



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

April 8, 2004

MEMORANDUM TO: Mr. Jon G. Nance, P.E.  
Division 5 Engineer

FROM: *for* Philip S. Harris, III, P.E., Manager *PHS*  
Office of the Natural Environment  
Project Development and  
Environmental Analysis Branch

SUBJECT: Vance County; Western Outer Loop from SR 1128 to SR 1101  
near Henderson. State Work Order Number 8.2390201; TIP  
Number U-2527.

Attached are the U. S. Army Corps of Engineers Individual Permit and the Division of Water Quality 401 Certification. These permits authorize the construction of the subject project. All environmental permits have been received for the construction of this project.

PSH/ang

Attachment

cc: Mr. Art McMillan, P.E.  
Mr. Omar Sultan  
Mr. Jay Bennett, P.E.  
Mr. David Chang, P.E.  
Mr. Randy Garris, P.E.  
Mr. Greg Perfetti, P.E.  
Mr. Mark Staley  
Mr. John F. Sullivan, III, FHWA  
Mr. Chris Murray, Division 5 DEO

# SPECIAL PROJECT COMMITMENTS

Western Outer Loop

From SR 1128 (Ruin Creek Road) to SR 1101 (Old Country Home Road) near Henderson,  
Vance County, Federal Aid No. STP-0509(2), State Project No. 8.2390201

T.I.P. Project U-2527

In addition to the standard Section 404 Only Conditions, Regional Conditions, State Consistency Conditions, General Certification Conditions, and Section 401 Conditions of Certification, the following special commitments have been agreed to by the NCDOT:

## **Commitments Developed Through Project Development and Design**

### ***Project Development & Environmental Analysis Branch, Hydraulics Unit***

Conditions for a Nationwide Permit No. 14 (minor road crossings) from the Corps of Engineers applies to the project. The project also requires a 401 Water Quality Certification from the N.C. Division of Environmental Management.

### ***Project Development & Environmental Analysis Branch, Hydraulics Unit***

The subject project is now included within the Tar-Pam River Basin; therefore, the Tar-Pam Basin buffer rules apply and NCDOT will need a Buffer Authorization from the NC Division of Water Quality (NCDWQ).

### ***Geotechnical Unit***

A field reconnaissance survey identified four underground storage tank (UST) facilities within the project limits. NCDOT will conduct a site assessment of underground storage facilities located within the project area during the right of way acquisition phase of the project. If leaks and contamination have occurred, NCDOT will notify the N.C. Division of Water Quality.

### ***Division 5 Construction Office, Location and Surveys Unit***

This project will impact one geodetic survey marker. NCDOT will notify the N.C. Geodetic Survey prior to construction with regards to the geodetic survey marker, located north of SR 1974.

### ***Roadside Environmental Unit, Division 5 Construction Office***

Increased stream channelization and sedimentation are the major anticipated impacts to water quality. Scouring of the stream bed, soil compaction, and loss of shading due to vegetation removal are also potential impacts. Increased sedimentation from lateral flows along with erosion is expected. Precautions will be taken to minimize impacts to water resources in the study area. NCDOT's Best Management Practices for the Protection of Surface Waters and Sedimentation Control guidelines will be enforced throughout construction.

### ***Roadside Environmental Unit, Division 5 Construction Office***

In order to minimize potential adverse impacts to the dwarf-wedge mussel, wetlands, and stream resources in the study area, the NCDOT's High Quality Water (HQW) Best Management Practices (BMPs) for the Protection of Surface Waters and Sedimentation

Control Guidelines will be strictly enforced during construction of the project. All cleared and grubbed areas along the roadways will be re-vegetated soon after project completion to reduce loss of wildlife habitat. The NCDOT will minimize activities, including clearing and grubbing, in and adjacent to bodies of water.

***Roadside Environmental Unit, Division 5 Construction Office***

Written notification of the project commencement date will be sent to the North Carolina Wildlife Resource Commission (NCWRC) and the U.S. Fish and Wildlife Service (USFWS).

***PD&EA, Roadside Environmental Unit, Division 5 Construction Office***

Two federally protected species, the dwarf-wedge mussel (*Alasmidonta heterodon*) and bald eagle (*Haliaeetus leucocephalus*), were listed by the USFWS for Vance County as of May 31, 2002. These species were surveyed for and discussed in the Environmental Assessment (EA). This project will not impact any of the species currently listed for Vance County. However, the NCDOT will incorporate HQW BMP's to reduce the potential for impacts to the dwarf-wedge mussel species resulting from construction of the proposed facility.

***PD&EA, Geotechnical Unit***

The EA included a commitment to perform a preliminary hazardous materials site assessment for a residential dumpsite located on SR 1242 (Trueman Avenue). This action was in conjunction with the previously proposed extension of SR 1242 to intersect the proposed Western Outer Loop. Since the extension of SR 1242 is no longer proposed in conjunction with this project, a preliminary site assessment is not necessary.

**Commitments Developed Through Permitting**

*PD&EA, Roadside Environmental Unit, Division 5 Construction Office*

**Mitigation**

NCDOT shall mitigate for 1,528 linear feet of impact to streams with important aquatic function, as described below (2,056 linear feet of onsite stream relocation).

Compensatory mitigation for impacts to 213,994 square feet of Tar-Pamlico Riparian Buffers shall be provided for as described below.

Zone of Impact	Impacts (Square Feet)	Replacement Ratio	Total Square Feet of Mitigation Required
Zone 1	127,710	3:1	383, 130
Zone 2	86,284	1.5:1	129,426
Total	213,994		512,556

Mitigation for unavoidable impacts to Tar-Pamlico Riparian Buffers shall be provided through an in-lieu payment to the North Carolina Wetlands Restoration Program (NCWRP) at a rate of \$0.96 per square foot. Therefore, a total payment of \$492,054 shall be submitted to the NCWRP to offset the impacts. No construction activities in Tar-Pamlico Riparian buffers shall begin until payment for buffer mitigation is made and the Wetland Restoration Program receives and clears the check (made payable to DENR-Wetland Restoration

Program). The payment to NCWRP shall be sent within two months of issuance of the 404 permit.

### **Onsite Stream Relocation/Restoration**

**IMPLEMENTATION:** NCDOT shall mitigate for 1,528 linear feet of unavoidable impact to streams with important aquatic function, associated with this project, by completing 2,056 linear feet of onsite stream relocation/restoration, as described in the permit application. The stream relocation/restoration shall be constructed in accordance with the North Carolina Wildlife Resources Commission's (NCWRC) "Stream Relocation Guidelines." NCDOT shall consult with NCWRC on the stream relocation/restoration and implement all practicable recommendations in the design of specific site requirements for re-establishment of bank vegetation, and placement of meanders and habitat structures. Vegetation shall be used to the maximum extent practicable to stabilize banks, and riprap and other man-made structural measures shall be minimized. NCDOT shall construct all channel relocations/restoration in a dry work area, and stabilize the new channel before stream flows are diverted. Whenever possible, NCDOT shall allow new channels to stabilize for an entire growing season.

**AS-BUILT SURVEY:** NCDOT shall complete an as-built channel survey within sixty days of completion of the stream relocation construction. NCDOT shall document changes in the dimension, pattern, profile, vegetation plantings, and structures installed, of the relocated channel from the proposed design. NCDOT shall also include in the as-built survey: photo documentation at representative segments and structures; and a plan view diagram.

**MONITORING SCHEDULE:** NCDOT shall perform the following components of Level I monitoring each year for the 5-year monitoring period: Reference photos; plant survival (i.e., identify specific problem areas (missing, stressed, damaged or dead plantings), estimated causes, and proposed/required remedial action); visual inspection of channel stability. Physical measurements of channel stability/morphology will not be required. NCDOT shall submit the monitoring reports to the USACE, Raleigh Regulatory Field Office Project Manager, within sixty days after completing the monitoring. If less than two bankfull events occur during the first 5 years, NCDOT shall continue monitoring until the second bankfull event is documented. The bankfull events must occur during separate monitoring years. In the event that the required bankfull events do not occur during the five-year monitoring period, the USACE, in consultation with the resource agencies, may determine that further monitoring is not required. It is suggested that all bankfull occurrences be monitored and reported through the required monitoring period. NCDOT shall perform and submit photo documentation twice each year (summer and winter) for the 5-year monitoring period, and for any subsequently required monitoring period.

**MONITORING DATA/REPORT:** NCDOT shall include the following information in the Level I monitoring report for the site: reference photos; plant survival notes and recommendations, as appropriate; and a report on the visual inspection of channel stability. Physical measurements of channel stability/morphology will not be required. NCDOT shall complete the Monitoring Data Record, Sections 1, 2 and 3 (pages 1, 2 and 3, attached), for each representative segment of the channel, and for each year of monitoring (twice each year, summer and winter, for reference photos). NCDOT shall include in the monitoring reports a

discussion of any deviations from as-built and an evaluation of the significance of these deviations and whether they are indicative of a stabilizing or destabilizing situation.

**STREAM MITIGATION SUCCESS CRITERIA:** The mitigation success criteria, and required remediation actions, will be generally based on the attached Appendix II, and the Photo Documentation, Ecological Function, and Channel Stability criteria in the “Stream Mitigation Guidelines”, dated April, 2003 (available on the internet at [http://www.saw.usace.army.mil/wetlands/Mitigation/stream\\_mitigation.html](http://www.saw.usace.army.mil/wetlands/Mitigation/stream_mitigation.html)), pages 24 and 25, under “Success Criteria: ”.

Prior to, and during the construction of the natural stream design from approximate station 41+00 to 47+20, the NCDOT shall coordinate with the North Carolina Wildlife Resources Commission (NCWRC) to ensure that the construction will not result in negative impacts to threatened and endangered mussels located downstream. Should the NCWRC require changes to the proposed stream design or construction activities, a modification to the 401 Water Quality Certification may be required. Any changes to the design authorized by this certification will require written approval from the NC Division of Water Quality.

Prior to incurring impacts anywhere on the project, a revised natural channel design shall be presented to, and approved by, the NC Division of Water Quality. The revised plan shall include proposed construction plans that describe how DOT plans to construct the new stream channel and control downstream transport of sediment to the sensitive species in Red Bud Creek. A copy of the proposed stream design and construction plans shall also be submitted to the NC Wildlife Resources Commission.

Haney



REPLY TO  
ATTENTION OF:

DEPARTMENT OF THE ARMY  
WILMINGTON DISTRICT, CORPS OF ENGINEERS  
P.O. BOX 1890  
WILMINGTON, NORTH CAROLINA 28402-1890

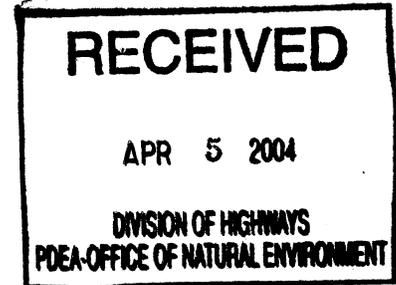


April 1, 2004

Regulatory Division

Action ID. 199708127; Tip No. U-2527

Dr. Gregory J. Thorpe, Ph.D.  
Environmental Management Director, PDEA  
N.C. Department of Transportation  
1548 Mail Service Center  
Raleigh, NC 27699-1548



Dear Dr. Thorpe:

In accordance with the written request of November 26, 2003, and the ensuing administrative record, enclosed is a permit to authorize the discharge of dredged and fill material into waters of the United States, for construction of the Western Outer Loop of Henderson (T.I.P. No. U-2527), crossing Red Bud Creek, unnamed tributaries, and an adjacent wetland, from SR 1128, to SR 1101, southwest of Henderson, in Vance County, North Carolina.

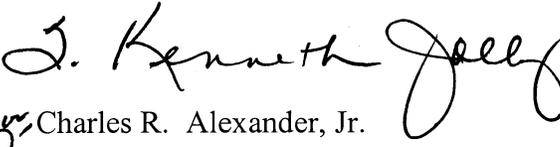
If any change in the authorized work is required because of unforeseen or altered conditions or for any other reason, the plans revised to show the change must be sent promptly to this office. Such action is necessary, as revised plans must be reviewed and the permit modified.

Carefully read your permit. The general and special conditions are important. Your failure to comply with these conditions could result in a violation of Federal law. Certain significant general conditions require that:

- a. You must complete construction before December 31, 2007.
- b. You must notify this office in advance as to when you intend to commence and complete work.
- c. You must allow representatives from this office to make periodic visits to your worksite as deemed necessary to assure compliance with permit plans and conditions.

Should you have questions, contact Mr. Eric Alsmeyer of my Raleigh Field Office regulatory staff at telephone (919) 876-8441, extension 23.

Sincerely,

  
for Charles R. Alexander, Jr.  
Colonel, U.S. Army  
District Engineer

Enclosures

Copy Furnished with enclosures:

Chief, Source Data Unit  
NOAA/National Ocean Service  
ATTN: Sharon Tear N/CS261  
1315 East-West Hwy., Rm 7316  
Silver Spring, MD 20910-3282

Copies Furnished with special conditions and plans:

Mr. Garland Pardue, Field Supervisor  
U.S. Fish and Wildlife Service  
Fish and Wildlife Enhancement  
Post Office Box 33726  
Raleigh, North Carolina 27636-3726

Mr. Ron Sechler  
National Marine Fisheries  
Service, NOAA  
Pivers Island  
Beaufort, North Carolina 28516

Mr. David Rackley  
National Marine Fisheries  
Service, NOAA  
219 Fort Johnson Road  
Charleston, South Carolina 29412-9110

Mr. Ronald Mikulak, Chief  
Wetlands Section - Region IV  
Water Management Division  
U.S. Environmental Protection Agency  
Atlanta Federal Center  
61 Forsyth Street, SW  
Atlanta, Georgia 30303

Mr. Doug Huggett  
Division of Coastal Management  
North Carolina Department of  
Environment and Natural Resources  
1638 Mail Service Center  
Raleigh, North Carolina 27699-1638

Mr. William D. Gilmore, P.E.  
EEP Transition Manager  
Ecosystem Enhancement Program  
1652 Mail Service Center  
Raleigh, NC 27699-1652

RECEIVED

MAR 3 1 2004

REGULATORY

DEPARTMENT OF THE ARMY PERMIT

Permittee NC Department of Transportation

Permit No. 199708127

Issuing Office USAED, Wilmington

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

Place fill material impacting a total of 2,368 linear feet of stream and 0.06 acres of wetlands, for construction of the Western Outer Loop of Henderson (T.I.P. No. U-2527), crossing Red Bud Creek and its unnamed tributaries.

Project Location:

From SR 1128 (Ruin Creek Road) to SR 1101 (Old County Home Road), generally southwest of Henderson, in Vance County, North Carolina.

Permit Conditions:

General Conditions:

December 31, 2007

1. The time limit for completing the work authorized ends on \_\_\_\_\_. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.
2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.
3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

d. Design or construction deficiencies associated with the permitted work.

authorized by this permit.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf

causes.

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

d. This permit does not authorize interference with any existing or proposed Federal project.

c. This permit does not authorize any injury to the property or rights of others.

b. This permit does not grant any property rights or exclusive privileges.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

2. Limits of this authorization.

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).

( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

Further Information:

See enclosed sheet.

Special Conditions:

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

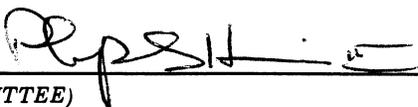
b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

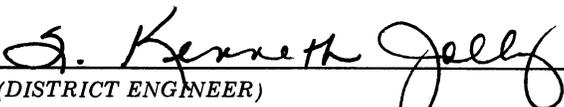
Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

  
(PERMITTEE)

3/29/04  
(DATE)

NC DEPARTMENT OF TRANSPORTATION

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

  
(DISTRICT ENGINEER)

4/1/04  
(DATE)

<sup>for</sup> CHARLES R. ALEXANDER, JR. COLONEL

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

\_\_\_\_\_  
(TRANSFEE)

\_\_\_\_\_  
(DATE)

199708129



Michael F. Easley, Governor  
William G. Ross Jr., Secretary  
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director  
Division of Water Quality  
Coleen H. Sullins, Deputy Director  
Division of Water Quality

February 19, 2004

Dr. Gregory J. Thorpe, Ph.D., Manager  
Planning and Environmental Branch  
North Carolina Department of Transportation  
1548 Mail Service Center  
Raleigh, North Carolina, 27699-1548

Dear Dr. Thorpe:

Re: 401 Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act,  
Proposed Henderson Western Outer Loop from SR 1128 to SR 1101.  
WQC Project No. 031494, TEP No. U-2527  
Vance County

Attached hereto is a copy of Certification No. 3451 issued to The North Carolina Department of Transportation dated February 13, 2004.

If we can be of further assistance, do not hesitate to contact us.

Sincerely,

Alan W. Klimek, P.E.  
Director

Attachments

- cc: Wilmington District Corps of Engineers
- Corps of Engineers Raleigh Field Office
- DWQ Raleigh Regional Office
- Bill Gilmore, Ecosystem Enhancement Program
- Travis Wilson, NC Wildlife Resources Commission
- Central Files
- File Copy

Post-It® Fax Note	7671	Date	2-23-04	# of pages	7
To	Eric Alsmeyer	From	Matt Haney		
Co./Dept.		Co.			
Phone #	876-8741	Phone #	715-1428		
Fax #	876-5823	Fax #	715-1501		





Michael F. Easley, Governor  
 William G. Ross Jr., Secretary  
 North Carolina Department of Environment and Natural Resources  
 Alan W. Klimmek, P.E. Director  
 Division of Water Quality  
 Coteen H. Sullins  
 Division of Water Quality

**Impacts to Tar-Pamlico Riparian Buffers**

Section	Zone 1	Zone 2
Site 1 (Station No. 18+40 -L)	10,340	6,714
Site 2 (Station No. 21+30 -L)	14,806	8,231
Site 3 (Station No. 23+40 -L)	12,944	8,576
Site 4 (Station No. 23+90 to 24+60)	1,356	6,165
Site 5 (Station No. 26+00 to 26+30 -L)	16,065	8,597
Site 6 (Station No. 35+40 to 35+80 -L)	6,994	7,607
Site 7 (Station No. 36+40 to 37+00 -L)	22,359	12,697
Site 8 (Station No. 40+81 -L)	11,793	8,221
Site 9 (Station No. 46+20 -L)	31,053	19,476
<b>Total</b>	<b>127,710</b>	<b>86,284</b>

The application provides adequate assurance that the discharge of fill material into the waters of the Tar-Pamlico River Basin in conjunction with the proposed development will not result in a violation of applicable Water Quality Standards and discharge guidelines. Therefore, the State of North Carolina certifies that this activity will not violate the applicable portions of Sections 301, 302, 303, 306, 307 of PL 92-500 and PL 95-217 if conducted in accordance with the application and conditions hereinafter set forth.

This approval is only valid for the purpose and design that you submitted in your application, as described in the Public Notice. Should your project change, you are required to notify the DWQ and submit a new application. If the property is sold, the new owner must be given a copy of this Certification and approval letter, and is thereby responsible for complying with all the conditions. If any additional wetland impacts, or stream impacts, for this project (now or in the future) exceed one acre or 150 linear feet, respectively, additional compensatory mitigation may be required as described in 15A NCAC 2H .0506 (h) (6) and (7). For this approval to remain valid, you are required to comply with all the conditions listed below. In addition, you should obtain all other federal, state or local permits before proceeding with your project including (but not limited to) Sediment and Erosion control, Coastal Stormwater, Non-discharge and Water Supply watershed regulations. This Certification shall expire three years from the date of the cover letter from DWQ or on the same day as the expiration date of the corresponding Corps of Engineers Permit, whichever is sooner.

**Condition(s) of Certification:**

1. Construction will be conducted in such a manner as to prevent a significant increase in turbidity outside the area of construction or construction-related discharge. Erosion and sediment control practices must be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices in order to assure compliance with the appropriate turbidity water quality standard.
  - a. The erosion and sediment control measures for the project must equal or exceed the proper design, installation, operation and maintenance outlined in the most recent version of the *North Carolina Sediment and Erosion Control Planning and Design Manual*. These devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) projects, including contractor-owned or leased borrow pits associated with the project.
  - b. For borrow pit sites, the erosion and sediment control measures must equal or exceed the proper design, installation, operation and maintenance outlined in the most recent version of the *North Carolina Surface Mining Manual*. The reclamation measures and implementation must comply with the reclamation in accordance with the requirements of the Sedimentation Pollution Control Act.



Michael F. Easley, Governor  
William G. Ross Jr., Secretary  
North Carolina Department of Environment and Natural Resources

Alan W. Kilmek, P.E. Director  
Division of Water Quality  
Coleen H. Sullins  
Division of Water Quality

We understand that you have chosen to perform compensatory mitigation for impacts to protected buffers through an in lieu payment to the North Carolina Wetland Restoration Program (NCWRP), and that the WRP has agreed to implement the mitigation for the project. Mitigation for unavoidable impacts to Tar-Pamlico Riparian Buffers shall be provided through an in-lieu payment to the North Carolina Wetlands Restoration Program (NCWRP) at a rate of \$0.96 per square foot. Therefore, a total payment of \$ 492,054 shall be submitted to the NCWRP to offset the impacts. No construction activities in Neuse River Riparian buffers shall begin until payment for buffer mitigation is made and the Wetland Restoration Program receives and clears your check (made payable to DENR - Wetland Restoration Program). The payment to NCWRP shall be sent within two months of issuance of the 404 permit. If you have any questions concerning the Wetland Restoration Program please contact them at 919-733-5208.

10. All stormwater runoff shall be directed to sheetflow through stream buffers at nonerosive velocities, unless approved otherwise by this certification.
11. NCDOT shall provide documentation to the NC Division of Water Quality with 2 months of the issuance of this 401 Water Quality Certification that demonstrates acceptance of the riparian buffer mitigation by the NC Wetlands Restoration Program, or the NC Ecosystem Enhancement Program.
12. During the construction of the project, no staging of equipment of any kind is permitted in waters of the U.S., or protected riparian buffers.
13. All temporary fills in wetlands and surface waters shall be removed upon completion of the project. In addition, the post-construction removal of any temporary bridge structures or fill will need to return the project site to its preconstruction contours and elevations. The revegetation of the impacted areas with appropriate native species will be required.
14. No changes to the horizontal or vertical placement of the stormwater outfall locations, the horizontal or vertical placement of the culverts, the horizontal or vertical placement of bridges, the horizontal or vertical placement of grassed swales, or the horizontal or vertical placement of open ditches is permitted without written approval from the NC Division of Water Quality 401 Wetlands Unit. In addition, no changes to the flow spreader locations or designs, preformed scour hole locations or designs are permitted without written approval from the NC Division of Water Quality 401 Wetlands Unit. Any request for changes to the referenced items above will require submittal of a modification request, with seven copies, and corresponding fees will need to be submitted to the North Carolina Division of Water Quality.
15. Riparian vegetation must be reestablished within the construction limits of the project by the end of the growing season following completion of construction.
16. The dimension, pattern and profile of the stream above and below the crossing should not be modified by widening the stream channel or reducing the depth of the stream. Disturbed floodplains and streams should be restored to natural geomorphic conditions.
17. Any riprap used must not interfere with thalweg performance and aquatic life passage during low flow conditions.
18. All mechanized equipment operated near surface waters must be regularly inspected and maintained to prevent contamination of stream waters from fuels, lubricants, hydraulic fluids, or other toxic materials.
19. Discharging hydroseed mixtures and washing out hydroseeders and other equipment in or adjacent to surface waters is prohibited.



Michael F. Easley, Governor  
William G. Ross Jr., Secretary  
North Carolina Department of Environment and Natural Resources  
Alan W. Klimmek, P.E. Director  
Division of Water Quality  
Coleen H. Sullins  
Division of Water Quality

**Site Specific Conditions**

- 27. Prior to, and during the construction of the natural stream design from approximately station 41+00 to 47+20, the NCDOT shall coordinate with the North Carolina Resources Commission to ensure that the construction will not result in negative impacts to threatened and endangered mussels located downstream. Should the Wildlife Resources Commission require changes to the proposed stream design or construction activities, a modification to this 401 Water Quality Certification may be required. Any changes to the design authorized by this certification will require written approval from the NC Division of Water Quality.
- 28. Prior to incurring impacts anywhere on the project, a revised natural channel design shall be presented to, and approved by, the NC Division of Water Quality. The revised plan shall include proposed construction plan that describes how DOT plans to construct the new stream channel and control downstream transport of sediment to the sensitive species in Red Bud Creek. A copy of the proposed stream design and construction plan shall also be submitted to the NC Wildlife Resources Commission.

Violations of any condition herein set forth may result in revocation of this Certification and may result in criminal and/or civil penalties. This Certification shall become null and void unless the above conditions are made conditions of the Federal 404 and/or Coastal Area Management Act Permit. This Certification shall expire upon the expiration of the 404 or CAMA permit.

If this Certification is unacceptable to you have the right to an adjudicatory hearing upon written request within sixty (60) days following receipt of this Certification. This request must be in the form of a written petition conforming to Chapter 150B of the North Carolina General Statutes and filed with the Office of Administrative Hearings, P.O. Box 27447, Raleigh, N.C. 27611-7447. If modifications are made to an original Certification, you have the right to an adjudicatory hearing on the modifications upon written request within sixty (60) days following receipt of the Certification. Unless such demands are made, this Certification shall be final and binding.

This the 19<sup>th</sup> day of February 2004

DIVISION OF WATER QUALITY

Alan W. Klimmek, P.E.  
Director





Michael F. Easley, Governor  
 William G. Ross Jr., Secretary  
 North Carolina Department of Environment and Natural Resources  
 Alan W. Kilmek, P.E. Director  
 Division of Water Quality  
 Coleen H. Sullins  
 Division of Water Quality

2. All sediment and erosion control measures shall not be placed in wetlands or waters to the maximum extent practicable. If placement of sediment and erosion control devices in wetlands and waters is unavoidable, they shall be removed and the natural grade restored after the Division of Land Resources has released the project;
3. If an environmental document is required, this Certification is not valid until a FONSI or ROD is issued by the State Clearinghouse. All water quality-related conditions of the FONSI or ROD shall become conditions of this Certification;
4. No live or fresh concrete shall come into contact with waters of the state until the concrete has hardened.
5. There shall be no excavation from or waste disposal into jurisdictional wetlands or waters associated with this permit without appropriate modification of this permit. Should waste or borrow sites be located in wetlands or stream, compensatory mitigation will be required since it is a direct impact from road construction activities.
6. All channel relocations will be constructed in a dry work area, and stabilized before stream flows are diverted. Channel relocations will be completed and stabilized prior to diverting water into the new channel. Whenever possible, channel relocations shall be allowed to stabilize for an entire growing season. Vegetation used for bank stabilization shall be limited to native woody species, and should include establishment of a 30 foot wide wooded and an adjacent 20 foot wide vegetated buffer on both sides of the relocated channel to the maximum extent practical. A transitional phase incorporating coir fiber and seedling establishment is allowable. Also, rip-rap may be allowed if it is necessary to maintain the physical integrity of the stream, but the applicant must provide written justification and any calculations used to determine the extent of rip-rap coverage requested.
7. Upon completion of the project, the NCDOT shall complete and return the enclosed "Certification of Completion Form" to notify DWQ when all work included in the 401 Certification has been completed. The responsible party shall complete the attached form and return it to the 401/Wetlands Unit of the Division of Water Quality upon completion of the project.
8. Placement of culverts and other structures in waters, streams, and wetlands must be placed below the elevation of the streambed to allow low flow passage of water and aquatic life unless it can be shown to DWQ that providing passage would be impractical. Design and placement of culverts and other structures including temporary erosion control measures shall not be conducted in a manner that may result in disequilibrium of wetlands or streambeds or banks, adjacent to or upstream and down stream of the above structures. The applicant is required to provide evidence that the equilibrium shall be maintained if requested in writing by DWQ.
9. Compensatory mitigation for impacts to 213,994 square feet of Tar-Pamlico Riparian Buffers shall be provided for as described below.

