

**PROJECT SPECIAL PROVISIONS**  
**PERMITS**

The Contractor's attention is directed to the following permits which have been applied for by the Department of Transportation to the authority granting the permit.

**PERMIT**

**AUTHORITY GRANTING THE PERMIT**

Dredge and Fill and/or  
Work in Navigable Waters

U. S. Army Corps of Engineers

Water Quality

Division of Environmental Management, DENR  
State of North Carolina

The Contractor shall comply with all applicable permit conditions during construction of this project. Those conditions marked by \* are the responsibility of the department and the Contractor has no responsibility in accomplishing those conditions.

Agents of the permitting authority will periodically inspect the project for adherence to the permits.

The Contractor's attention is also directed to Articles 107-10 and 107-14 of the Standard Specifications and the following:

Should the Contractor propose to utilize construction methods (such as temporary structures or fill in waters and/or wetlands for haul roads, work platforms, cofferdams, etc.) not specifically identified in the permit (individual, general, or nationwide) authorizing the project it shall be the Contractor's responsibility to coordinate with the Engineer to determine what, if any, additional permit action is required. The Contractor shall also be responsible for initiating the request for the authorization of such construction method by the permitting agency. The request shall be submitted through the Engineer. The Contractor shall not utilize the construction method until it is approved by the permitting agency. The request normally takes approximately 60 days to process; however, no extensions of time or additional compensation will be granted for delays resulting from the Contractor's request for approval of construction methods not specifically identified in the permit.

**Where construction moratoriums are contained in a permit condition which restricts the Contractor's activities to certain times of the year, those moratoriums will apply only to the portions of the work taking place in the waters or wetlands provided that activities outside those areas is done in such a manner as to not affect the waters or wetlands.**



REPLY TO  
ATTENTION OF:

193  
**DEPARTMENT OF THE ARMY**  
**WILMINGTON DISTRICT, CORPS OF ENGINEERS**  
**P.O. BOX 1890**  
**WILMINGTON, NORTH CAROLINA 28402-1890**

October 1, 2004

Regulatory Division

Action ID. 200431320, TIP No. R-2206 B/C

Dr. Gregory J. Thorpe, Ph.D., Director  
Project Development and Environmental Analysis Branch  
North Carolina Department of Transportation  
1548 Mail Service Center  
Raleigh, North Carolina 27699-1548

Dear Dr. Thorpe:

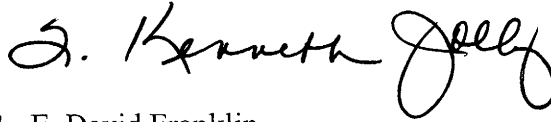
In accordance with your written request of June 15, 2004, subsequent submittals of July 9 and 23, 2004 and the ensuing administrative record, enclosed are two copies of a permit to discharge dredged or fill material into 6.21 acres of wetland, 13,321 linear feet of stream channel and 4.47 acres of open water ponds in and adjacent to the waters of Forney Creek, Killian Creek, Reed Creek and unnamed tributaries to facilitate the relocation of 10.6 miles of NC Highway 16 from NC Highway 73 on the south to SR 1895 (Tower Road) at existing NC 16 on the north, west of Denver, Lincoln and Catawba Counties, North Carolina (TIP No. R-2206 B/C, State Project No. 8.1830501).

You should acknowledge that you accept the terms and conditions of the enclosed permit by signing and dating each copy in the spaces provided ("Permittee" on page 3). Your signature, as permittee, indicates that, as consideration for the issuance of this permit, you voluntarily accept and agree to comply with all of the terms and conditions of this permit. All pages of both copies of the signed permit with drawings should then be returned to this office for final authorization. A self-addressed envelope is enclosed for your convenience.

In addition, I have enclosed a copy of the Notification of Administrative Appeal Process and Options and Request for Appeal. Please carefully read Section "B" of this form for information regarding the appeal process for proffered permits.

After the permit is authorized in this office, the original copy will be returned to you; the duplicate copy will be permanently retained in this office. Should you have questions, contact Mr. Steven Lund, Regulatory Division, Asheville Regulatory Field Office, telephone (828) 271-7980 extension 223.

Sincerely,



*G.* E. David Franklin  
Chief, NCDOT Team

Enclosures

DEPARTMENT OF THE ARMY PERMIT

NC Department of Transportation

Permittee \_\_\_\_\_

200431320

Permit No. \_\_\_\_\_

USAED, Wilmington

Issuing Office \_\_\_\_\_

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:

To discharge dredged or fill material into 6.21 acres of wetland, 13,321 linear feet of stream channel and 4.47 acres of open water pond in an adjacent to the waters of Forney Creek, Killian Creek, Reed Creek and unnamed tributaries to facilitate the relocation of 10.6 miles of NC Highway 16 from NC Highway 73 to SR 1895 west of Denver, Lincoln and Catawba Counties, North Carolina (TIP No. R-2206 B/C).

Project Location: From NC Highway 73 on the south to SR 1895 (Tower Road) at existing NC 16 on the north, west of Denver, Lincoln and Catawba Counties, North Carolina (TIP No. R-2206 B/C, State Project No. 8.1830501).

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.

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.
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.
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.

**Special Conditions:**

See enclosed sheet.

**Further Information:**

1. **Congressional Authorities:** You have been authorized to undertake the activity described above pursuant to:
  - ( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
  - (x) Section 404 of the Clean Water Act (33 U.S.C. 1344).
  - ( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).
2. **Limits of this authorization.**
  - a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.
  - b. This permit does not grant any property rights or exclusive privileges.
  - c. This permit does not authorize any injury to the property or rights of others.
  - d. This permit does not authorize interference with any existing or proposed Federal project.
3. **Limits of Federal Liability.** In issuing this permit, the Federal Government does not assume any liability for the following:
  - a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
  - b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
  - c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
  - d. Design or construction deficiencies associated with the permitted work.





September 21, 2004

RECEIVED

SEP 21 2004

CESAW-CO-RA

Dr. Gregory J. Thorpe, PhD., Manager  
Project Development and Environmental Analysis 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 Relocation of NC 16, TIP No. R-2206B/C  
Individual WQC No. 3476  
Lincoln and Catawba Counties

Attached hereto is a copy of Certification No. 3476 issued to The North Carolina Department of Transportation dated September 21, 2004.

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

Sincerely,

Alan W. Klimek, P.E.  
Director

Attachments

cc: Steve Lund, Army Corps of Engineers Asheville Regulatory Field Office  
Polly Lespinasse, DWQ Mooresville Regional Office  
Central Files  
File Copy

### APPROVAL OF 401 Water Quality Certification and ADDITIONAL CONDITIONS

**THIS CERTIFICATION** is issued in conformity with the requirements of Section 401 Public Laws 92-500 and 95-217 of the United States and subject to the North Carolina Division of Water Quality (DWQ) Regulations in 15 NCAC 2H, Section .0500, and 15 NCAC 2B .0259. This certification authorizes the NCDOT to place fill material in, drain, excavate, and mechanically clear 6.21 acres of jurisdictional wetlands, to place fill material, culverts, and piping in 13,320.8 linear feet of streams, and to drain 4.47 acres of ponds in Lincoln and Catawba Counties. The project shall be constructed pursuant to the application dated June 15, 2004, to relocate NC 16 from north of NC 73 to SR 1895. The approved design is that submitted in your application dated June 15, 2004. The authorized impacts are as described below:

#### Wetland Impacts in the Catawba Basin

Section	Riverine (acres)	Non-Riverine (acres)	Total (acres)
Site 1B - Station No. -Y12-15+81 Lt to 106+25 Rt	0	0.11	0.11
Site 9B - Station No. -L-150+96 Rt to 151+55 Lt	0.19	0	0.19
Site 10B - Station Nos. -L- 156+ 75Rt to 157+75 Rt; -L- 157+94 Rt to 160+37 Lt	3.12	0	3.12
Site 14B - Station No. -Y9-REV 18+46 Rt to 18+56 Lt	0	0.10	0.10
Site 3C - Station No. -L-194+96 Lt to 195+14 Lt	0	0.01	0.01
Site 4C - Station No. -L-196+71 Lt to 197+40 Lt	0	0.01	0.01
Site 10C - Station No. -L-217+75 Lt to 218+37 Rt	0.10	0	0.10
Site 11C - Station No. -L-221+11 Rt to 221+37 Rt	0	0.12	0.12
Site 14C - Station Nos. -L- 262+64 Rt to 263+00 Rt -L- 262+39 Rt to 264+38 Lt	0.49	0.17	0.66
Site 15C - Station No. -L-264+72 Rt to -NBL- 11+54 Rt	0	1.69	1.69
Site 16C - Station No. -SBL-269+29 Rt to 271+02 Lt	0.10	0	0.10
<b>Total</b>	<b>4.00</b>	<b>2.21</b>	<b>6.21</b>



## Surface Water Impacts for the Catawba River Basin

Section	Stream Impacts (linear feet)	Ponds (acres)	On-Site Natural Channel Design (linear feet)	Mitigation Required
Site 1B - Station No. -Y12-15+81 Lt to 106+25 Rt	377.6	0	0	377.6 lf
Site 2B - Station No. -L-114+65 Lt to 115+27 Rt	429.8	0	0	429.8 lf
Site 3B - Station No. -L-121+69Rt to 122+44 Rt	678.5	0	0	678.5 lf
Site 4B - Station No. -L-132+03 Rt to 133+12 Lt	834.3	0	0	834.3 lf
Site 6B - Station No. -L-139+59 Rt to 140+01 Lt	355.3	0	0	0
Site 7B - Station No. -L-142+91 Lt to 143+36 Rt	299.2	0	0	299.2 lf
Site 8B - Station No. -L-145+50 Rt to 145+88 Lt	382.2	0	0	382.2 lf
Site 9B - Station No. -L-150+96 Rt to 151+55 Lt	531.8	0	0	531.8 lf
Site 10B - Station Nos. -L- 156+ 75Rt to 157+75 Rt; -L- 157+94 Rt to 160+37 Lt	0	3.27	459.3 242.8	3.27 ac.
Site 11B - Station No. -L-169+69 Lt to 170+01 Rt	563.3	0	0	0
Site 12B - Station No. -L-172+55 Lt to 173+39 Rt	660.7	0	0	660.7 lf
Site 13B - Station No. -L-177+58 Rt to 179+75 Lt	1,345.8	0	0	1,345.8 lf
Site 14B - Station No. -Y9-REV 18+46 Rt to 18+56 Lt	209.3	0	0	209.3 lf
Site 1C - Station Nos. -L- 181+46 Rt to 181+74 Lt -L- 182+23 Rt to 182+49 Lt -L- 181+92 Lt to 183+99 Rt	220.1 425.5 1,040.3	0	164.0	1,685.9 lf
Site 2C - Station Nos. -L- 190+86 Lt to 191+05 Rt -L- 190+96 Lt to 192+03 Rt	447.8 464.9	0	0	447.8 lf 0
Site 3C - Station No. -L-194+96 Lt to 195+14 Lt	145.0	0	0	0
Site 4C - Station No. -L-196+71 Lt to 197+40 Lt	230.3	0	0	0
Site 6C - Station No. -L-202+25 Rt to 203+66 Rt	571.8	0	0	0
Site 7C - Station No. -L-207+91 Rt to 207+96 Rt	230.0	0	0	0

