnston County Planning Department anticipates changes in land use patterns associated with the Clayton Bypass (Johnston County Planning Department 1997).

Additional development of the Swift Creek watershed can be anticipated, if the proposed Southern Wake Expressway (TIP R-2828) and Eastern Wake Expressway (Tip R-2829) are constructed. Beltway projects around metropolitan areas have been extensively studied with regard to economic impacts. Beltways have contributed to the conversion of undeveloped land to urban usage, by promoting net new growth as well as redistributing growth from already urbanized areas (USDOT and USHUD 1980, Lathrop and Cook 1990, Transportation Research Board 1995). Lathrop and Cook (1990) concluded that beltways "permit and encourage" intensified land usage in the formerly remote areas around beltways, which are attractive to development because of the gained accessibility and lower cost of property. This type of development particularly affects communities near interchanges (Gamble et al. 1966). Beltways have also been shown to foster development in environmentally sensitive areas such as aquifer recharge locations (USDOT and USHUD 1980). The existing beltline facility constructed around the city of Raleigh has been a significant factor in determining the locations of residential, commercial and industrial developments, as well as contributing to increased land values (Khasnabis et al. 1975).

3.3.2.9 Cumulative Impacts

As discussed earlier, Swift Creek has been impacted by a variety of land and water uses. The DWM population in the creek has exhibited recent declines in both numbers and range. Although considered to be a "good" population in 1994 (Strayer 1996), surveys conducted by biologists from the USFWS, NCWRC and NCDOT in May 1996, revealed a reduction in range of the DWM in Swift Creek. The status of this population was conducted in the summer of 2002- fall 2003, in approximately 337 man-hours, one dwarf wedgemussel was found in Swift Creek. A new very small population was found in Little Creek. NCDOT and The Catena Group found two dwarf wedgemussels last summer (2003) in Little Creek.

Johnston County, in 2004, approved the following projects that may effect the Swift Creek and Little Creek Watersheds and also shows the stormwater ordinances are being used by the land dedication and in lieu fee payment (Johnston County Planning and Zoning Department 2004).

Trent Tract

Location Data: Little Creek Church Road (SR 1563) approximately ½ of a mile north of its intersection with Steel Bridge Road (SR1562) in Clayton Township.

Site Data: 40.01 acres, lots 44, (maximum allowed: 60) open space provided: 5.64 acres, open space required 4.0 acres.

Lee Tract

Location Data: Cole Road (SR 1573) just north of its intersection with Rock Pillar Road (SR 1572) in Clayton Township.

Site Data: 53.29 acres, lots 58, (maximum allowed: 80), open space provided 18.87 acres, open space required 5.33 acres.

Heritage Farms I and II

Location Data: Cornwallis Road (SR 1525) approximately ½ of a mile southwest of its intersection with Cleveland Road (SR 1010) in Cleveland Township.

Site Data: 48.64 acres, lots 122 (maximum allowed: N/A), open space provided 8.68 acres, open space required 4.86.

James Lester Peele, Jr.

Location Data: Peele Road (SR 1571) just west of its intersection with Little Creek Church Road (SR 1563) in Clayton Township.

Site Data: 4.78 acres, lots 5 (maximum allowed: 7), open space provided: fee in lieu in the amount of $2,000, open space required: 2.00 acre minimum.

Broadmoor West

Location Data: Cleveland Road (SR 1010) approximately ¼ of a mile northwest of its intersection with Allen Road (SR 1516) in Cleveland Township.

Site Data: 144.85 acres, lots 216, (maximum allowed: 217), open space provided: fee in lieu in the amount of $86,400, open space required: 14.49 acres.

Coventry

Location Data: Slate Top Road (SR 1559) just east of its intersection with Government Road (SR 1556) in the Clayton Township.

Site Data: 23.74 acres, lots 33, (maximum allowed: 35), open space provided: fee in lieu in the amount of $13,200, open space required: 2.37 acres.

Green Court

Location Data: Josephine Road (SR 1526) just east of its intersection with Cornwallis Road (SR 1525) in Cleveland Township.

Site Data: 3.98 acres, lots 5, (maximum allowed: 5), open space provided: fee in lieu in the amount of $2,000, open space required: 2.00 acre minimum.

Jordan Ridge Phase Three

Location Data: Josephine Road (SR 1526) approximately ½ of a mile northwest of its intersection with Cleveland Road (SR 1010) in Cleveland Township.

Site Data: 115.21 acres, lots 133, (maximum allowed: 172), open space provided: 26.78 acres, open space required 11.52 acres.

The Meadows at Swift Creek

Location Data: Intersection of Short Journey Road (SR 1578) and Swift Creek Road (SR 1501) in the Smithfield Township.

Site Data: 22.06 acres, lots 7, (maximum allowed: 33), open space provided: fee in lieu $2,800, open space required: 2.21 acres.

Nicklaus Knoll

Location Data: Slate Top Road (SR 1559) approximately ¼ of a mile west of its intersection with Barber Mill Road (SR 1555) in the Clayton Township.

Site Data: 7 acres, lots 10, (maximum allowed: 10), open space provided: fee in lieu $4,000.

Little Creek Farms Phase III

Location Data: At the intersection of Steel Bridge Road (SR 1562) and Jack Road (SR 1557) in the Clayton Township.

Site Data: 66.47 acres, lots 40, (maximum allowed: 99), open space provided: 6.75 acres, open space required: 6.64 acres.

Stoneybrook

Location Data: Norris Road (SR 1576) approximately ½ of a mile southeast of its intersection with Barber Mill Road (SR 1555) in the Clayton Township.

Site Data: 11.95 acres, lots 13, (maximum allowed: 18) open space provided: fee in lieu in the amount of $5,200, open space required: 2.00 acre minimum.

The Point

Location Data: Cleveland Road (SR 1010) approximately ½ of a mile southeast of its intersection with Barber Mill (SR 1555) in Cleveland Township.

Site Data: 101.47, lots 152, (maximum allowed: 152), open space provided: 42.80 acres, open space required: 10.15 acres.

Hood Tract I and II

Location Data: Josephine Road (SR 1526) approximately one mile northwest of its intersection with Cleveland Road (SR 1010) in the Cleveland Township.

Site Data: 81.86 acres, lots 122, (maximum allowed: 122), open space provided: 10.37 acres, open space required: 8.19 acres.

Summerset Place

Location Data: Steel Bridge Road (SR 1562) approximately one mile north of its intersection with Cleveland Road (SR 1010) in the Clayton/Smithfield Township.

Site Data: 203.220 acres, lots 188, (maximum allowed: 305), open space provided: 22.65 acres, open space required: 20.322 acres.

There are currently 10 major projects proposed in the Swift Creek watershed (Table 7). This list does include privately funded projects such as residential/commercial developments, which require less public review. A brief description of the privately funded projects and the Lake Benson Water supply project in the Swift Creek watershed follow. The impacts associated with these projects, and other land use activities in the Swift Creek watershed will result in an incremental degradation of Swift Creek and ultimate extirpation of the DWM, which can be avoided only if protective measures on a entire watershed basis are taken soon. These measures must include specific land use restrictions in the riparian areas of the Swift Creek watershed. The proposed ESA's, the existing ESA and stormwater ordinances in Johnston County, Neuse Buffer Rules, and Wake County stormwater ordinances should provide some watershed protection that dwarf wedgemussel needs to survive.

Table 7. Major Projects that are proposed in Swift Creek Watershed

Project	Agency
Lake Benson Water Supply	City of Raleigh and Town of Garner
Lions Gate Subdivision	Town of Clayton
Cobblestone Subdivision	Town of Clayton
Guy Road Subdivision	Town of Clayton and Johnston County
Johnston Community College Industrial Training Center	Johnston County
Clayton By-pass (R-2552)	NCDOT
NC 42 Widening: multi-lane (R-3825	NCDOT
Southern 540 Connector	NCDOT
Northern Industrial Connector	NCDOT
Booker Dairy Road U-3334	NCDOT

Lake Benson Water Supply

The City of Raleigh is proposing to construct a new water treatment plant at Lake Benson for two reasons. First, the proposed project will provide the dependability and reliability of an independent water supply source for a large majority of users in Wake County. Second, the City of Raleigh must meet post 2010 water supply needs due to the normal projected growth in the project area (City of Raleigh 2004).

The 309 square mile project area includes corporate limits, extraterritorial jurisdictions, short-range urban service areas, and long-range urban service areas for the City of Raleigh, the Town of Garner, and the Town of Rolesville. The short and long-range urban service areas are those areas currently outside of Raleigh's planning jurisdiction, but are targeted for future urban expansion and urban facilities services. As these areas develop to urban standards, it is anticipated that they will become a part of Raleigh's extraterritorial jurisdiction and at some point be annexed into the

City. The project area is bounded by Falls Lake and the Town of Wake Forest to the north, the Little River and Buffalo Creek watersheds to the east, the Middle Creek watershed to the south, and the Towns of Cary, Morrisville, and Apex to the west (City of Raleigh 2004).

The jurisdiction for the City of Raleigh is located within the Crabtree Creek, Walnut Creek, and Neuse River Watersheds. The jurisdiction for the Town of Garner is located within the Walnut Creek, Swift Creek, and Middle Creek watersheds. The jurisdiction for the Town of Rolesville is located within the Neuse River and Buffaloe Creek watersheds (City of Raleigh 2004).

The Dempsey E. Benton WTP is proposed to be located on two adjacent parcels east of NC 50 at the intersection of Buffaloe Road. The property is bordered by Swift Creek to the south and Mahles Creek to the east. The City proposes to use the existing intake structure and pump station at the Lake Benson dam (City of Raleigh 2004).

The Dempsey E. Benton WTP will be operated as a base load plant at a normal treatment rate of 14 mgd. Varying production at the E.M. Johnson WTP will accommodate daily variation and seasonal peaking. Additional treatment capacity, up to 20 mgd, will be provided to allow occasional short term increases in production for the purpose of performing maintenance at the E.M. Johnson WTP. These short-term increases will be limited to high flow periods when both Lake Wheeler and Lake Benson are full and the total stream flow at Lake Benson is greater than 40 cfs (City of Raleigh 2004).

A new 48-inch finished water transmission main route will be located in the existing City of Raleigh water line easement corridor from the Lake Benson raw water pump station to north of the US 70 intersection at Mechanical Boulevard. Just north of the US 70 intersection, the finished water line will fork into a 36-inch water main and a 30-inch water main. The 36-inch main will turn east along Garner Road, north along Creech Road, north along Sanderford Road, north along Rock Quarry Road, and west on Martin Luther King Jr. Boulevard. The 30-inch transmission main will continue to follow the existing City of Raleigh water line easement corridor and connect to an existing 30-inch at the E.B. Bain Facility for re-pumping. A 16-inch water main will start at the Dempsey E. Benton WTP and then follow Lake Benson Road and connect at Atchison Street. There are approximately 19,100 feet; 35,300 feet, 18,400 feet and 7,000 feet of 48-inch, 36-inch, 30-inch, and 16-inch finished water transmission mains, respectively (City of Raleigh 2004).

The City is proposing to use the Town of Garner Spray Irrigation Facility for spray irrigation of excess gravity thickener effluent (from the clarification step in the water treatment process) via the existing 4.2 mgd pump station on the Dempsey E. Benton WTP site. The existing 4.2-mgd pump station is the Town of Garner's primary pump station for sending influent wastewater from the Town of Garner service area to the 201 Spray Irrigation Facility for treatment (City of Raleigh 2004).