Zone of Impact	Impacts (Square Feet)	Replacement Ratio	Total Square Feet of Mitigation Required
Zone 1	127,710	3:1	383,130
Zone 2	86,284	1.5:1	129,426
Total	213,994		512,556



Michael F. Easley, Governor  
William G. Rose Jr., Secretary  
North Carolina Department of Environment and Natural Resources

Alan W. Kirtrek, P.E. Director  
Division of Water Quality  
Coleen M. Sullins  
Division of Water Quality

20. Pursuant to NCAC15A 2B.0233(6), sediment and erosion control devices shall not be placed in Zone 1 of any Neuse Buffer without prior approval by the NCDWQ. At this time, the NCDWQ has not approved any sediment and erosion control devices in Zone 1 anywhere on this project. Moreover, sediment and erosion control devices shall be allowed in Zone 2 of the buffers provided that Zone 1 is not compromised and that discharge is released as diffuse flow.
21. Two copies of the final construction drawings shall be furnished to NCDWQ prior to the pre-construction meeting. Written verification shall be provided that the final construction drawings comply with the attached permit drawings contained in the application dated November 26, 2003, and Right-of Way plans submitted on February 13, 2004.
22. All protected riparian buffers impacted by the placement of temporary fill or clearing activities shall be restored to the preconstruction contours and revegetated with native woody species upon completion of the project construction. A post-construction as-built with the restoration activities included shall be submitted to the DWQ no later than 60 days after the project is closed out by the Department of Transportation.
23. The outside buffer, wetland or water boundary as well as along the construction corridor within these boundaries approved under this authorization shall be clearly marked by orange fabric fencing for the areas that have been approved to infringe within the buffer, wetland or water prior to any land disturbing activities.
24. NCDOT, and its authorized agents, shall conduct its activities in a manner consistent with State water quality standards (including any requirements resulting from compliance with §303(d) of the Clean Water Act) and any other appropriate requirements of State law and Federal law. If DWQ determines that such standards or laws are not being met (including the failure to sustain a designated or achieved use) or that State or federal law is being violated, or that further conditions are necessary to assure compliance, DWQ may reevaluate and modify this Certification to include conditions appropriate to assure compliance with such standards and requirements in accordance with 15A NCAC 2H.0507(d). Before modifying the Certification, DWQ shall notify NCDOT and the US Army Corps of Engineers, provide public notice in accordance with 15A NCAC 2H.0503 and provide opportunity for public hearing in accordance with 15A NCAC 2H.0504. Any new or revised conditions shall be provided to NCDOT in writing, shall be provided to the United States Army Corps of Engineers for reference in any permit issued pursuant to Section 404 of the Clean Water Act, and shall also become conditions of the 404 Permit for the project.
25. A copy of this Water Quality Certification shall be posted on the construction site at all times. In addition, the Water Quality Certification (and all subsequent modifications, if any, shall be maintained with the Division Engineer and the on-site project manager.
26. Culverts that are less than 48-inch in diameter should be buried to a depth equal to or greater than 20% of their size to allow for aquatic life passage. Culverts that are 48-inch in diameter or larger should be buried at least 12 inches below the stream bottom to allow natural stream bottom material to become established in the culvert following installation and to provide aquatic life passage during periods of low flow. These measurements must be based on natural thalweg depths.

**SPECIAL CONDITIONS (Action ID. 199708127; NCDOT/TIP U-2527)**

**Work Limits**

a. All work authorized by this permit must be completed in strict compliance with the attached plans, which are a part of this permit. The permittee will ensure that the construction design plans for this project do not deviate from the permit plans attached to this authorization. Any deviation in the construction design plans will be brought to the attention of the U.S. Army Corps of Engineers (USACE), Raleigh Regulatory Field Office, prior to any active construction in waters or wetlands, and any modification to the permit plans must be approved by the USACE prior to implementation.

b. Except as authorized by this permit or any USACE approved modification to this permit, no excavation, fill, or mechanized land-clearing activities shall take place at any time in the construction or maintenance of this project, within waters or wetlands, or any activities that cause the degradation of waters or wetlands, except as authorized by this permit, or any modification to this permit. This permit does not authorize temporary placement or double handling of excavated or fill material within waters or wetlands outside the permitted area. There shall be no excavation from, waste disposal into, or degradation of, jurisdictional waters or wetlands associated with this permit without appropriate modification of this permit, including appropriate compensatory mitigation. This prohibition applies to all borrow and fill activities connected with this project.

c. Except as specified in the plans attached to this permit, no excavation, fill or mechanized land-clearing activities shall take place at any time in the construction or maintenance of this project, in such a manner as to impair normal flows and circulation patterns within waters or wetlands or to reduce the reach of waters or wetlands.

**Related Laws**

d. The North Carolina Division of Water Quality has issued a conditioned Water Quality Certification for your project, the conditions of that certification are hereby incorporated as special conditions of this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

e. All mechanized equipment will be regularly inspected and maintained to prevent contamination of waters and wetlands from fuels, lubricants, hydraulic fluids, or other toxic materials. In the event of a spill of petroleum products or any other hazardous waste, the permittee shall immediately report it to the N.C. Division of Water Quality at (919) 733-5083, Ext. 526 or (800) 662-7956 and provisions of the North Carolina Oil Pollution and Hazardous Substances Control Act will be followed.

## **Project Maintenance**

f. Unless otherwise authorized by this permit, all fill material placed in waters or wetlands shall be generated from an upland source and will be clean and free of any pollutants except in trace quantities. Metal products, organic materials (including debris from land clearing activities), or unsightly debris will not be used.

g. The permittee shall require its contractors and/or agents to comply with the terms and conditions of this permit in the construction and maintenance of this project, and shall provide each of its contractors and/or agents associated with the construction or maintenance of this project with a copy of this permit, and any authorized modifications. A copy of this permit, and any authorized modifications, including all conditions, shall be available at the project site during construction and maintenance of this project

h. The permittee shall employ all sedimentation and erosion control measures necessary to prevent an increase in sedimentation or turbidity within waters and wetlands outside the permit area. This shall include, but is not limited to, the immediate installation of silt fencing or similar appropriate devices around all areas subject to soil disturbance or the movement of earthen fill, and the immediate stabilization of all disturbed areas. Additionally, the project must remain in full compliance with all aspects of the Sedimentation Pollution Control Act of 1973 (North Carolina General Statutes Chapter 113A Article 4).

## **Enforcement**

i. Violations of these conditions or violations of Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act must be reported in writing to the USACE within 24 hours of the permittee's discovery of the violation.

## **Mitigation**

j. The permittee shall mitigate for 1,528 linear feet of impact to streams with important aquatic function, as described below (2,056 linear feet of onsite stream relocation).

## **Onsite Stream Relocation/Restoration**

k. IMPLEMENTATION: The permittee shall mitigate for 1,528 linear feet of unavoidable impact to streams with important aquatic function, associated with this project, by completing 2,056 linear feet of onsite stream relocation/restoration, as described in the permit application. The stream relocation/restoration shall be constructed in accordance with the North Carolina Wildlife Resources Commission's (NCWRC) "Stream Relocation Guidelines." NCDOT shall consult with NCWRC on the stream relocation/restoration and implement all practicable recommendations in the design of specific site requirements for re-establishment of bank vegetation, and placement of meanders and habitat structures. Vegetation shall be used to

the maximum extent practicable to stabilize banks, and riprap and other man-made structural measures shall be minimized. The permittee shall construct all channel relocations/restoration in a dry work area, and stabilize the new channel before stream flows are diverted. Whenever possible, the permittee shall allow new channels to stabilize for an entire growing season.

l. AS-BUILT SURVEY: The permittee shall complete an as-built channel survey within sixty days of completion of the stream relocation construction. The permittee shall document changes in the dimension, pattern, profile, vegetation plantings, and structures installed, of the relocated channel from the proposed design. The permittee shall also include in the as-built survey: photo documentation at representative segments and structures; and a plan view diagram.

m. MONITORING SCHEDULE: The permittee shall perform the following components of Level I monitoring each year for the 5-year monitoring period: Reference photos; plant survival (i.e., identify specific problem areas (missing, stressed, damaged or dead plantings), estimated causes, and proposed/required remedial action); visual inspection of channel stability. Physical measurements of channel stability/morphology will not be required. The permittee shall submit the monitoring reports to the USACE, Raleigh Regulatory Field Office Project Manager, within sixty days after completing the monitoring. If less than two bankfull events occur during the first 5 years, the permittee shall continue monitoring until the second bankfull event is documented. The bankfull events must occur during separate monitoring years. In the event that the required bankfull events do not occur during the five-year monitoring period, the USACE, in consultation with the resource agencies, may determine that further monitoring is not required. It is suggested that all bankfull occurrences be monitored and reported through the required monitoring period. The permittee shall perform and submit photo documentation twice each year (summer and winter) for the 5-year monitoring period, and for any subsequently required monitoring period.

n. MONITORING DATA/REPORT: The permittee shall include the following information in the Level I monitoring report for the site: reference photos; plant survival notes and recommendations, as appropriate; and a report on the visual inspection of channel stability. Physical measurements of channel stability/morphology will not be required. The permittee shall complete the Monitoring Data Record, Sections 1, 2 and 3 (pages 1, 2 and 3, attached), for each representative segment of the channel, and for each year of monitoring (twice each year, summer and winter, for reference photos). The permittee shall include in the monitoring reports a discussion of any deviations from as-built and an evaluation of the significance of these deviations and whether they are indicative of a stabilizing or destabilizing situation.

o. STREAM MITIGATION SUCCESS CRITERIA: The mitigation success criteria, and required remediation actions, will be generally based on the attached Appendix II, and the Photo Documentation, Ecological Function, and Channel Stability criteria in the “Stream Mitigation Guidelines”, dated April, 2003 (available on the internet at [http://www.saw.usace.army.mil/wetlands/Mitigation/stream\\_mitigation.html](http://www.saw.usace.army.mil/wetlands/Mitigation/stream_mitigation.html)), pages 24 and 25, under “Success Criteria: ”.

p. Failure to institute and carry out the details of special conditions a. - o., above, may result in a directive to cease all ongoing and permitted work within waters and/or wetlands associated with TIP U-2527, or such other remedy as the District Engineer or his authorized representatives may seek.

### **Pre-Construction**

q. Prior to commencing construction within jurisdictional waters of the United States, the permittee shall forward the latest version of project construction drawings to the USACE, Raleigh Regulatory Field Office NCDOT Regulatory Project Manager. Half-size drawings are acceptable.

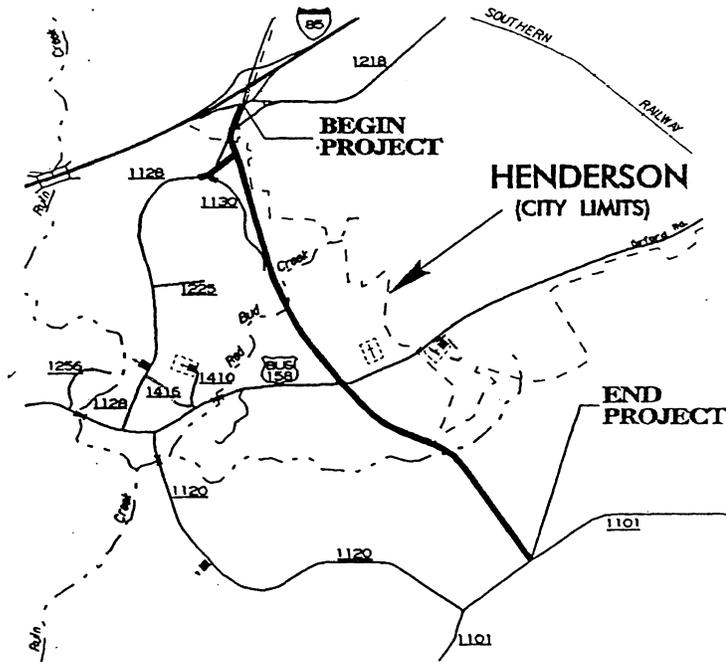
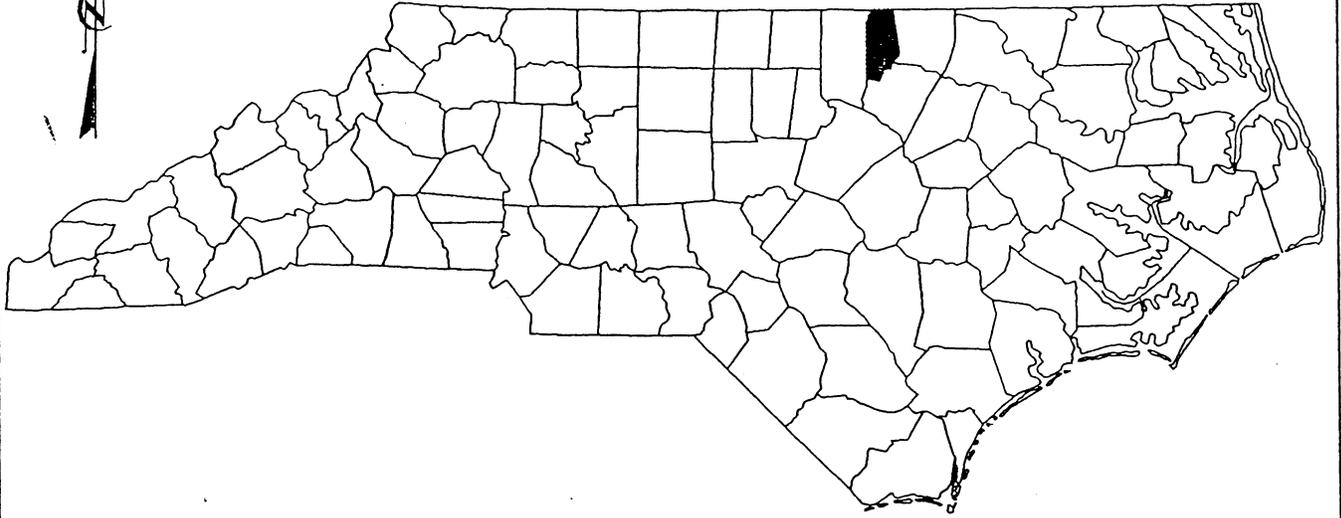
r. The permittee shall schedule an environmental preconstruction meeting between its representatives, the contractor's representatives, and the USACE, Raleigh Regulatory Field Office NCDOT Regulatory Project Manager, prior to any work within jurisdictional waters and wetlands to ensure that there is a mutual understanding of all of the terms and conditions contained within this Department of the Army Permit. The permittee shall provide the USACE, Raleigh Regulatory Field Office NCDOT Regulatory Project Manager, with a copy of the final plans at least two weeks prior to the preconstruction meeting along with a description of any changes that have been made to the project's design, construction methodology or construction timeframe. The permittee shall schedule the environmental preconstruction meeting for a time when the USACE and North Carolina Division of Water Quality (NCDWQ) Project Managers can attend. The permittee shall invite the Corps and NCDWQ Project Managers a minimum of four weeks in advance of the scheduled meeting in order to provide those individuals with ample opportunity to schedule and participate in the required meeting.

s. To ensure that all borrow and waste activities occur on high ground and do not result in the degradation of adjacent wetlands and streams, except as authorized by this permit, the permittee shall require its contractors and/or agents to identify all areas to be used to borrow material, or to dispose of dredged, fill, or waste material. The permittee shall provide the USACE with appropriate maps indicating the locations of proposed borrow or waste sites as soon as the permittee has that information. The permittee will coordinate with the USACE before approving any borrow or waste sites that are within 400 feet of any streams or wetlands. The permittee shall ensure that all such areas comply with condition b. of this permit, and shall require and maintain documentation of the location and characteristics of all borrow and disposal sites associated with this project. This information will include data regarding soils, vegetation and hydrology sufficient to clearly demonstrate compliance with condition b. All information will be available to the USACE upon request. NCDOT shall require its contractors to complete and execute reclamation plans for each waste and borrow site and provide written documentation that the reclamation plans have been implemented and all work is completed. This documentation will be provided to the Corps of Engineers within 30 days of the completion of the reclamation work.

## **Endangered Species**

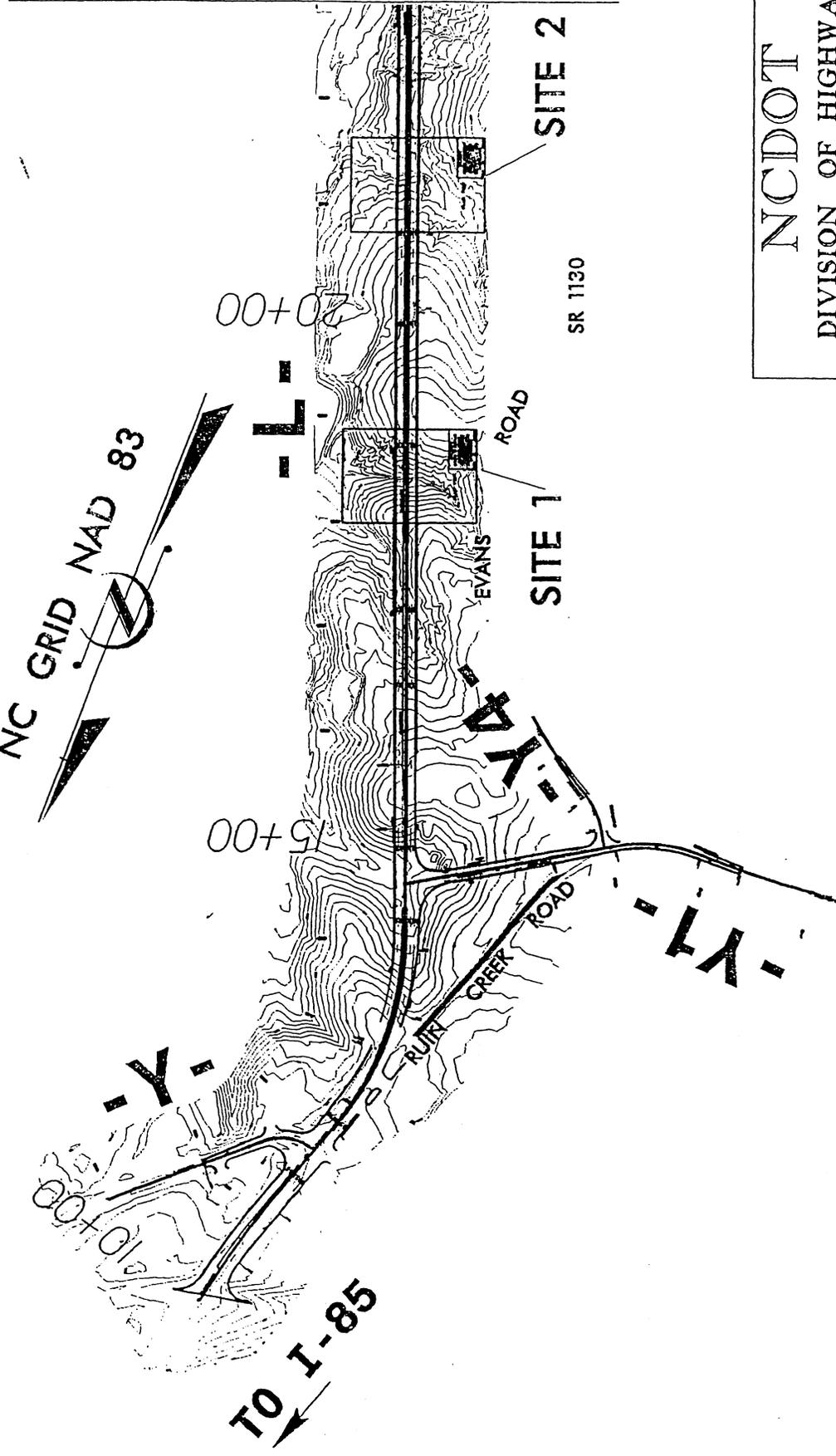
t. NCDOT shall implement and enforce the High Quality Water Best Management Practices for the Protection of Surface Waters and Sedimentation Control Guidelines, to avoid an adverse effect to the endangered dwarf wedgemussel, (*Alasmidonta heterodon*).

# NORTH CAROLINA



## STREAM AND WETLANDS IMPACTS VICINITY MAPS

**NCDOT**  
DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2390201 (U-2527)  
HENDERSON WESTERN  
OUTER LOOP PROJ  
SR 1128 TO SR 1101  
SHEET 1 OF 41



SR 1130

NCDOT  
DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2390201 (U-2527)  
HENDERSON WESTERN  
OUTER LOOP FROM  
SR 1128 TO SR 1101

SHEET 4 OF 4 3/16/02

SITE VIEW  
STREAM AND WETLAND IMPACTS

HENDERSON  
CITY  
LIMITS

NC GRID NAD 83

-Y2- US 158 BUS

SITE 5

25+00

SITE 3

SITE 4

00+01

00+00

00+00

00+00

RED BUD  
CREEK

SITE VIEW  
STREAM AND WETLAND IMPACTS

NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2390201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

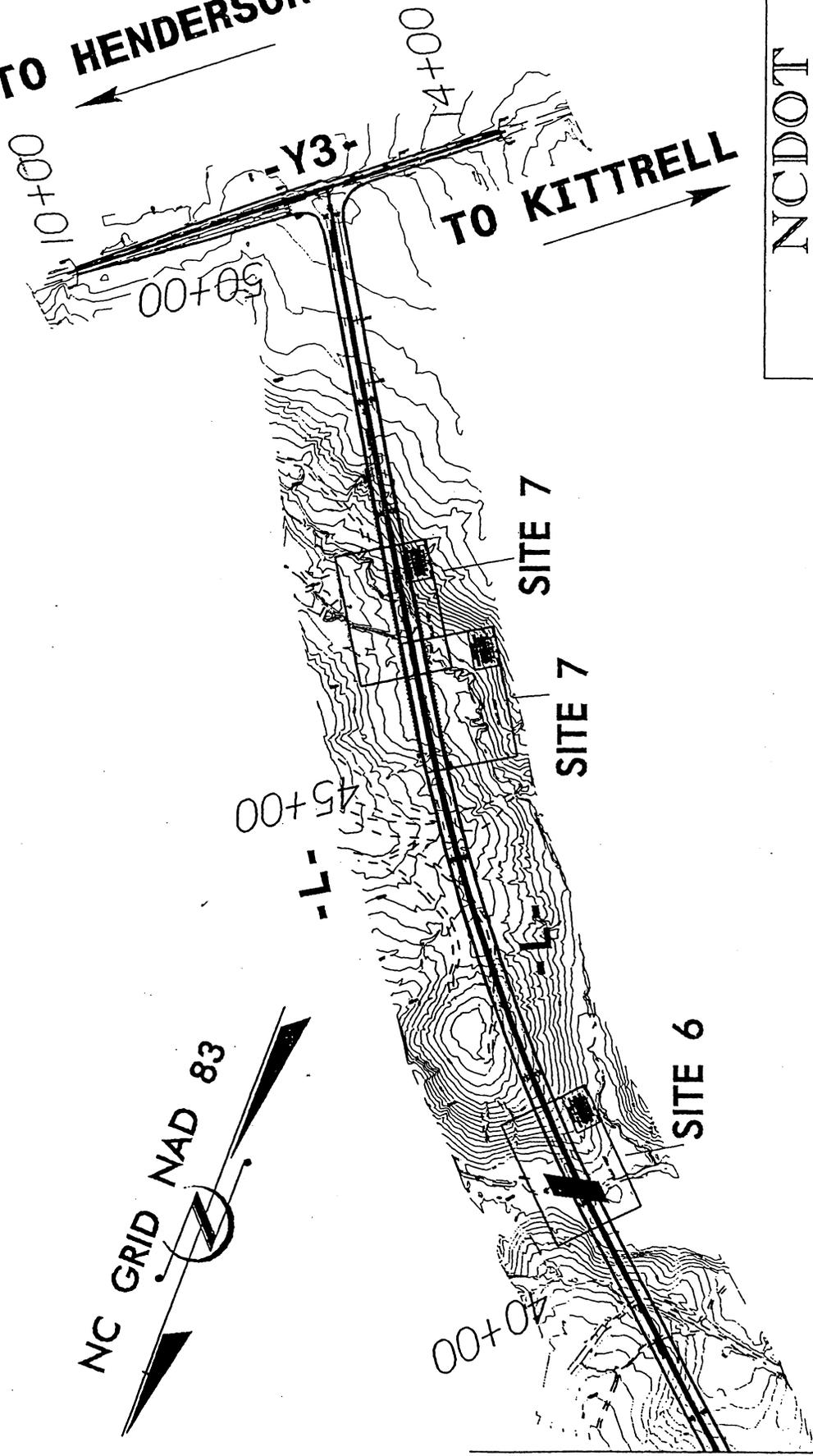
SR 1128 TO SR 1101

SHEET 3 OF 4

3/16/02

TO HENDERSON  
←

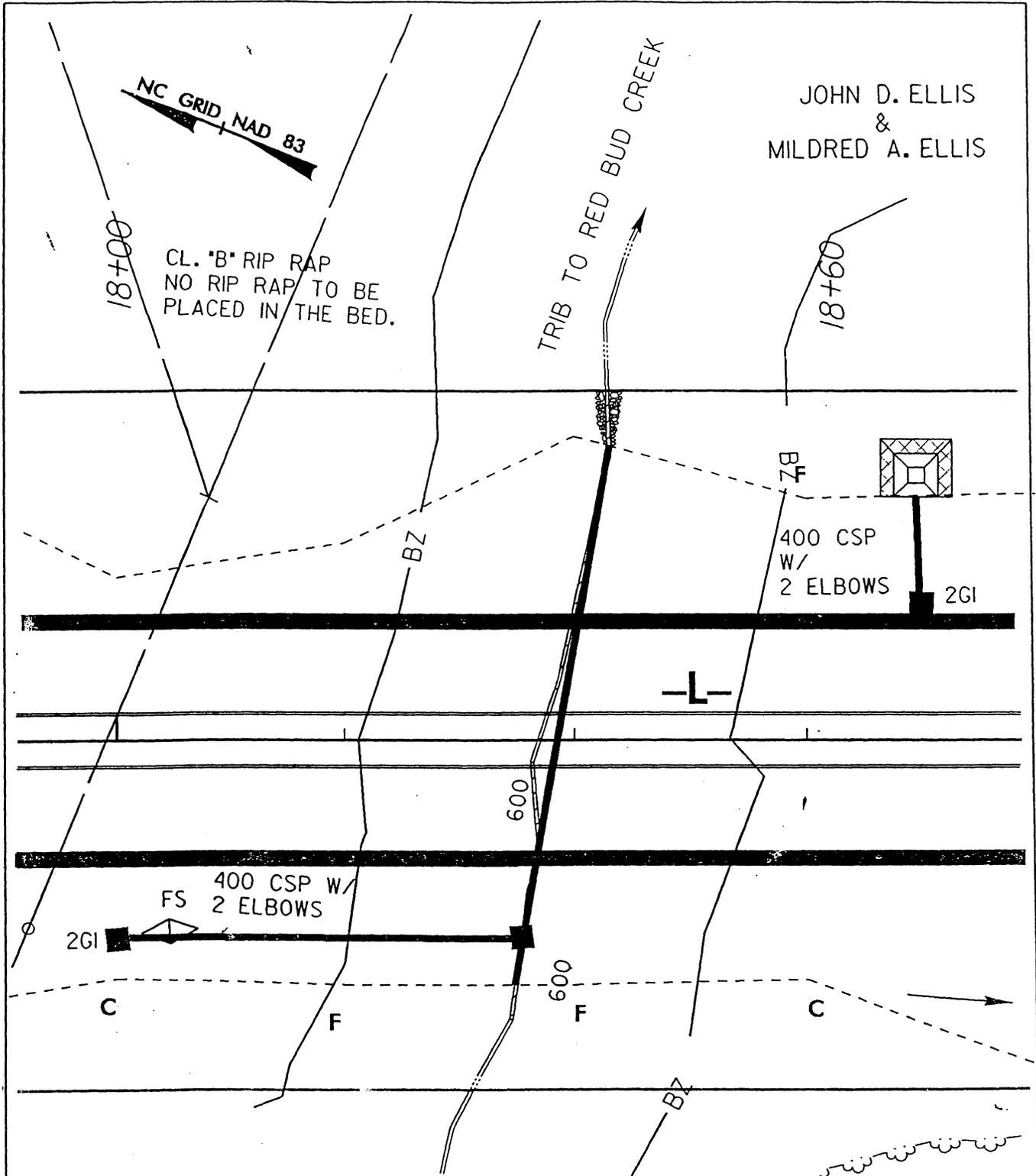
TO KITTRELL  
→



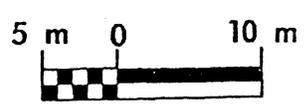
NCDOT

DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2390201 (U-2527)  
HENDERSON WESTERN  
OUTER LOOP FROM  
SR 1128 TO SR 1101