Site 8C - Station No. -L- 208+89 Rt to 209+04 Rt	51.5	0	0	0
Site 9C - Station Nos. -L- 211+68 Lt to 211+95 Rt -L- 211+95 Rt to 212+42 Lt	335.0 203.4	0	0	335.0 lf 203.4 lf
Site 10C - Station No. -L- 217+75 Lt to 218+37 Rt	303.5	0	0	303.5 lf
Site 14C - Station Nos. -L- 262+64 Rt to 263+00 Rt -L- 262+39 Rt to 264+38 Lt	631.6	0		631.6 lf
Site 15C - Station No. -L- 264+72 Rt to -NBL- 11+54 Rt	917.0	0	0	917.0 lf
Site 16C - Station No. -SBL- 269+29 Rt to 271+02 Lt	334.6	1.2	0	334.6 lf, 1.2 ac.
Site 17C - Station Nos. -Y14- 20+08 Lt to 20+25 Rt -Y14- DET 20+26 Lt to 20+31 Rt	56.1 44.6	0	0	0
<b>Total</b>	<b>13,320.8</b>	<b>4.47</b>	<b>866.1*</b>	<b>10,608 lf, 4.47 ac.</b>

\* Natural stream design mitigation conducted on-site of this project is designated for other projects and does not count towards mitigation of impacts for this project.

The application provides adequate assurance that the discharge of fill material into the waters of the Catawba 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:

Project Specific Conditions of Certification:

1. Alternating baffles shall be installed in the reinforced concrete box culverts at sites 4B, 10B, and 1C. Revised design drawings detailing the baffles in the above referenced box culverts shall be submitted to the Division of Water Quality, Transportation Permitting Unit within 30 days of the receipt of this water quality certification.
2. We understand that you have chosen to perform compensatory mitigation for impacts to wetlands and streams through an in-lieu payment to the North Carolina Ecosystem Enhancement Program (NCEEP), and that the NCEEP has agreed to implement the mitigation for the project. NCEEP has indicated in a letter dated August 5, 2004 that they will assume responsibility for satisfying the federal Clean Water Act compensatory mitigation requirements for the above-referenced project as detailed in the table below.

Type of Impact	Amount of Impact
Riverine Wetlands	4.00 ac
Non-Riverine Wetlands	2.21 ac
Streams	13,320.8 lf

General Conditions of Certification:

3. 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. All stream relocation and restoration activities shall comply with the final natural channel design plans approved by the NC Division of Water Quality.
4. 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.

3. 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.
4. 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.
5. No live or fresh concrete shall come into contact with waters of the state until the concrete has hardened.
6. 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.
7. Excavation of the stream crossings should be conducted in the dry. Sandbags, cofferdams, flexible pipe, or other diversion structures should be used to minimize excavation in flowing water.
8. 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.
9. 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.
10. 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 dis-equilibrium 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.
11. 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.

12. 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.
13. Riparian vegetation must be reestablished within the construction limits of the project by the end of the growing season following completion of construction.
14. Any riprap used must not interfere with thalweg performance and aquatic life passage during low flow conditions.
15. Heavy equipment should be operated from the bank rather than in the stream channel whenever possible in order to minimize sedimentation and reduce the likelihood of introducing other pollutants into the stream. 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.
16. Discharging hydroseed mixtures and washing out hydroseeders and other equipment in or adjacent to surface waters is prohibited.
17. 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 May 11, 2004.
18. The outside buffer, wetland or water boundary located within the construction corridor approved by this authorization shall be clearly marked by orange fabric fencing prior to any land disturbing activities. Impacts to areas within the fencing are prohibited unless otherwise authorized by this certification.
19. 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.
20. 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.

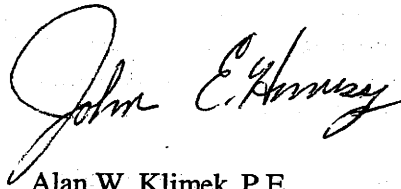
21. Culverts that are less than 48-inch in diameter should be buried to a depth equal to or greater than 20% of their size to allow for aquatic life passage. Culverts that are 48-inch in diameter or larger should be buried at least 12 inches below the stream bottom to allow natural stream bottom material 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.

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 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 13th day of September 2004

DIVISION OF WATER QUALITY



Alan W. Klimek, P.E.  
Director

WQC No. 3476

**SPECIAL CONDITIONS (ACTION ID: 200431320; NCDOT/TIP NO. R-2206B/B)**

1. All work authorized by this permit must be performed in strict compliance with the attached plans, which are a part of this permit.
2. All conditions of Section 401, Clean Water Act, Water Quality Certification No. 3476, issued by the North Carolina Division of Water Quality on September 21, 2004, will be regarded as conditions of this Department of the Army (DA) permit.
3. The permittee shall schedule a preconstruction meeting between their representatives, the contractor and a representative of the Corps of Engineers, Asheville Regulatory Field Office prior to any work in jurisdictional waters and wetlands to ensure that there is a mutual understanding of all terms and conditions contained in this DA permit. The permittee shall notify the Corps of Engineers a minimum of thirty (30) days in advance of the meeting.
4. The permittee and his contractors and/or agents shall not excavate, fill or perform mechanized land clearing at any time in the construction or maintenance of this project within waters and/or wetlands except as authorized by this permit or any modification to this permit. There shall be no excavation from, waste disposal into, or degradation of jurisdictional waters or wetlands associated with this permit without the necessary modification of this permit to include appropriate compensatory mitigation. This prohibition applies to all borrow and fill activities associated with this project.
5. To ensure that all borrow and waste activities occur on uplands and do not result in the degradation of adjacent waters and wetlands, 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 will coordinate with the Corps of Engineers before approving any borrow or waste sites that are within 400 feet of any stream or wetland by providing appropriate map(s) indicating the location (s) of such borrow or waste sites. The permittee shall ensure that all such areas comply with Special Condition No. 4 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 documentation will include data regarding soils, vegetation and hydrology sufficient to clearly demonstrate compliance with Special Condition No. 4 above. All information will be available to the Corps of Engineers upon request. The permittee 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.
6. The permittee shall require his 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 his contractors and/or agents associated with the construction or maintenance of this project with a copy of this permit.

7. The permittee will ensure that the construction design plans for this project do not deviate from the permit plans attached to this authorization. Any deviations in the construction design plans will be brought to the attention of the Corps of Engineers, Asheville Regulatory Field Office prior to any active construction in waters or wetlands.

8. Adequate sedimentation and erosion control measures must be implemented prior to any ground disturbing activities to minimize impacts to downstream aquatic resources. These measures must be inspected and maintained regularly, especially following rainfall events. Temporary or permanent herbaceous should be planted on all bare soil within 15 days of ground disturbing activities. Tall fescue should not be used in riparian areas. Erosion control matting should be used in riparian areas instead of mulch.

9. During the clearing phase of the project, heavy equipment must not be operated in surface waters or stream channels. Temporary stream crossings will be used to access the opposite sides of stream channels. Grubbing of riparian vegetation will not occur until immediately before construction begins on a given segment of stream channel.

10. All temporary diversion channels and stream crossings will be constructed of non-erodable materials. Any such structures located outside of the authorized construction limits of the project will be reported in writing to the Corps of Engineers, Asheville Regulatory Field Office, together with a location map and restoration plan for any necessary permit modification.

11. All authorized culverts will be installed to allow the passage of low stream flows and the continued movement of fish and other aquatic life as well as to prevent head-cutting of the streambed. For all box culverts and for pipes greater than 48 inches in diameter, the bottom of the pipe will be buried at least one foot below the bed of the stream. For culverts 48 inches in diameter or smaller, the bottom of the pipe must be buried below the bed of the stream to a depth equal to or greater than 20 percent of the diameter of the culvert. Wet concrete will be isolated from contact with any flowing streams.

12. In order to allow for the continued movement of bed load and aquatic organisms, existing stream channel widths and depths will be maintained at the inlet and outlet ends of culverts. Riprap armoring of streams at culvert inlets and outlets shall be minimized above the ordinary high water elevation in favor of bioengineering techniques such as bank sloping, erosion control matting and re-vegetation with deep-rooted, woody plants. Riprap should not interfere with aquatic life passage during low flow conditions.

13. All mechanized equipment operating near surface waters shall be regularly inspected to prevent contamination of streams from leakage of fuels, lubricants, hydraulic fluids or other toxic materials. No equipment staging or storage of construction material will occur in wetlands. Hydroseeding equipment will not be discharged or washed out into any surface waters or wetlands.