A new 9-mgd Highway 50 Pump Station will replace the existing 4.2-mgd pump station. The Highway 50 Pump Station will send wastewater flow from the Town of Garner to the Neuse River WWTP via a 24-inch force main and then a 30-inch force main. These new force mains will tie into the existing 72-inch twin outfalls that route influent wastewater from the City of Raleigh to the Neuse River WWTP. There are approximately 28,000 feet of 24-inch force main

and 24,500 feet of 30-inch force main. The proposed Highway 50 force mains will be located primarily within existing sanitary sewer easements on the Dempsey E. Benton WTP property or within North Carolina DOT right-of-way along New Bethel Church Road (SR 2703), Clifford Road (SR 2706), Hebron Church Road (SR 2547), Win Road (SR 2702), Hicks Road (SR 2701), White Oak Road (SR 1209), Raynor Road (SR 2555), AND Auburn-Knightdale Road (SR 2555) (City of Raleigh 2004).

The existing 2- mgd White Oak Pump Station located off Raynor Road, also currently routes influent wastewater flow to the Garner 201 Spray Irrigation Facility. Flow from this pump station will also have to be rerouted to the City of Raleigh Neuse River WWTP. The pump station capacity will remain at 2 mgd and the existing pump station footprint will not change, but the existing pumps will be retrofitted with larger motors to accommodate the new operating point. Approximately 200 feet of new 16-inch force main will connect the White Oak Pump Station to the 30-inch Highway 50 force main at Raynor Road (City of Raleigh 2004).

LionsGate

A mixed-use development of 130 acres, located on the southwest side of the current town limits between NC 42 West and Shotwell Road. Currently in the development stage, there will be, upon completion, 410 single-family dwellings, 88 apartments, and a commercial village with adjacent health club.

Cobblestone

A 260-acre residential development located on the southeast side of the current town limits at the southern end of Champion Street and west of Little Creek Church Road. It is approximately 25% completed, with a planned total build out of 593 single-family dwellings, 336 multi-family dwellings, and common areas with amenities (pool, tennis courts, etc.) provided.

Moss Creek Commons (Guy Road Subdivision)

This mixed-use development is located on the south side of Guy Road, just east of the intersection of Amelia Church Road. The project contains 49 acres to be developed in 171 townhomes (two and three unit buildings), 12 commercial lots, and one institutional lot to be developed as a church.

Johnston County Workforce Development Center

The Johnston County Workforce Development Center will be a training center for undergraduate students preparing to work in the County's pharmaceutical industry. This facility is designed to house approximately 497 students at one time. A curb and Gutter paved parking lot is proposed with 158 parking spaces. The initial project is proposed on approximately 8 acres of land in the northwest corner of the parent parcel. The remaining area will remain undeveloped at this time with some wetlands located southeast of the project area.

Biological Conclusion: May Affect, Not Likely to Adversely Affect (Conditional)

The potential direct sedimentation impacts to Swift Creek, associated with the Clayton Bypass, and the secondary watershed development impacts related to the transportation system (US 70\I-40\Raleigh Outer Loop Corridors), coupled with existing and future impacts associated with other activities, will continue to result in incremental degradation of Swift Creek.

The intensified land development that has been occurring and is expected to continue in the Swift Creek watershed is closely linked to the transportation system of the Triangle area. The potential direct and secondary impacts to Swift Creek associated with this and future NCDOT projects, coupled with other existing and future impacts to the watershed will very likely result in significant impacts and ultimate extirpation of the DWM. The DWM population in Swift Creek has already been significantly impacted as is evidenced by the apparent reduction in range within the Creek. These impacts are continuing to occur.

The potential direct effects that could result from the construction of the Clayton Bypass should be address by the conservation measures NCDOT is putting in place, for example; the placement of hazardous spill basins, cutting in half the time it takes to stabilize erodible areas once grading has been completed, the use of Polycrylamides, skimmers and baffles which raise sediment retention efficiency in basins to 90 percent, and regular water quality monitoring to make sure if problems do arise NCDOT can shut the construction down until the problem can be resolved.

The indirect and cumulative effects from the Clayton Bypass are insignificant. This conclusion is based on the ICE and the ICI information on the impacts associated with the Clayton Bypass on a 92.5 square mile (239.5 square kilometers) watershed. This conclusion also takes into account the entire DWM species population. The indirect and cumulative effects related to the Clayton Bypass are 5.1 percent increase additional development, 6.83 percent increase in total nitrogen, and 0.18 percent increase in total phosphorus and 2.63 percent in overland sediment.

The additional water quality effects will be reduced if Wake and Johnston County implement the proposed ESA. The effects will be reduced, because of the 100-foot buffer implemented on all perennial streams that will go with the implementation of the ESA. This reduction is shown in Table 2 and Table 3 of the Addendum Water Quality Analysis, September 2004, (prepared by EcoScience Corporation for NCDOT). The tables show the Future Bypass with the ESA's, a reduction in the upper Swift Creek sub-watershed by 15.3 percent for total nitrogen, 13.78 percent for Total Phosphorus and 10.87 percent for overland sediment over Clayton Bypass with existing measures (Appendices, Table 3). In the lower Little Creek sub-watershed it shows the Future Bypass with ESA will have a reduction on Total Nitrogen by 9.55 percent, a reduction in total phosphorus by 10.53 percent and a reduction in overland sediment by 8.51 percent, versus Future Bypass with existing measures (Appendices, Table 4).

The Clayton Bypass has had a beneficial effect on the species. The benefit came through the coordination with NCWRC, USFWS, NCDOT and Johnston County. Through this coordination Johnston County developed their stormwater ordinances and the existing ESA, through which NCDOT helps provide funding for the Watershed Administrator position. The stormwater ordinance for the ESA limits the amount of impervious surface for residential and commercial development. If those percentages are exceeded then there is a land dedication requirement or in lieu fee payment to Johnston County. This stipulation acts as a deterrent to development. The stormwater ordinances along with the ESA from the five years of monitoring reports suggest that

the use of BMP'S has increased from 1998 to 2003. Without these measures in place DWM might have been extirpated from Swift Creek already.

Another benefit that came out of the coordination between NCWRC, USFWS and NCDOT was the research that Richard Neves at Virginia Polytechnic Institute and State University did on the development of the technique to propagate dwarf wedgemussel. The research was funded by NCDOT as part of the conservation measures from the BA in 1998. This may help in the future with the reintroduction of DWM into its historic range.

NCDOT believes that small effects associated with the construction of the Clayton Bypass, along with the following conservation measures that have been implemented and that the proposed ESA conditions gets implemented by Wake and Johnston Counties, that the Clayton Bypass "May Affect, but is Not Likely to Adversely Affect" the dwarf wedgemussel population.

4.0 CONSERVATION MEASURES

Conservation measures include those measures that are taken to avoid, minimize and compensate for impacts to the dwarf wedgemussel as a result of project construction. These measures address both the direct and secondary impacts associated with construction. Potential opportunities for mitigative measures have been discussed between the USFWS, NCWRC and the Project Development and Environmental Analysis Branch of NCDOT.

4.1 Direct Impacts

The following measures were discussed and agreed upon by NCDOT, NCWRC and USFWS. This information came out of the original Biological Assessment written by NCDOT. Construction-related Environmental Commitments that will minimize the likelihood of direct impacts to the dwarf wedgemussel will be implemented regardless of the mitigation option chosen. These include:

1) The use of High Quality Water's erosion control standards throughout the construction process in all areas within the Swift Creek Watershed.

2) The resident engineer will provide written notice of the pre-construction conference to the USFWS (Raleigh Field Office), the NCWRC non-game and protected species program, and the protected species coordinator of the NCDOT Project Development and Environmental Analysis Branch.

3) NCDOT will schedule field meetings and discussions at the proposed crossings of I-40 Clayton Bypass Interchange, to develop methods to avoid/minimize direct impacts to Swift Creek.

NCDOT, WRC, USFWS, and Division of Water Quality and U.S. Army Corps of Engineers discussed the following measures. The measures came from a meeting held on September 24, 2004.

4.2 Indirect and Cumulative Impacts

It is apparent that the Clayton Bypass will result in some degree of secondary impacts to the DWM population in Swift Creek. However, more substantial secondary impacts are anticipated with regard to the future NCDOT projects described earlier, particularly the Raleigh outer Loop. In order to develop a mitigative option that will provide the maximum benefit to the resource, NCDOT believes that a comprehensive mitigative package be developed to lessen the impacts of secondary development. NCDOT proposes that the secondary impacts associated with these future projects be mitigated for along with the Clayton Bypass at this time. This package should apply to the Clayton Bypass as well as future NCDOT projects (Raleigh Outer Loop, NC 42 Widening etc.). These future projects will be consulted (Section 7) on an individual basis, and any direct impacts associated with these projects will be addressed during those consultations.

Johnston County has put into place a comprehensive land use ordinance to protect the Swift Creek watershed. The plan includes provisions for an Environmental Sensitive Area (ESA). The following describes the ESA:

- The ESA states that all perennial streams will have 100 foot buffers and buffers shall be measured from the from the top of the channel bank and extend landward a minimum distance of 100 feet measured horizontally on a line perpendicular to the waterbody. The following rules apply to the 100-foot buffer. Figure 1. Show the boundaries of the existing ESA.

    1. The buffer shall be undisturbed and remain forested if currently forested.

    2. If the existing buffer is not forested, it shall be maintained in a natural state and allowed to revegetate.

    3. There shall be no fill allowed within the buffer area.

- There is stormwater restriction inside the ESA. The restriction concerns the amount of impervious surface for any planned development. The development can only have 12 percent impervious surface versus 15 percent outside the ESA for residential and 50 percent for non-residential versus 60 percent outside. If a developer wishes to exceed the amount of impervious surface stipulated above, the following requirements must be met.

    1. The developer may identify the land to be dedicated into the County's Land Dedication program per acre of additional land required to achieve a calculated impervious area limit and secure the conservation easement. The land must meet the criteria identified below. The rate for developer finding and dedicating to the program is 1.5:1.

    2. In the County's sole discretion, the County may allow a developer to pay a fee into the County's Land Dedication Program per acre of additional land required, at a land dedication rate of 2.5:1, to achieve a calculated impervious area limit under the ordinance. The County will set the per acre fee. The interim per acre fee has been set at $10,000.00 per acre. The fee is based upon the actual cost of land identified by the County or other party for dedication plus program administration cost.

All land dedication must be done within the same subbasin.

NCDOT provided $25,000 for a period from 1998-2003 and a total of $125,000 to Johnston County for a Watershed Administrator position. The requirements for this position were to implement a watershed ordinances that will provide needed protection of Swift Creek, but protective measures are not just limited to Swift Creek, it may be used for the entire county.

NCDOT also provided the USFWS with funding in the sum of $75,000 that went towards dwarf wedgemussel propagation efforts to augment the Swift Creek population. The propagation project was preformed by Richard Neves at Virginia Polytechnical Institute and State University and took about three years to complete. The project would have involved the collection of gravid dwarf wedgemussel females from the Swift Creek subbasin, coordinated with John Alderman formerly with The North Carolina Wildlife Resources Commission (NCWRC). NCDOT was not allowed to take gravid females out of Swift Creek, because of the decline in population. NCDOT, NCWRC and the USFWS were able to get gravid females out of Moccasin Creek to use for this research. Glochidia removal and subsequent juvenile propagation was done at Virginia Polytechnical Institute and State University. The juveniles were cultured for 3-6 months. The project produced 500 juveniles per year for release. The juveniles that were cultured and were set to release into Swift Creek at suitable sites, but the WRC was worried about the risk of contamination between the juveniles and the existing population. The release into Swift Creek never took place, however, valuable scientific information was gathered from this research.