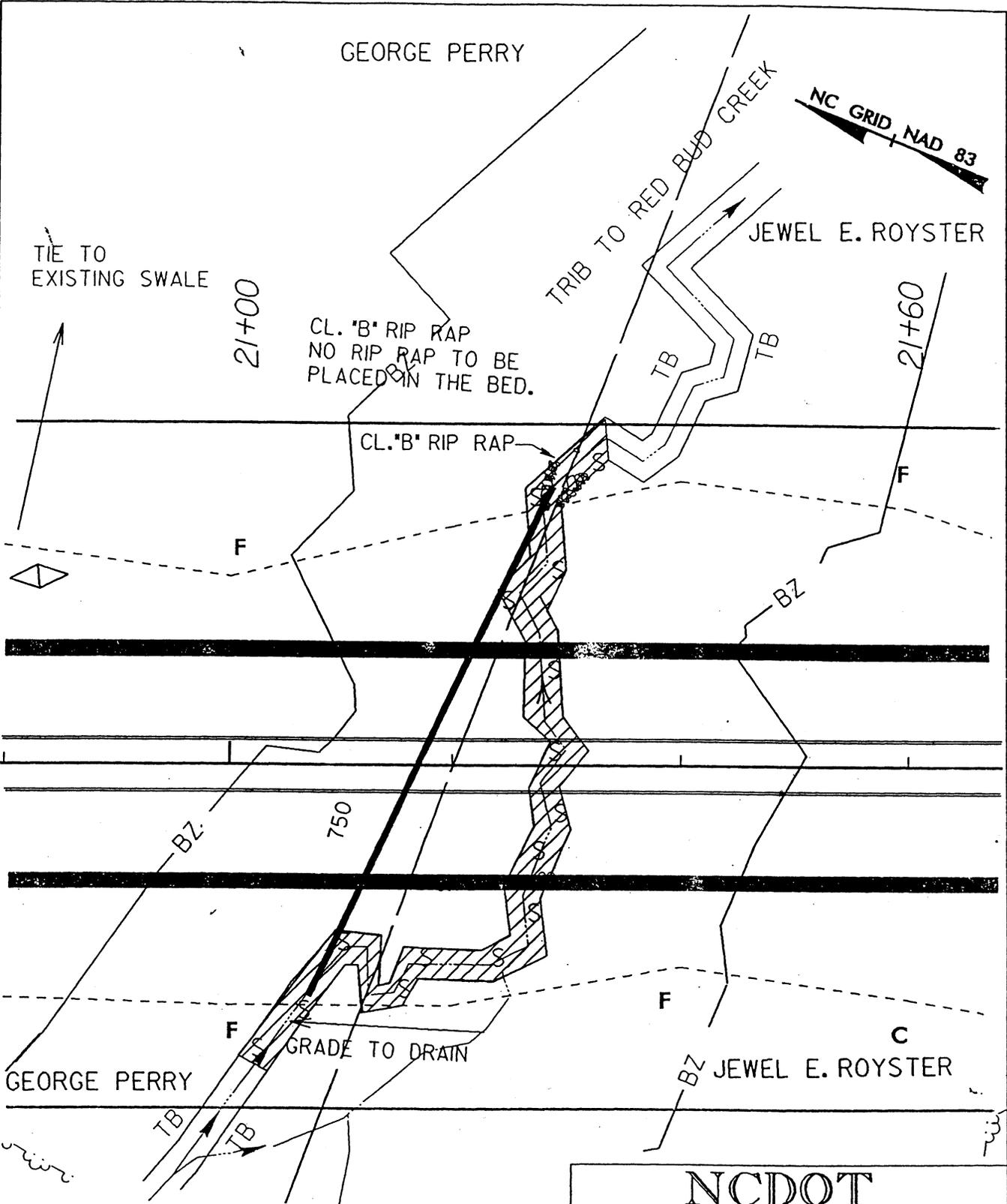
SITE VIEW  
STREAM AND WETLAND IMPACTS



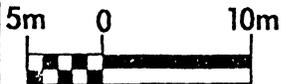
SITE 1  
PLAN VIEW



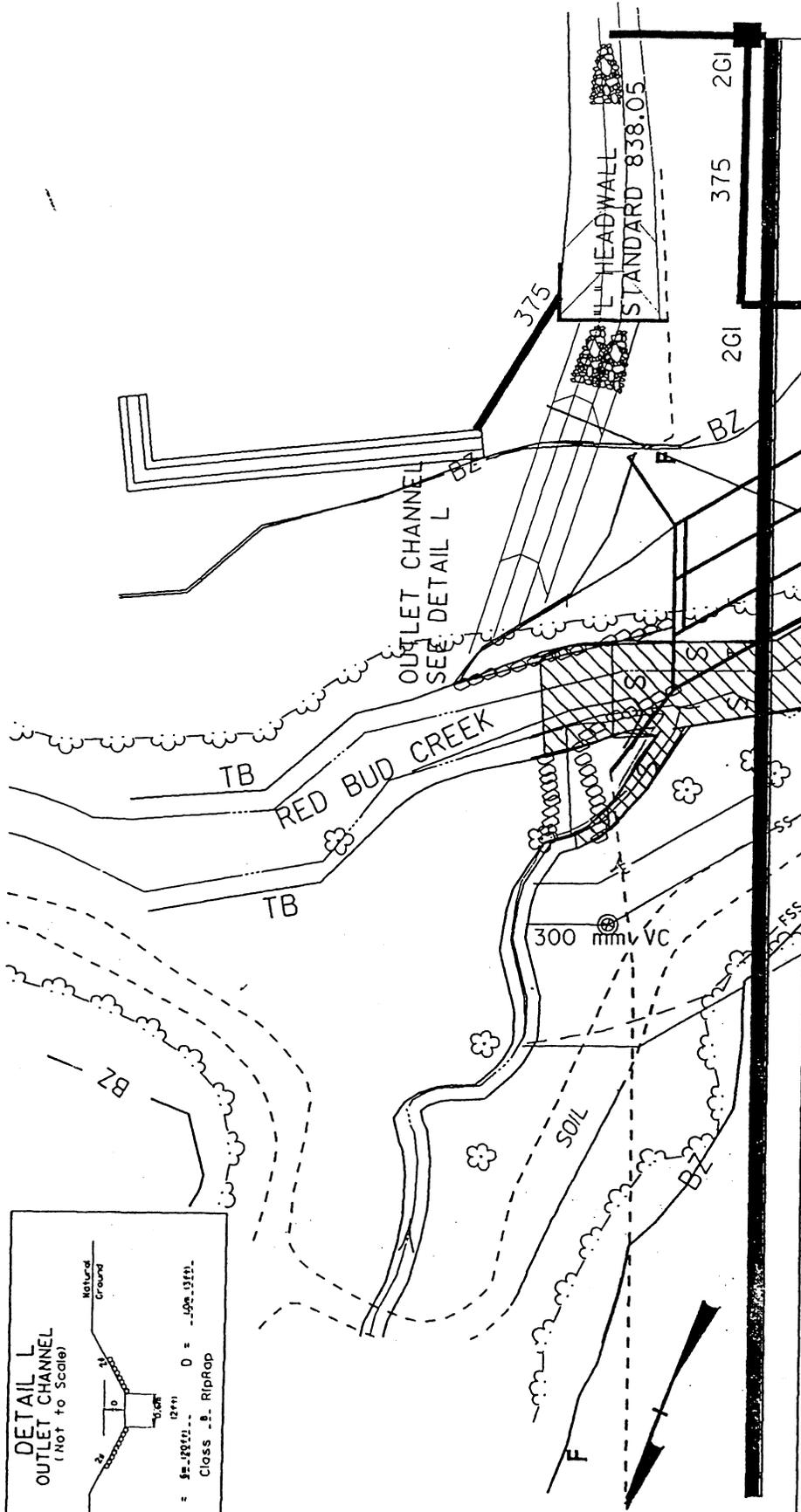
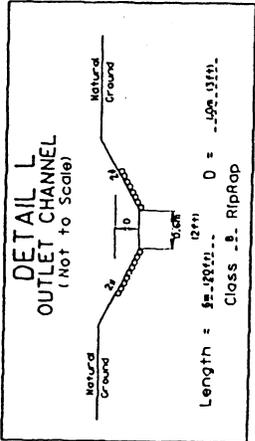
NCDOT  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 5 OF 41 3/16/02



SITE 2  
PLAN VIEW



**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 6 OF 41 3/16/02



MATCH LINE A  
 3 @ 3.6m X 2.7m RCBC  
 Depth bkf = 0.5m (1.6ft)  
 Width bkf = 5.4m (17.7ft)  
 Area bkf = 2.3 m<sup>2</sup> (24.8sq.ft.)

**NCDOT**

**DIVISION OF HIGHWAYS**

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 7 OF 41

3/16/02

SITE 3

PLAN VIEW

23+00

23+60



23+00



23+60

3 @ 3.6m X 2.7m RCBC  
Depth bkf = 0.5m (1.6ft)  
Width bkf = 5.4m (17.7ft)  
Area bkf = 2.3 m2 (24.8sq.ft.)

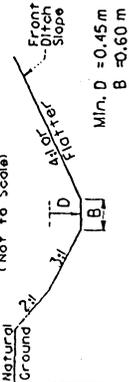
MATCH LINE A



3 @ 3.6m X 2.7m RCBC

DA = 1.2 ha (3 acres)  
LENGTH = 150m (492ft)  
Q10 = .20 cms (7 cfs)  
V = .74 mps (2.4 fps)  
D = .20m (.7ft)  
S = 0.030 m/m  
Q2 = .15 cms (5.3 cfs)  
V = .70 mps (2.3 fps)

DETAIL H  
SPECIAL CUT BASE DITCH  
(Not to Scale)



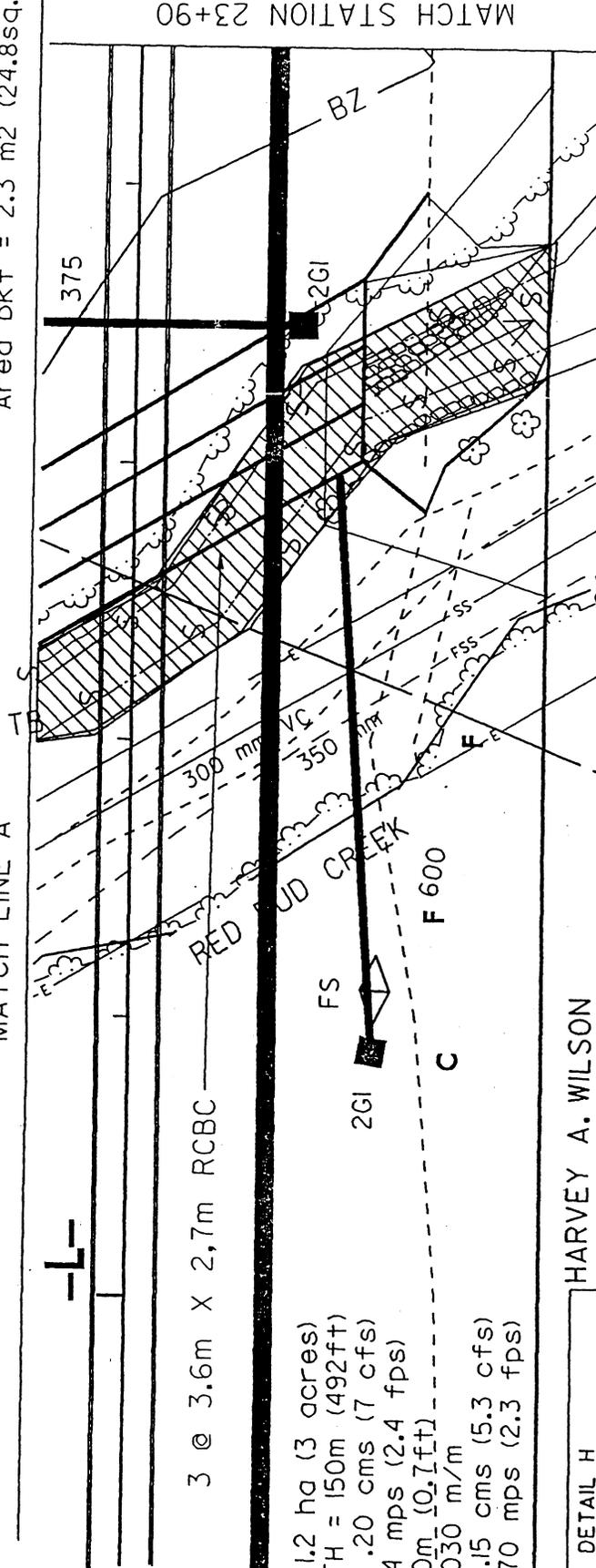
5 m 0 10 m



SITE 3  
PLAN VIEW

HARVEY A. WILSON  
&  
GLORIA D. CARVER

MARJORIE P. LEWIS



MATCH STATION 23+90

NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8:2290201 (U-2527)

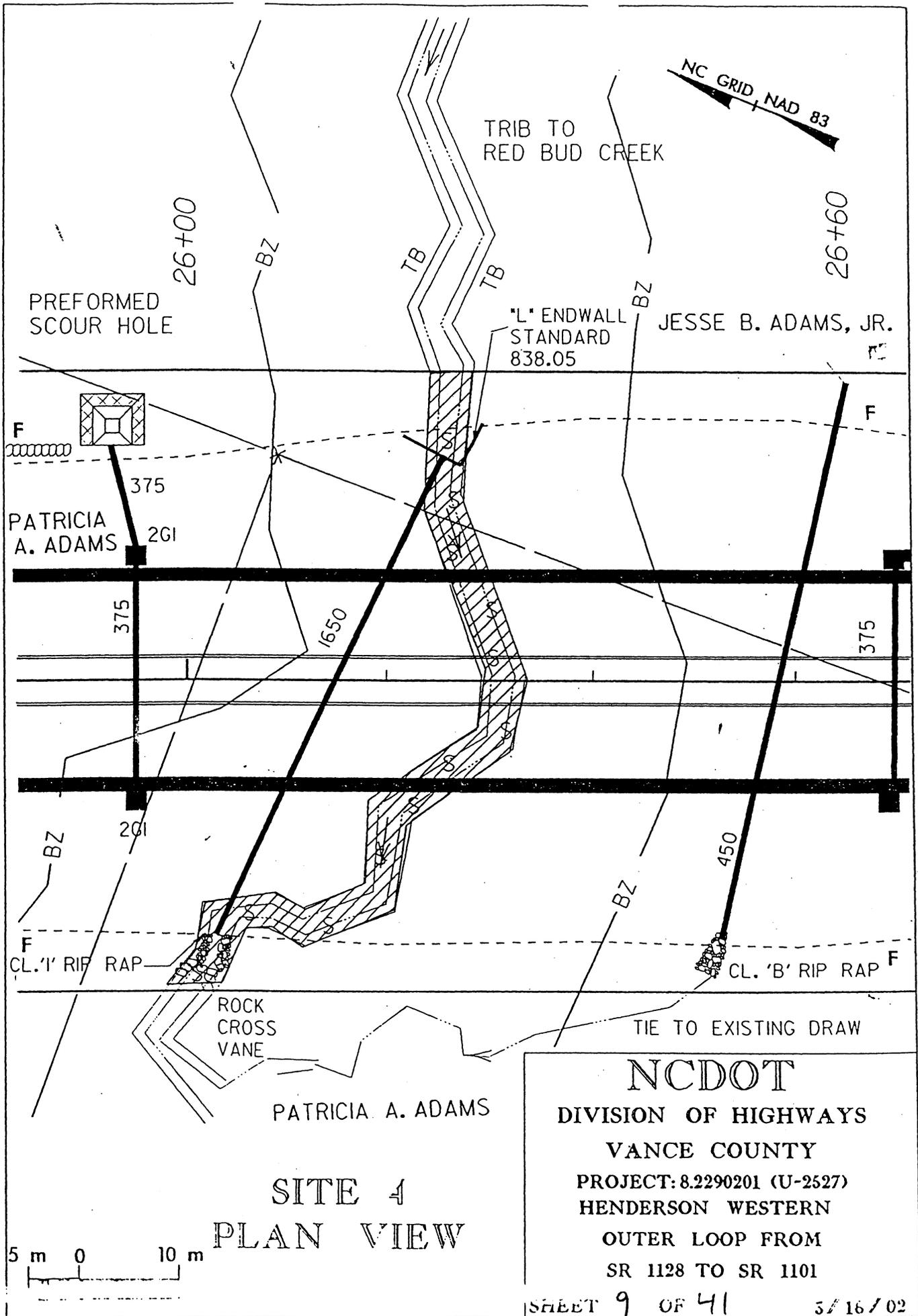
HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 8 OF 11

3/16/02



26+00  
 PREFORMED SCOUR HOLE

TRIB TO RED BUD CREEK

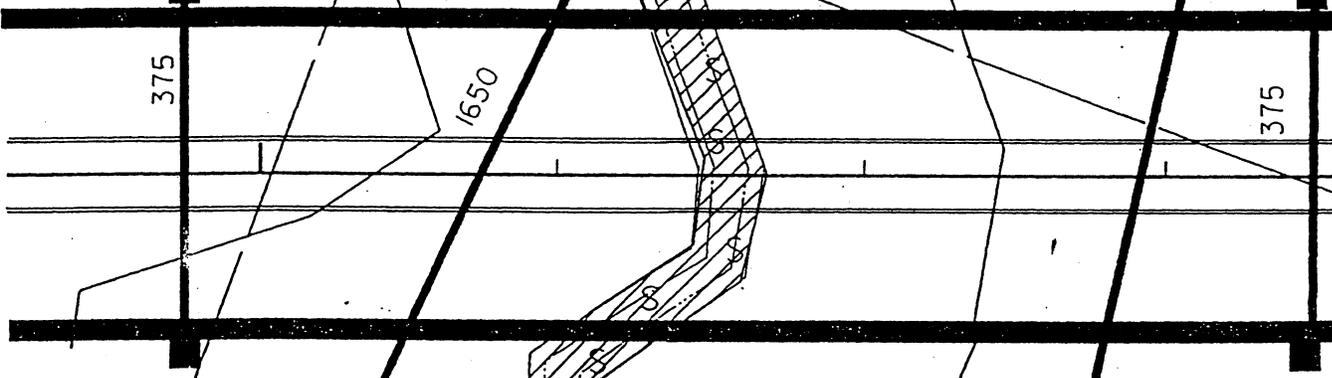
NC GRID, NAD 83

26+60

F  
 PATRICIA A. ADAMS  
 375  
 2G1

"L" ENDWALL STANDARD  
 838.05

JESSE B. ADAMS, JR.



F  
 CL. 'A' RIP RAP

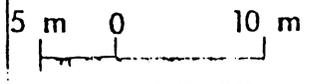
450  
 CL. 'B' RIP RAP F

ROCK CROSS VANE

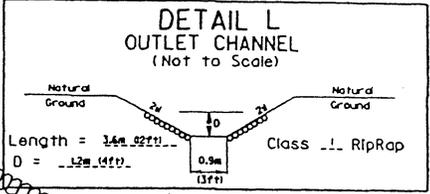
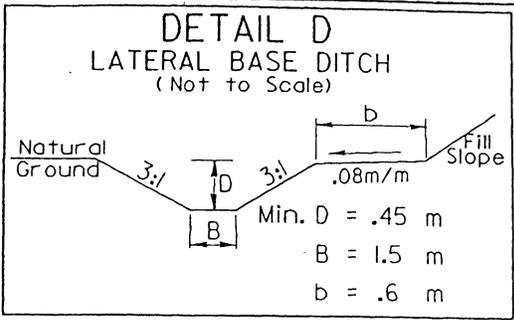
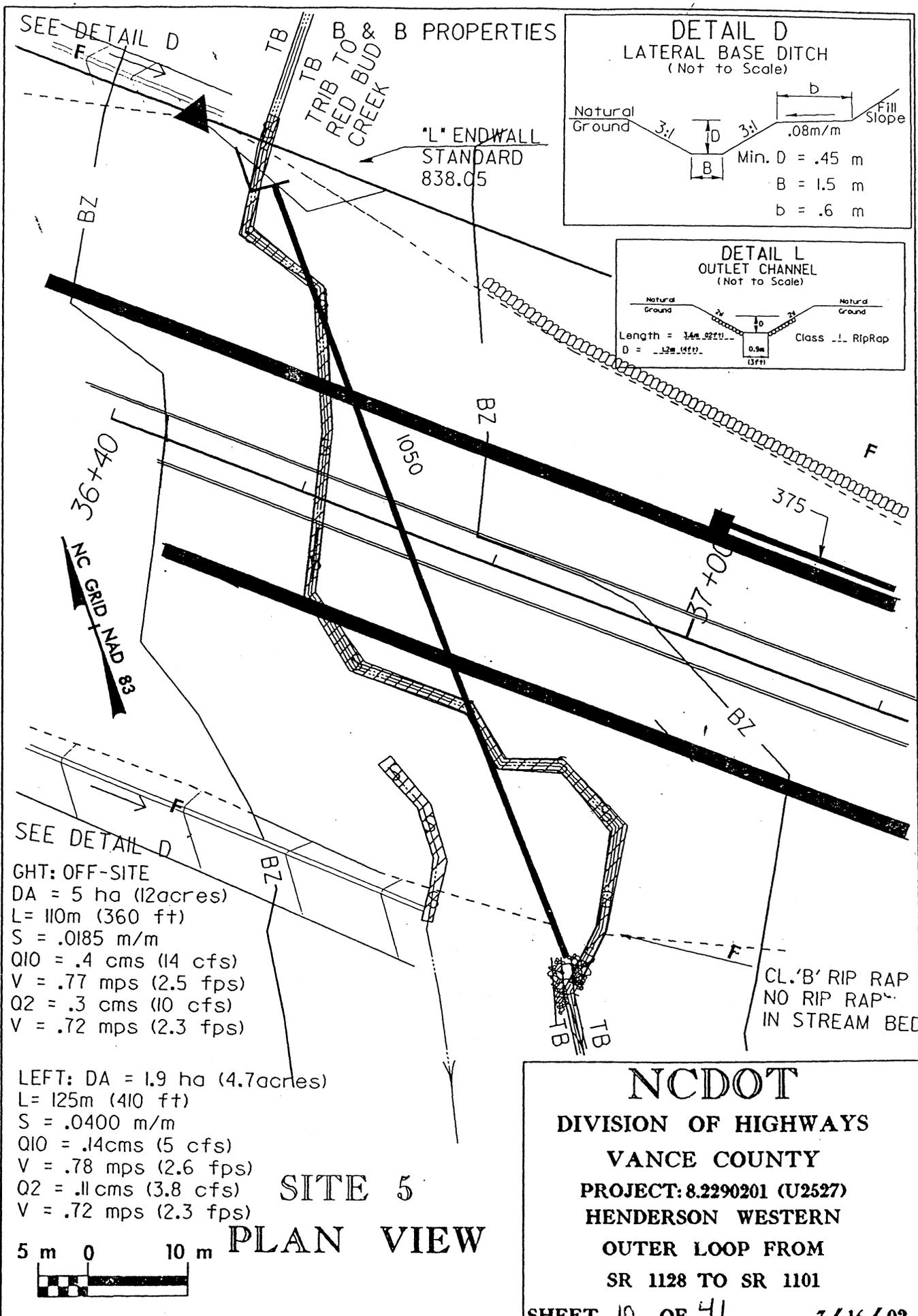
TIE TO EXISTING DRAW

PATRICIA A. ADAMS

SITE 4  
 PLAN VIEW



**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 9 OF 41 3/16/02



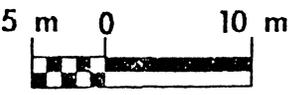
SEE DETAIL D

GHT: OFF-SITE  
 DA = 5 ha (12 acres)  
 L = 110m (360 ft)  
 S = .0185 m/m  
 Q10 = .4 cms (14 cfs)  
 V = .77 mps (2.5 fps)  
 Q2 = .3 cms (10 cfs)  
 V = .72 mps (2.3 fps)

LEFT: DA = 1.9 ha (4.7 acres)  
 L = 125m (410 ft)  
 S = .0400 m/m  
 Q10 = .14cms (5 cfs)  
 V = .78 mps (2.6 fps)  
 Q2 = .11cms (3.8 cfs)  
 V = .72 mps (2.3 fps)