14. The authorized channel relocation at Permit Sites 10B and 1C2 will be constructed in a dry work area and stabilized before stream flow is diverted through it. The Corps of Engineers, Asheville Regulatory Field Office will be notified in advance by facsimile transmission or

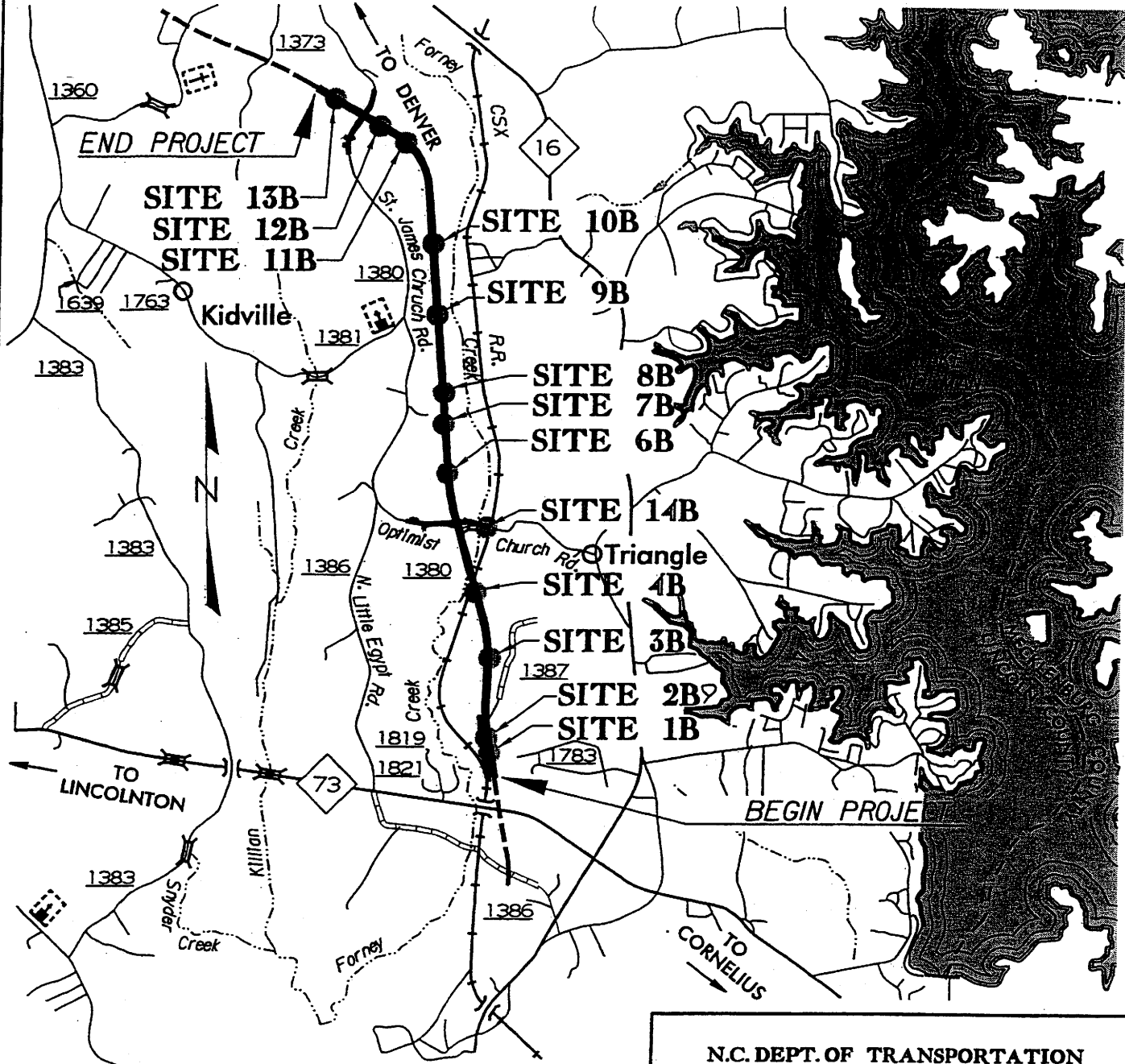
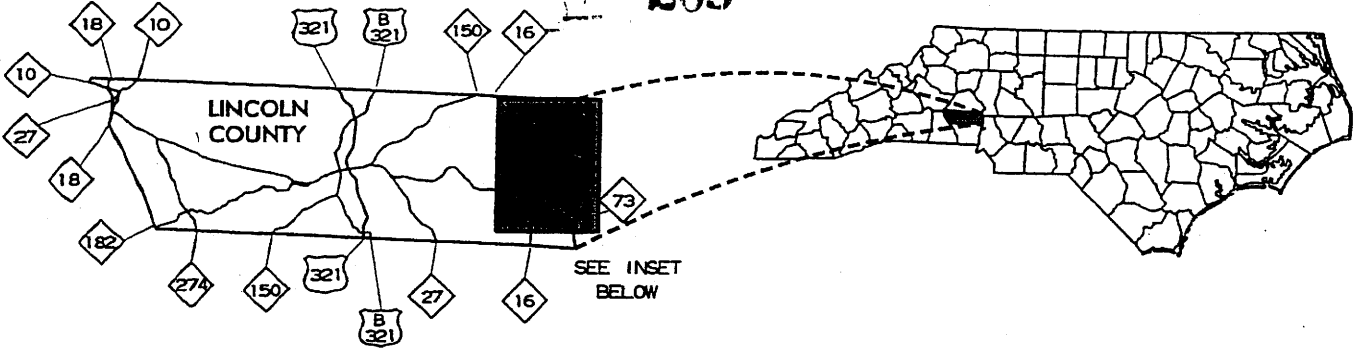


electronic mail of the intended diversion of water into the new channels. The banks and buffer areas of the relocated channels will be planted with appropriate species of native deep-rooted, woody vegetation. A final inspection of the channel relocation by a representative of the Corps of Engineers, Asheville Regulatory Field Office will be conducted prior to completion of the road project. Field revisions to the relocation plans, including in-stream structures, may be directed by the Corps where needed to provide channel stability.

15. Compensatory mitigation for unavoidable impacts to 4.0 acres of riverine, 2.22 acres of non-riverine wetlands and 13,321 linear feet of stream channel shall be provided by the Ecosystem Enhancement Program (EEP) as outlined in the August 5, 2004 letter from William D. Gilmore, EEP Transition Manager. The EEP will use existing assets to provide 0.3 acres of riverine wetland restoration and 1.87 acres of non-riverine wetland restoration in the Upper Catawba River Basin (Hydrologic Cataloging Unit 03050101). The EEP will also provide 37.0 acres of preservation of riverine wetlands at the Drowning Creek II/Rankin Site in Richmond and Moore Counties (34.0 acres) and at the Allen Site in Wake County (3.0 acres); 3.55 acres of preservation of non-riverine wetlands at the Drowning Creek II/Rankin Site in Richmond and Moore Counties; and a total of 113,210 linear feet of preservation of warm water stream channel at the Linville White Creek Site in Burke County (45,863 feet), at the Broad River Greenway Site in Cleveland County (67,050 feet), and at the Drowning Creek II/Rankin Site in Richmond and Moore Counties (903 feet) in the Southern Piedmont Eco-Region; and 19,393 linear feet of preservation of warm water stream channel at the Haw River/Duke Forest Site in Chatham County in the Central Piedmont Eco-Region which have been acquired and protected by the EEP. In addition to the above compensation, pursuant to the EEP Memorandum of Agreement (MOA) between the State of North Carolina and the US Army Corps of Engineers signed on July 22, 2003, the EEP will provide a minimum of 3.99 acres of restoration of riverine wetlands, 2.22 acres of restoration of non-riverine wetlands and 13,321 linear feet of restoration of warm water stream channel in the Upper Catawba River Basin (Hydrologic Cataloging Unit 03050101) by July 22, 2005 and half of the proposed preservation mitigation would be available at that time for mitigation for other project impacts.

16. Low-elevation, alternating baffles will be constructed within the authorized single-cell box culverts at Permit Sites 4B, 10B and 1C at intervals sufficient to retain bed material and provide aquatic life passage at low flow conditions.

17. The permittee will report any violations of the above conditions and any violation of Section 404 of the Clean Water Act from unauthorized work in writing to the Wilmington District, US Army Corps of Engineers within 24 hours of the violation.



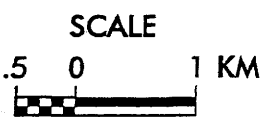
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

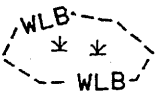



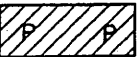


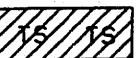




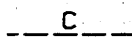
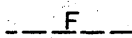

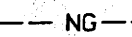
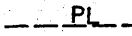
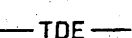
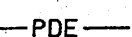


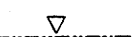
PROJECT: 8.1830501 (R-2206B)  
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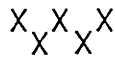



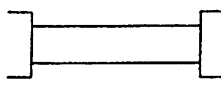
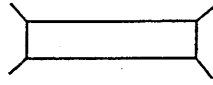
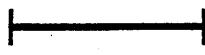

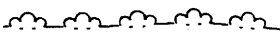

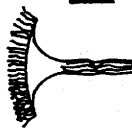


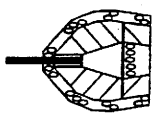
LOCATION MAP

NOTE: SITE 5B REMOVED  
DUE TO NO IMPACT



# LEGEND 210

- WLB --- WETLAND BOUNDARY
-  WETLAND
-  DENOTES FILL IN WETLAND
-  DENOTES DRAINED WETLAND
-  DENOTES SURFACE WATER IMPACT (NATURAL)
-  DENOTES SURFACE WATER IMPACT (POND)
-  DENOTES TEMPORARY FILL IN WETLAND
-  DENOTES EXCAVATION IN WETLAND
-  DENOTES TEMPORARY FILL IN SURFACE WATER
-  DENOTES MECHANIZED CLEARING
-  FLOW DIRECTION
-  TOP OF BANK
-  EDGE OF WATER
-  PROP. LIMIT OF CUT
-  PROP. LIMIT OF FILL
-  PROP. RIGHT OF WAY
-  NATURAL GROUND
-  PROPERTY LINE
-  TEMP. DRAINAGE EASEMENT
-  PERMANENT DRAINAGE EASEMENT
-  EXIST. ENDANGERED ANIMAL BOUNDARY
-  EXIST. ENDANGERED PLANT BOUNDARY
-  WATER SURFACE

-  LIVE STAKES
-  BOULDER
-  COIR FIBER ROLLS
-  ADJACENT PROPERTY OWNER OR PARCEL NUMBER
-  PROPOSED BRIDGE
-  PROPOSED BOX CULVERT
-  PROPOSED PIPE CULVERT
- (DASHED LINES DENOTE EXISTING STRUCTURES)
-  SINGLE TREE
-  WOODS LINE
-  DRAINAGE INLET
-  ROOTWAD
-  VANE
-  RIP RAP
-  RIP RAP ENERGY DISSIPATOR BASIN

**N.C. DEPT. OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
  
**LINCOLN COUNTY**  
  
**PROJECT: 8.1830501 (R-2206B)**  
**NC-16 BYPASS**  
  
**SHEET 2 OF 35** 1/16/04

Project No. 8.1830501 (R-2206B)