4.3 New Conservation Measures for Direct Impacts

NCDOT has implemented some new conservation measures since the original BA. The following list includes the new conservation measures that NCDOT will be implementing for potential direct impacts.

R-2552 AA section

- NCDOT will be constructing a hazardous spill catch basin at the following locations on this section: Rt. –LREV- Sta. 12+20, Rt. –LREV- Sta. 15+80, Rt. –L- Sta. 23+00, Rt. –L- Sta. 25+60, Rt. –I1Y1- Sta. 30+40 and Lt. –RPD- Sta. 14+00. Figure 2. (Show the locations of the hazardous spill catch basins as it relates to the surrounding area).

R-2552 AB section

- NCDOT will be constructing a hazardous spill catch basin at the following locations on this section: Lt. –L- Sta. 42+00, Rt. –L- Sta. 45+70, and Rt. –RPA- Sta. 11+40. Figure 3. (Shows the location of the hazardous spill catch basins as it relates to the surrounding area).

- Controlled Access was extended north on –Y2- (NC 42) from Sta. 15+55 to Sta. 14+73 on the left and to Service Road –B- on the right. The Controlled Access was also extended south from –Y2- Sta. 21+40 to Sta. 22+60 on the left and Sta. 22+42 on the right. Figure 3. (Shows the location of the Controlled Access changes and how it relates to the surrounding area).

See North Carolina Division of Highways, Guidelines for Drainage and Hydraulic Design, 1999, Appendix O, Guidelines for the Location and Design of Hazardous Spill Basins.

NCDOT commits to providing the locations of above mentioned hazardous spill catch basins and instructions on how they are used, to the local emergency response units for Wake and Johnston Counties.

R-2552 B section

- Removed curb and gutter from Ranch Road from –Y11- REV Sta. 15+70 to Sta. 20+80. Figure 4. (Shows the location where the curb and gutter was removed and how it relates to the surrounding area).

- Extended Controlled Access limits from –Y11- REV Sta. 21+99.185 to Sta. 23+35 Lt. and Rt. Figure 4. (Shows the location where the limits of the Controlled Access was changed and how it relates to the surrounding area).

R-2552 C section

- Extended Controlled Access limits from Rt. –Y4- from Sta. 28+60 to Sta. 30+20 –Y4-Rt. Figure 5. (Shows the location where the limits of the Controlled Access was changed and how it relates to the surrounding area).

The North Carolina Department of Transportation proposes to construct R-2552, which will be located in the Swift Creek watershed. The Swift Creek Watershed is currently the habitat for a threatened and endangered aquatic species. In order to ensure the species is protected the Department of Transportation will utilize various improved techniques and devices to minimize and control erosion and sedimentation. These techniques and devices are listed below as part of the design criteria. It should be noted that these devices would only be used in areas where it will flow directly into a waterway that is tributary to Swift Creek. Areas that are at grade or flow through wooded areas are not included (NCDOT 2004c).

- Basins will be designed to meet the surface area requirement for the peak runoff event for a 25-year storm.
- Basins located at critical discharge points on the project will utilize the Faircloth Skimmer with jute baffles and polyacrylamides to improve settling efficiency.
- Exposed areas located adjacent to critical areas will utilize erosion control matting to assist in stabilization.
- Erosion control matting will be utilized in ditchlines to reduce accelerated erosion.

See North Carolina Administrative Code Title 15A, Department of Environment and Natural Resources, Chapter 4, 2000, 15A NCAC 04B.108, Design and Performance Standard.

Water Quality Monitoring Proposal:

The North Carolina Department of Transportation will also initiate a water quality-monitoring program to quickly and effectively identify the sources of sediment discharges to Swift Creek from R-2552 construction activities so that corrective actions can be quickly implemented and water quality degradation minimized (NCDOT 2004c).

Monitoring stations will be located throughout the project to adequately measure the upstream and downstream water quality. An observation period will occur prior to construction where acceptable background turbidity levels will be established. Once construction begins the consultant will monitor and notify the Department when established thresholds are exceeded or changes in upstream and downstream readings exceed water quality standards (NCDOT 2004c).

When a threshold level is exceeded the consultant will coordinate with the Roadside Environmental Unit and project personnel to investigate the reason for the increased turbidity levels. All occurrences will be documented identifying the cause and corrective action taken. All records will be made available for the regulatory agency to review (NCDOT 2004c).

Seeding and Mulching Special Provision:

All exposed areas located throughout the project that are not graded in a continuous manner will be stabilized weekly. This includes but is not limited to all spoil material, fill slopes, cut slopes, shoulders, medians, borrow pits, and waste pits. Seeding and mulching will be performed in such a manner as to ensure that all exposed erodible areas are protected from storm events. Failure to comply with this provision will result in an immediate project shutdown until corrective actions can be taken (NCDOT 2004c).

Erosion and Sedimentation Control Inspection and Oversight:

The Department of Transportation will designate an inspector that will inspect the erosion and sedimentation control devices on a daily basis to ensure that the contractor is implementing the erosion and sedimentation control plan. The Roadside Environmental Unit will provide oversight on a weekly basis to ensure that the project is in compliance with the Sedimentation Pollution Control Act (NCDOT 2004c).

Clearing Limits:

The Department of Transportation will note the clearing limits on the project plan sheets to prevent any confusion on what can and can not be cleared (NCDOT 2004c).

Summary:

The Department of Transportation recognizes the importance of minimizing the impact to the threatened and endangered species located in Swift Creek. The Department will implement BMP's that exceed the current practices and regulations that mandate environmental protection (NCDOT 2004c).

The North Carolina Sedimentation Pollution Control Act of 1973 requires 15 working days or 30 calendar days to stabilize erodible areas once grading has been completed. The Department will voluntarily reduce this time in half. Furthermore, the Department will utilize Polyacrylamides, skimmers, and baffles in the basins located at critical drainage points to raise the basin's efficiency from 70% to 90% (NCDOT 2004c).

See North Carolina Administrative Code Title 15A, Department of Environment and Natural Resources, Chapter 4, 2000, 15A NCAC 04B .0124, Design Standards in Sensitive Watersheds, Section E.

The combination of these devices and techniques will improve the Departments ability to protect the species located in Swift Creek. It should be understood that these devices will require more oversight and maintenance then traditional devices and therefore will require daily inspection by project personnel and weekly oversight inspections by the representative of the Roadside Environmental Unit (NCDOT 2004c).

Finally, the Department will indicate on the construction plans the clearing limits to ensure that the contractor does not exceed the clearing limits agreed upon by the Department and Regulatory agencies.

The Department is confident that these newer technologies (Polyacrylamides and Skimmers) along with the older technologies (Baffles and reduction in soil exposure) will offer the protection required to minimize the impact to the threatened and endangered specie located in Swift Creek (NCDOT 2004c).

The following are conservation measures that NCDOT did as a result of the Avoidance and Mitigation step of the National Environmental Policy Act (NEPA) PROCESS:

- Shifting Clayton Bypass/I-40 interchange north and reducing the footprint to eliminate some buffer impacts and stream impacts that could have had potential direct impacts.

- NCDOT put in 4 bridges, 2 on UT Swift Creek, 1 on UT Little Creek, and 1 on Little Creek to minimize any potential direct impacts.

- NCDOT has committed to that no bridge drains will drain over water.

4.4 New Conservation Measures for Indirect and Cumulative Impacts

There is a proposed extension of the existing ESA by Wake and Johnston Counties. The extension would include most of the Upper Swift Creek watershed from Lake Benson to the Wake and Johnston County Lines. The extension would also include bring the ESA up from the existing boundary to the edge of the Clayton Bypass in the Little Creek watershed (Figure 6.) Show the existing ESA and the proposed ESA locations and how it relates to the Swift Creek watershed.

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6.0 LIST OF PREPARERS AND QUALIFICATIONS

Investigator:	Jared Gray
Education:	B.S. Environmental Science, Morehead State University
Experience:	Environmental Biologist, Enviro-Pro, October 1994 – May 1997 Environmental Technician, Appian Consulting Engineers, P.A., October 1997 – May 1998 Environmental Specialist, NCDOT, October 1998-present
Expertise:	Endangered species (terrestrial/aquatic) surveys; benthic macroinvertebrate collection, wetland delineation; soils, water quality analysis, and 404/401 permitting.

Investigator:	Mary E. Frazer, Natural Systems Specialist, NCDOT, August 2000-present
Education:	B.S. Zoology, University of Wisconsin M.E.M. (Master of Environmental Management), Resource Ecology, Duke University
Experience:	Water Regulation Specialist, Wisconsin Department of Natural Resources, 1998-2000 Wisconsin Coastal Management Program, 1994-1998 Biologist, Soil and Environmental Consultants, 1992-1994
Expertise:	Section 7 field investigations; NEPA documentation, wetland and aquatic investigations.

Investigator:	Karen M. Lynch, Environmental Specialist
Education:	B.S. Wildlife Biology and Fisheries, North Carolina State University
Experience:	Environmental Specialist, NCDOT, November 1998 - present Environmental Biologist, NC Division of Water Quality November 1984 – October 1998
Expertise:	Section 7 field investigations; NEPA documentation, protected species (terrestrial/aquatic) surveys, benthic macroinvertebrate collection, water quality analyses, aquatic plant surveys.

Investigator:	Jason Mays, Environmental Specialist, NCDOT, March 2004-present
Education:	B.S. Biological Sciences minor Chemistry, UNC Chapel Hill 2002
Experience:	NCWRC Field Biologist May 2002-October 2003
Expertise:	Section 7 field investigations, protected species (terrestrial/aquatic) surveys, 404/401 permitting, wetland delineation/ determination, GIS studies

Investigator:	Michael Sanderson, Environmental Specialist, NCDOT April 2004-present
Education:	B.S. Fisheries and Wildlife Science, North Carolina State University
Experience:	Wildlife Research Biologist, Down to Earth Environmental, February – June 2003 Wildlife Research Technician, NC Cooperative Fish and Wildlife Research unit, October, 1991-March 1999 Biological Science Technician (Wildlife), US Fish and Wildlife Service, April 1995-April 1997
Expertise:	Bird surveys, behavioral analysis, habitat use/evaluation, Section 7 field investigations, protected species (terrestrial/aquatic) surveys, Wetland delineation/determination

Investigator:	Dennis Herman, Environmental Supervisor
Education:	B.S. Biology, Western Carolina University
Experience:	Environmental Specialist/Supervisor, NCDOT, August 2004 – present Coordinator of Living Collections, NC Museum of Natural Sciences, NCDENR, May 1996 – August 2004 Director & Co-Chair, Project Bog Turtle, November 1995 – present Assistant Curator of Herpetology, Zoo Atlanta, Atlanta, Georgia, February 1981- May 1996; Senior Keeper, Herpetology & Primate departments, Atlanta Zoological Park, Atlanta, Georgia, September 1972 - February 1981 Working Member, World Conservation Union (IUCN) Freshwater Turtle & Tortoise Specialist Group/Turtle Survival Alliance, January 1988 – present Member, Asian Turtle Consortium, May 2002 – present Reptile & Amphibian Advisory Committee, NC Wildlife Resources Commission, January 1985 – present
Expertise:	Endangered species surveys (bog turtles primarily); Non-game species (reptiles, amphibians, freshwater fish, rare plants) & wetland flora and fauna surveys; Report writing

Investigator:	Tim Savidge
Education:	BS Biology (Guilford College), MS Marine Biology/Biological Oceanography (UNC Wilmington)
Experience:	Environmental Specialist, NCDOT, 1992-2002 Environmental Supervisor, Catena Group, 2002-present
Expertise:	NEPA Documentation, Terrestrial and Aquatic Ecology, Freshwater mussel biology, Protected species surveys, freshwater mussel surveys (NC-2003ES-58), Section 7 coordination, and wetland delineation.