**SITE 5**

**PLAN VIEW**

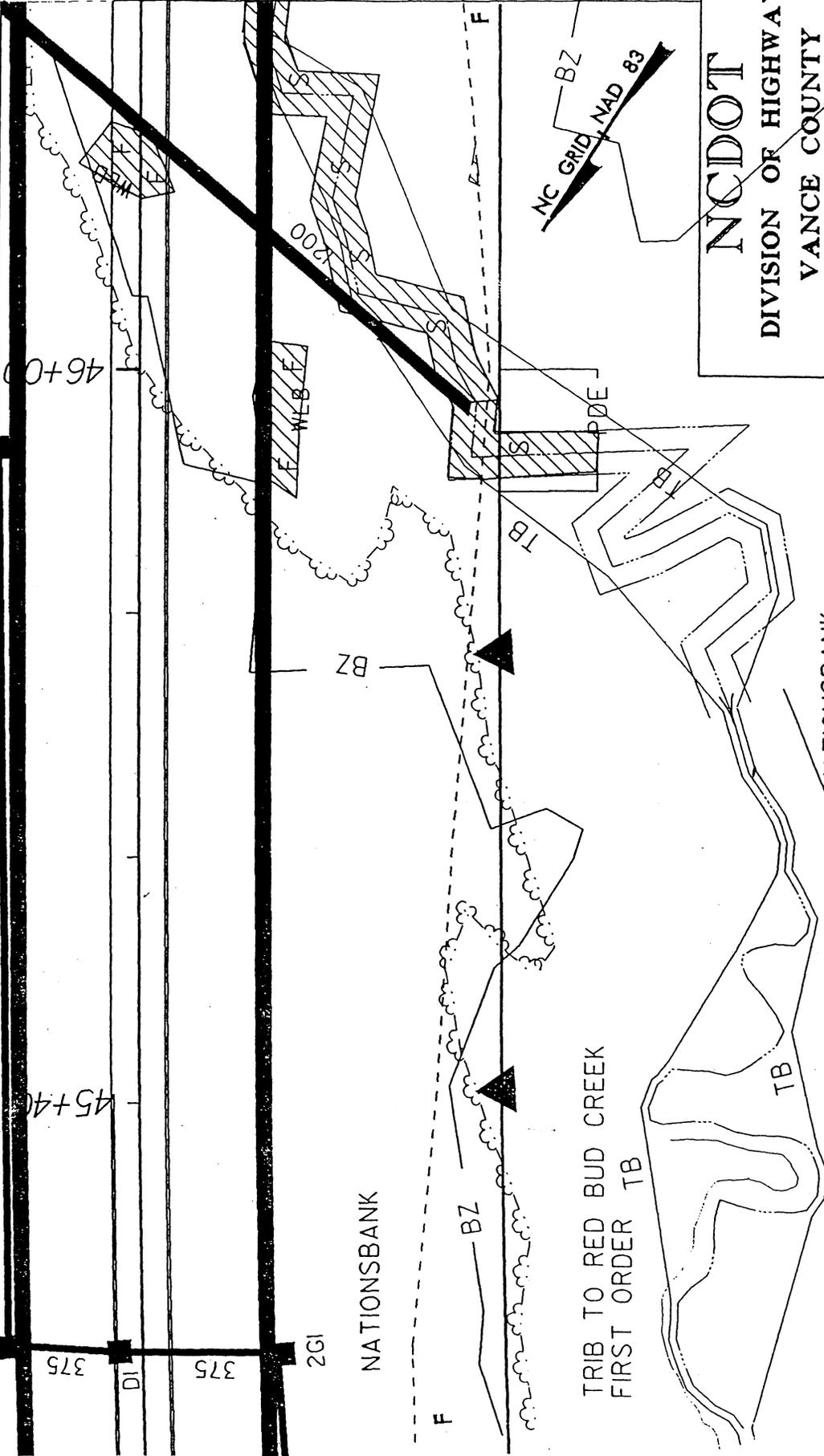


CL. 'B' RIP RAP  
 NO RIP RAP  
 IN STREAM BED

**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 10 OF 41  
 3/16/02



MATCH STATION 46+30

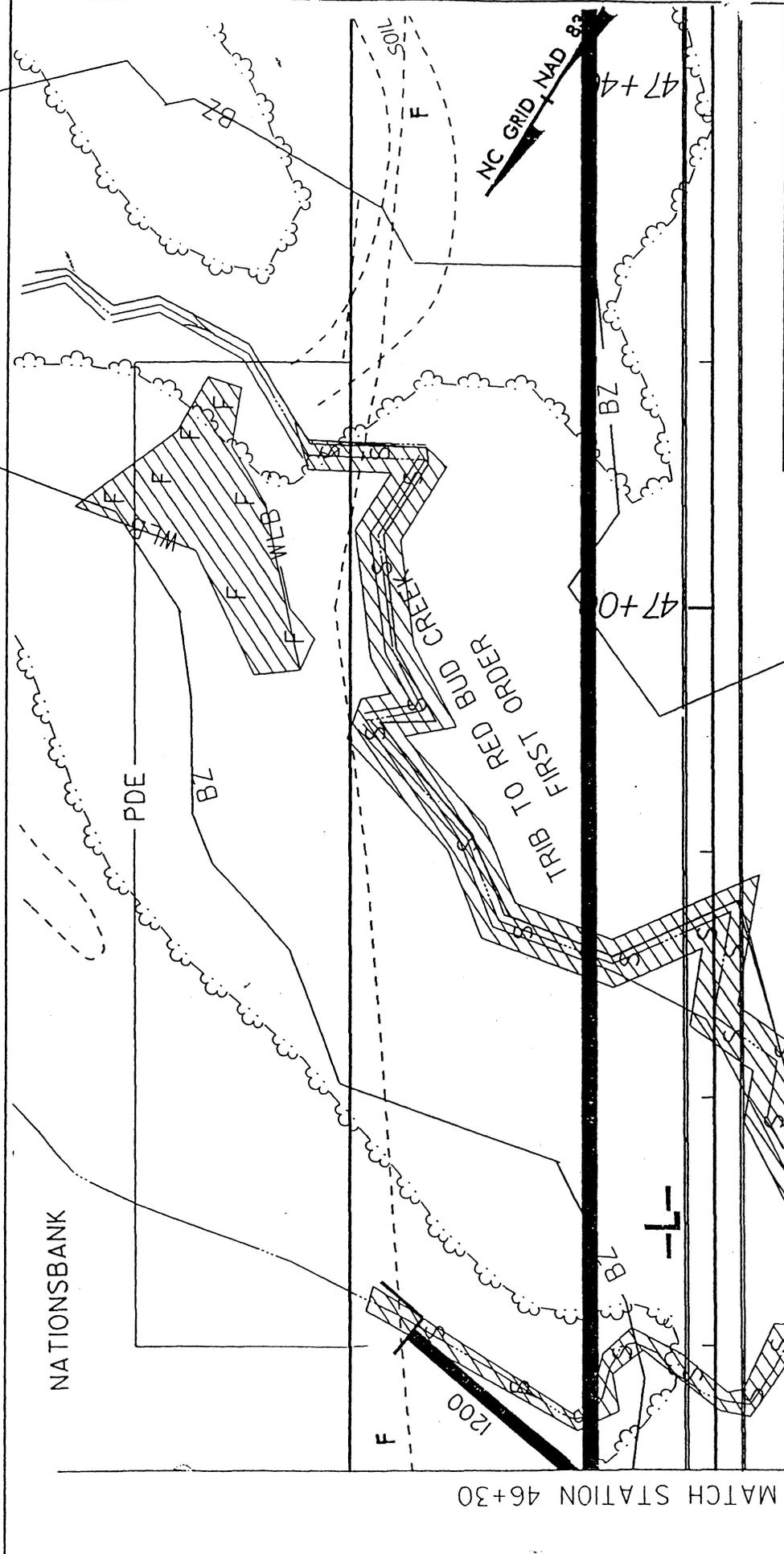


**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101

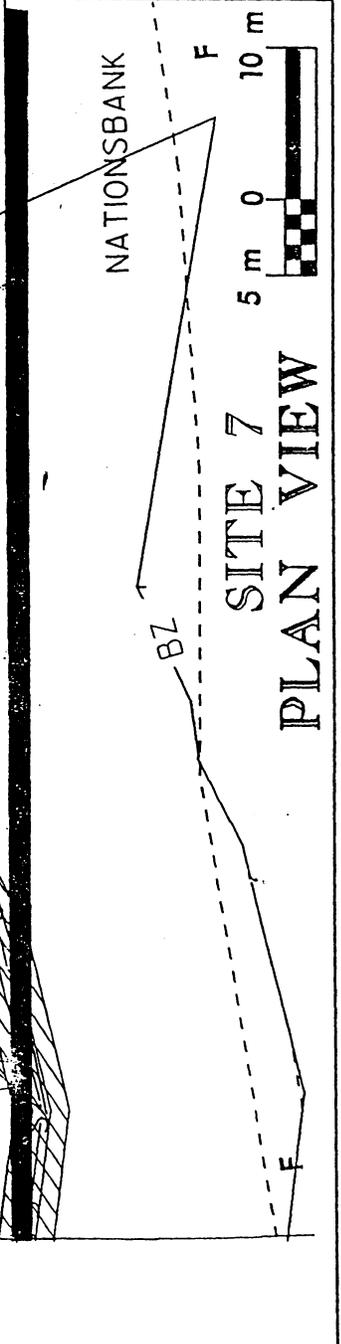
SHEET 12 OF 41 3/16/02

SITE 7  
 PLAN VIEW





**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 13 OF 41 3/16/02



MATCH STATION 46+30



PROPERTY OWNER

NAME AND ADDRESS

OWNER'S NAME	ADDRESS
J.P. Howard Heirs	630 Farrar Ave. Henderson, NC 27536
David & Marjorie Lewis	Rt. 4 Box 290 Henderson, NC 27536
Nationsbank c/o Nannie Crowder	Nationsbank Trust HSZ-5 P.O. Box 27287 Raleigh, NC 27611
George Washington Perry	Rt. 5 Box 26 Henderson, NC 27536
Shannon P. & John Rock	P.O. Box 676 Louisburg, NC 27549
Jewel Royster	Rt. 4 Box 352-A Henderson, NC 27536
Geneva Turner	243 North 8th Street Kenilworth, NJ 07033
W.D. Turner, et al.	938 Hargrove St. Henderson, NC 27536

NCDOT  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 15 OF 41 3/16/02

# PROPERTY OWNER

## NAME AND ADDRESS

OWNER'S NAME	ADDRESS
Jesse B. Adams, Jr.	3758 Evans Trailway Beltsville, MD 20705
Patricia Ann Adams	9039 Sligo Parkway, #509 Silver Springs, MD 20901
B & B Properties c/o W. L. Stanley	P. O. Box 1092 Henderson, NC 27536
Gloria Carver & Harvey A. Wilson	Rt. 4 Box 352-C Henderson, NC 27536
John D. Ellis & Mildred Ellis	435 Oak Hill Street Henderson, NC 27536
Virgil Evans c/o Lillian B. Evans	PO BOX 684 Henderson, NC 27536
John H. Faulkner	215 Crestwood Road Henderson, NC 27536
Plummer Howard	630 Farrar Ave. Henderson, NC 27536

NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

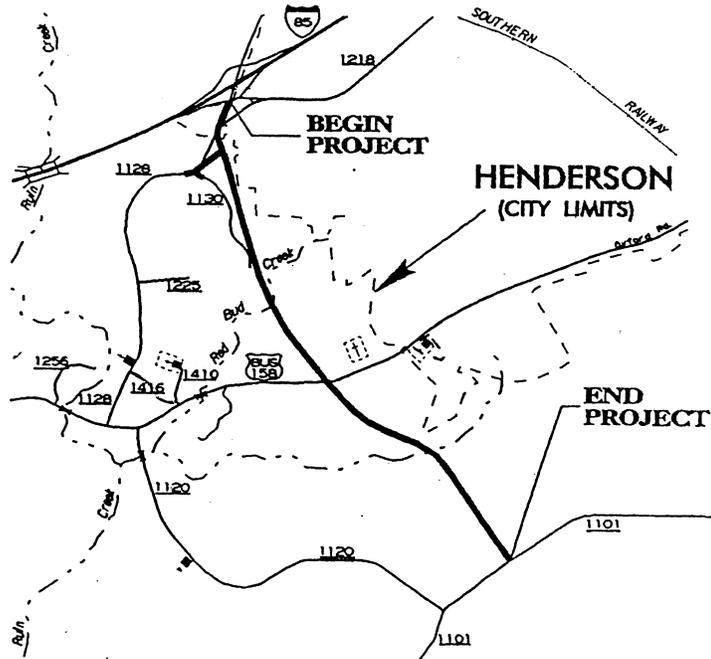
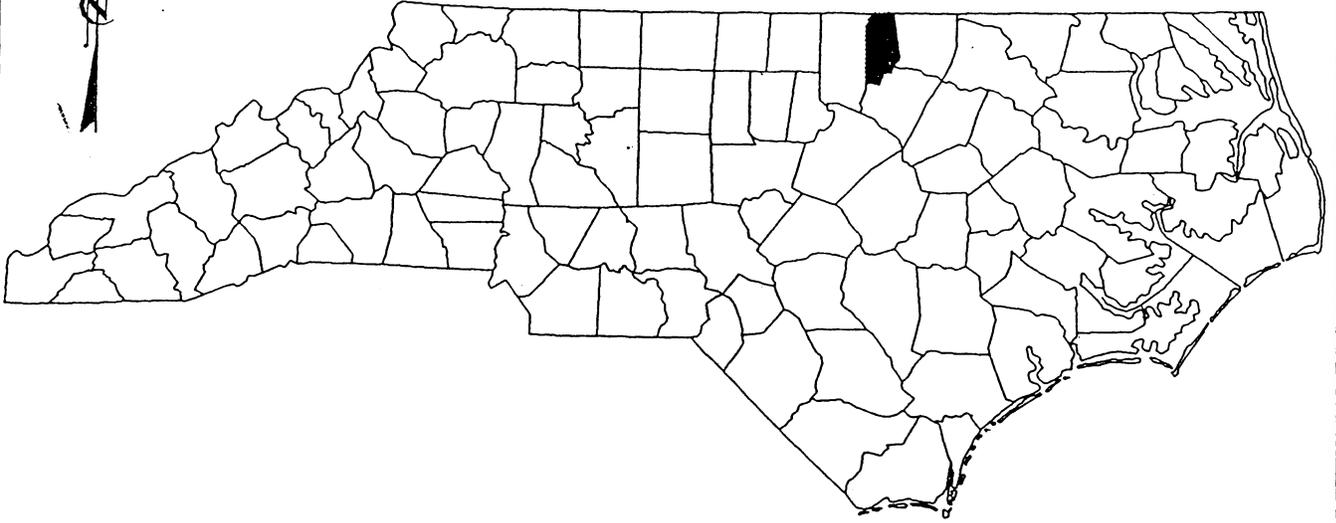
OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 16 OF 41

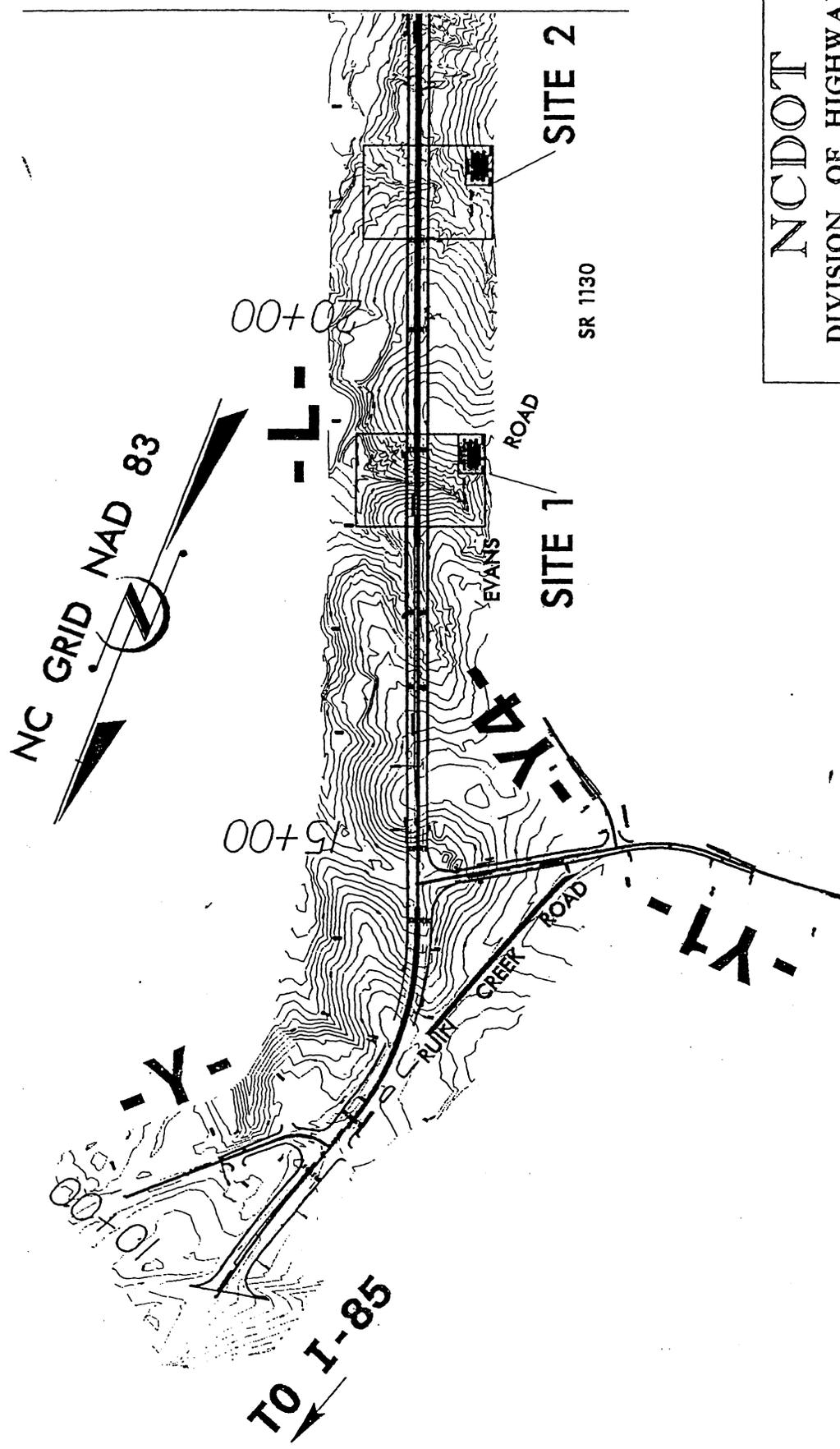
3/16/02

# NORTH CAROLINA



## BUFFER IMPACTS VICINITY MAPS

NCDOT  
DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2390201 (U-2527)  
HENDERSON WESTERN  
OUTER LOOP FROM  
SR 1128 TO SR 1101



NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2390201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

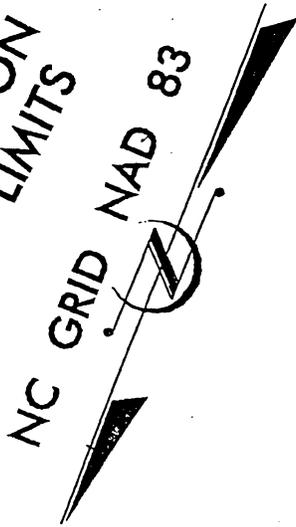
SR 1128 TO SR 1101

SHEET 17 OF 41

3/16/02

SITE VIEW  
 BUFFER IMPACTS

HENDERSON  
CITY LIMITS



-Y2- US 158 BUS

SITE 7

SITE 6

SITE 3

SITE 4

SITE 5

25+00

00+01

00+00

00+41

RED BUD  
CREEK



SITE VIEW  
BUFFER IMPACTS

NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2390201 (U-2527)

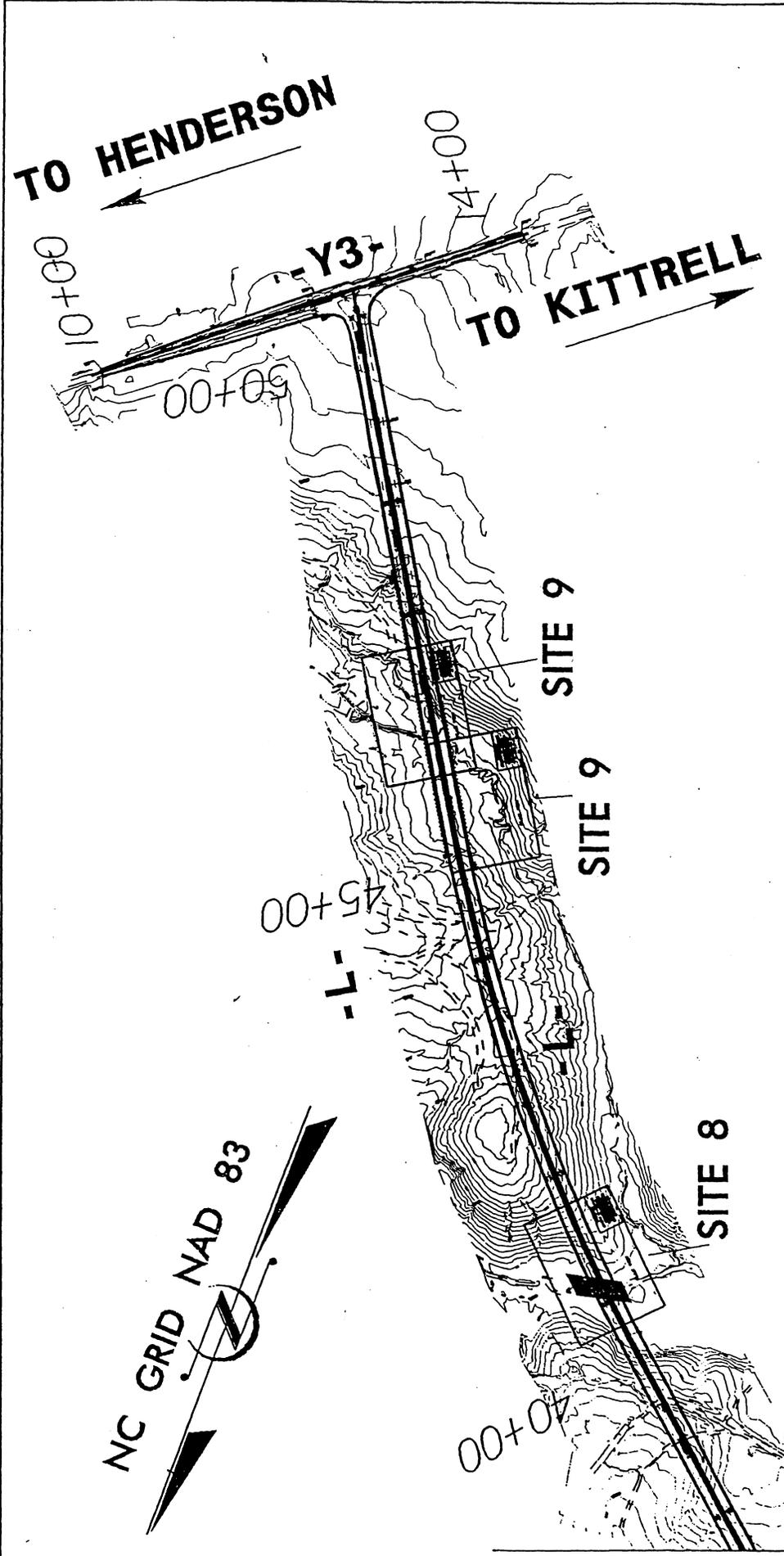
HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 19 OF 71

3/16/02

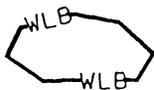


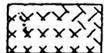
NCDOT  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2390201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 30 OF 41 3/16/02

SITE VIEW  
 BUFFER IMPACTS

# BUFFER LEGEND

—WLB— WETLAND BOUNDARY

 WETLAND

 ALLOWABLE IMPACTS ZONE 1

 ALLOWABLE IMPACTS ZONE 2

 MITIGABLE IMPACTS ZONE 1

 MITIGABLE IMPACTS ZONE 2

—BZ— RIPARIAN BUFFER ZONE

—BZ1— RIPARIAN BUFFER ZONE 1  
30 ft (9.2m)

—BZ2— RIPARIAN BUFFER ZONE 2  
20 ft (6.1m)

← FLOW DIRECTION

—TB— TOP OF BANK

—WE— EDGE OF WATER

—C— PROP. LIMIT OF CUT

—F— PROP. LIMIT OF FILL

▲ PROP. RIGHT OF WAY

—NG— NATURAL GROUND

—PL— PROPERTY LINE

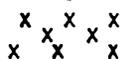
—TDE— TEMP. DRAINAGE EASEMENT

—PDE— PERMANENT DRAINAGE EASEMENT

—EAB— EXIST. ENDANGERED ANIMAL BOUNDARY

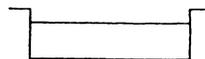
—EPB— EXIST. ENDANGERED PLANT BOUNDARY

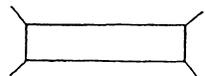
▽ WATER SURFACE

 LIVE STAKES

 BOULDER

— CORE FIBER ROLLS

 PROPOSED BRIDGE

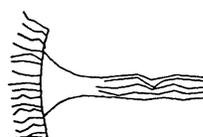
 PROPOSED BOX CULVERT

 PROPOSED PIPE CULVERT  
12"-48"  
PIPES  
54" PIPES  
& ABOVE

(DASHED LINES DENOTE  
EXISTING STRUCTURES)

 SINGLE TREE

— WOODS LINE

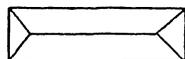
 DRAINAGE INLET

 ROOTWAD

 RIP RAP

 ADJACENT PROPERTY OWNER  
OR PARCEL NUMBER  
IF AVAILABLE

 PREFORMED SCOUR HOLE (PSH)

 LEVEL SPREADER (LS)