## Property Owner List

Property NO.	Name DB and Pg	Address
(1)	ARLIE PARK, INC. DB 828 Pg 687, 688	P.O. Box 9 Lincolnton, NC 28093
(2)	CATAWBA SPRINGS LAND CO. DB 657 Pg 387, 396 DB 671 Pg 102-104	P.O. Box 9 Lincolnton, N.C. 28093
(3)	EAST LINCOLN LAND CO. INC. DB 711 Pg 505 TRACT 3,4,7	P.O. Box 9 Lincolnton, N.C. 28093
(4)	MICHAEL LANDIS BRYANT DB 895 Pg 588 TRACT 2	7036 Dorn Circle Charlotte, N.C. 28212
(5)	CSX Railroad	229 Nolichucky Avenue Erwin, Tenn. 37650
(6)	CATAWBA SPRINGS LAND CO. DB 657 Pg 387 TRACT 2 PARCEL 4	P.O. Box 9 Lincolnton, N.C. 28093
(7)	EAST LINCOLN LAND COMPANY DB 711 Pg 510 TRACT 2,6,11	P.O. Box 9 Lincolnton, N.C. 28093
(8)	HAYWOOD W. THOMPSON ROSA C. THOMPSON DB 344 Pg 331	2022 St. James Church Road Denver, N.C. 28037
(9)	CATAWBA SPRINGS HUNTING CLUB DB 653 Pg 493 DB 729 Pg 50 DB 699 Pg 592	P.O. Box 483 Denver, N.C. 28037

(continued)

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

Project No. 8.183u501 (R-2206B)

## Property Owner List

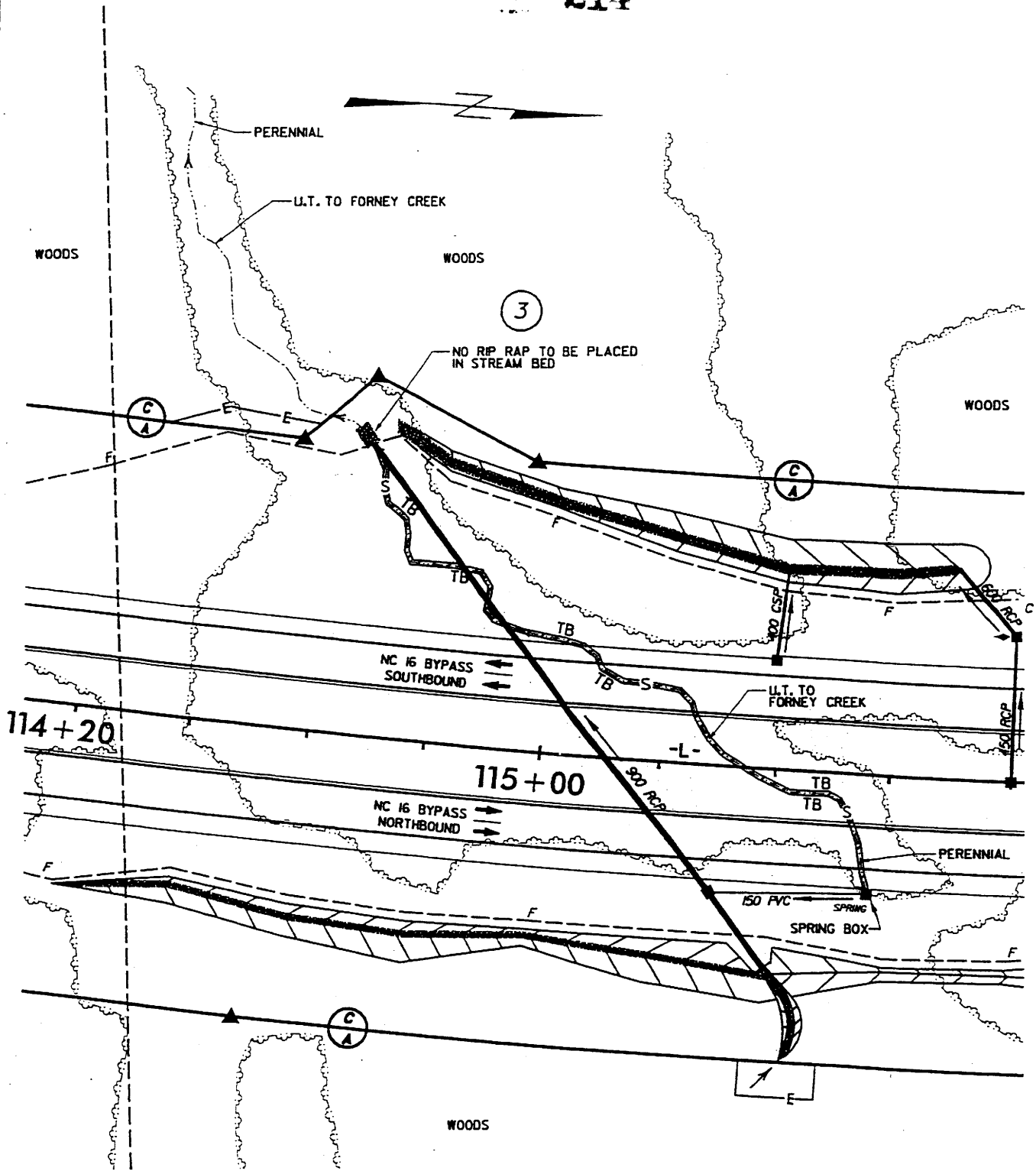
Property NO.	Name DB and Pg	Address
(10)	WILLIAM SHIPP HEIRS DB 134 Pg 479	322 Auten Street Charlotte, N.C. 28208
(11)	DALLAS VANESS BARKER DB 707 Pg 556	2838 St. James Church Road Denver, N.C. 28037
(12)	CALLAWAY HOMES INC. DB 649 Pg 251	P.O. Box 448 3525 St James Church Road Denver NC 28037
(13)	JOY L. FLOYD, LORETTA BLANTON & DEANE L. SAIN DB 571 Pg 353	328 E. Congress St. Lincolnton, N.C. 28092
(14)	TERRY C. LOVE MELODY LAWING LOVE DB 611 Pg 637	7764 Optmist Club Road Denver, N.C. 28037

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DIVISION OF HIGHWAYS

LINCOLN COUNTY

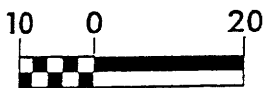
PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS





PLAN VIEW  
SITE 2B

DENOTES SURFACE WATER  
IMPACT (NATURAL)



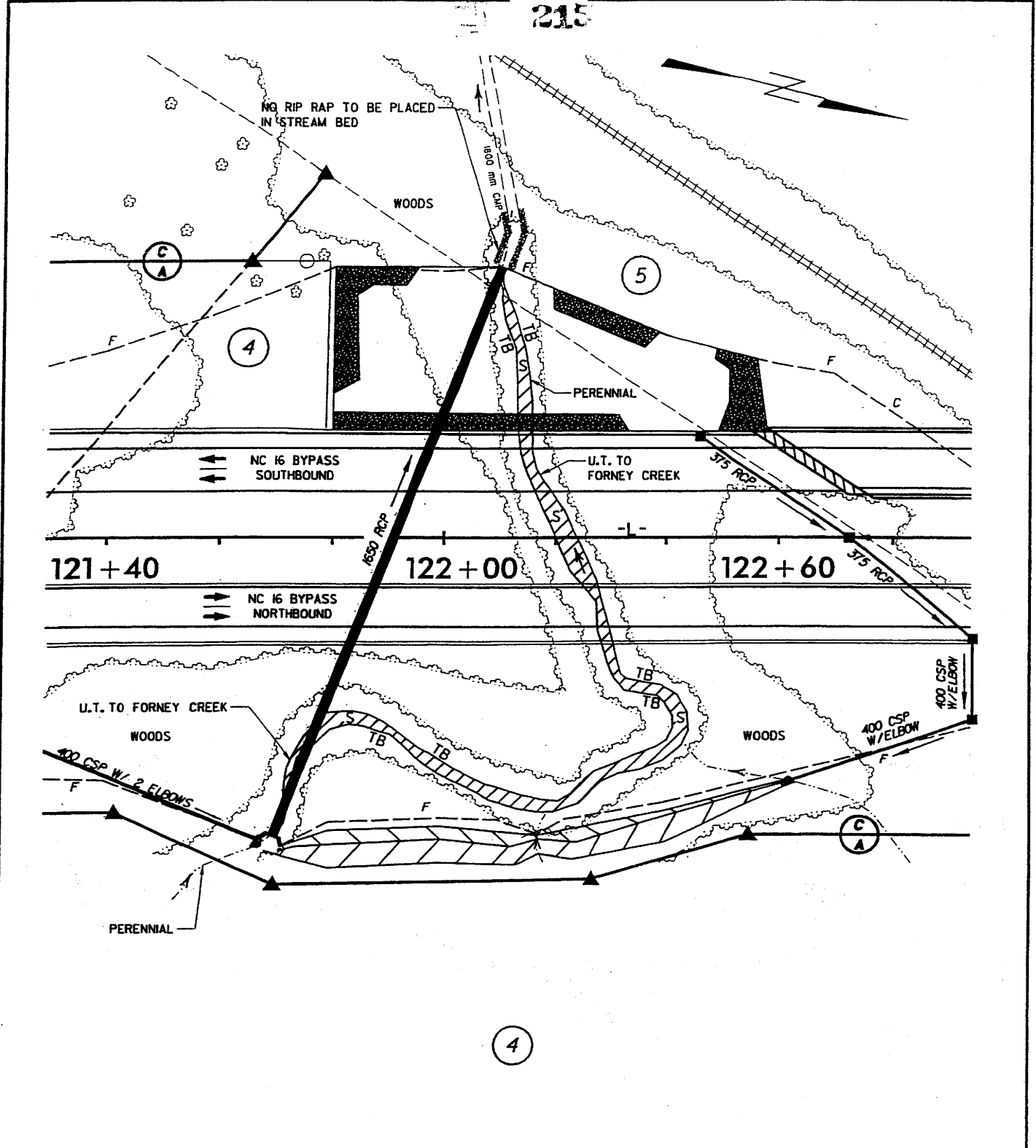
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

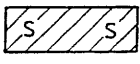
PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

SHEET 6 OF 35

1/16/04



**PLAN VIEW  
SITE 3B**

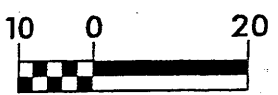
DENOTES SURFACE WATER IMPACT (NATURAL) 