Investigator:	LeiLani Paugh
Education:	Bachelor of Science in Fisheries and Wildlife Science, North Carolina State University, 1995, Master's of Natural Resource Management, Hydrology, Soil Science Minor, 1998.
Experience:	Biological Technician, Biological Assessment Unit, CP&L, May 1995 – December 1996 Environmental Specialist, NCDOT, June 1998-June 2003 Environment Supervisor, NCDOT, June 2003-June 2004 ICI/Mitigation Unit Head, NCDOT, June 2004-present
Expertise:	Stream and wetland restoration, wetland delineation, soils, water quality analysis, and 404/401 permitting.

Appendices

Table 1. Corresponding land-use categories used in AnnAGNPS and SWAT. Study Area land use was categorized using tax parcels as land-use units.

AnnAGNPS Land-use Category	SWAT Land-use Category
COMM: Business, Commercial, 85% impervious	UCOM: Commercial
CROPLAND: Fallow, Row Crops, Small Grain	SOYB: Soybean
HOUSE20: Housing, 1-acre lots, 20% impervious	URLD: Residential, Low Density
HOUSE25: Housing, 0.5-acre lots, 25% impervious	URML: Residential, Med/Low Density
HOUSE30: Housing, 0.3-acre lots, 30% impervious	URML: Residential, Med/Low Density
HOUSE38: Housing, 0.25-acre lots, 38% impervious	URMD: Residential, Medium Density
HOUSE65: Housing, 0.125-acre lots, 65% impervious	URHD: Residential, High Density
INDUST: Business, Industrial, 72% Impervious	UIDU: Industrial
PASTURE: Pasture, Grassland, or Range	PAST: Pasture
WATER: Lakes, Ponds, Reservoirs	Ponds have been inserted as a separate feature, not a land-use category
WOODG: Woods-Grass Combination	FRSE: Forest-Evergreen
WOODS: Woodland or Forest	FRST: Forest-Mixed

Table 2. Exported annual yields of pollutants from the Study Area. All numbers are reasonable yields for use in comparitive analyses, but should not be interpreted as an estimate of actual Study Area yields. All mass units are in metric tons. Percent change in pollutant yields are color coded to assist in percent change interpretation. The percent change of each pollutant has a unique color, with TN depicted in red, TP depicted in blue, overland sediment depicted in purple, and stream sediment depicted in green.

Scenario	TN (Tons)	TP (Tons)	Overland Sediment (Tons)	Stream Sediment (Tons)	TN Change (Tons)	TN Percent Change	TP Change (Tons)	TP Percent Change	Overland Sediment Change (Tons)	Stream Sediment Change (Tons)	Overland Sediment Percent Change	Stream Sediment Percent Change	
Existing	67.40	116.60	15279.90	22921.00	-----	-----	-----	-----	-----	-----	-----	-----	
Future No Bypass	88.20	122.40	20149.30	30225.60	20.80	**30.86%**	5.80	**4.97%**	4869.40	7304.60	**31.87%**	47.81%	**Over Existing**
Future Bypass	92.80	122.60	20551.50	30828.90	25.40	**37.69%**	6.00	**5.15%**	5271.60	7907.90	**34.50%**	51.75%	**Over Existing**

*Sediment has been divided into two distinct source categories.

Table 3. Exported annual yields of pollutants from the upper Swift Creek sub-watershed. All numbers are reasonable yields for use in comparitive analyses, but should not be interpreted as an estimate of actual Study Area yields. All mass units are in metric tons. Percent change in pollutant yields are color coded to assist in percent change interpretation. The percent change of each pollutant has a unique color, with TN depicted in red, TP depicted in blue, and overland sediment depicted in purple.

Scenario	TN (Tons)	TP (Tons)	Overland Sediment (Tons)	Stream Sediment (Tons)	TN Change (Tons)	TN Percent Change	TP Change (Tons)	TP Percent Change	Overland Sediment Change (Tons)	Stream Sediment Change (Tons)	Overland Sediment Percent Change	
Existing	7.846	1.3352	3438.17	10901.83	-----	-----	-----	-----	-----	-----	-----	
Future No Bypass A	8.397	1.4258	3309.75	11490.25	0.55	7.02%	0.09	6.79%	-128.42	588.42	-3.74%	Over Existing
Future Bypass A	8.725	1.4931	3035.40	11794.60	0.88	11.20%	0.16	11.83%	-402.77	892.77	-11.71%	Over Existing
Future No Bypass B	7.745	1.3213	3105.44	11514.56	-0.10	-1.29%	-0.01	-1.04%	-332.73	612.73	-9.68%	Over Existing
Future Bypass B	7.524	1.3092	2661.81	11858.19	-0.32	-4.10%	-0.03	-1.95%	-776.36	956.36	-22.58%	Over Existing

*Sediment has been divided into two distinct source categories.

Table 4. Exported annual yields of pollutants from the lower Little Creek sub-watershed. All numbers are reasonable yields for use in comparitive analyses, but should not be interpreted as an estimate of actual sub-watershed yields. All mass units are in metric tons. Percent change in pollutant yields are color coded to assist in percent change interpretation. The percent change of each pollutant has a unique color, with TN depicted in red, TP depicted in blue, and overland sediment depicted in purple.

Scenario	TN (Tons)	TP (Tons)	Overland Sediment (Tons)	Stream Sediment (Tons)	TN Change (Tons)	TN Percent Change	TP Change (Tons)	TP Percent Change	Overland Sediment Change (Tons)	Stream Sediment Change (Tons)	Overland Sediment Percent Change	
Existing	2.20	0.29	1280.28	5760.70	-----	-----	-----	-----	-----	-----	-----	
Future No Bypass A	1.95	0.24	1021.50	5813.50	-0.25	**-11.36%**	-0.05	**-17.24%**	-258.78	52.80	-20.21%	**Over Existing**
Future Bypass A	2.11	0.26	912.54	5787.46	-0.09	**-4.09%**	-0.03	**-10.34%**	-367.74	26.76	-28.72%	**Over Existing**
Future No Bypass B	1.79	0.22	939.78	5834.22	-0.41	**-18.64%**	-0.07	**-24.14%**	-340.50	73.52	-26.60%	**Over Existing**
Future Bypass B	1.90	0.23	803.58	5801.42	-0.30	**-13.64%**	-0.06	**-20.69%**	-476.70	40.72	-37.23%	**Over Existing**

*Sediment has been divided into two distinct source categories.

Figures

Figure 1

color

Color

2.

REVISIONS
RIGHT OF WAY REVISION 9/29/04

MATCHLINE TO SHEET 9-A

MATCHLINE TO SHEET 9-B

-FLYLWREV-
PVI Sta. 10+00.00
PVI Elev. 862.762
L = 600.00
K = 60.006
ST = 500.05

-FLYLWREV-
PVI Sta. 12+27.79
PVI Elev. 874.79
L = 600.00
K = 60.006
ST = 500.05

-FLYLWREV-
PVI Sta. 10+00.00
PVI Elev. 862.762
L = 600.00
K = 60.006
ST = 500.05

-FLYLWREV-
PVI Sta. 12+43.68
PVI Elev. 874.68
L = 600.00
K = 60.006
ST = 500.05

PROJECT REFERENCE NO.	SHEET NO.
R-2633AA	9
S.W. SHEET NO.	TOTAL SHEETS
14	17
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONSTR/N.

R/W REV.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

TRAFFIC DIAGRAM

2004 ADT
2025 ADT
T.T.A.D.H.V.

CLAYTON BYPASS

NCDOT FORMERLY:

-L- POT2m 10+00.000

-FLYLWREV- BCSm 10+94.000

-LREV- POT2m 11+04.621 =
-FLYLWREV- ETSm 10+80.000 (14.1m LT)
-FLYLWREV- ETSm 10+80.000 (14.1m RT)

S 85° 03' 54.8" E

S 87° 37' 28.5" E

-FLYLWREV-

-LREV-

-FLYLWREV- BCSm 12+99.000

60' DIAMETER HAZARDOUS SPILL BASIN

MATCHLINE TO SHEET 9-C

MATCHLINE TO SHEET 9-C

MATCHLINE TO SHEET 15A

MATCHLINE TO SHEET 9-C

MATCHLINE TO SHEET 10 -LREV- STA. 13+82.800

NOTE:
(1) SEE SHEET 27 FOR -FLYLWREV- PROFILE
(2) SEE SHEETS 30 & 31 FOR -FLYLWREV- PROFILE
(3) SEE SHEET 36 FOR -LREV- PROFILE
(4) FOR GRADE SECTIONS AND ADDITIONAL STANDARD DRAWINGS, REFER TO SHEET 8, SHEET 9 FOR SPECIAL MEDIAN GRADING

-L- +15.000
342.846m
(793.94')

-L- +34.000
258.806m
(714.29')

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA.

LOCATION:	
TIP NO.:	COUNTY:
DESIGNED BY:	DATE:
CHECKED BY:	DATE:

REVISIONS

RIGHT OF WAY REVISION 9/21/04

MATCHLINE TO SHEET 9-B

METRIC

PROJECT REFERENCE NO. B-31033 | SHEET NO. 11

R/W SHEET NO. 11

STATE HIGHWAY ADMIN. | DISTRICT ENGINEER

PRELIMINARY PLANS
NOT FOR CONSTRUCTION, RIGHT OF WAY OR EASEMENT PURPOSES

CONST. DIV.

R/W DIV.

-LREV-
Pt Sta. 18+79.76
Δ = 5°37'53.5" (RT)
D = 5.00°
T = 98.64'
L = 197.01'
R = 1,146.000
S.E. = NC

-LREV- PTSta. 18+99.765 BK =
-L- PTSta. 18+99.765 AH

-LREV- PCSta. 17+63.646

-L- +33.000
72.000m
(236.22')

-L- +17.000
54.000m
(177.17')

-L- +83.000
192.000m
(630.05')

-L- +65.000
162.000m
(531.50')

-L- +35.000
92.000m
(301.84')

-L- +18.000
56.000m
(183.73')

-L- +65.000
162.000m
(531.50')

-L- +85.000
192.000m
(630.05')

-L- +45.000
102.000m
(334.65')

-L- +55.000
132.000m
(433.07')

-L- +35.000
92.000m
(301.84')

-L- +18.000
56.000m
(183.73')

-Y2B- +31.276
9.144m
(30.00')

-Y2B- PCSta. 11+33.721

-Y2B- PTSta. 12+97.007

N 67° 14' 32.0" E

-Y2B- +23.725
18.000m
(59.06')

-Y2B- +08.000
2.000m
(6.56')

-Y2B- ON R\W
EXIST. MONUMENT

-Y2B-

MATCHLINE TO SHEET 9 -LREV- STA. 13+00.000

MATCHLINE TO SHEET 11 -L- STA. 19+60.000

MCCOY
FORMERLY

DRY DETENTION
/HAZARDOUS SPILL BASIN

BEGIN BRIDGE
-LREV- STA 13+18.500
BEGIN APPROACH SLAB
-LREV- STA 13+31.500

END APPROACH SLAB
-LREV- STA 15+48.700
END BRIDGE
-LREV- STA 15+61.500

END BRIDGE
-LREV- STA. 15+17.500
END APPROACH SLAB
-LREV- STA. 15+34.700

BEGIN APPROACH SLAB
-LREV- STA. 13+17.500
BEGIN BRIDGE
-LREV- STA. 13+34.500

S. 85° 03' 54.8" E

S. 87° 37' 28.5" E

S. 85° 03' 54.8" E

-LREV-

NOTE:
(1) SEE SHEETS 36 & 37 FOR -LREV- PROFILE
(2) SEE SHEET 37 FOR -L- PROFILE
(3) SEE 40 FOR -Y2B- PROFILE
(4) SEE CROSS-SECTIONS AND ROADWAY STANDARD DRAWINGS, STD. NO. 663.01, SHEET 2 FOR SPECIAL MEDIAN GRADING

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA.