 GRASS SWALE

## NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

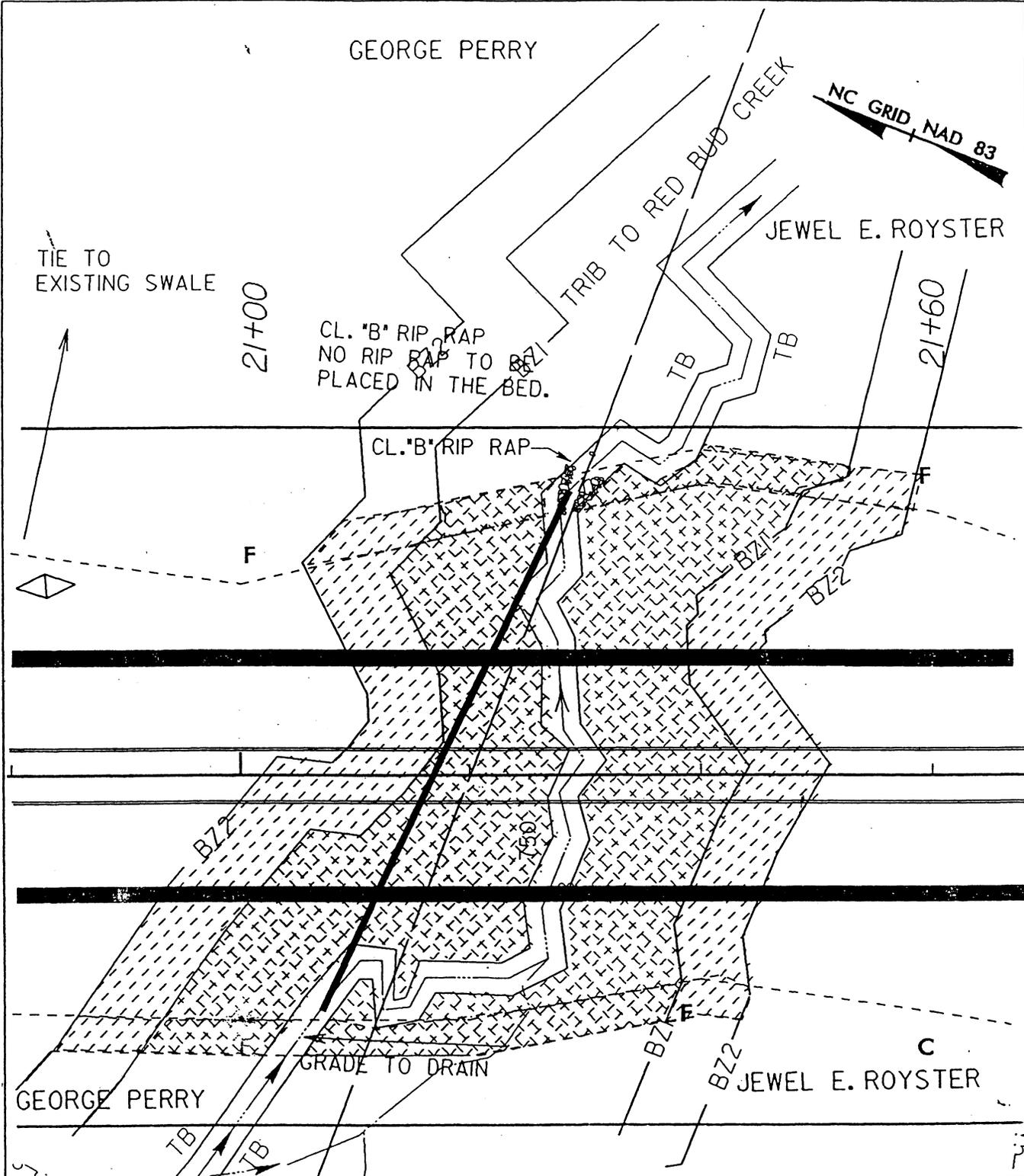
OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 21 OF 41

3/16/02

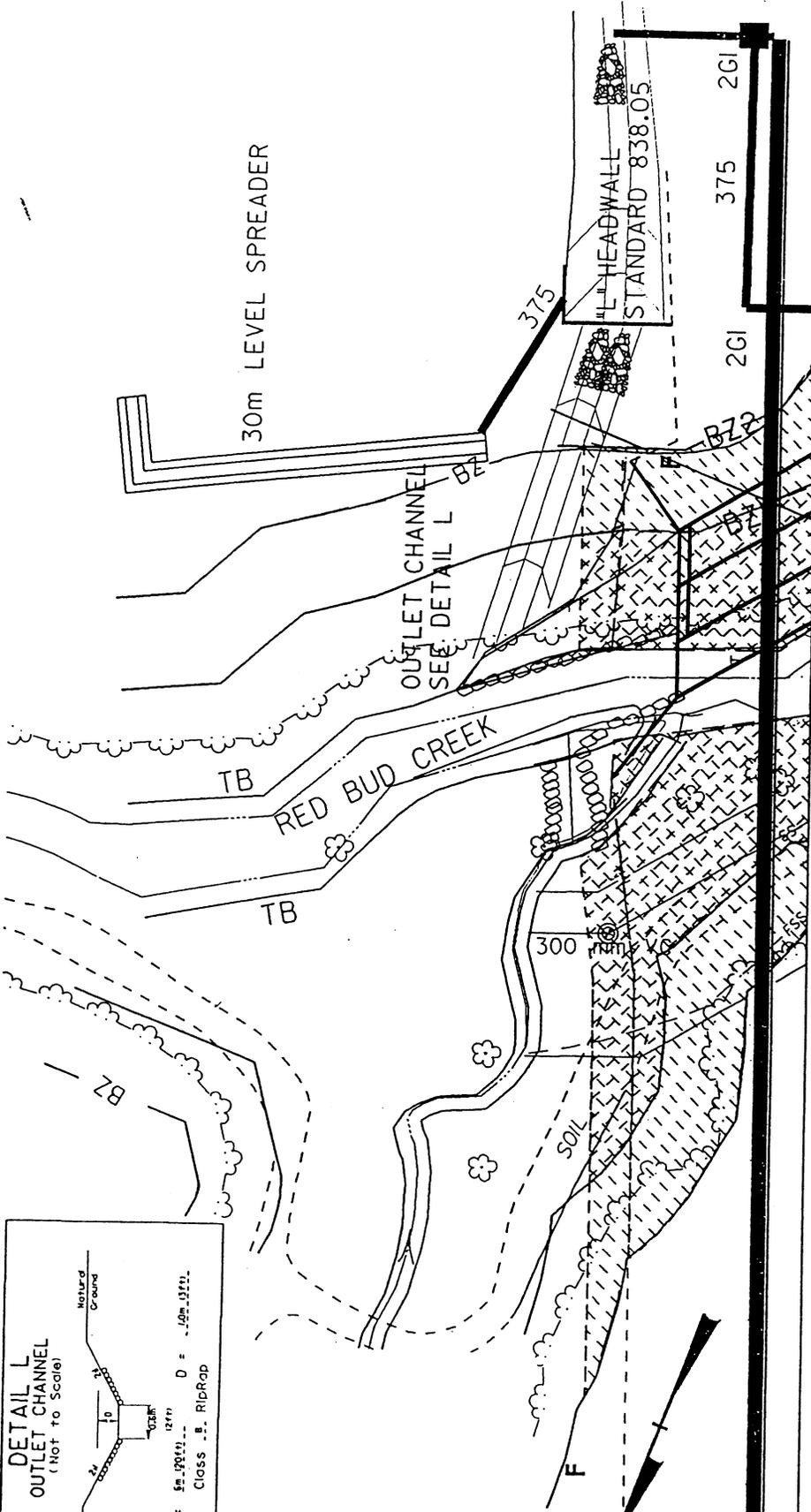
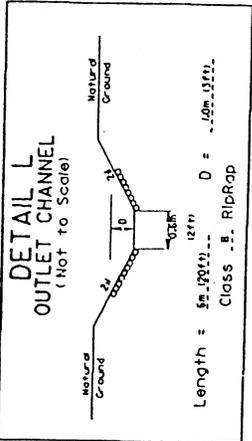




BUFFER IMPACTS  
 SITE 2  
 PLAN VIEW



**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 23 OF 41  
 3/16/02



**NC DOT**  
DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2290201 (U-2527)  
HENDERSON WESTERN  
OUTER LOOP FROM  
SR 1128 TO SR 1101  
SHEET 24 OF 41 3/16/02

MATCH LINE A 3 @ 3.6m X 2.7m RCBC  
Depth bkf = 0.5m (1.6ft)  
Width bkf = 5.4m (17.7ft)  
Area bkf = 2.3 m<sup>2</sup> (24.8sq.ft.)

**BUFFER IMPACTS  
SITE 3  
PLAN VIEW**



23+00

23+60



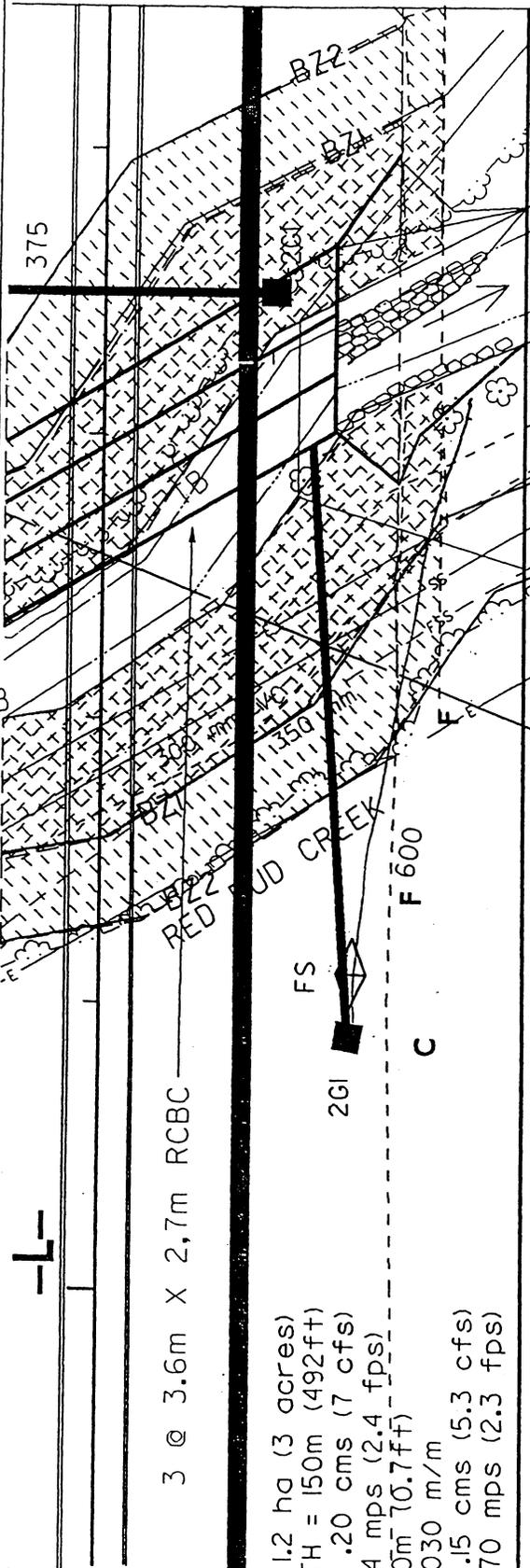
23+00

23+60

3 @ 3.6m X 2.7m RCBC  
 Depth bkf = 0.5m (1.6ft)  
 Width bkf = 5.4m (17.7ft)  
 Area bkf = 2.3 m<sup>2</sup> (24.8sq.ft.)

MATCH LINE A

MATCH STATION 23+90

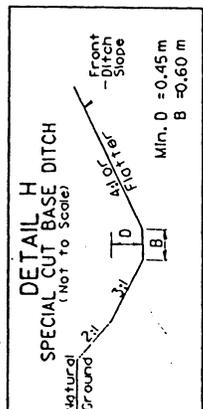


3 @ 3.6m X 2.7m RCBC

DA = 1.2 ha (3 acres)  
 LENGTH = 150m (492ft)  
 Q10 = .20 cms (7 cfs)  
 V = .74 mps (2.4 fps)  
 D = .20m (0.7ft)  
 S = 0.030 m/m  
 O2 = .15 cms (5.3 cfs)  
 V = .70 mps (2.3 fps)

HARVEY A. WILSON  
 &  
 GLORIA D. CARVER

MARJORIE P. LEWIS



### BUFFER IMPACTS

### SITE 3

### PLAN VIEW

5 m 0 10 m



# NCDOT

## DIVISION OF HIGHWAYS

### VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 25 OF 41

3/16/02

24+00

24+60

MARJORIE P. LEWIS

MATCH STATION 23+90

VIRGIL EVANS

GENEVA F. TURNER

B72

F

RED BUD CREEK

ELSON FLOYD

NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

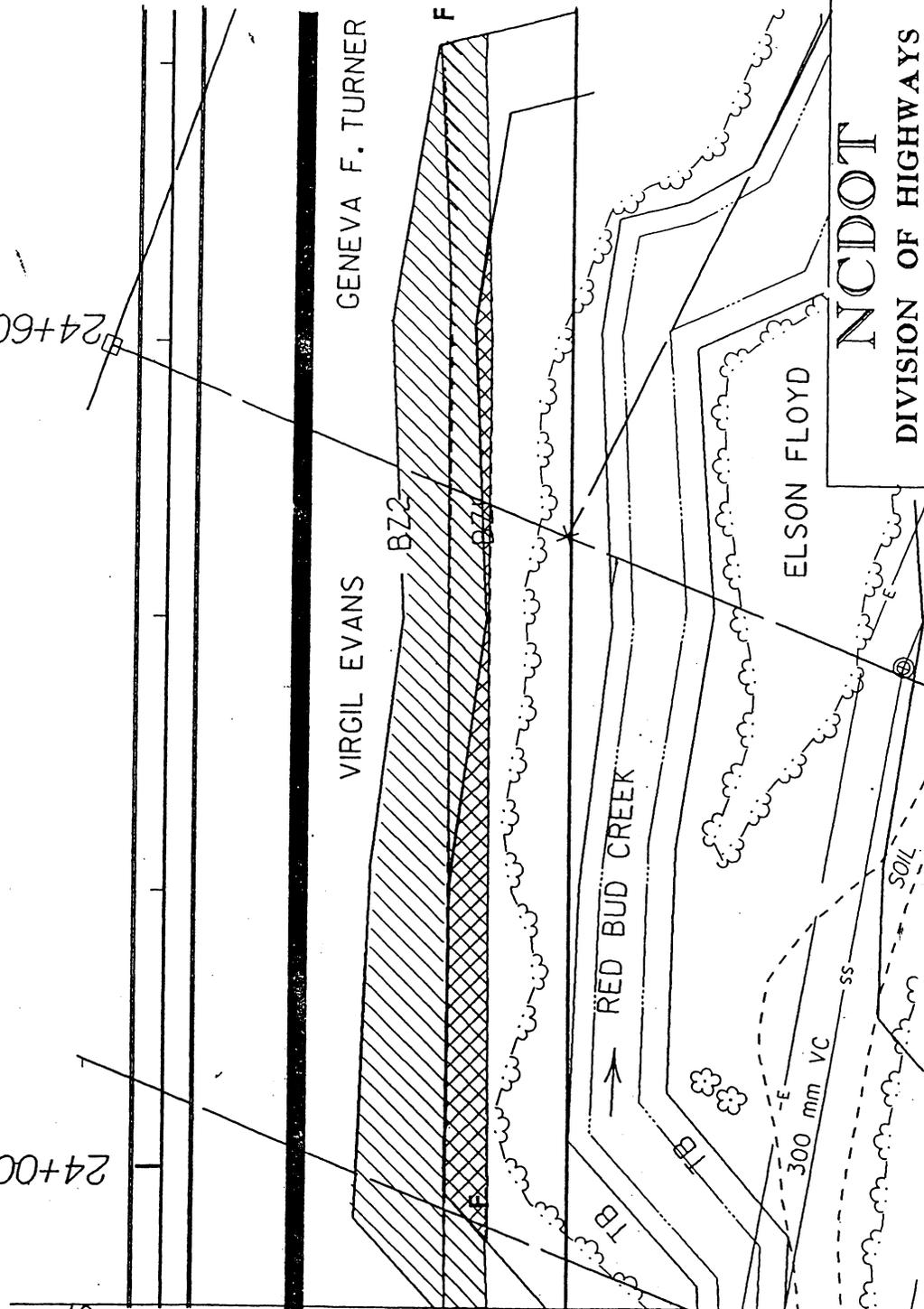
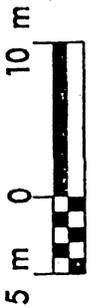
SR 1128 TO SR 1101

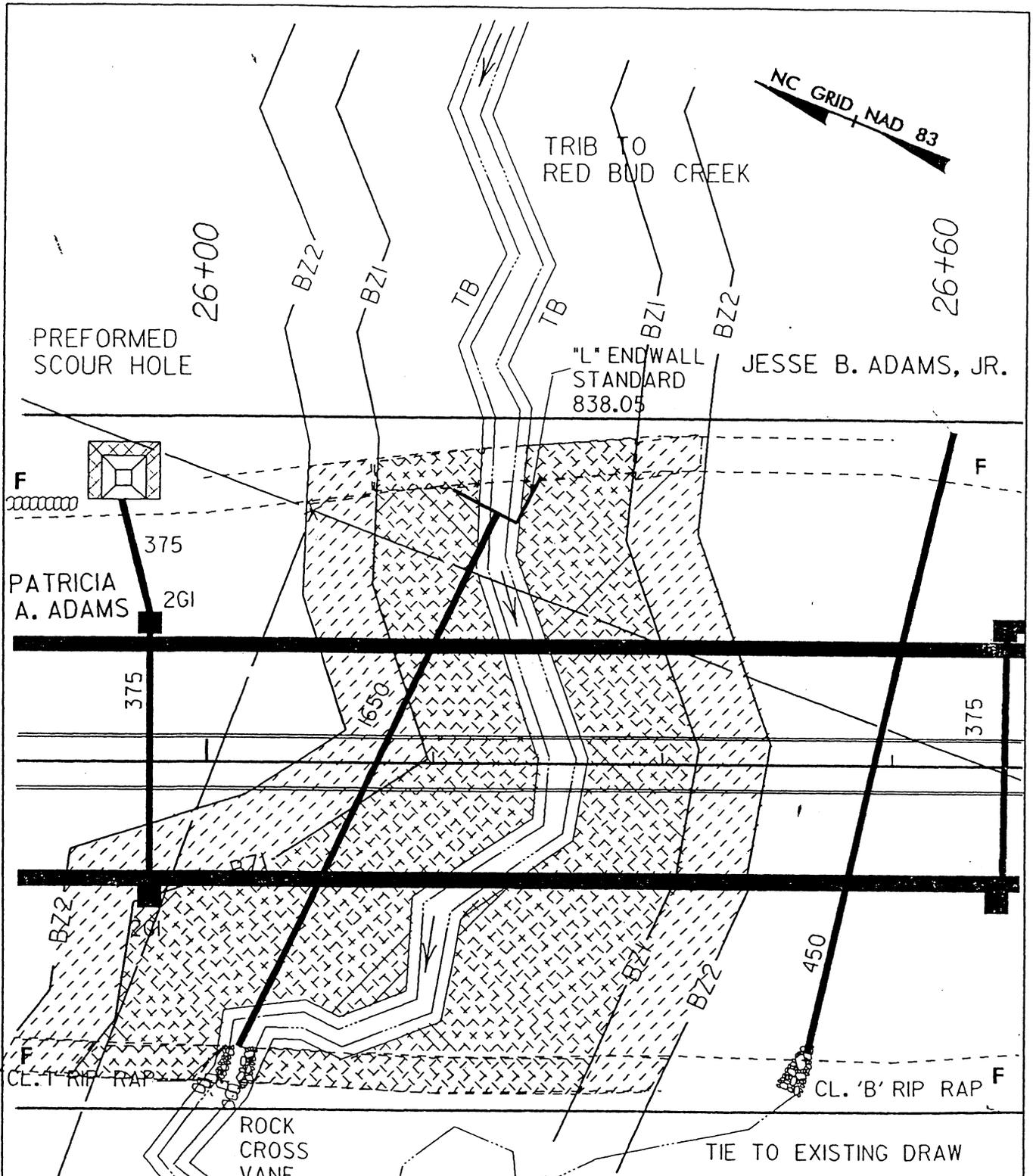
SHEET 26 OF 41 3/16/02

BUFFER IMPACTS

SITE 4

PLAN VIEW





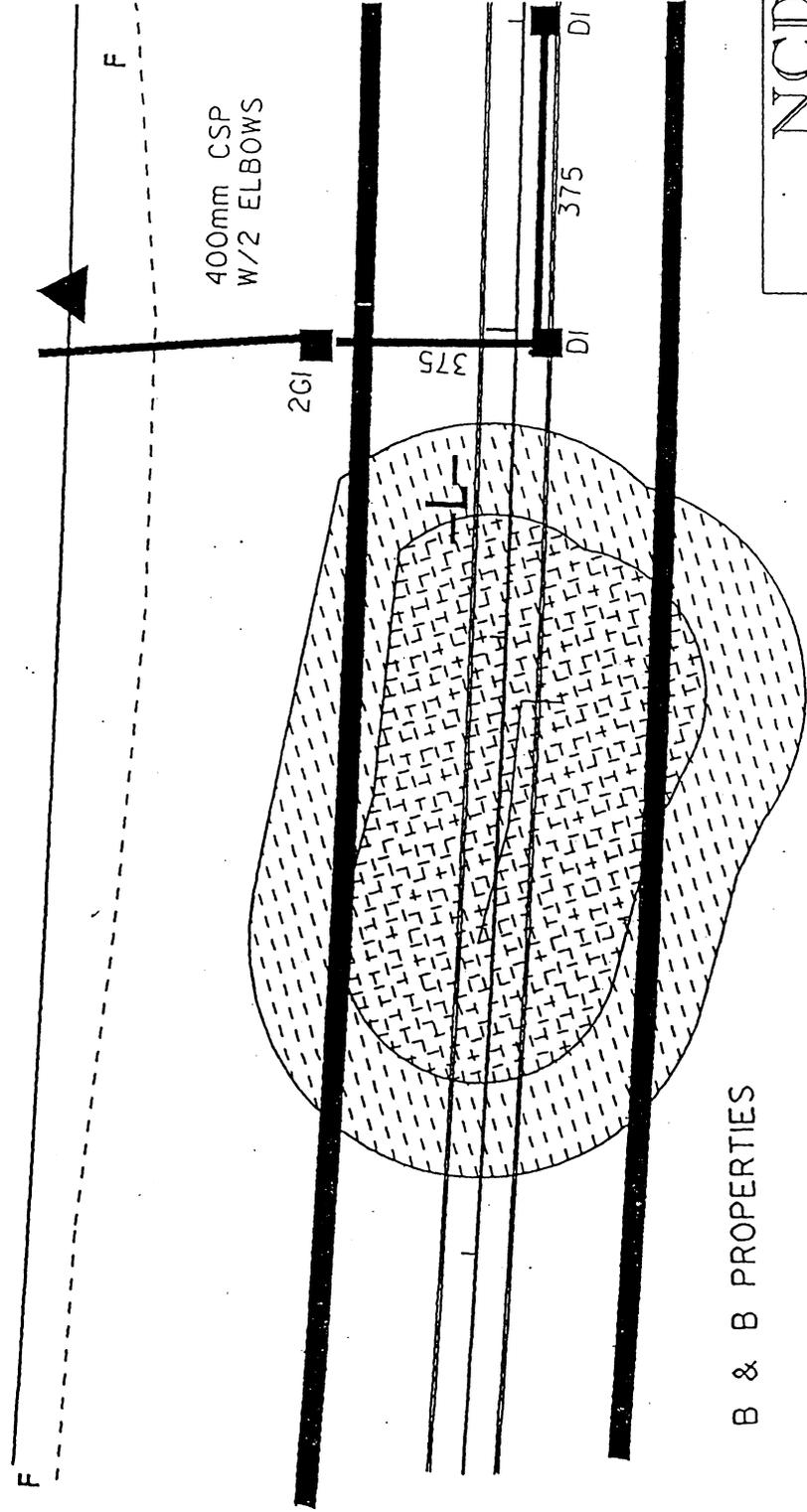
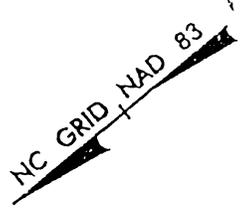
PATERIA A. ADAMS  
 BUFFER IMPACTS  
 SITE 5  
 PLAN VIEW

**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 27 OF 41

3/16/02

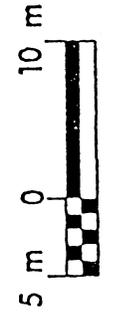
35+40

36+00



B & B PROPERTIES

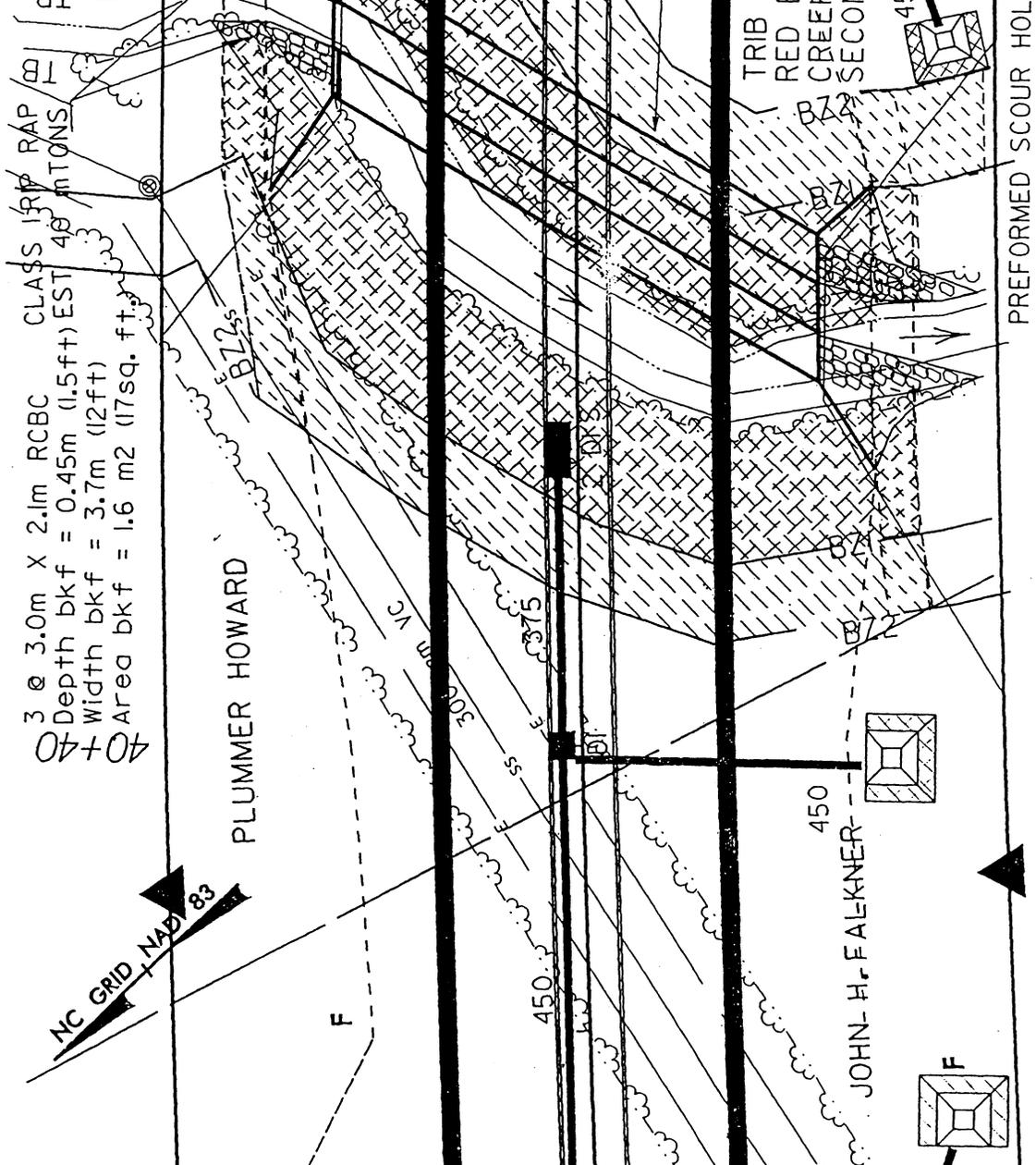
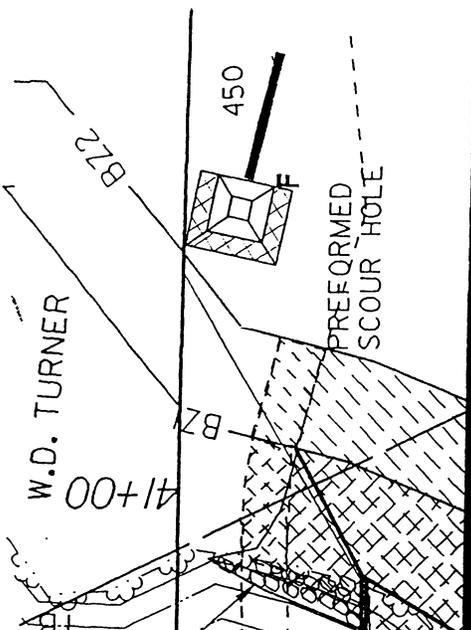
BUFFER IMPACTS  
SITE 6  
PLAN VIEW



**NC DOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101



3 @ 3.0m X 2.1m RCBC  
 CLASS 1R RAP  
 Depth bkf = 0.45m (1.5ft) EST 40 m TONS  
 Width bkf = 3.7m (12ft)  
 Area bkf = 1.6 m<sup>2</sup> (17sq. ft.)