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

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7

WOODS

U.T. TO FORNEY CREEK

PERENNIAL

WOODS

NC 16 BYPASS  
SOUTHBOUND

132 + 00

NC 16 BYPASS  
NORTHBOUND

133 + 00

620 RCP

375 RCP

400 CSP  
2 ELBOWS

18" 21 x 15 RCP

NO RIP RAP TO BE PLACED  
IN STREAM BED

PERENNIAL

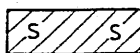
U.T. TO FORNEY CREEK

WOODS

6

# PLAN VIEW SITE 4B

DENOTES SURFACE WATER  
IMPACT (NATURAL)



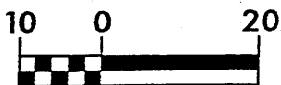
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

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1/16/04



240

240

235

235

230

230

225

225

220

220

-L- PROFILE GRADE LINE

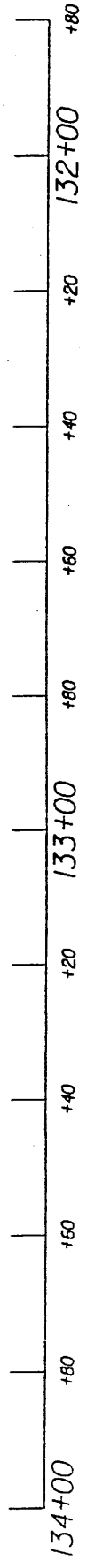
PVC STA. 133+00.000 -L-  
EL. = 236.562

(+) 2.1900%

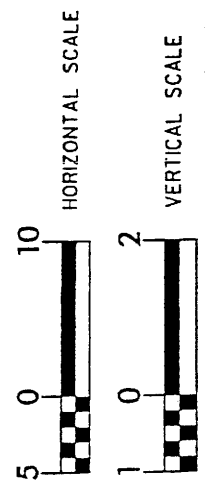
1 @ 2.1m x 1.5m RCBC

EXISTING GROUND LINE  
AT RCBC INLET

EXISTING STREAM BED  
PROPOSED STREAM BED



# PROFILE SITE 4B



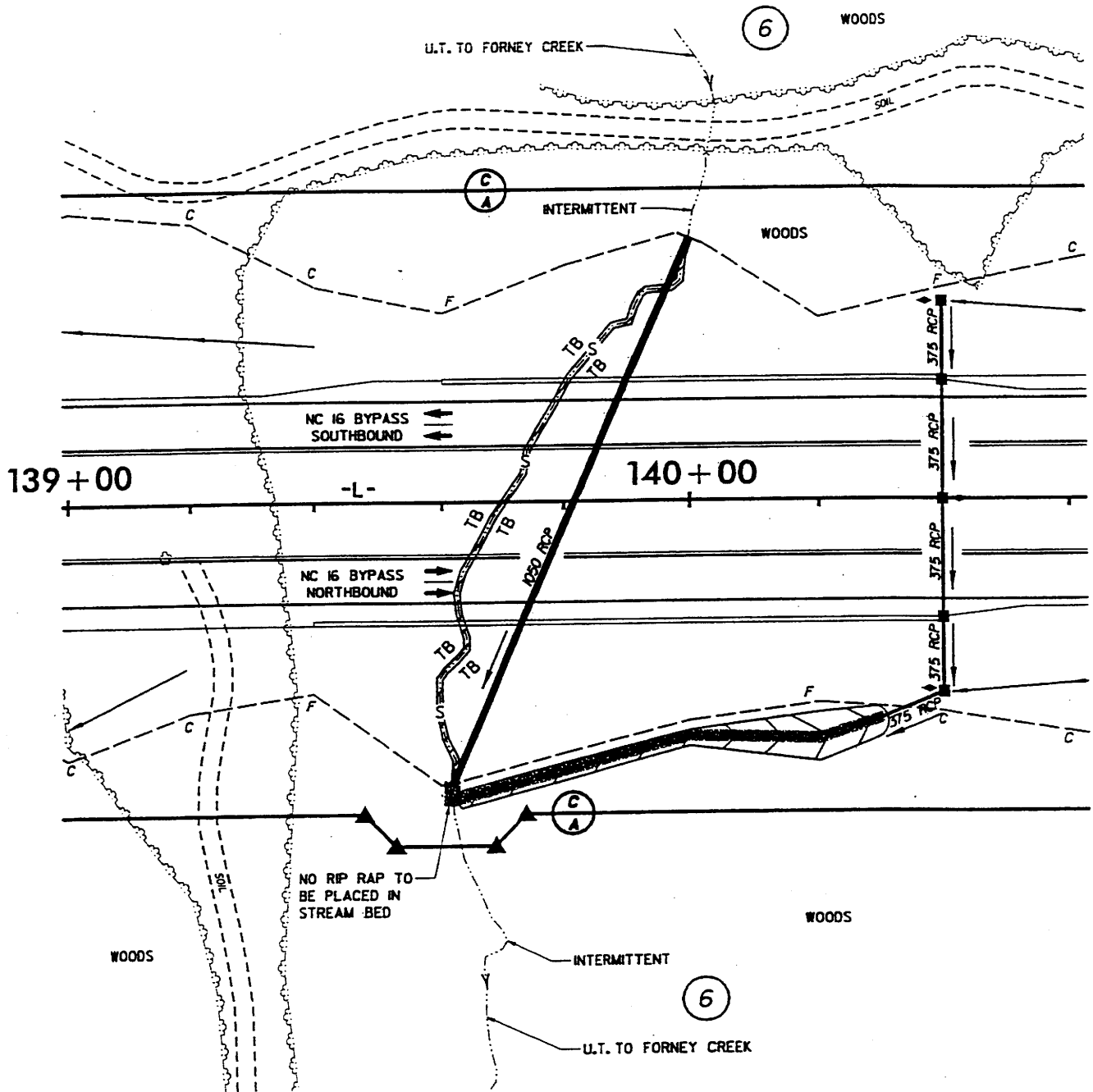
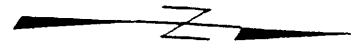
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

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NC-16 BYPASS

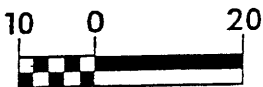
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**PLAN VIEW  
SITE 6B**

DENOTES SURFACE WATER  
IMPACT (NATURAL)



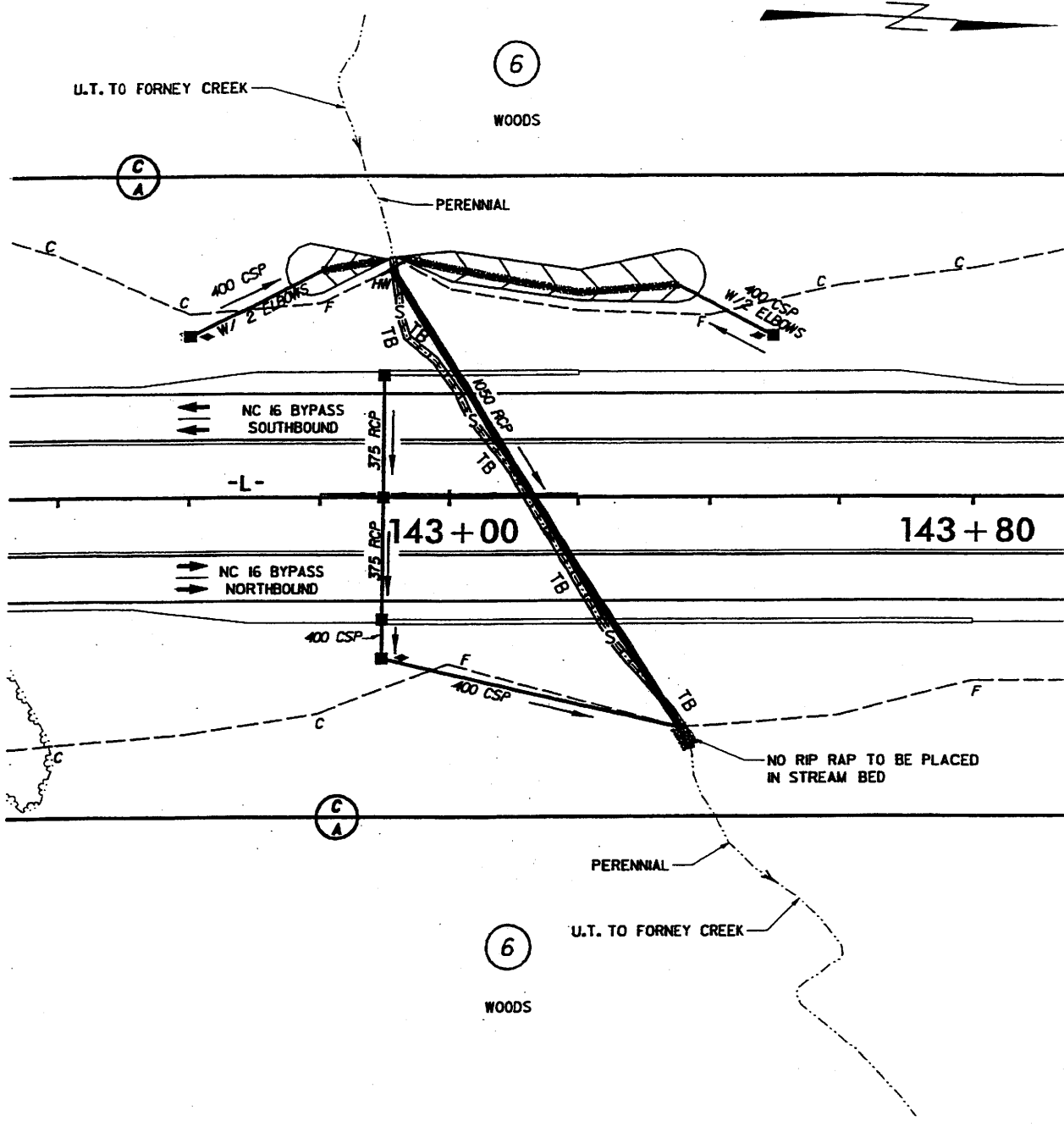
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

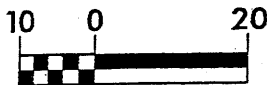
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**PLAN VIEW  
SITE 7B**

DENOTES SURFACE WATER  
IMPACT (NATURAL)