LOCATION:

TIP NO.: COUNTY:

DESIGNED BY: DATE:

CHECKED BY: DATE:

REVISIONS
RIGHT OF WAY REVISION 9/21/04

METRO	PROJECT REFERENCE NO.	SHEET NO.
	R-2635AA	37 OF 53
CONST. ENGR.	R/W SHEET NO.	
R/W ENGR.	STATE CONSTRUCTION ENGINEER	PROJECT DEVELOPMENT ENGINEER

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

MATCHLINE TO SHEET 12 -L- STA.12+40.000

MATCHLINE TO SHEET 12 -L- STA.26+21.000

NAD 83

S 85°03'54.8" E

S 85°03'54.8" E

DRY DETENTION /HAZARDOUS SPILL BASIN

DRY DETENTION /HAZARDOUS SPILL BASIN

-L- +16.765
83.471m
(273.77')

-L- +27.672
83.992m
(357.28')

-L- +35.000
83.363m
(233.94')

-L- +35.000
83.363m
(233.94')

-L- +35.000
83.363m
(233.94')

-L- +80.000
83.509m
(317.64')

-L- +80.000
83.509m
(317.64')

-L- +80.000
50.980m
(164.64')

-L- +30.535
83.938m
(317.63')

-L- +20.000
83.509m
(364.64')

-L- +68.000
83.509m
(364.64')

-L- +17.000
83.509m
(368.48')

-L- +18.000
83.509m
(272.37')

-L- +80.000
83.509m
(364.64')

-L- +80.000
83.509m
(364.64')

-Y2B- +78.000
0.000m

-Y2B- +30.000
18.000m
(59.06')

-Y2B- +55.000
83.509m
(364.64')

-Y2B- +55.000
83.509m
(364.64')

-Y2B- +11.645
18.509m
(59.06')

-Y2B- POCSta.11+26.000 =
POTSta. 13+98.000 -DR2-

-Y2B- +63.000
83.509m
(364.64')

-Y2B- +91.995
18.509m
(59.06')

-Y2B- PCSta. 17+83.974

-Y2B- +55.622
PL

-Y2B- PTSta. 14+91.995

-Y2B- +68.000
34.142m
(112.01')

-Y2B- PL
PL

-Y2B- +54.999
11.229m
(36.82')

28

30

31

32

32

32

32

NOTE:
(1) SEE SHEETS 37 & 38 FOR -L- PROFILE
(2) SEE SHEETS 40 & 41 FOR -Y2B- PROFILE
(3) SEE SHEET 39 FOR -DR2- PROFILE
(4) SEE CROSS-SECTIONS AND ROADWAY STANDARDS DRAWING FOR DETAILS. SHEET 1 FOR STRAIT MEDIAN GRADING

-Y2B-
Pi Sta. 4+68.43
Δ = 9°00'00.0" (RT)
D = 7°09'43.7"
T = 18.97'
L = 36.00'
R = 801.358

-Y2B-
Pi Sta. 8+72.80
Δ = 46°29'59.9" (RT)
D = 45°49'11.3"
T = 49.84'
L = 93.66'
R = 125.000
SC = 15
RC = 42

-Y2B-
Pi Sta. 11+43.82
Δ = 34°29'59.9" (LT)
D = 9°10'00.0"
T = 100.86'
L = 196.36'
R = 625.000
SC = 15
RC = 37.5

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA.

LOCATION:	
TIP NO.:	COUNTY:
DESIGNED BY:	DATE:
CHECKED BY:	DATE:

REVISIONS

RIGHT OF WAY REVISION 9/23/04

MATCHLINE TO SHEET 15-A

MATCHLINE TO SHEET 13+60.000 & -RPD- STA. 13+60.000

METRIC

PROJECT, BRIDGE NO. | SHEET NO.
R-5821A | 14
R/W SHEET NO. | TOTAL SHEETS
HAZARDOUS WASTE SITE | PROJECTION

CONST.ESTIMATE | R/W ESTIMATE

PRELIMINARY PLANS
NOT FOR CONSTRUCTION, R/W OR UTILITY PURPOSES

TRAFFIC DIAGRAM

2006 ADT
2025 ADT
D = 6.000%

CLAYTON BYPASS

I-40: 2060 / 1306
I-40: 692 / 387

HAZARDOUS SPILL BASIN

-RPD- CESta. 36+78.621

-LTV- POTSta. 35+85.578 = -RPD- PTSta. 11+66.555 (17.023m LT)

-WB-

-EB-

-LTV-

S 3°49'54.3"W

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

MATCHLINE TO SHEET 7 -LTV- STA. 29+88.000

MATCHLINE TO SHEET 15 -LTV- STA. 36+14.000

MATCHLINE TO SHEET 7

-LTV- +15.000 RT STA. 29+73.179 (14.317m)

-LTV- +20.000 LT STA. 29+73.179 (19.317m)

-RPD-
PI Sta. 6+45.078
Δ = 107°49'52" (LT)
D = 4.000°
L = 1395.00
R = 2865.00

PC Sta. 6+00.726
DE = 1° 0' 30"
LE = 504.00
TE = 497.95
ST = 3045'4

NOTES:
(1) SEE SHEETS 33,33 & 34 FOR -LTV- PROFILE
(2) SEE SHEET 35 FOR -RPD- PROFILE
(3) SEE CROSS-SECTIONAL AND ROADWAY STANDARD DRAWING NO. 852.01, SHEET 7 FOR SPECIAL MEDIAN GRADING

MATCHLINE TO SHEET 14-A

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA.

LOCATION:

TIP NO.: COUNTY:

DESIGNED BY: DATE:

CHECKED BY: DATE:

Figure 3

PROJECT REFERENCE NO.	SHEET NO.
R-2552AB	8
R/W SHEET NO. R-2552AA *22 & R-2552AB *8	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

5 0 10

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONST.REV.

R/W REV.

REVISIONS

8/17/99

-L-
PI= 38+81.623
Δ= 20° 44' 47.5" (RT)
L = 905.237
T = 457.630
R = 2,500.000
SE = .03
Vdes. = 110 km/hr

STA. 39+89.046 -L-
BEGIN TIP PROJECT R-2552AB (R/W)

(R-2552AA)
-L- +40.000
45.000m
(147.64')

BEGIN APPROACH SLAB
-L- POC 39+33.844
10.500m LT.

BEGIN BRIDGE
-L- POC 39+46.974
10.500m LT.

(R-2552AA)
-L- PL
45.000m
(147.64')

EXISTING R/W

END BRIDGE
-L- POC 42+00.903
10.500m LT.

END APPROACH SLAB
-L- POC 42+09.378
10.500m LT.

+68.000
56.000 (183.73')
48.000 (157.48')
45.000 (147.63')

DRY DETENTION / HAZARDOUS SPILL BASIN

+60.000
48.000 (157.48')

+60.000
45.000 (147.64')

PDE PDE PDE PDE TDE

MATCH LINE SEE SHEET 7 STA. 38+65.000

MATCH LINE SEE SHEET 9 STA. 42+20.000

39 -L- 40 -L- 41 42

STA. 39+50.000 -L-
BEGIN TIP PROJECT R-2552AB

BEGIN BRIDGE
-L- POC 39+77.907
10.500m RT.

BEGIN APPROACH SLAB
-L- POC 39+69.608
10.500m RT.

(R-2552AA)
-L- +40.000
45.000m
(147.64')

(R-2552AA)
-L- PL
45.000m
(147.64')

END BRIDGE
-L- POC 42+07.860
10.500m RT.

NOTE: SEE CROSS-SECTIONS AND ROADWAY STANDARD DRAWINGS STD.NO.865.01, SHEET 2 FOR SPECIAL MEDIAN GRADING
SEE SHEETS 18 AND 19 FOR -L- PROFILE
SEE SHEET 2-C FOR DRAINAGE DETAILS
SEE SHEETS S-1 TO S-7 FOR STRUCTURE PLANS

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA

8/17/99

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-2552AB	9
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONST.REV.

R/W REV.

NOTE: SEE CROSS-SECTIONS AND ROADWAY STANDARD DRAWINGS.
STD.NO.865.01, SHEET 2 FOR SPECIAL MEDIAN GRADING.
SEE SHEETS 19 AND 20 FOR -L- PROFILE
SEE SHEET 2-C FOR DRAINAGE DETAILS

-L-
PI= 38+81.623
Δ= 20° 44' 47.5" (RT)
L = 905.237
T = 457.630
R = 2,500.000
SE = .03
$V_{DES.}$ = 110 km/hr

MATCH LINE SEE SHEET 8 -L- STA 42+20.000

MATCH LINE SEE SHEET 10 -L- STA 45+88.000

-L- STA 42+20.000

+30.000
56.000 (183.73')

+61.000
49.000 (160.76')
45.000 (147.63')

+29.230
45.000 (147.64')

+43.000
45.000 (147.64')

+05.000
55.000 (180.45')

END SPECIAL GRADING
-L- POT 44+16.233

+34.000
45.000 (147.64') &
55.000 (180.45') &
56.000 (183.73')

+84.000
58.000 (190.29')

+25.000
58.000 (190.29')

+60.000
48.000 (157.48')

+80.000
48.000 (157.48')

PDE

E

RW

CA

3

-L-

43

44

45

S 64°19'07.4" E

END APPROACH SLAB
-L- POC 42+23.323
10.500m RT.

-L- PT 43+29.230
45.000 (147.64')

+95.000
45.000 (147.64')

+20.000
48.000 (157.48')

+60.000
48.000 (157.48')

+92.000
45.000 (147.64')

+48.000
45.000 (147.64')

DRY DETENTION /
HAZARDOUS SPILL BASIN

+48.000
85.000 (278.87')

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA

R-2552AB_09.dgn
Bocore 24" R8212160

PROJECT REFERENCE NO.	SHEET NO.
R-2552AB	12
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONST.REV.