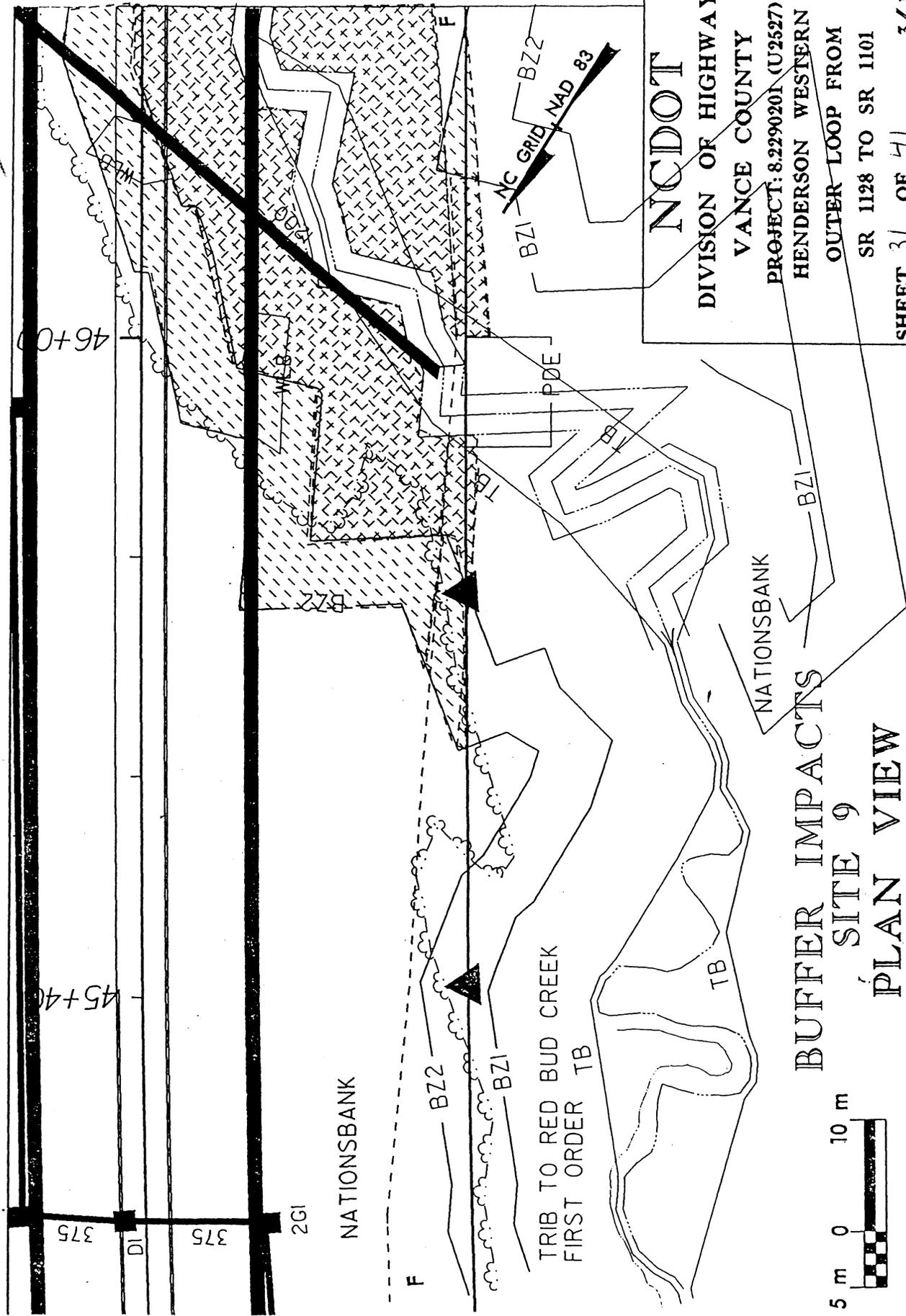
**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U-2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 SHEET 30 OF 41

PREFORMED SCOUR HOLE  
 5 m 0 10 m  


**BUFFER IMPACTS  
 SITE 8  
 PLAN VIEW**

Rev. 10/03  
 5/16/02

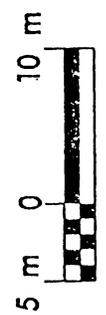
MATCH STATION 46+30



**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101

SHEET 3 OF 41 3/16/02

**BUFFER IMPACTS  
 SITE 9  
 PLAN VIEW**



MATCH STATION 46+30

NATIONSBANK

PDE

B72

WLB

B22

MLB

B21

B21

B21

F

1005

F



47+40

47+00

47+00

47+00

47+00

47+00

47+00

# BUFFER IMPACTS

## NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 32 OF 41

3/16/02

NATIONSBANK

SITE 9

# PLAN VIEW

5 m 0 10 m



F

B72

B21

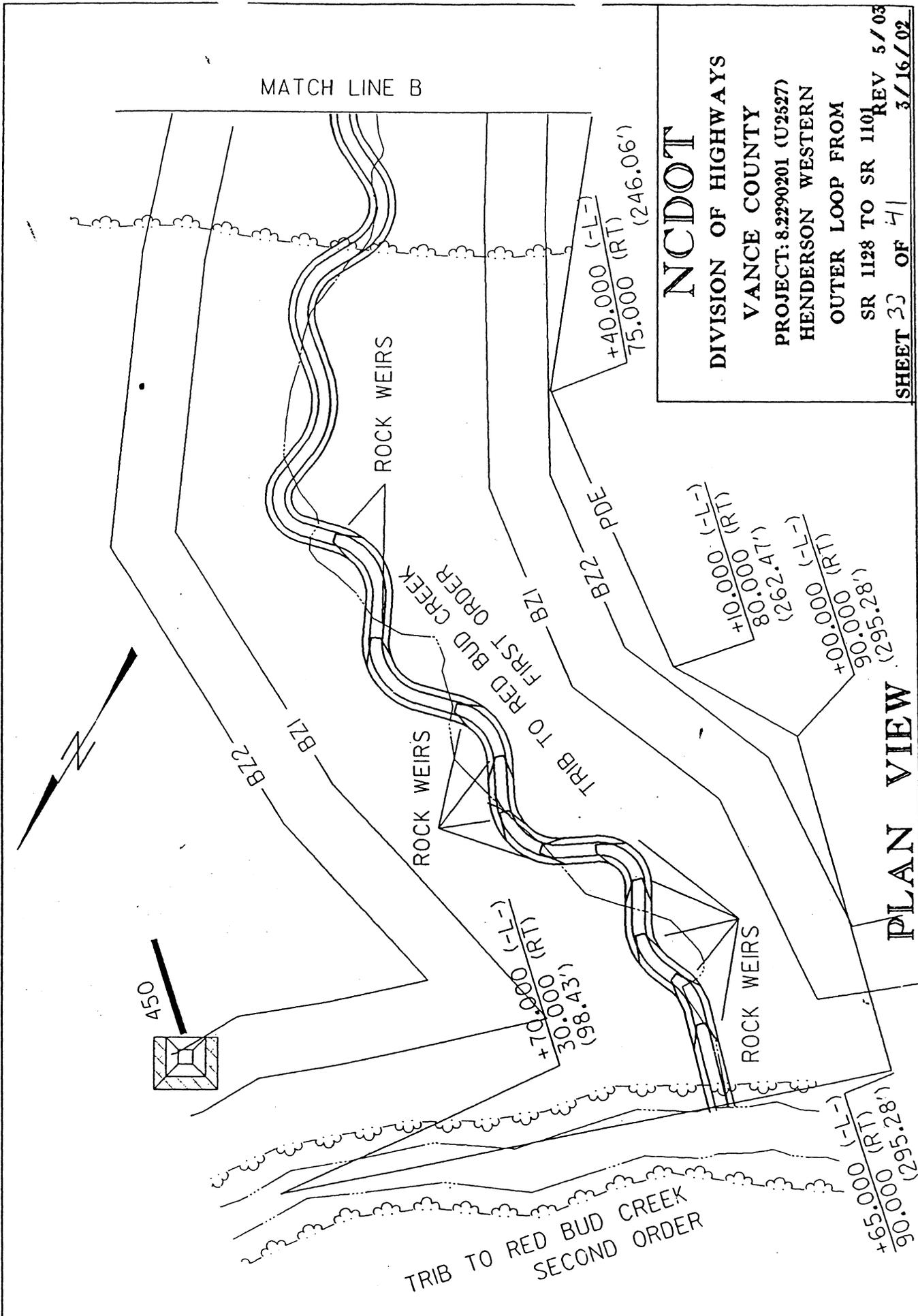
B21

B21

B21

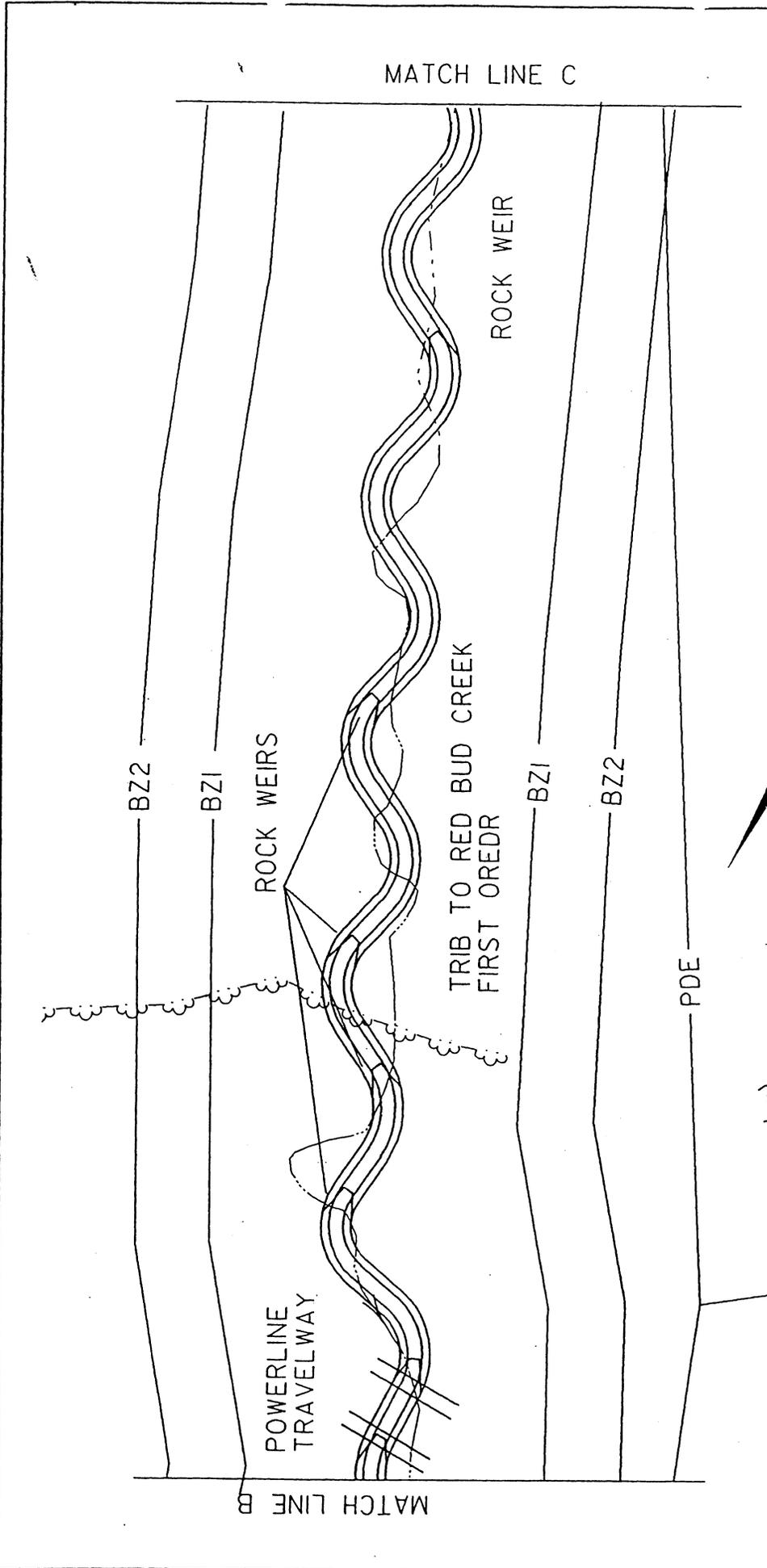
B21

MATCH LINE B



**NC DOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101 REV 5/03  
 SHEET 33 OF 41 3/16/02

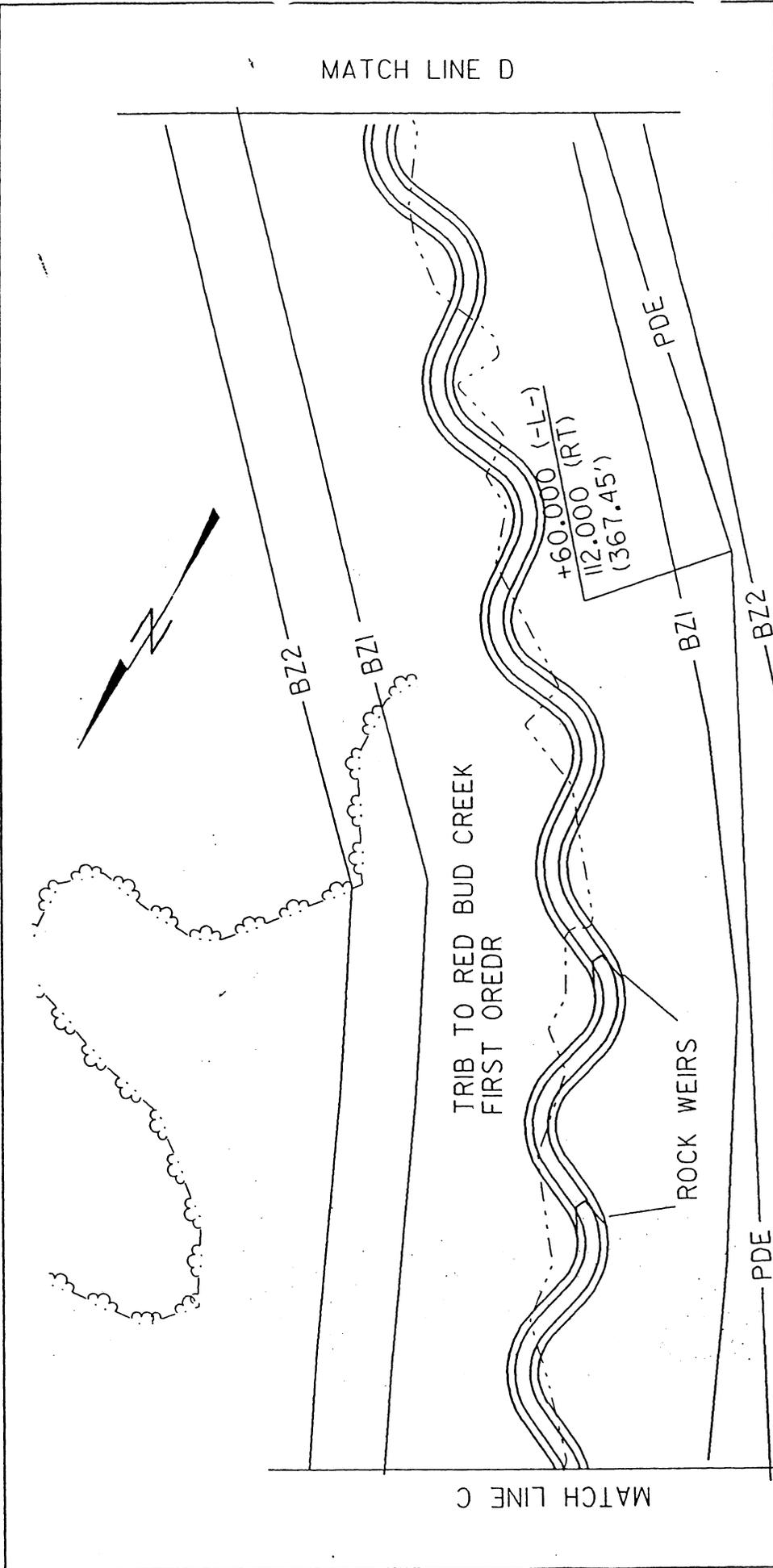
PLAN VIEW



+80.000 (-L-)  
 90.000 (RT)  
 (295.28')

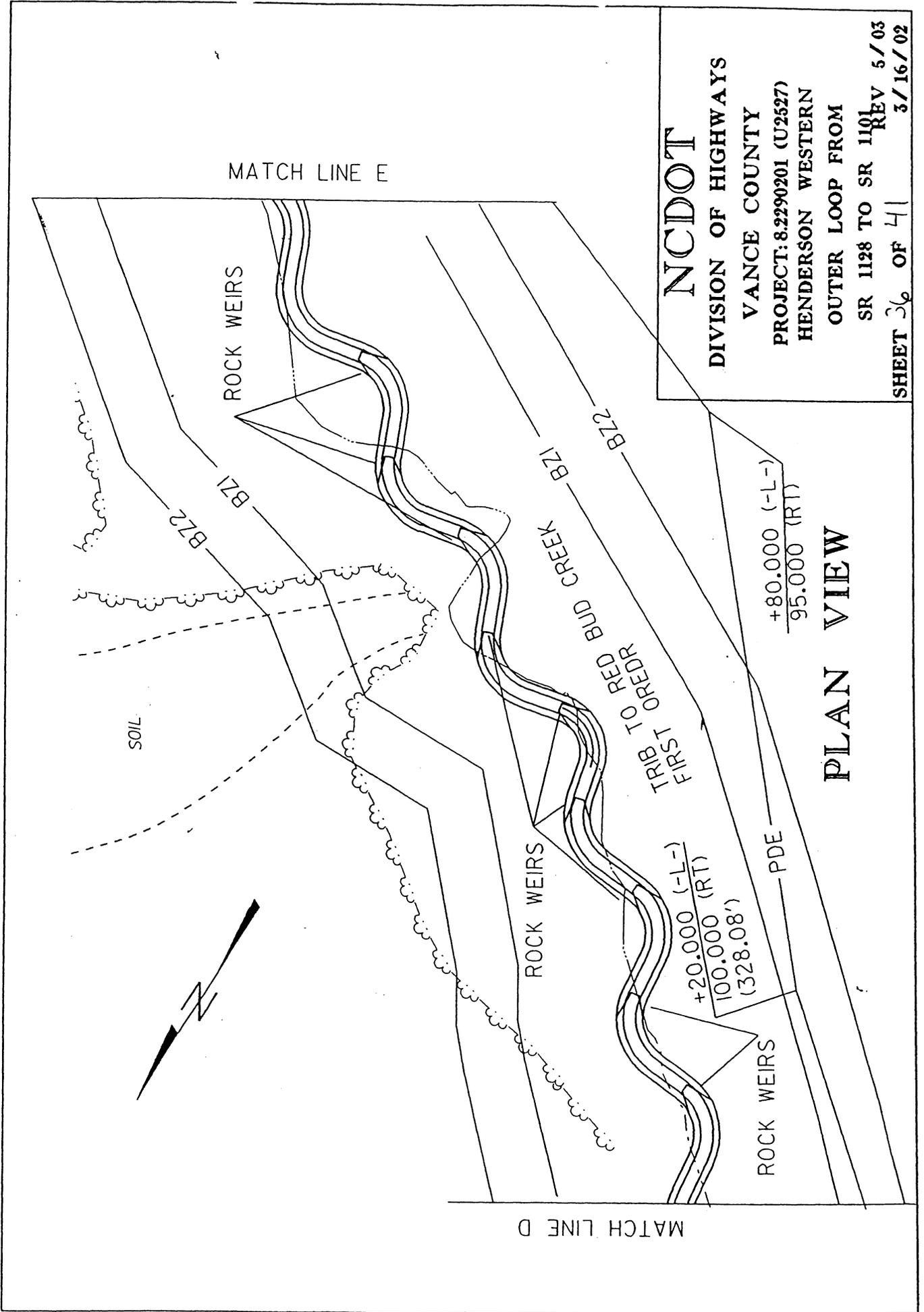
PLAN VIEW

**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 REV 5/03  
 SHEET 34 OF 41 3/16/02



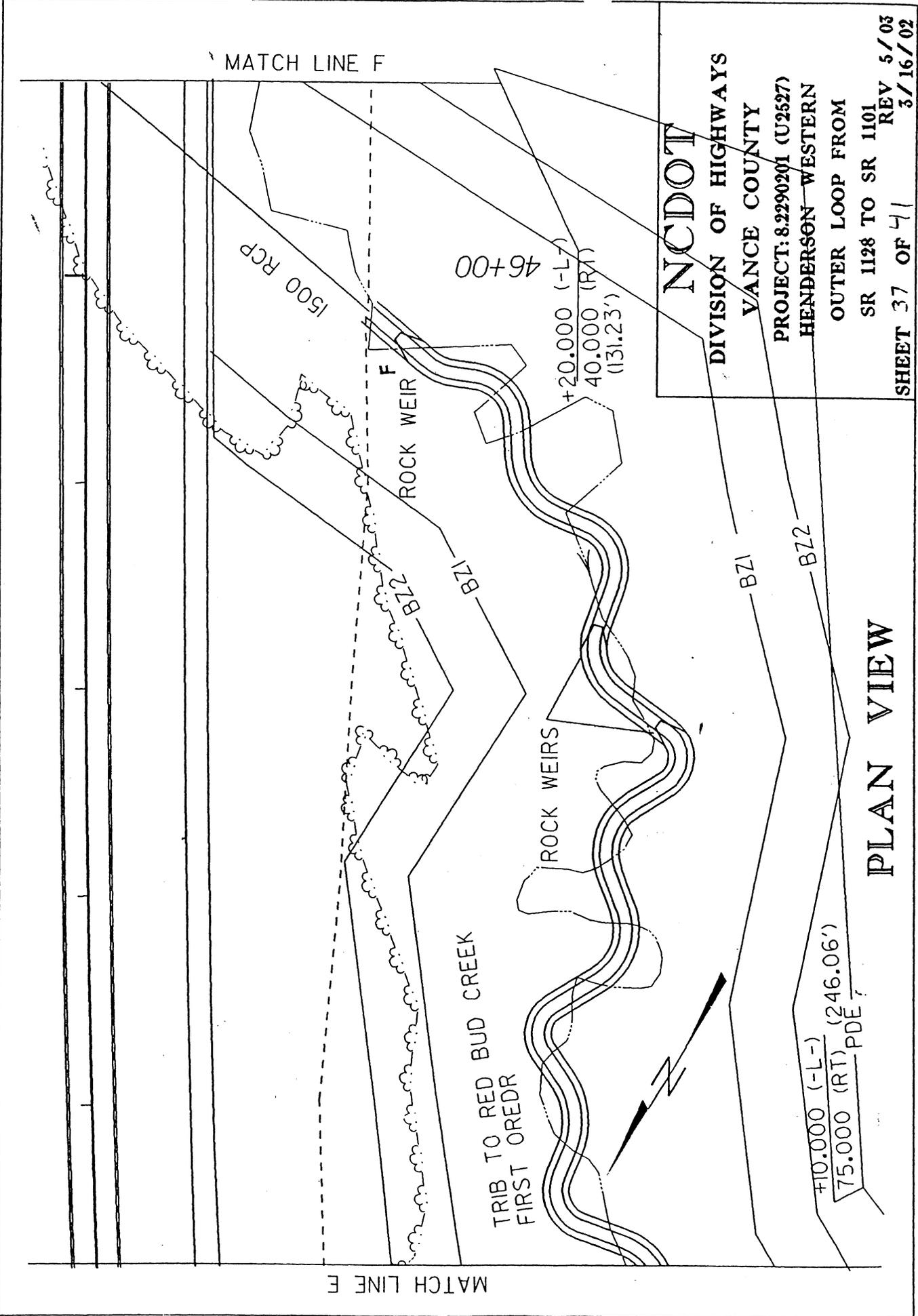
**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 REV 5/03  
 3/16/02

**PLAN VIEW**



**NCDOT**  
 DIVISION OF HIGHWAYS  
 VANCE COUNTY  
 PROJECT: 8.2290201 (U2527)  
 HENDERSON WESTERN  
 OUTER LOOP FROM  
 SR 1128 TO SR 1101  
 REV 5/03  
 SHEET 36 OF 41 3/16/02

**PLAN VIEW**



**NCDOT**

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U2527)

HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 37 OF 41

REV 5/03  
3/16/02

**PLAN VIEW**





# PROPERTY OWNER

NAME AND ADDRESS

OWNER'S NAME

ADDRESS

J.P. Howard Heirs

630 Farrar Ave.  
Henderson, NC 27536

David & Marjorie Lewis

Rt. 4 Box 290  
Henderson, NC 27536

Nationsbank c/o Nannie Crowder

Nationsbank Trust HSZ-5  
P.O. Box 27287  
Raleigh, NC 27611

George Washington Perry

Rt. 5 Box 26  
Henderson, NC 27536

Shannon P. & John Rock

P.O. Box 676  
Louisburg, NC 27549

Jewel Royster

Rt. 4 Box 352-A  
Henderson, NC 27536

Geneva Turner

243 North 8th Street  
Kenilworth, NJ 07033

W.D. Turner, et al.