**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

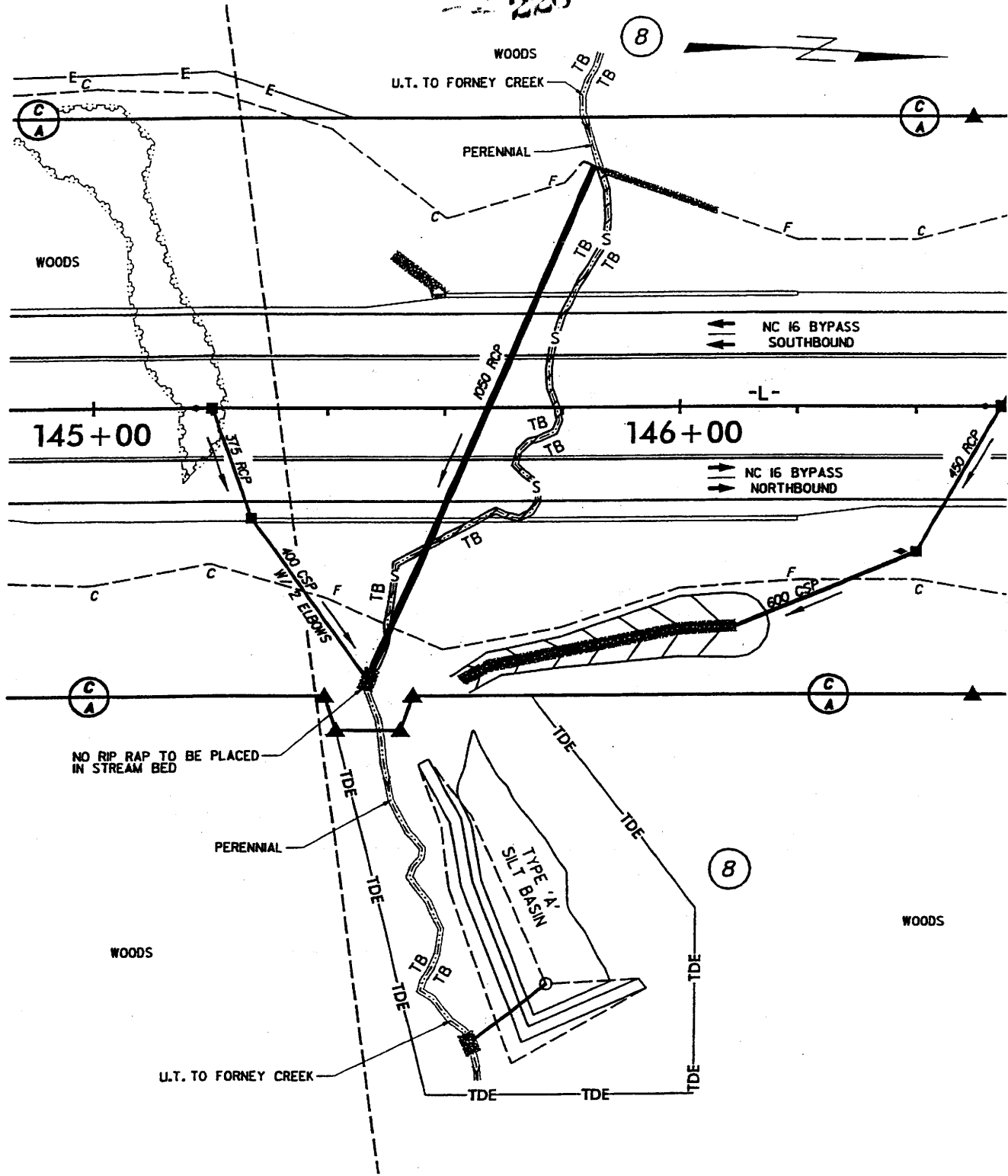
**LINCOLN COUNTY**

**PROJECT: 8.1850501 (R-2206B)  
NC-16 BYPASS**

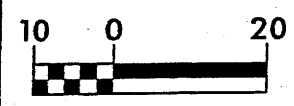
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**PLAN VIEW  
SITE 8B**



DENOTES SURFACE WATER  
IMPACT (NATURAL)

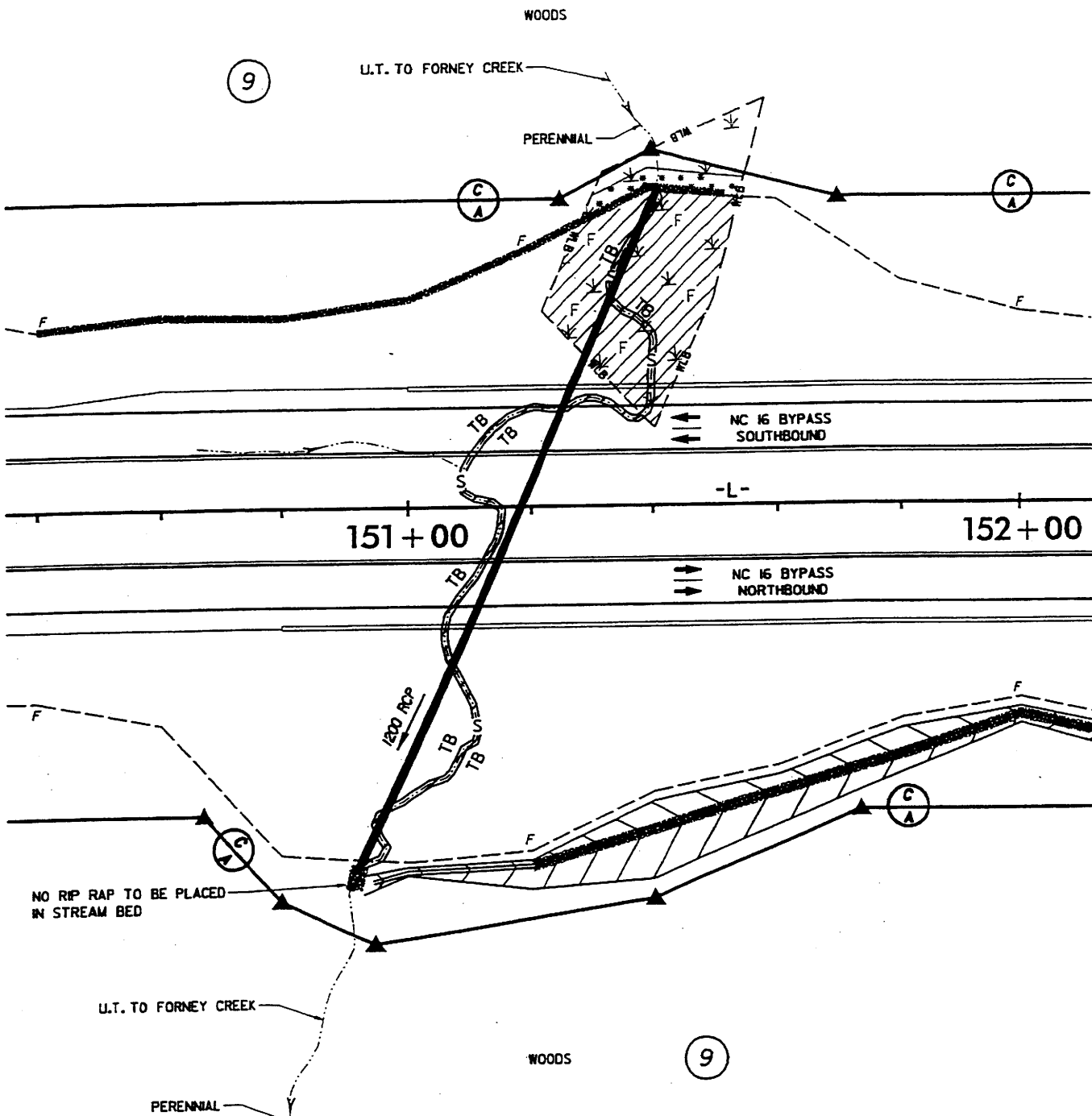
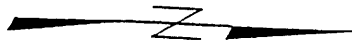
**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

**LINCOLN COUNTY**




**PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS**

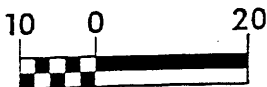
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1/16/04



**PLAN VIEW  
SITE 9B**

- DENOTES FILL IN WETLANDS 
- DENOTES MECHANIZED CLEARING 
- DENOTES SURFACE WATER IMPACT (NATURAL) 



N.C. DEPT. OF TRANSPORTATION  
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LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

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-L-

157+00

156+00

120' END GUTTER

20' (B)

EA

NC 16 BYPASS NORTHBOUND

200' CS2

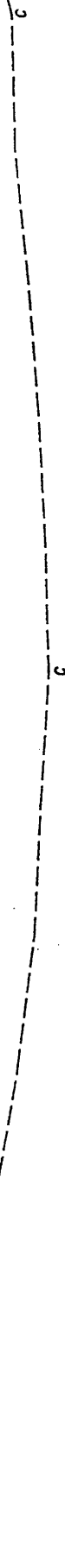
EA

20' (B)