R/W REV. 6/10/04

REVISIONS

8/17/93

NOTE: SEE SHEETS 23 AND 24 FOR -L- PROFILE
SEE SHEET 22 FOR -RPA- PROFILE
SEE SHEET 25 FOR -RPD- PROFILE
SEE SHEET 2-C FOR DRAINAGE DETAILS
SEE SHEET C-? TO C-? FOR CULVERT PLANS

-RP-A

PIs = 10+38.594
R 1 = 1682.500
Θs 1= 1° 05' 20.3" (RT)
R 2 = 400.000
Θs 2 = 4° 35' 04.4" (RT)
Ls = 64.000
LT = 38.594
ST = 25.455

PI = 11+55.297
Δ = 25° 42' 50.9" (RT)
L = 179.519
T = 91.297
R = 400.000
SE = .08
V = 100 km/hr

PIs = 12+64.865
Θs = 4° 35' 01.2" (RT)
Ls = 64.000
LT = 42.681
ST = 21.346

-L-

PIs= 54+26.592
Θs = 1° 36' 03.3" (LT)
Ls = 95.000
LT = 63.336
ST = 31.669

PI= 57+45.284
Δ = 19° 10' 00.7" (LT)
L = 568.692
T = 287.028
R = 17,000.000
SE = .04
Vdes. = 110 km/hr

PIs= 60+58.617
Θs = 1° 36' 03.3" (LT)
Ls = 95.000
LT = 63.336
ST = 31.669

RP-A- CS 12+43.519
30.000 (98.43')

-RPA- +18.000
48.000 (157.48')

RP-A- SC 10+64.000
30.000 (98.43') &
36.000 (118.11')

-RPA- +85.000
44.000 (144.36')
30.000 (98.43')

-RPA- +68.000
42.000 (137.80')

-RPA- +76.000
30.000 (98.43')

-L- POC 57+89.672
-RP-A TS 10+00.000
OFFSET 17.700 (LT)

-RPA- +40.000
30.000 (98.43') &
36.000 (118.11')

-RPA- +00.000
30.000 (98.43')

PDE PDE PDE PDE PDE

DRY DETENTION / HAZARDOUS SPILL BASIN

CHORD

MATCH LINE SEE SHEET 11 -L- STA 55+20.000

MATCH LINE SEE SHEET 13 -L- STA 58+20.000

-L-

56 57 58

20 12 11

CHORD

-RP-D SRS 10+64.000
30.000 (98.43')

-RP-D SC 11+28.000
30.000 (98.43')

CHORD

+91.499
30.000 (98.43')

TDE TDE TDE

-RPD- +29.000
30.000 (98.43') &
47.000 (154.20')

+18.510
30.000 (98.43')

-L- POC 57+18.510
-RP-D TS 10+00.000
OFFSET 17.700 (RT)

-RPD- +04.000
30.000 (98.43')

-RPD- +17.000
47.000 (154.20')

CHORD

+00.000
45.000 (147.64')

-RP-D

PIs = 10+21.334
Θs = 1° 04' 02.6" (RT)
Ls = 64.000
LT = 42.667
ST = 21.334

PIs = 11+06.681
Θs = 4° 38' 30.5" (LT)
Ls = 64.000
LT = 42.681
ST = 21.347

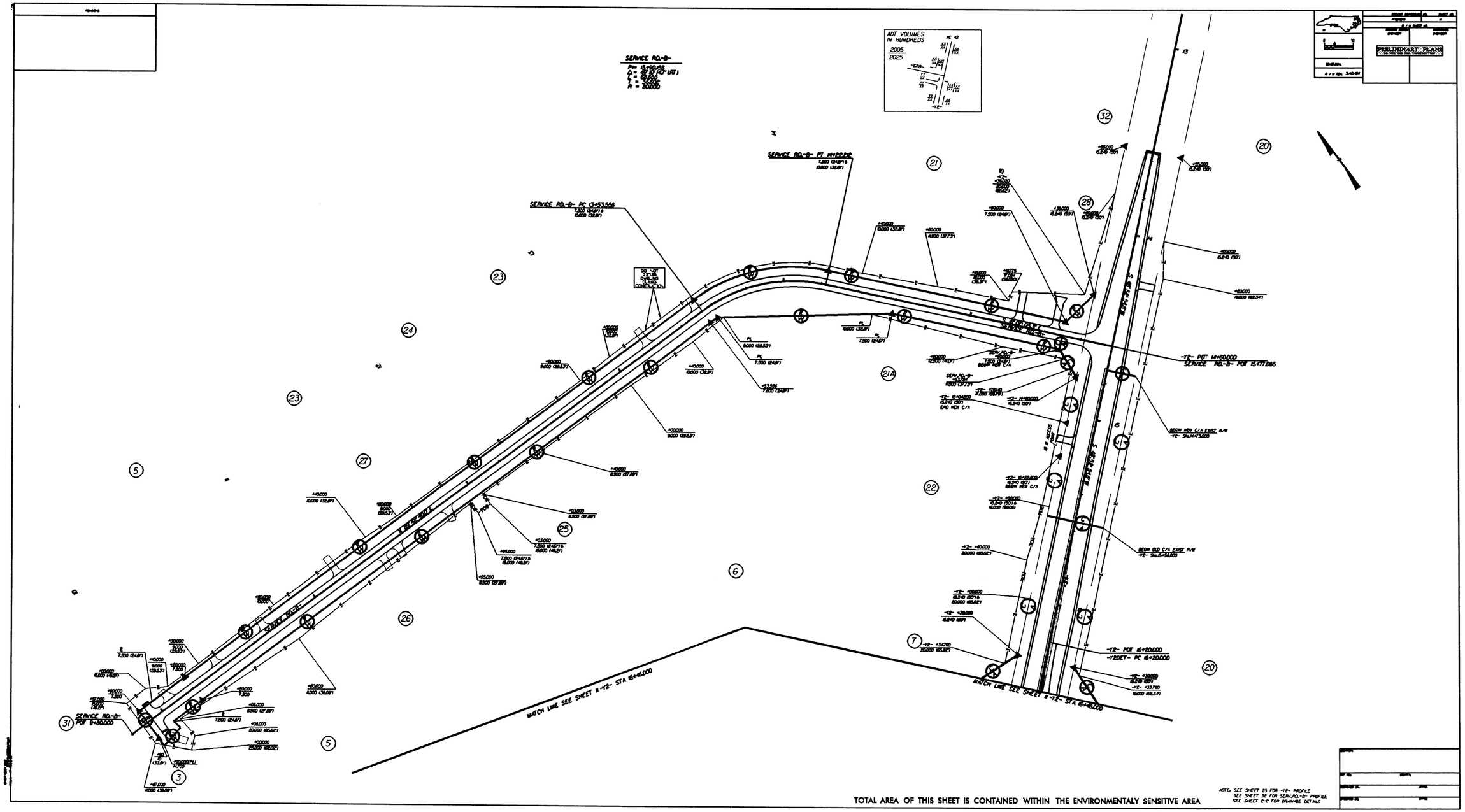
PI = 12+24.123
Δ = 27° 21' 14.7" (LT)
L = 188.580
T = 96.123
R = 395.000
SE = .08
V = 100 km/hr

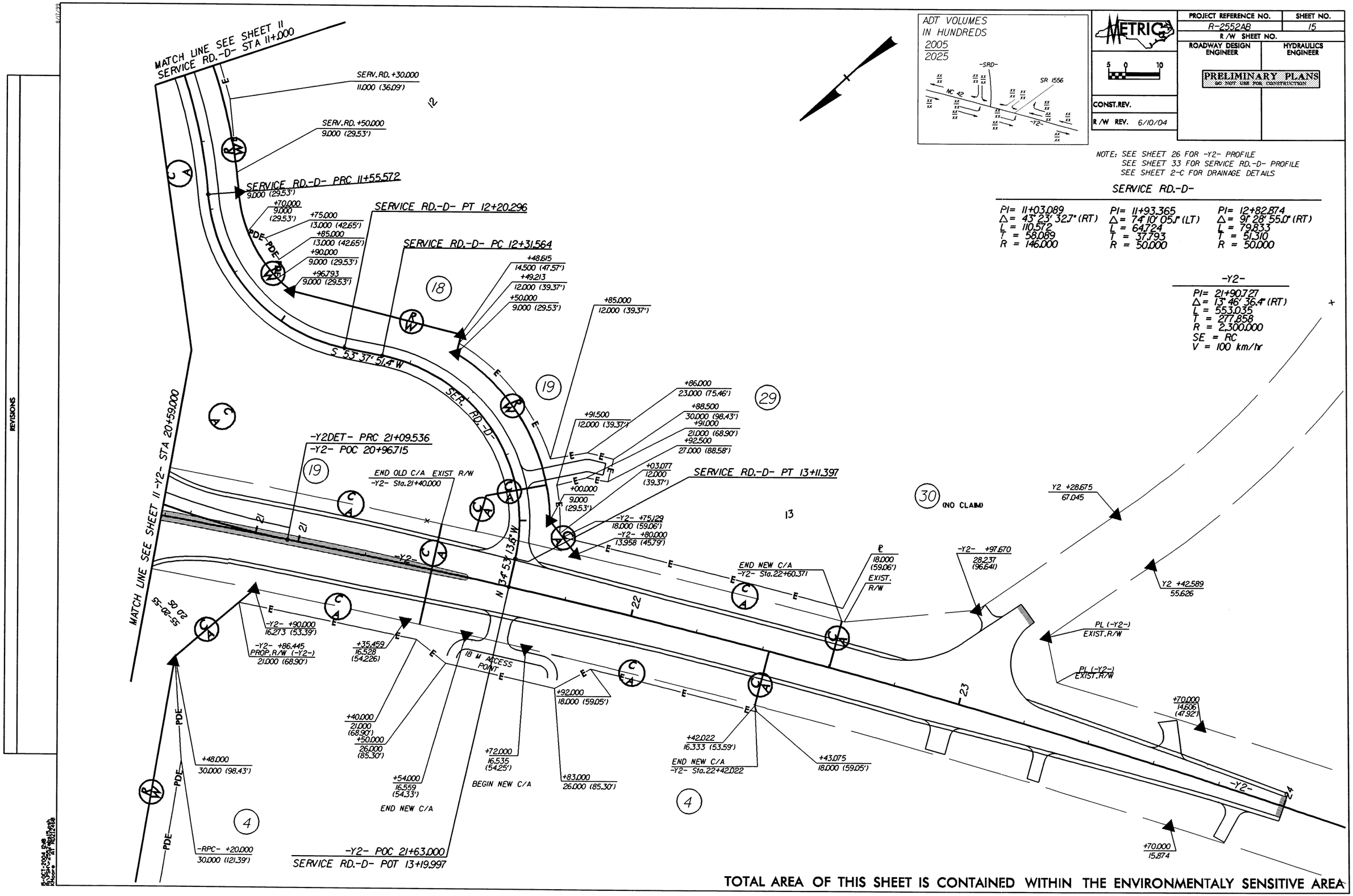
STA. 58+00.000 -L-

END TIP PROJECT R-2552SB

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA

5-OCT-2004 08:12
rhicks 25" Roll12AB


SERVICE RD.-B-
ADT VOLUMES IN HUNDREDS
2005
2025
PRELIMINARY PLANS
SERVICE RD.-B- PT 14+22.26
SERVICE RD.-B- PC 13+53.56
SERVICE RD.-B- PT 14+80.000
SERVICE RD.-B- POE 15+77.085
SERVICE RD.-B- POT 9+80.000
-Y2- PT 14+80.000
-Y2- PC 15+20.000
-Y2DET- PC 15+20.000
-Y2- POE 15+80.000
MATCH LINE SEE SHEET 8 -Y2- STA 15+45.000
MATCH LINE SEE SHEET 8 -Y2- STA 15+45.000
TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA
NOTE: SEE SHEET 25 FOR -Y2- PROFILE
SEE SHEET 3R FOR SERVICE RD.-B- PROFILE
SEE SHEET E-C FOR DRAINAGE DETAILS



ADT VOLUMES
IN HUNDREDS
2005
2025

METRIC
5 0 10

CONST.REV.