938 Hargrove St.  
Henderson, NC 27536

## NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 40 OF 41

3/16/02

PROPERTY OWNER

NAME AND ADDRESS

OWNER'S NAME	ADDRESS
Jesse B. Adams, Jr.	3758 Evans Trailway Beltsville, MD 20705
Patricia Ann Adams	9039 Sligo Parkway, #509 Silver Springs, MD 20901
B & B Properties c/o W.L. Stanley	P.O. Box 1092 Henderson, NC 27536
Gloria Carver & Harvey A. Wilson	Rt. 4 Box 352-C Henderson, NC 27536
John D. Ellis & Mildred Ellis	435 Oak Hill Street Henderson, NC 27536
Virgil Evans c/o Lillian B. Evans	PO BOX 684 Henderson, NC 27536
John H. Faulkner	215 Crestwood Road Henderson, NC 27536
Plummer Howard	630 Farrar Ave. Henderson, NC 27536

NCDOT  
DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2290201 (U-2527)  
HENDERSON WESTERN  
OUTER LOOP FROM  
SR 1128 TO SR 1101  
SHEET 41 OF 41 3/16/02

**Stream Mitigation Plan**  
**U-2527 Vance County**  
**June 2, 2003**

This project involves restoration of approximately 790 m. (2592ft.) of an unnamed tributary to Red Bud Creek. The proposed Western Outer Loop near Henderson is unavoidably impacting Red Bud Creek as well as its tributaries along the proposed alignment. The proposed restoration will be used to mitigate these impacts. The existing stream flows through cut over woods with uncut trees along the stream. The stream has low riffle/ pool sequence and sinuosity. The side slopes are 1:1 in some areas and eroded in pool areas. The existing stream reach is entrenched and most nearly fits the geomorphic characteristics of a G4 stream type (see Morphological Measurement Table). At the confluence of the tributary to Red Bud Creek and the proposed stream, bedrock exist and will prevent any further down cutting at the confluence. With this in mind it is proposed to restore the unnamed tributary to its original dimension, pattern, and profile to the extent practicable by installing grade control structures in a riffle pool sequence at the confluence thus exposing the tributary to its original floodplain.

The drainage area contributing to the project site is 0.16 sq.mi. The drainage area for the proposed restoration for the most part lies between the main tributary to the north, NCSR 1101 to the south, and approximately 2000 feet east of the proposed outer loop. This drainage basin is totally wooded and cut over for the most part. Currently there is no development in the basin. Development in the future would encompass approximately 10 to 15 percent of the drainage basin. The stream extends approximately 1200 feet upstream of the site.

As stated above the existing stream is entrenched. Morphological data was difficult to collect on the existing stream but was attempted and is shown on the Morphological Measurement Table. Pebble counts were conducted at two locations and the D50 size material was approximately 0.031 inches (.79 mm). The bankfull depth and width were determined for the existing stream so that a bankfull discharge could be developed for design purposes.

The reference stream for the proposed project is Sandy Creek near Malancton in Randolph County (see attached location map). The drainage area for Sandy Creek is 0.97 sq.mi. Morphological ratios from the reference stream in conjunction with natural stream design techniques from the Applied River Morphology book by Dave Rosgen and bankfull depth from the existing stream were used to extrapolate pertinent data to the proposed stream. Sandy Creek best fits the geomorphic characteristics of an E4 stream type (see Morphological Measurement Table).

The proposed stream reach has a drainage area of 0.16 sq.mi. and will be 791m (2595ft.) long. The width/depth ratio was adjusted to 10.42 so that the stream could be constructed as a E4 stream type. Bed material from the existing stream will be removed, stockpiled and placed on the riffles of the proposed stream (see plan for location.). Shear

calculations indicate that the bed material will need to be supplemented with rock to increase the d50 size material such that the calculated shear is slightly higher than the permissible shear for the bed. This will insure motion of the bed load and reduce the possibility of degrading the riffles (see shear calculations).

Sediment Transport:

The following is a summary of the shear stress and stream power for the proposed stream restoration.

The shear calculations come from the HYCHL program in the FHWA Integrated Drainage Design Computer System, Version 6.0 (HYDRAIN). HYCHL can analyze channels for stability through application of tractive force theory. The program compares shear exerted on the lining with the permissible shear stress of the lining. HYCHL can analyze composite linings (i.e. a bed lining and a side slope lining). Attached are the results calculated by HYCHL for the proposed stream having a natural cobble bed liner (d50=1.0in.) and vegetative side slope lining. The results were determined for the proposed bankfull elevation. The results indicate a stable side slope lining and an unstable bed lining for the stockpiled bed material (d50=0.031in.). It would take a d50 = 4.0in to increase the permissible shear to slightly less than the bed shear.

Stream power in lb/ft-s is given by the equation  $\omega = \tau V$ , where:  $\tau$  is the average channel shear stress in lb/ft<sup>2</sup> given by HYCHL.

	<u>STREAM POWER</u>	<u>BED SHEAR</u>	<u>SIDE SHEAR</u>	<u>PERMISSIBLE SHEAR</u>	
				Bed,	Side
D50 = 0.031in	1.1	1.34	1.07	0.33	2.10
D50 = 4.0in	1.1	1.47	1.15	1.34	2.10

```

JOB U-2527 FIRST ORDER TRIBUTAR.
UNI 0
** UNITS PARAMETER = 0 (ENGLISH)
   CHL 0.0162 27
   TRP 4 2
** LEFT SIDE SLOPE 2.0 AND RIGHT SIDE SLOPE 2.0
** THE BASE WIDTH OF THE TRAPEZOID (ft) 4.00
   N .055 .08
** LOW FLOW N VALUE= .055
** SIDE SLOPE N VALUE= .080
   LRR .333
** D50' (ft) .33
   CPS .25
   LVG B
   PSS 1.34 2.10
** USER SUPPLIED - LOW PERMIS. SHEAR = (lb/ft^2) 1.34
** USER SUPPLIED - HIGH PERMIS. SHEAR = (lb/ft^2) 2.10
   END
*****END OF COMMAND FILE*****

```

U-2527 FIRST ORDER TRIBUTARY

-----  
INPUT REVIEW  
-----

```

DEFAULT ANGLE OF REPOSE (degrees): 40.96
DESIGN PARAMETERS:
  DESIGN DISCHARGE (ft^3/s): 27.00
  CHANNEL SHAPE: TRAPEZOIDAL
  CHANNEL SLOPE (ft/ft): .016
  LINING TRANSITION HEIGHT (ft): .25

```

-----  
HYDRAULIC CALCULATIONS USING NORMAL DEPTH  
-----

	DESIGN	MAXIMUM
FLOW (cfs)	27.00	22.76
DEPTH (ft)	1.46	1.33
AREA (ft^2)	10.06	8.82
WETTED PERIMETER (ft)	10.51	9.93
HYDRAULIC RADIUS (ft)	.96	.89
VELOCITY (ft/s)	2.68	2.58
MANNINGS N (LOW FLOW)	.055	.055
MANNINGS N (SIDE SLOPE)	.080	.080
EFFECTIVE MANNINGS N	.068	.068
REYNOLDS NUMBER (10^5)	.22	

-----  
STABILITY ANALYSIS  
-----

CONDITION	LINING TYPE	PERMIS SHR (lb/ft^2)	CALC. SHR (lb/ft^2)	STAB. FACTOR	REMARKS
LOW FLOW LINING					
BOTTOM; STRAIGHT	RIPRAP	1.34	1.47	.91	UNSTABLE
SIDE SLOPE LINING					
SIDE; STRAIGHT	VEGETATIVE B	2.10	1.13	1.85	STABLE

RATIO OF SIDE SHEAR TO BOTTOM SHEAR = .77

\*\*\* NORMAL END OF HYCHL \*\*\*

```

JOB U-2527 FIRST ORDER TRIBUTARY
UNI 0
** UNITS PARAMETER = 0 (ENGLISH)
   CHL 0.0162 27
   TRP 4 2
** LEFT SIDE SLOPE 2.0 AND RIGHT SIDE SLOPE 2.0
** THE BASE WIDTH OF THE TRAPEZOID (ft) 4.00
   N .03 .08
** LOW FLOW N VALUE= .030
** SIDE SLOPE N VALUE= .080
   LRR .003
** D50 (ft) .00
   CPS .25
   LVG B
   PSS .33 2.10
** USER SUPPLIED - LOW PERMIS. SHEAR = (lb/ft^2) .33
** USER SUPPLIED - HIGH PERMIS. SHEAR = (lb/ft^2) 2.10
   END
*****END OF COMMAND FILE*****

```

U-2527 FIRST ORDER TRIBUTARY

-----  
INPUT REVIEW  
-----

```

DEFAULT ANGLE OF REPOSE (degrees): 33.98
DESIGN PARAMETERS:
  DESIGN DISCHARGE (ft^3/s): 27.00
  CHANNEL SHAPE: TRAPEZOIDAL
  CHANNEL SLOPE (ft/ft): .016
  LINING TRANSITION HEIGHT (ft): .25

```

-----  
HYDRAULIC CALCULATIONS USING NORMAL DEPTH  
-----

	DESIGN	MAXIMUM
FLOW (cfs)	27.00	3.59
DEPTH (ft)	1.33	.33
AREA (ft^2)	8.82	1.52
WETTED PERIMETER (ft)	9.93	5.46
HYDRAULIC RADIUS (ft)	.89	.28
VELOCITY (ft/s)	3.06	2.37
MANNINGS N (LOW FLOW)	.030	.030
MANNINGS N (SIDE SLOPE)	.080	.080
EFFECTIVE MANNINGS N	.057	.034
REYNOLDS NUMBER (10^5)	.00	

-----  
STABILITY ANALYSIS  
-----

CONDITION	LINING TYPE	PERMIS SHR (lb/ft^2)	CALC. SHR (lb/ft^2)	STAB. FACTOR	REMARKS
LOW FLOW LINING					
BOTTOM; STRAIGHT	RIPRAP	.33	1.34	.25	UNSTABLE
SIDE SLOPE LINING					
SIDE; STRAIGHT	VEGETATIVE B	2.10	1.03	2.03	STABLE

RATIO OF SIDE SHEAR TO BOTTOM SHEAR = .77

\*\*\* NORMAL END OF HYCHL \*\*\*

Variables	Existing Channel	Proposed Reach	USGS Station	Reference Reach
1. Stream type	G4	E4	NONE	E4
2. Drainage area (D.A.) (ac.)	102.5 ac.	102.5 ac.		620.4 ac.
3. Bankfull width ( $W_{bkt}$ ) (ft.)	5.26 ft.	8.23 ft.		12.1 ft.
4. Bankfull mean depth ( $d_{bkt}$ ) (ft.)	1.04 ft.	0.79 ft.		1.4 ft.
5. Width/depth ratio ( $W_{bkt}/d_{bkt}$ )	5.06	10.42		8.5
6. Bankfull cross-sectional area ( $A_{bkt}$ ) (ft <sup>2</sup> )	5.47 ft <sup>2</sup>	6.47		17.3 ft <sup>2</sup>
7. Bankfull mean velocity ( $V_{bkt}$ ) (ft/s)	4.84 ft/s	4.18		4.1 ft/s
8. Bankfull discharge ( $Q_{bkt}$ ) (ft <sup>3</sup> /s)	26.50 ft <sup>3</sup> /s	27		70.0 ft <sup>3</sup> /s
9. Bankfull max depth ( $d_{mbkt}$ ) (ft)	1.47 ft.	1.06		2.1 ft
10. Width of floodprone area ( $W_{fpa}$ ) (ft)	2.95 ft.	20.58 ft.		80.0 ft
11. Entrenchment ratio ( $W_{fpa}/W_{bkt}$ )	0.56	2.5		6.6
12. Meander length ( $L_m$ ) (ft)	62.57 ft.	65.10 ft.		75.5 ft
13. Ratio of meander length to bankfull width ( $L_m/W_{bkt}$ )	11.90	7.91		6.3
14. Radius of curvature ( $R_c$ ) (ft)	8.04 ft.	18 ft.		26.0 ft
15. Ratio of radius of curvature to bankfull width ( $R_c/W_{bkt}$ )	1.53	2.2		2.2
16. Belt width ( $W_{bt}$ ) (ft)	26.02 ft.	24.48 ft.		40.0 ft
17. Meander width ratio ( $W_{bt}/W_{bkt}$ )	4.95	2.97		3.3
18. Sinuosity (stream length/valley length) (K)	1.35	1.18		1.35
19. Valley Slope (VS)	.0196	.0191		0.0043
20. Average slope (CS)	.0145	.0162		0.0058
21. Pool slope	.0142	.005		0.0026
22. Ratio of pool slope to average slope	.01	.31		0.45
23. Maximum pool depth ( $dp_{max}$ ) (ft)	1.80 ft.	1.80		3.0 ft
24. Ratio of pool depth to average bankfull depth ( $dp/d_{bkt}$ )	1.73	2.28		2.1
25. Pool width ( $W_p$ ) (ft)	3.29 ft.	10.80 ft.		9.5 ft
26. Ratio of pool width to bankfull width	.63	1.31		0.79
27. Pool to pool spacing (ft)	23.83 ft.	36.30		75.1 ft
28. Ratio of pool to pool spacing to bankfull width	4.53	4.41		6.3
29. Ratio of lowest bank height to bankfull height (or max bankfull depth) ( $BH_{low}/d_{mbkt}$ )	1.00	1.00		1.0

**NATURAL CHANNEL DESIGN DATA**  
**MORPHOLOGICAL MEASUREMENT**  
**TABLE (ENGLISH UNITS)**

**SITE 1**

\* Reference reach is a tributary to Sandy Creek near Malancton in Randolph County, NC.

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
VANCE COUNTY  
PROJECT: 8.2390201 (U-2527)

June 2, 2003  
SHEET \_\_ OF \_\_

### Pebble Count

 Project: 8.2390201

 Sheet # 5 of 6

 TIP No.: U-2527

Comm. No.: \_\_\_\_\_

### Pebble Count

	Particle	mm	PARTICLE COUNT			Total #	Item %	% Cum.
			1	2	3			
	Silt/Clay	<.062	11	1		12	6.8	6.8
(Sand)	Very Fine	.062-.125	15	1		16	9.1	15.9
	Fine	.125-.25	14	32		46	26.1	42.0
	Medium	.25-.50	6			6	3.4	45.5
	Coarse	.50-1.0	2	10		12	6.8	52.3
	Very Coarse	1.0-2	4	1		5	2.8	55.1
(Gravel)	Very Fine	2.0-4.0	4	8		12	6.8	61.9
	Fine	4.0-5.7	3	5		8	4.5	66.5
	Fine	5.7-8.0	3	3		6	3.4	69.9
	Medium	8.0-11.3	3	9		12	6.8	76.7
	Medium	11.3-16.0	5	4		9	5.1	81.8
	Coarse	16.0-22.6	9			9	5.1	86.9
	Coarse	22.6-32.0	10			10	5.7	92.6
	Very Coarse	32-45				0	0.0	92.6
	Very Coarse	45-64	3			3	1.7	94.3
(Cobble)	Small	64-90	4			4	2.3	96.6
	Small	90-128				0	0.0	96.6
	Large	128-180	1			1	0.6	97.2
	Large	180-256				0	0.0	97.2
(Boulder)	Small	256-362				0	0.0	97.2
	Small	362-512				0	0.0	97.2
	Medium	512-1024				0	0.0	97.2
	Lg-Very Lg	1024-2048	2			2	1.1	98.3
(Bedrock)			3			3	1.7	100.0
<b>TOTALS</b>						<b>176</b>		<b>100.0</b>

 D<sub>16</sub>: 0.13 mm

 Sand &< 55 %

 D<sub>35</sub>: 0.21 mm

 Gravel 39 %

 D<sub>50</sub>: 0.79 mm

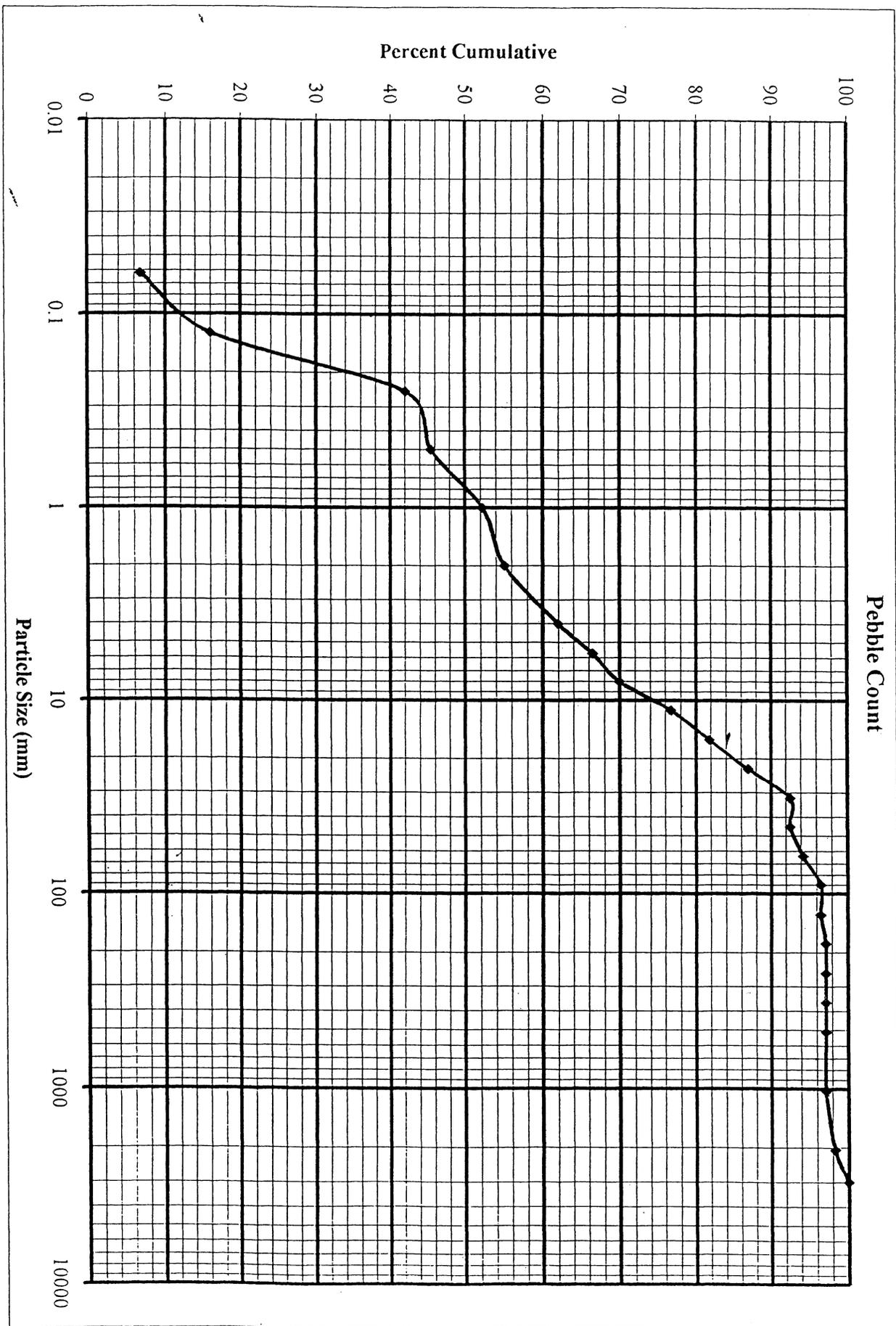
 Cobble 3 %

 D<sub>84</sub>: 18.57 mm

 Boulder 1 %

 D<sub>95</sub>: 71.0 mm

 Bedrock 2 %



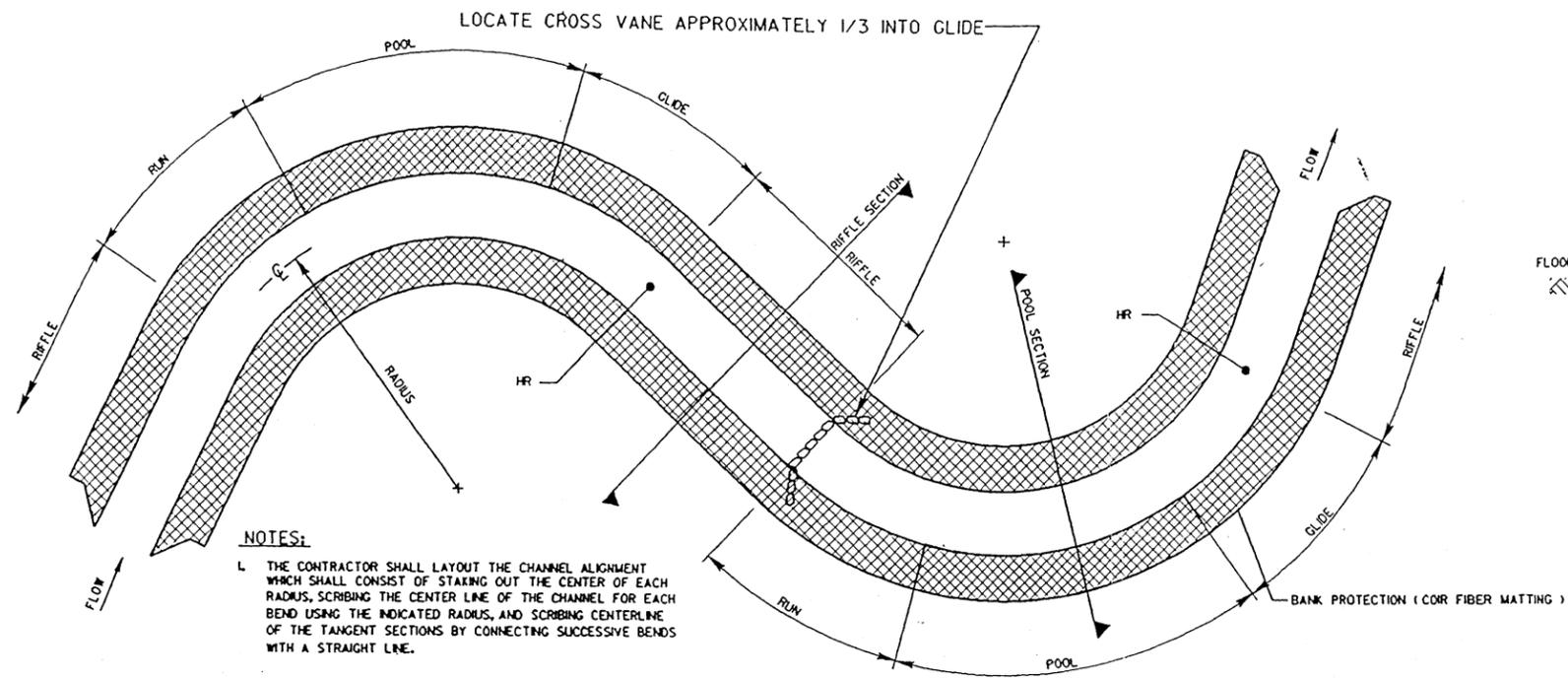
# CHANNEL CHANGE TYPICALS

PROJECT REFERENCE NO. **U-2527** SHEET NO. **2-F**  
 ROADWAY DESIGN ENGINEER  
 HYDRAULICS ENGINEER

**METRIC**

SEAL 24487  
 1701 N. L. ST.  
 TAMPA, FL 33604

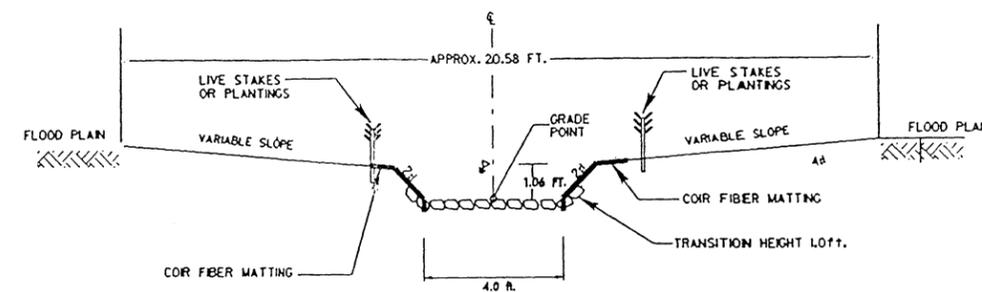
SEAL 14600  
 1701 N. L. ST.  
 TAMPA, FL 33604



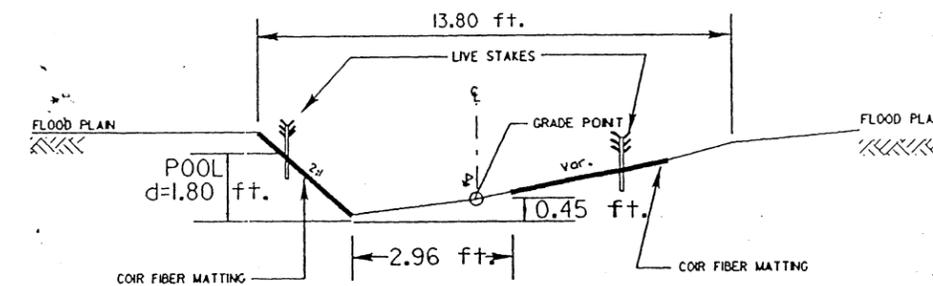
**NOTES:**

1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT WHICH SHALL CONSIST OF STAKING OUT THE CENTER OF EACH RADIUS, SCRIBING THE CENTER LINE OF THE CHANNEL FOR EACH BEND USING THE INDICATED RADIUS, AND SCRIBING CENTERLINE OF THE TANGENT SECTIONS BY CONNECTING SUCCESSIVE BENDS WITH A STRAIGHT LINE.
2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO AVOID CERTAIN OBSTACLES. APPROVAL BY THE ENGINEER OF THE STAKE-OUT ALIGNMENT SHALL BE REQUIRED PRIOR TO INITIATION OF THE CONSTRUCTION OF THE CHANNEL.
3. LOCATE ROCK CROSS VANES ACCORDING TO PLAN SHEET.