FUT. CAT. 1

FUT. GRAV. 350

MATCHLINE B-B



C/A

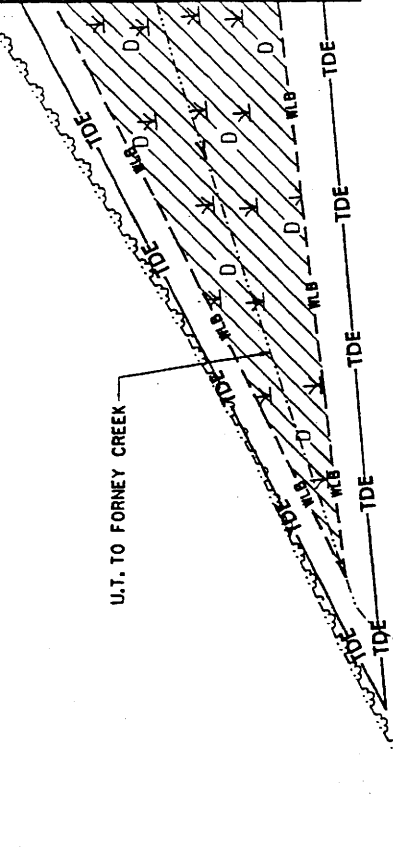
C/A

WOODS

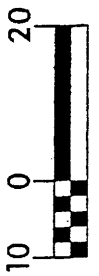
9

U.T. TO FORNEY CREEK

222



# PLAN VIEW SITE 10B



DENOTES DRAINED WETLANDS

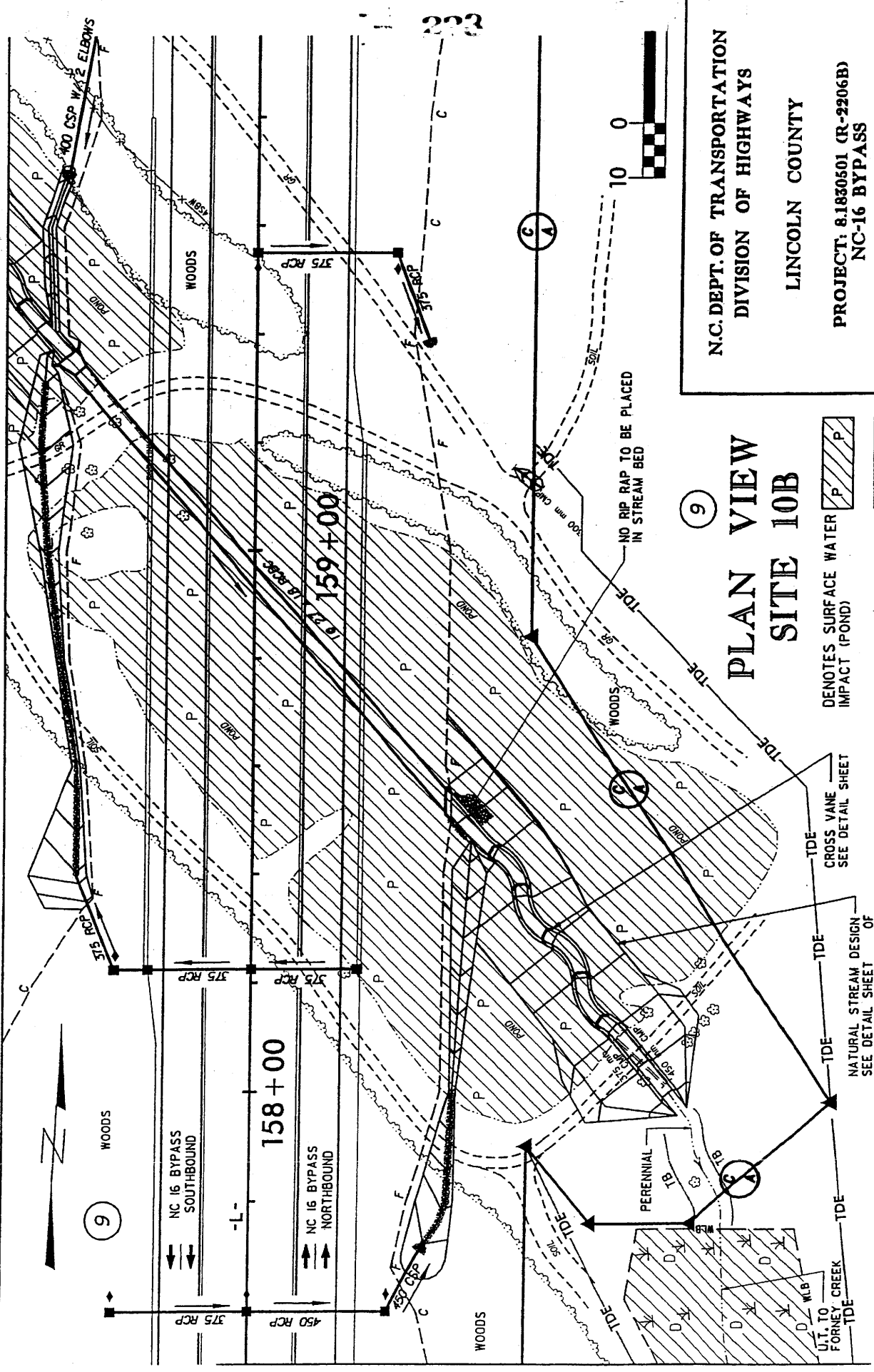


N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
LINCOLN COUNTY  
PROJECT: 8.1830501 (R-2206B)  
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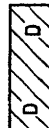
MATCHLINE A-A



MATCHLINE B-B

9

# PLAN VIEW SITE 10B

-  DENOTES SURFACE WATER IMPACT (POND)
-  DENOTES DRAINED WETLANDS

NO RIP RAP TO BE PLACED IN STREAM BED

CROSS VANE — SEE DETAIL SHEET

NATURAL STREAM DESIGN OF SEE DETAIL SHEET AND SUMMARY SHEET

U.T. TO FORNEY CREEK

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

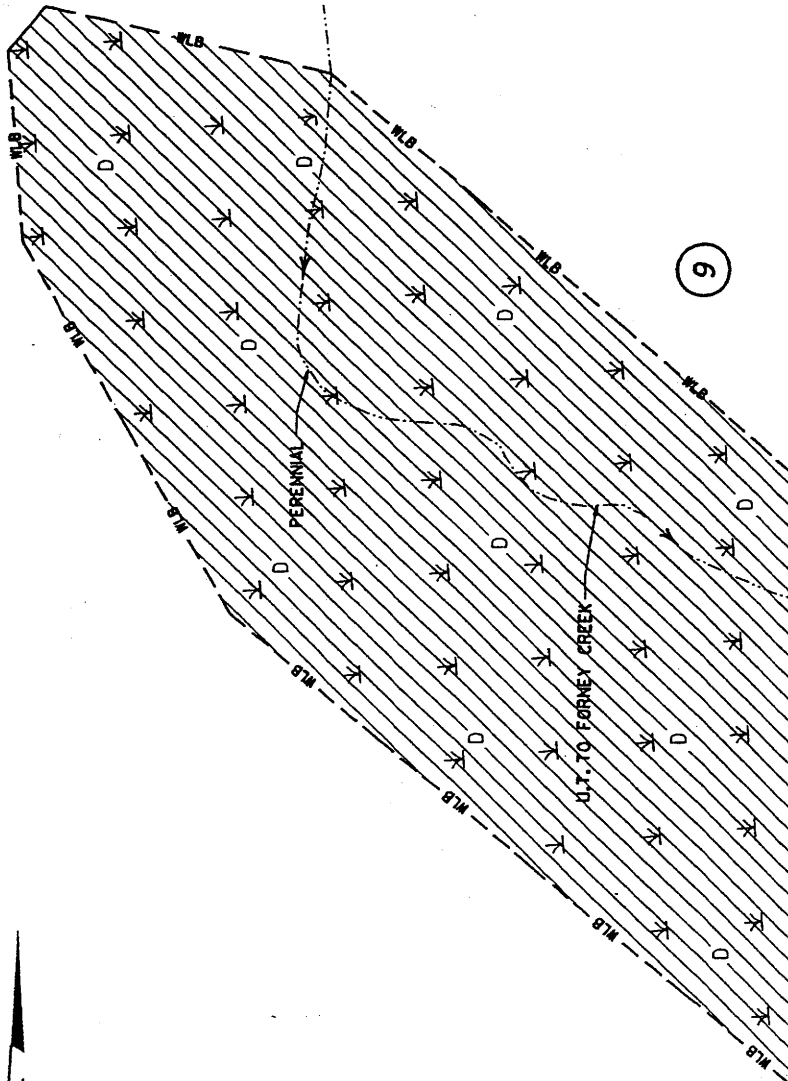
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N.C. DEPT. OF TRANSPORTATION  
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LINCOLN COUNTY