R/W REV. 6/10/04

PROJECT REFERENCE NO.	SHEET NO.
R-2552AB	15
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NOTE: SEE SHEET 26 FOR -Y2- PROFILE
SEE SHEET 33 FOR SERVICE RD.-D- PROFILE
SEE SHEET 2-C FOR DRAINAGE DETAILS

SERVICE RD.-D-

PI= 11+03.089
Δ= 43° 23' 32.7" (RT)
L = 110.572
T = 58.089
R = 146.000

PI= 11+93.365
Δ= 74° 10' 05.1" (LT)
L = 64.724
T = 37.793
R = 50.000

PI= 12+82.874
Δ= 91° 28' 55.0" (RT)
L = 79.833
T = 51.310
R = 50.000

-Y2-

PI= 21+90.727
Δ= 13° 46' 36.4" (RT)
L = 553.035
T = 277.858
R = 2,300.000
SE = RC
V = 100 km/hr

TOTAL AREA OF THIS SHEET IS CONTAINED WITHIN THE ENVIRONMENTALY SENSITIVE AREA

REVISIONS

9/17/2004

Fig. 4

REVISIONS

R/W REVISION MADE 15 JUNE 2000 JDH
R/W REVISION MADE 6 JULY 2000 JDH
R/W REVISION MADE 5-15-01 JDH
R/W REVISION MADE 07-01-01 JDH
R/W REVISIONS - JUNE 7,2002 PER SUBMITTAL OF APRIL 9,2002 VARIOUS NAME AND PLANNING CHANGES ADDITION OF PARCEL NUMBERS 38,39,41,39B,39C 39H

MATCHLINE -Y11- REV 16+82.200 SEE SHEET 22

MATCHLINE -Y11- 17+38 SEE SHEET 23

-Y11- REV +00 45.6 (149.61') 8 @ 400

-Y8- REV POT 17+38.000
RP-A- POT 4+40.074

-Y11- REV +24 30 (98.43')

-L- PC 93+95.000 LB=
-L-LT POT 93+95.000 MOS LT/LA
-L-RT POT 93+95.000 MOS RT/LA

-L- POC 95+65.654=
-Y8- POC 8+40.558

-L- POC 95+65.654=
-Y8- DET POT 8+40.558

-L-LT PC 94+63.401

-Y8- PT 8+71.633

-L- POC 97+82.54=
-Y8- POC 8+93.246=
-Y8- POT 9+93.000

-Y8- PC 20+34.547

-L-LT PT 99+54.728

-L-LT

-L-RT

RP-A- ST 2+64.900

RP-A- CS 1+92.900

TYPE A SALT BASIN

RP-A- SRS 3+46.847

RP-B- CS 2+44.847

RP-B- SC 3+88.847

-Y8- PT 0+36.000 = -Y8- DET PT 0+36.000 LA BEGIN CONSTRUCTION

RP-B- PT 5+79.654

RP-C- CS 2+82.804

RP-C- SC 0+87.810

RP-C- ST 3+53.804

RP-D- PT 7+02.522

RP-C- POT 4+46.589
RP-D- POT 7+32.522
-Y8-REV POT 20+33.000

RP-D- SC 9+56.78

RP-D- SRS 4+84.78

RP-D- CS 4+82.78

-L-RT

-L-LT PC 94+63.401

-L-RT PC 94+63.401

-L- PC 84+63.401

-Y11- REV 20+80 SEE SHEET 21

-Y11- REV 17+38 SEE SHEET 23

SEE SHEET 14

SEE SHEET 16

SEE SHEET 21

SEE SHEET 22

MATCHLINE -L- 93+60

MATCHLINE -L- 101+00

A

B

C

D

40 TAPER

30 TAPER

CABLE GUIDERAIL

TYPE III

ESTIMATED 1999/2025 ADT
ITST- 13 : 14800
DUAL - 13 : 15,800

ITST-10% DUAL - 3% : 3100 4600 1800 1800 1800 1800 1800 1800

US 70 BYPASS (CLAYTON BYPASS)

RP 1549 (RAMP No.)

=PAVEMENT REMOVAL
=MONOLITHIC ISLAND
=PROPOSED TRAFFIC SIGNAL

PRELIMINARY PLANS
NOT FOR CONSTRUCTION

PROJECT REFERENCE NO. R-2633B
SHEET NO. 15
R/W SHEET NO.
ROADWAY DESIGN Engineer
HYDRAULICS Engineer
CONST. REV.
R/W REV.

LOCATION: SR 70 / CLAYTON BYPASS FROM EAST OF SR 1172 TO EAST OF SR 1180 (BRANCH ROAD)

TIP NO.: R-2633B COUNTY: JOHNSTON

DESIGNED BY: J.D.THOMPSON DATE: 3-00

CHECKED BY: DATE:

PROJECT REFERENCE NO.	SHEET NO.
R-2552B	22
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONST.REV.

R/W REV.

REVISIONS

R/W REVISION - 6-15-2000 JDW
R/W REVISION - 6-15-2000 JDW
R/W REVISION - 9-25-2000 MRH
R/W REVISIONS - 06-07-02 MRH
R/W REVISIONS - 07-11-02 MRH
R/W REVISIONS - 11-08-02 PER SUBMITTAL OF 11-04-02 MRH
R/W REVISIONS - AUGUST 26, 2004 DUE TO DRAINAGE REVISIONS. ADDED TEMPORARY DRAINAGE EASEMENT LEFT AND RIGHT OF EXISTING -Y11- AT EXISTING BRIDGE FOR GRADING PURPOSES ON PARCELS 40 AND 58. ADJUSTED RIGHT OF WAY RIGHT OF -Y11REV- ON PARCEL 60. AND ADDED TEMPORARY CONSTRUCTION EASEMENT TO PARCEL 42

-Y13-REV
PI= 9+56.970
Δ = 25° 37' 03.8" (LT)
L = 71.538
T = 36.377
R = 160.000
SE = 0.040

-Y13-REV
PI= 10+29.999
Δ = 13° 55' 05.1" (RT)
L = 19.433
T = 9.765
R = 80.000
SE = 0.030

-Y11-
PI= 13+31.101
Δ = 21° 30' 04.3" (RT)
L = 191.589
T = 96.935
R = 510.541

-Y13-REV +87.527 9 (29.53')
-Y13-REV POT 8+87.738
BEGIN CONSTRUCTION 9+00
-Y13-REV +20.53 9 (29.53')
-Y13-REV +87.365 9 (29.53')
-Y13-REV +20.593 26 (85.30')
-Y13-REV PC 9+20.593
-Y13-REV +30 28 (91.86')
-Y13-REV +20.53 9 (29.53')
-Y13-REV +20.593 20 (65.617')
-Y13-REV PT 9+92.131
-Y13-REV +65 9 (29.53')
-Y11-REV +48 30 (98.43')
-Y11-REV POT 15+62.000
-Y13-REV POT 10+00.000
-Y13-REV +62 9 (29.53')
-Y11-REV +06 30 (98.43')
-Y11-REV +80 30 (98.43')
-Y11-REV +00 18 (59.06')
-Y11-REV +00 15 (49.21')
-Y11-REV +12 21 (68.90')
-Y11-REV +30 30 (98.43')
-Y13-REV N 17° 30' 21" W
-Y13-REV PC 10+20.234
-Y13-REV +39.667 9 (29.53')
-Y11-REV +80 34 (111.55')
-Y11-REV +90 35 (114.83')
-Y13-REV +39.667 9 (29.53')
+16 37.505 (RT) (123.05')
PL 48.509 (RT) (159.15')
PL 42.240 (RT) (138.58')
-Y11-REV +00
-Y11-REV +40 33 (108.27')
-Y11-REV +59.260 25 (82.02')
-Y11- +10 EX. R/W & 17.0 (55.774')
-Y11- PT 14+85.755
-Y11 +25.755 9.144 (30')
-Y11- +35 28.0 (91.863')
-Y11- +64.700 9.144 (30')
-Y11-REV +63.750 30 (98.43')
-Y11-REV +05.62 30 (98.43)
-Y11-REV +41 30 (98.43')
-Y13-REV PT 10+39.667
-Y11- +65.653 EX. R/W
+13 EX. R/W
-Y11- +00 40.0 (131.234')
-Y11-REV S 41° 04' 54.9" W
-Y11-REV N 42° 55' 05.1" W
-Y11-REV STA 17+65
REMOVED PROF CURB & GUTTER
BEGIN FENCE
REMOVE EXISTING BRIDGE
EXIST. R/W TO BE ABANDONED
MATCHLINE -Y11-REV 16+82.200 SEE SHEET 15
MATCHLINE -Y13-REV 10+40 SEE SHEET 23
MATCHLINE -Y11- 15+10.500 SEE SHEET 23
MATCHLINE -Y11-REV 13+40 SEE SHEET 21
NAD 83
14+00
15+00
16+00
GRAU 350
TDE
AT-1
AT-2
C A
= PAINT STRIPING
= MONOLITHIC ISLAND
= PAVEMENT REMOVAL

FOR BRIDGE SKETCH SEE SHEET 2-H
FIR DITCH DETAILS SEE SHEET 2-F
-Y11-REV ALIGNMENT SEE PROFILES 38-40
-Y13-REV ALIGNMENT SEE PROFILE 48

8-OCT-2004 06:55

PROJECT REFERENCE NO.	SHEET NO.
R-2552B	24
R /W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONST.REV.

R /W REV.

REVISIONS
R/W REVISION - 7-31-2000 JDM
R/W REVISION - 8-08-2000 JDM
R/W REVISIONS - 6-07-02 MRH
R/W REVISIONS - FEBRUARY 19, 2004 - EXTENDED CONTROL OF ACCESS TO 23+35 LT &RT -YIIREV- ON PARCEL 39 BY MRH

18-OCT-2004 06:59
K:\TIP\R2552B\roadway\r2552bx24.dgn
SDKendall

ESA

MATCHLINE -Y11- 21+67.700 SEE SHEET 15

MATCHLINE -Y11-REV 20+80 SEE SHEET 15

MATCHLINE -Y11-REV 24+40 SEE SHEET 25

CAROLINA PACKERS INC.
DB 610 PG 403
DB 557 PG 225
902

CAROLINA PACKERS INC.
DB 921 PG 523
39

JOHN A JONES JR.
DB 951 PG 315
64

JOSEPH M WHITLEY
DB 945 PG 470
36

TAYLOR MORTON LANGFORD, JR.
DB 931 PG 775
34

-Y11-
PI= 21+83.114
Δ = 53° 11' 04.5" (RT)
L = 275.857
T = 148.767
R = 297.181

-BY11- 36 PINC 18+81.761
-Y11- 22+64.285± OFF 13.978

-Y11- PT 23+10.204

-DR-1
PI= 10+69.241
Δ = 67° 42' 32.4" (RT)
L = 106.357
T = 60.374
R = 90.000

-Y11- POT 24+10.000 L.B. =
-DR-1 POT 10+00.000 L.A.
BEGIN CONSTRUCTION -DR-1

-BY11- 1 S 18° 51' 46.2" W

S 55° 12' 35.2" W

-BY11-
-Y11-
S 54° 07' 03.5" W

-Y11-REV TS 21+39.185
-Y11-REV +39.185
30 (98.43')

-Y11-REV SC 21+99.185
-Y11-REV +99.185
30 (98.43')

OLD C/A LIMITS

(CHORD)

-Y11-REV
PI= 21+79.187
Θs= 1° 57' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

-Y11-REV
PI= 22+85.954
Δ = 11° 19' 35.1" (LT)
L = 172.973
T = 86.769
R = 875.000
SE = 0.080

-Y11-REV
PI= 23+92.160
Θs= 1° 57' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

NEW C/A LIMITS

+35
END C/A
& FENCE
LT. & RT

-Y11-REV +90
30 (98.43')

-Y11-REV +72.157
30 (98.43')

-Y11-REV CS 23+72.157

-Y11-REV

-Y11-DET
S 37° 22' 46.2" W

-Y11-DET PC 20+97.684

-Y11-DET PT 21+82.485

-Y11-DET
+00
15
(49.21')

-Y11-REV +39.185
30 (98.43')

-Y11-REV +99.185
30 (98.43')

-Y11-DET
+00
14
(45.93')

-Y11-REV
+45
30
(98.43')