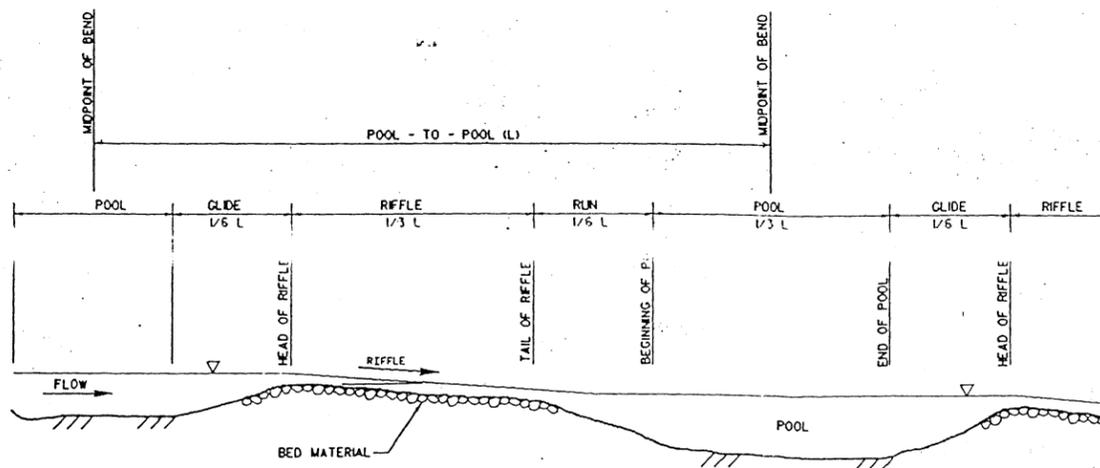
**TYPICAL PLAN**  
NOT TO SCALE



**TYPICAL RIFFLE SECTION**  
NOT TO SCALE



**TYPICAL POOL SECTION**  
NOT TO SCALE



**NOTES:**

1. THE POOL TO POOL SPACING (L) SHALL BE MEASURED AS THE DISTANCE FROM THE MIDPOINT OF THE UPSTREAM BEND TO THE MIDPOINT OF THE DOWNSTREAM BEND.
2. REFER TO MORPHOLOGICAL MEASUREMENT TABLE AND PLAN SHEET FOR DIMENSIONS. NOTE THAT POOL TO POOL SPACING VARIES.

**TYPICAL PROFILE**  
NOT TO SCALE

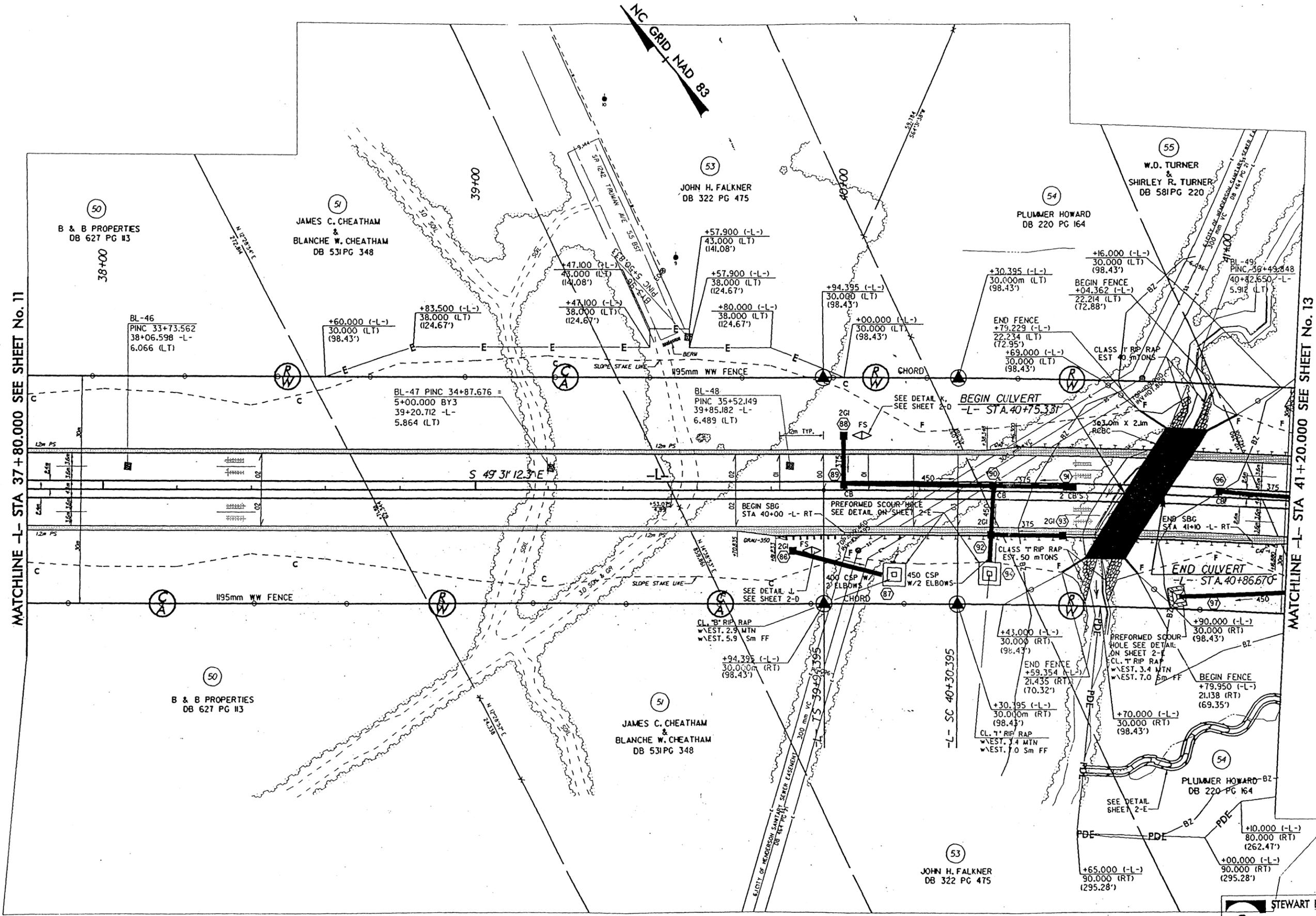
**MORPHOLOGICAL MEASUREMENT TABLE**

VARIABLES	EXISTING CHANNEL	PROPOSED REACH 1	PROPOSED REACH 2	REFERENCE REACH 3
U STREAM TYPE	G4	E4	NONE	E4
D DRAINAGE AREA	0.16sq.m	0.16sq.m		0.97sq.m
B BANKFULL WIDTH	5.26ft	8.23ft		12.1ft
B BANKFULL MEAN DEPTH	1.04ft	0.79ft		1.1ft
7) BANKFULL MEAN VELOCITY	4.84fps	4.18fps		4.1fps
8) BANKFULL DISCHARGE	26.50cfs	27cfs		70cfs
9) BANKFULL MAX DEPTH	1.47ft	1.06ft		2.1ft
10) WIDTH OF FLOODPRONE AREA	2.95ft	20.58ft		80ft
11) ENTRENCHMENT RATIO	0.56	2.5		6.6
12) MEANDER LENGTH	62.57ft	65.10ft		75.5ft
13) RATIO OF MEANDER LENGTH TO BANKFULL WIDTH	8.90	7.91		6.30
14) RATIO OF CURVATURE TO BANKFULL WIDTH	8.04ft	18ft		26ft
15) RATIO OF RADIUS OF CURVATURE TO BANKFULL WIDTH	1.53	2.2		2.2
16) MEAN WIDTH	26.02ft	24.48ft		40ft
17) MEANDER WIDTH RATIO	4.95	2.97		3.3
18) RATIO OF STREAM LENGTH/VALLEY LENGTH	1.35	1.18		1.35
19) VALLEY SLOPE	0.0196	0.0191		0.0043
20) AVERAGE SLOPE	0.0145	0.0162		0.0058
21) POOL SLOPE	.0142	0.005		0.0026
22) RATIO OF POOL SLOPE TO AVERAGE SLOPE	.01	0.31		0.45
23) MAXIMUM POOL DEPTH	1.80ft	1.80ft		3.0ft
24) RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH	1.73	2.28		2.1
25) POOL WIDTH	3.29ft	10.80ft		9.5ft
26) RATIO OF POOL WIDTH TO BANKFULL WIDTH	.63	1.31		0.79
27) POOL TO POOL SPACING	23.83ft	36.30ft		75.10ft
28) RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH	4.53	4.41		6.3
29) RATIO OF LOWEST BANK HEIGHT TO BANKFULL HEIGHT	1.8	1.0		1.0

U-2527-2004-0001 (Metric) Plans U-2527.dwg

MATCHLINE -L- STA 37 + 80.000 SEE SHEET No. 11

MATCHLINE -L- STA 41 + 20.000 SEE SHEET No. 13



SEE SHEETS 22 & 23 FOR -L- PROFILE

SEE SHEETS C-1 THRU C-7 FOR CULVERT

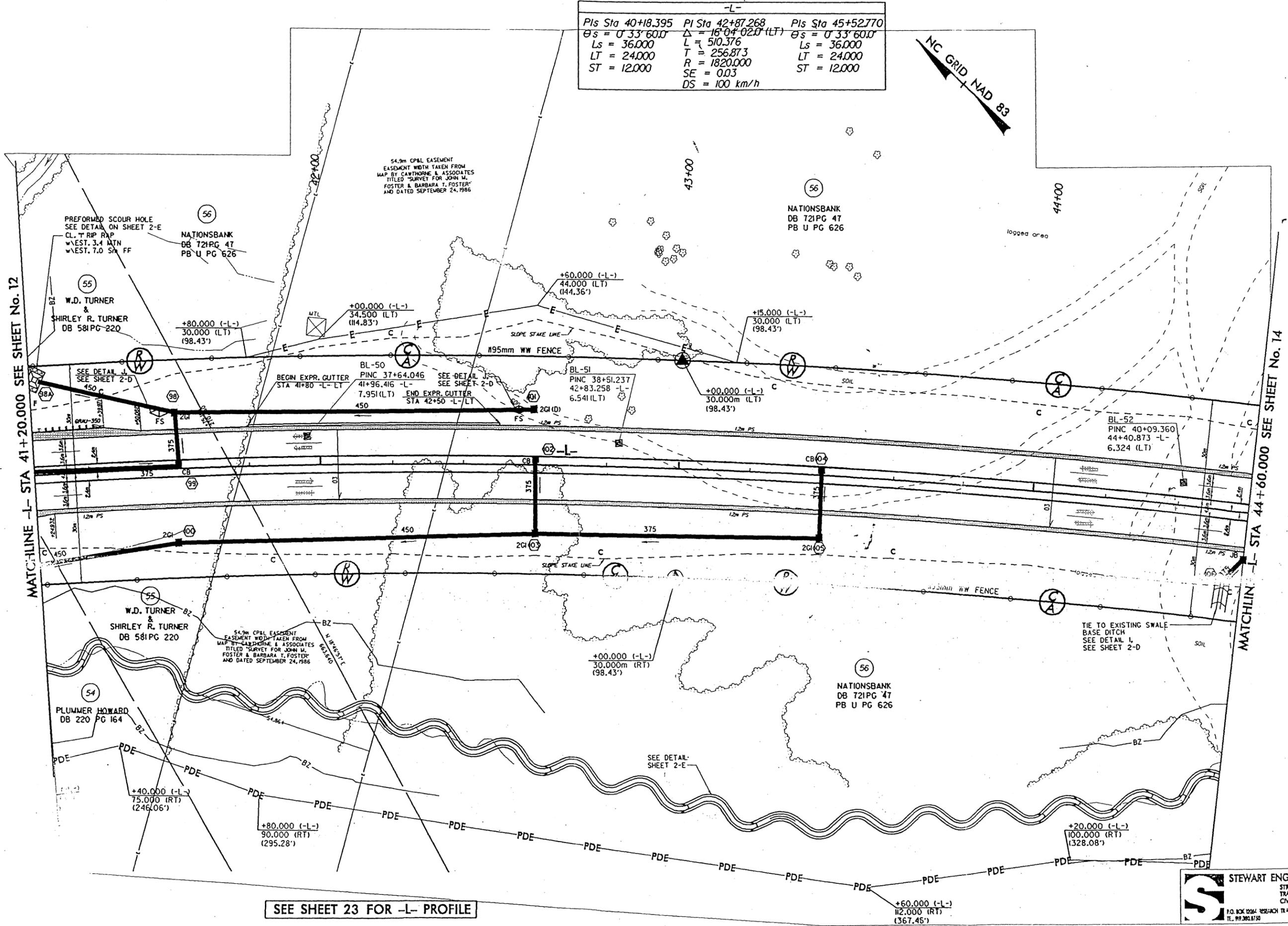
**STEWART ENGINEERING**  
 STRUCTURAL  
 TRANSPORTATION  
 CIVIL

P.O. BOX 2054 RESEARCH TRIANGLE PARK, NC 27709  
 TEL 919 286 8750 FAX 919 286 8752

DATE: 08/05/04  
 DRAWN: J. H. HARRIS  
 PLANNED: W. S. HARRIS

-L-		
Pls Sta 40+18.395	PI Sta 42+87.268	Pls Sta 45+52.770
$\theta_s = 0^\circ 33' 60.0''$	$\Delta = 16^\circ 04' 02.0''$ (LT)	$\theta_s = 0^\circ 33' 60.0''$
$L_s = 36.000$	$L = 510.376$	$L_s = 36.000$
$LT = 24.000$	$T = 256.873$	$LT = 24.000$
$ST = 12.000$	$R = 1820.000$	$ST = 12.000$
	$SE = 0.03$	
	$DS = 100 \text{ km/h}$	

NC GRID NAD 83



MATCHLINE -L- STA 41+20.000 SEE SHEET No. 12

MATCHLINE -L- STA 44+60.000 SEE SHEET No. 14

SEE SHEET 23 FOR -L- PROFILE

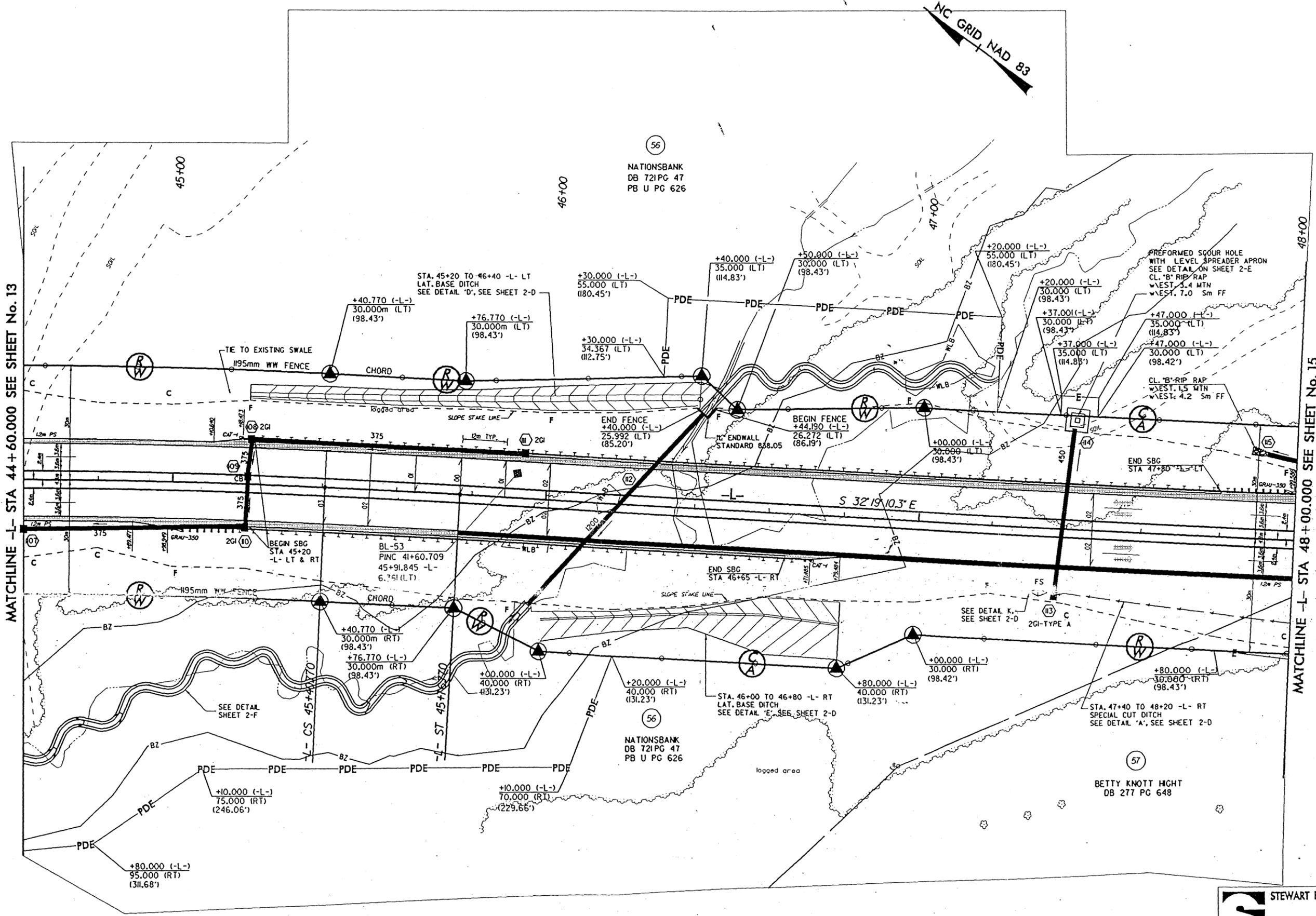
**STEWART ENGINEERING**  
 STRUCTURAL  
 TRANSPORTATION  
 CIVIL

P.O. BOX 10544 RESEARCH TRIANGLE PARK, NC 27709  
 TEL: 919.382.1750 FAX: 919.382.1752

NC GRID, NAD 83

MATCHLINE -L- STA 44 + 60.000 SEE SHEET No. 13

MATCHLINE -L- STA 48 + 00.000 SEE SHEET No. 15



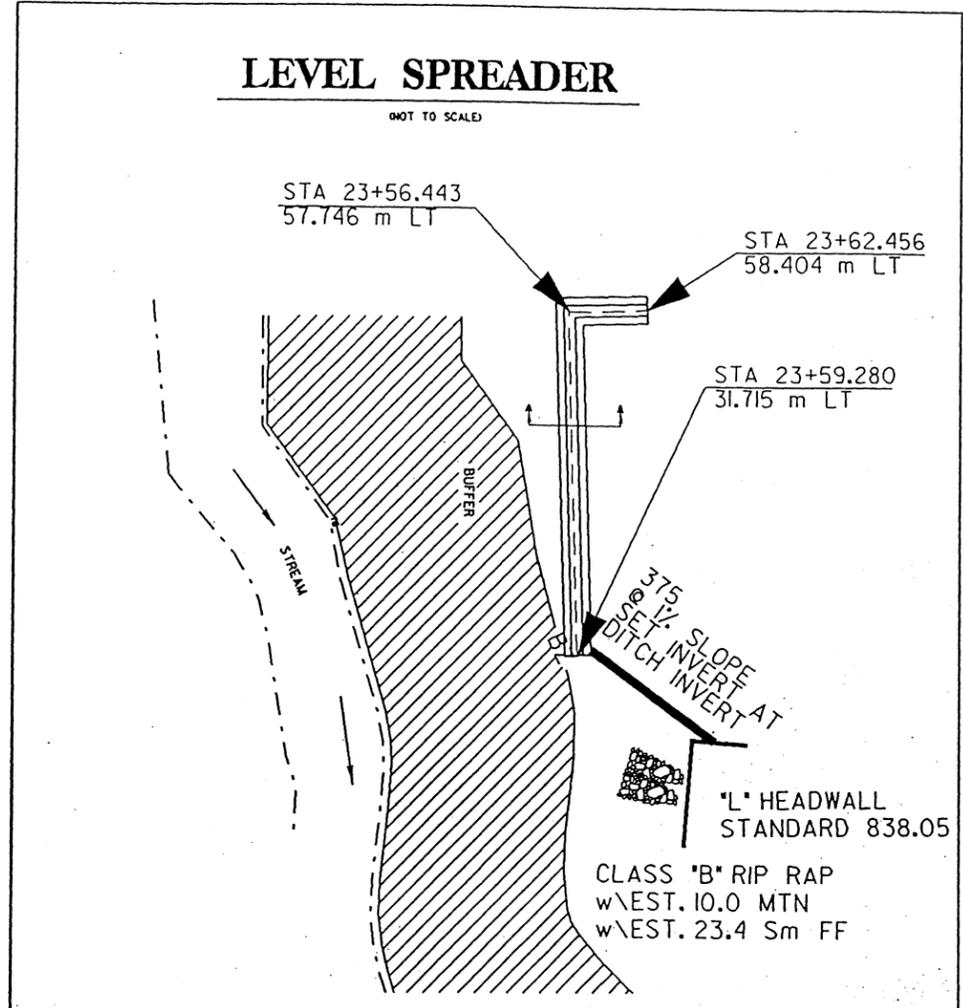
SEE SHEETS 23 & 24 FOR -L- PROFILE

**STEWART ENGINEERING**  
 STRUCTURAL  
 TRANSPORTATION  
 CIVIL

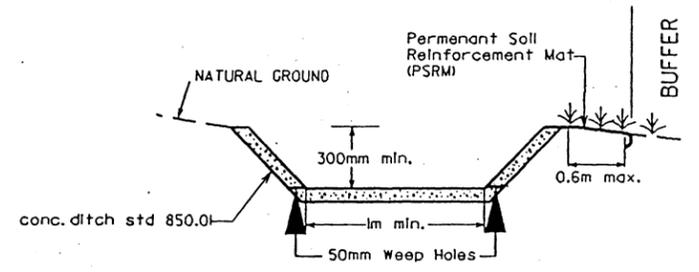
110 BOX 2064 RESEARCH TRIANGLE PARK, NC 27709  
 TEL: 919.286.1750 FAX: 919.286.8725

DATE: 03/03/04  
 DRAWN: P. LAM  
 CHECKED: M. J. HARRIS

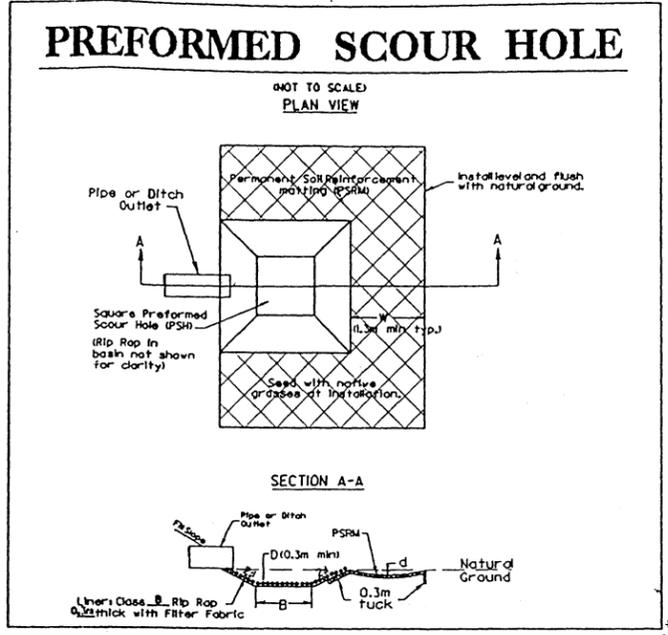
# DRAINAGE TYPICALS



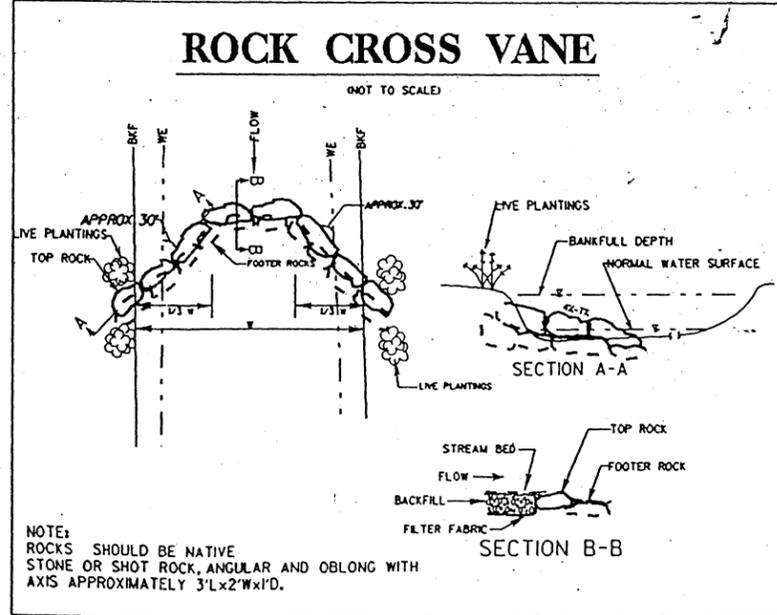
SECTION-AA CONCRETE PAVED DITCH LEVEL SPREADER



NOTE:  
STAGGER 50mm WEEPHOLES @ 2m OC



- |         |         |
|---------|---------|
| B 1.25m | B 1.5m  |
| D 0.40m | D 0.45m |
| W 1.2m  | W 1.2m  |
| d 0.15m | d 0.15m |
- STA 18+70 LT -L-      STA 40+40 RT -L-  
 STA 24+95 RT -L-      STA 40+90 RT -L-  
 STA 25+40 RT -L-      STA 41+20 LT -L-  
 STA 25+95 LT -L-      STA 47+40 LT -L-  
 STA 37+20 LT -L-  
 STA 37+55 RT -L-  
 STA 40+20 RT -L-



NOTE:  
ROCKS SHOULD BE NATIVE  
STONE OR SHOT ROCK, ANGULAR AND OBLONG WITH  
AXIS APPROXIMATELY 3'Lx2'Wx1'D.

STA 26+00 RT -L-  
AS NOTED IN STREAM RELOCATION

### BUFFER LEGEND

—WLB— WETLAND BOUNDARY	PROPOSED BRIDGE
WETLAND	PROPOSED BOX CULVERT
ALLOWABLE IMPACTS ZONE 1	PROPOSED PIPE CULVERT
ALLOWABLE IMPACTS ZONE 2	(DASHED LINES DENOTE EXISTING STRUCTURES)
MITIGABLE IMPACTS ZONE 1	SINGLE TREE
MITIGABLE IMPACTS ZONE 2	WOODS LINE
—BZ— RIPARIAN BUFFER ZONE	DRAINAGE INLET
—BZ1— RIPARIAN BUFFER ZONE 1 30 ft (9.2m)	ROOTWAD
—BZ2— RIPARIAN BUFFER ZONE 2 20 ft (6.1m)	RIP RAP
—>— FLOW DIRECTION	ADJACENT PROPERTY OWNER OR PARCEL NUMBER IF AVAILABLE
—TB— TOP OF BANK	PREFORMED SCOUR HOLE (PSH)
—WE— EDGE OF WATER	LEVEL SPREADER (LS)
—C— PROP. LIMIT OF CUT	GRASS SWALE
—E— PROP. LIMIT OF FILL	
PROP. RIGHT OF WAY	
—NG— NATURAL GROUND	
—PL— PROPERTY LINE	
—TDE— TEMP. DRAINAGE EASEMENT	
—PDE— PERMANENT DRAINAGE EASEMENT	
—EAB— EXIST. ENDANGERED ANIMAL BOUNDARY	
—EPB— EXIST. ENDANGERED PLANT BOUNDARY	
WATER SURFACE	
LIVE STAKES	
BOULDER	
CORE FIBER ROLLS	

U-2527-0001-01-01 (02) PLANS U-2527.dwg  
 11/15/2011 10:00 AM  
 11/15/2011 10:00 AM