-Y11-DET
PI =21+40.117
Δ = 5° 33' 10.2" (LT)
L = 84.801
T = 42.434
R = 875.000
SE = 0.060

S 39° 16' 51" W
267.005

TEMPORARY
450 CSP
143

TEMPORARY
GRADE TO DRAIN

TEMPORARY
GRADE TO DRAIN

-Y11-DET
S 31° 49' 35.9" W

PERMANENT SOIL
REINFORCEMENT MATTING
TRANSITION PROTECTION
DETAIL 13
EST 80 SM

-Y11-REV +03
30
(98.43')

-Y11-REV +94.5
37.5
(123.03')

-Y11-REV +96.5
66
(216.54')

NOTE:
MAN MADE POND
DRAIN & REMOVE P
BERM TO
RETURN TO
NATURAL
CONDITIONS

FILL POND

REMOVE BERM

TDE

S 00° 10' 47" E
263.755

-Y11-REV
+41
30
(98.43')

-Y11-REV
+72.157
30
(98.43')

-Y11-DET POT 24+32.157 L.B.=
-Y11-REV ST 24+32.157

JOSEPH M WHITLEY
DB 945 PG 470
NEUSE RIVER BUFFER

-Y11-REV +32.157
30 (98.43')

-Y11-REV POS 24+10.000
-DR-1 PT 11+29.325

N 58° 07' 24" W
324.96

-DR-1 PT 11+15.224

-DR-1
+00
9.144 (30')

-DR-1
+08.867
9.144 (30')

-DR-1 PC 10+08.867

-DR-1
+50
15 (49.21')

-DR-1 10+87
9 (29.53')

-BYII- 1037 PINC 20+66.744
-YII- 24+41.265± OFF 4.349

SEE DETAIL SHEET 2-H
EST 20 TONS CLASS 'B' RIP RAP
EST 25 SM FF

LATERAL 'Y' DITCH DETAIL 5

AT-1

600 RCP

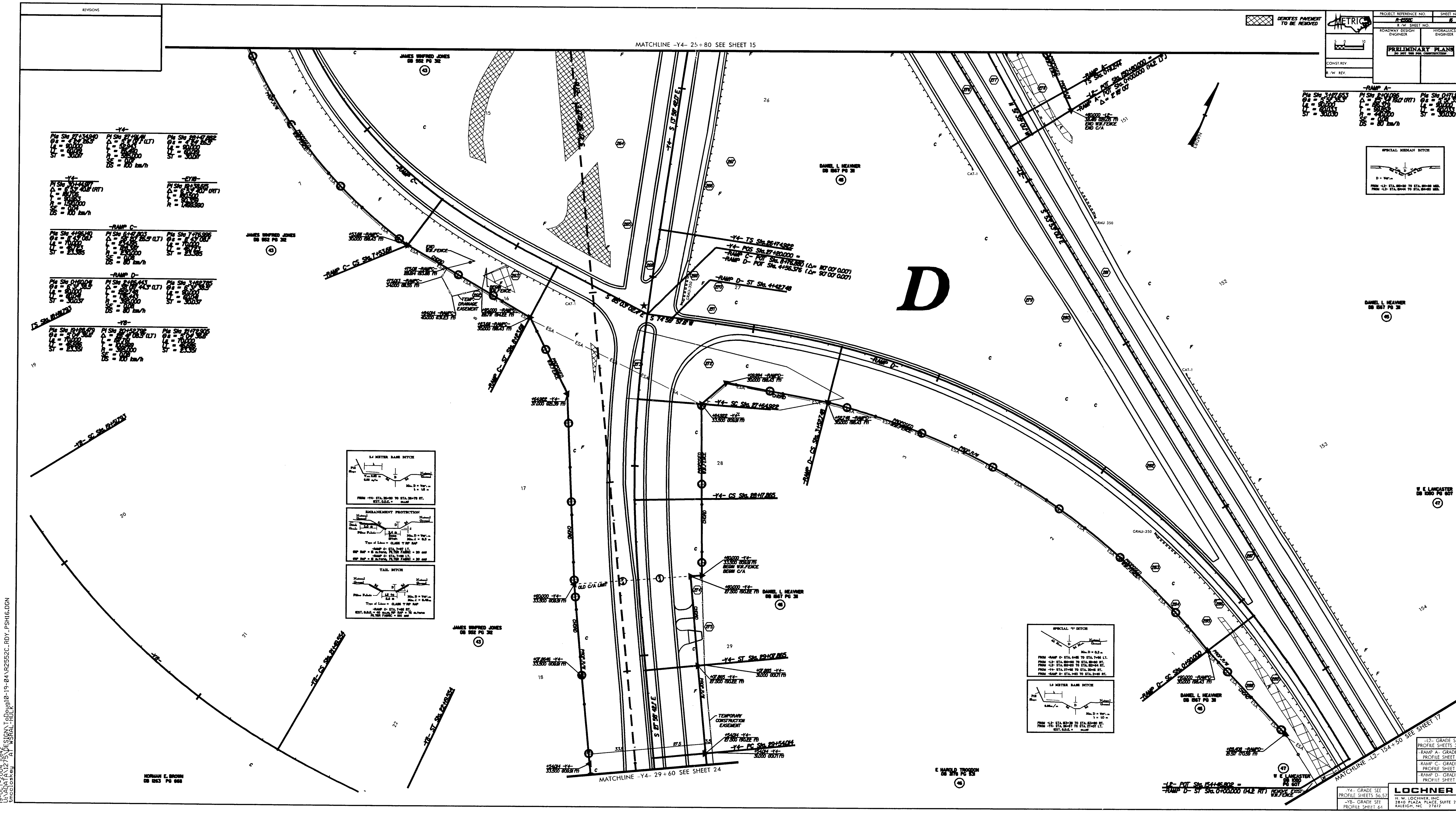
INLET CHANNEL IMPROVEMENTS SEE DETAIL 18 DDE EST 38 CM

BZ-2

FOR DITCH DETAILS SEE SHEET 2-F
-Y11-DET ALIGNMENT SEE PROFILE 41
-Y11-REV ALIGNMENT SEE PROFILES 38-40
-DR-1 ALIGNMENT SEE PROFILE 46

= PAINT STRIPING
= MONOLITHIC ISLAND
= PROPOSED REMOVAL OF EXISTING PAVEMENT & OBLITERATION

Figure 5



19-OCT-2004 10:42
U:\ADATA\1275\DESIGN\ToDoug10-19-04\R2552C_RDY_PSH16.DGN
tmccloskey AT WSRAL-HULK

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-2552C	24
R /W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONST.REV.

R /W REV.

-EY18-
PI Sta 19+38.615
Δ = 6° 53' 40.7" (RT)
L = 180.500
T = 90.359
R = 1,499.990

-Y4-
PI Sta 30+44.977
Δ = 6° 53' 40.8" (RT)
L = 181.706
T = 90.963
R = 1,510.000
SE = 0.04
Runoff = As shown
DS = 100 km/h

-Y7-
PI Sta 11+09.902
Δ = 4° 37' 00.0" (RT)
L = 96.691
T = 48.372
R = 1,200.000
SE = 0.03
Runoff = As shown
DS = 80 km/h

-Y8-
PIs Sta 19+28.479
Θs = 5° 04' 36.6"
Ls = 70.000
LT = 46.686
ST = 23.351

PI Sta 20+52.792
Δ = 28° 41' 08.5" (LT)
L = 197.761
T = 100.999
R = 395.000
SE = 0.08
DS = 100 km/h

PIs Sta 21+72.905
Θs = 5° 04' 36.6"
Ls = 70.000
LT = 46.686
ST = 23.351

NAD83

MATCHLINE -Y4- 29+60 SEE SHEET 16

-Y8- CS Sta. 21+49.554

-Y8- ST Sta. 22+19.554

-Y8-
S 87° 37' 44.1" E

-Y4-

-EY18-

-Y7-

-Y4- POC Sta. 30+46.719
-Y7- POT Sta. 10+00.000
-Y8- POT Sta. 23+73.488

-Y7- PC Sta. 10+61.530

-Y4- PT Sta. 31+35.720

MATCHLINE -Y7- 11+30 SEE SHEET 26

MATCHLINE -Y4- 31+60 SEE SHEET 25

S 27° 03' 01.3" E

PROP. R/W

NEW C/A LIMIT

15R CTR.

TEMPORARY CONSTRUCTION EASEMENT

TEMP. CONST. EASEMENT

+20.000 -Y4-
33.500 (109.91 ft)
END W.W. FENCE
END C/A

+53.000 -Y4-
53.000 (173.88 ft)

+60.000 -Y4-
53.000 (173.88 ft)

+65.000 -Y4-
40.000 (131.23 ft)

+85.224 -Y4-
33.500 (109.91 ft)

+87.894 -Y4-
27.500 (90.22 ft)

+20.000 -Y4-
31.000 (101.71 ft)

+26.762 -Y4-
27.500 (90.22 ft)

+30.000 -Y7-
27.500 (90.22 ft)

+85.126 -Y7-
17.930 (58.83 ft)

+35.720 -Y4-
27.500 (90.22 ft)

+44.839 -Y7-
15.000 (49.21 ft)

+61.531 -Y7-
15.000 (49.21 ft)

+00.000 -Y7-
15.000 (49.21 ft)

+44.755 -Y7-
20.946 (68.72 ft)

+88.603 -Y4-
24.746 (81.19 ft)

+25.000 -Y4-
25.043 (82.16 ft)

+39.076 -Y4-
24.531 (80.48 ft)
ON ℄ CORNER

+397

E HAROLD TROGDON
DB 1918 PG 423
57

E HAROLD TROGDON
DB 1913 PG 423
46

WILLIAM DAVID JONES
DB 1199 PG 310
58

ROGER G BOYETTE
DB 943 PG 504
59

WILLIAM DAVID JONES
DB 1199 PG 310
58

JAMES WINFRED JONES
DB 552 PG 312
43

NORMAN E. BROWN
DB 1263 PG 668

THOMAS EDWARD GREEN
DB 953 PG 514

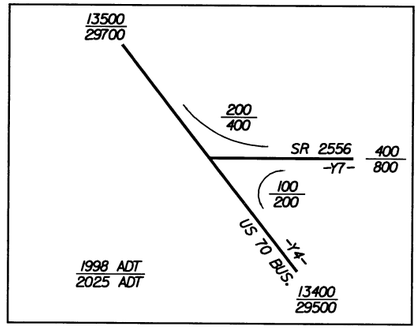
FLOYD M EDWARDS
DB 1073 PG 568
60

JAEKYU PARK
DB 903 PG 798
61

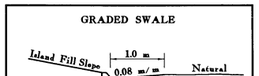
JAMES W BARBOUR
DB 999 PG 111

G O PARRISH
DB 487 PG 45
DB 485 PG 570
62

OLIVE FARMS, INC.
DB 952 PG 440
DB 731 PG 451
63



GRADED SWALE



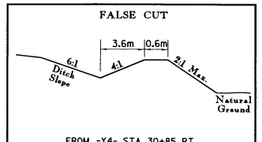
FROM -Y7- STA. 10+45 TO STA. 10+71 RT.

SPECIAL 'V' DITCH

Min. D = 0.3 m

FROM -Y7- STA. 10+80 TO STA. 11+00 RT.
FROM -Y7- STA. 10+65 TO STA. 11+40 LT.
FROM -Y4- STA. 29+60 TO STA. 30+64 RT.

FALSE CUT



FROM -Y4- STA. 30+85 RT.

-Y4- GRADE SEE PROFILE SHEET 57	-Y7 GRADE SEE PROFILE SHEET 61

LOCHNER
H. W. LOCHNER, INC.
2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

Fig 6.

Fig. 7