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# PLAN VIEW SITE 10B



DENOTES DRAINED  
WETLAND



MATCHLINE C-C

245

245

240

240

235

235

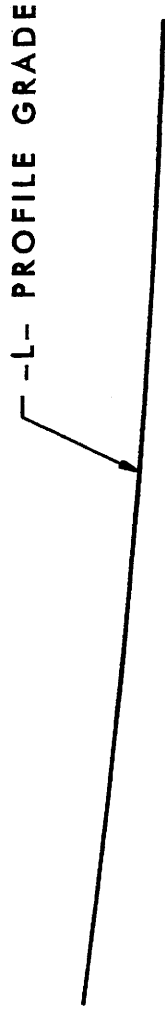
230

230

225

225

-L- PROFILE GRADE LINE

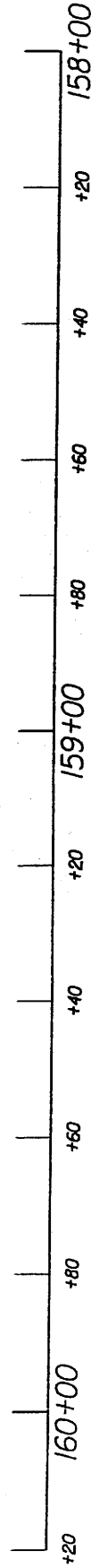


1 @ 2.7m x 1.8m RCBC

EXISTING GROUND LINE  
AT RCBC INLET

EXISTING BOTTOM OF POND  
PROPOSED STREAM BED

NOTE: INVERTS OF CULVERT ARE SET 0.3m (1.0')  
BELOW STREAM TO ALLOW FORMATION OF  
NATURAL BED



# PROFILE SITE 10B



HORIZONTAL SCALE



VERTICAL SCALE

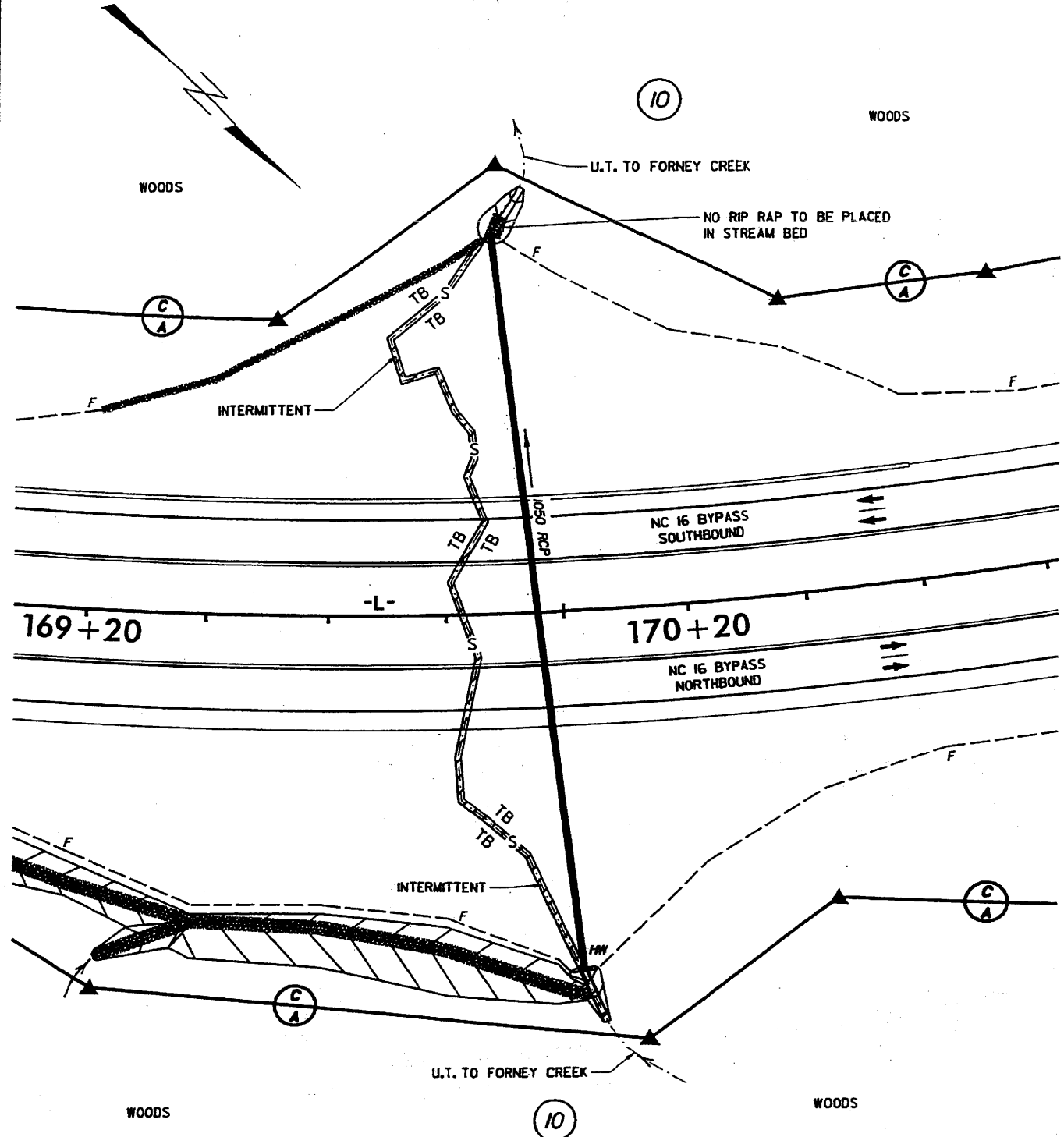
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

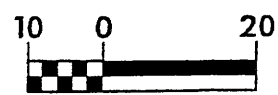
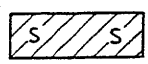
SHEET 18 OF 35

1/16/04



**PLAN VIEW  
SITE 11B**

DENOTES SURFACE WATER  
IMPACT (NATURAL)



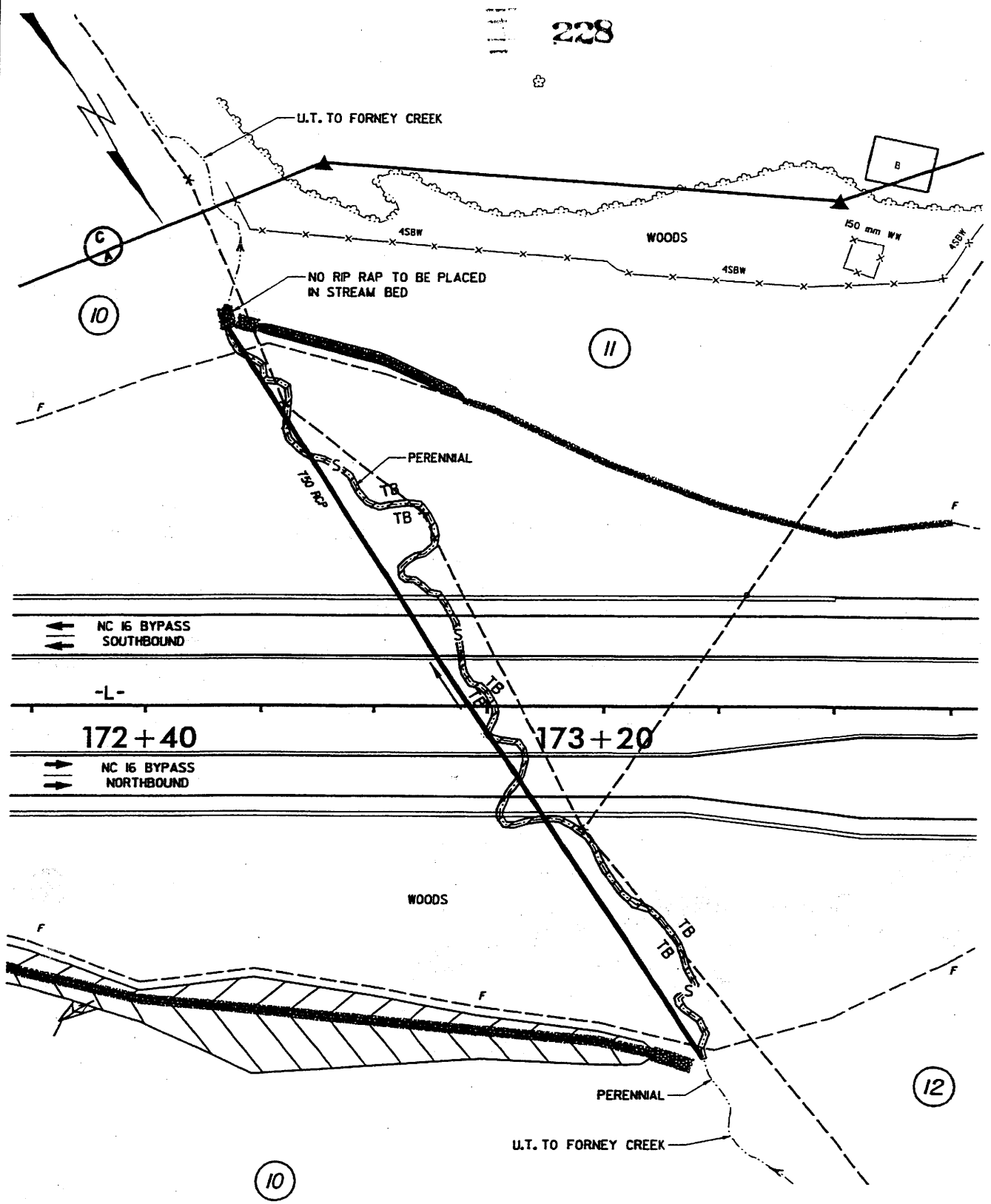
**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

**LINCOLN COUNTY**

**PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS**

**SHEET 19 OF 35**

**1/16/04**

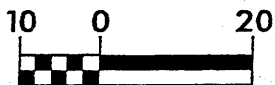


PLAN VIEW  
SITE 12B

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

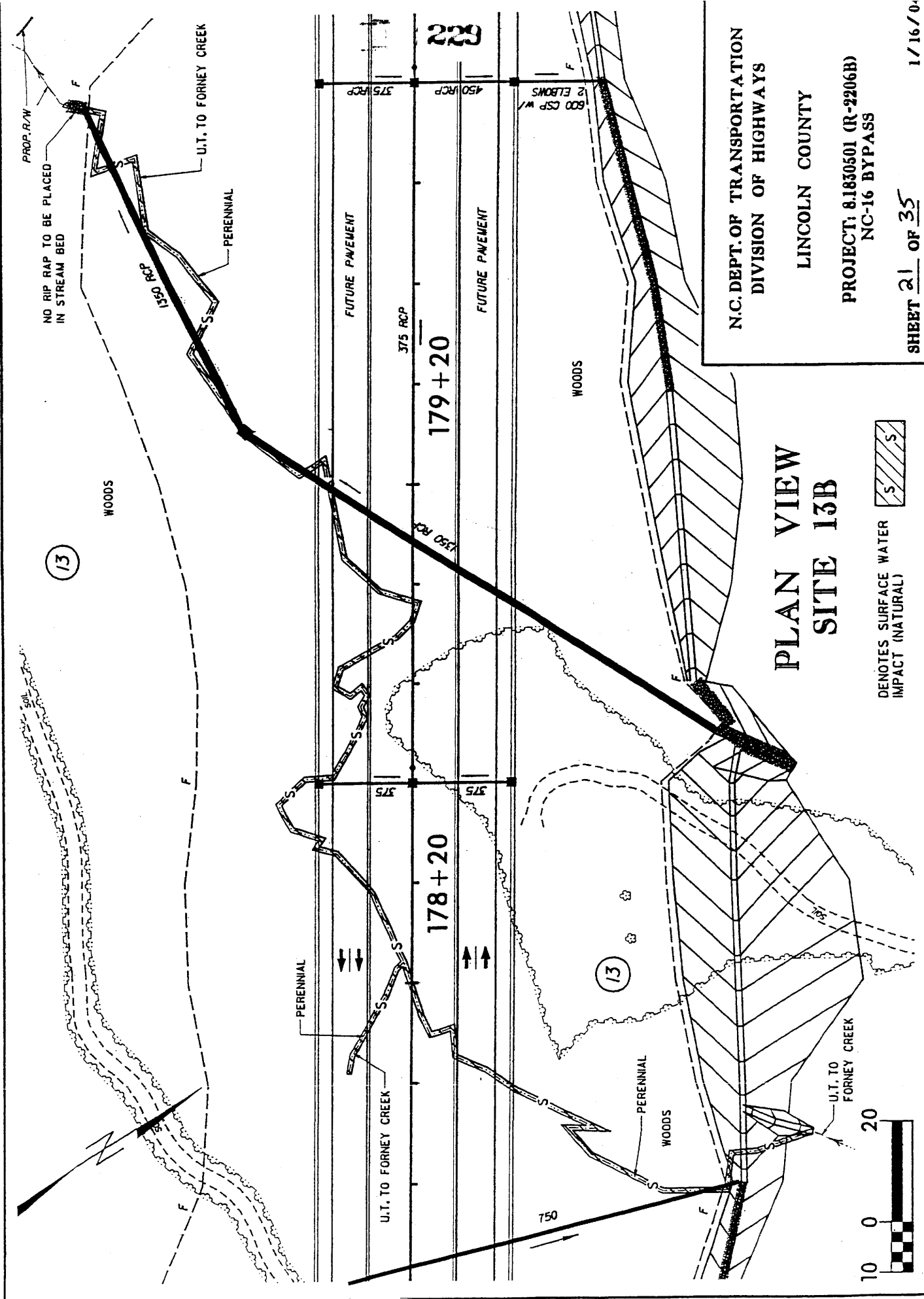
LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS



DENOTES SURFACE WATER  
IMPACT (NATURAL)



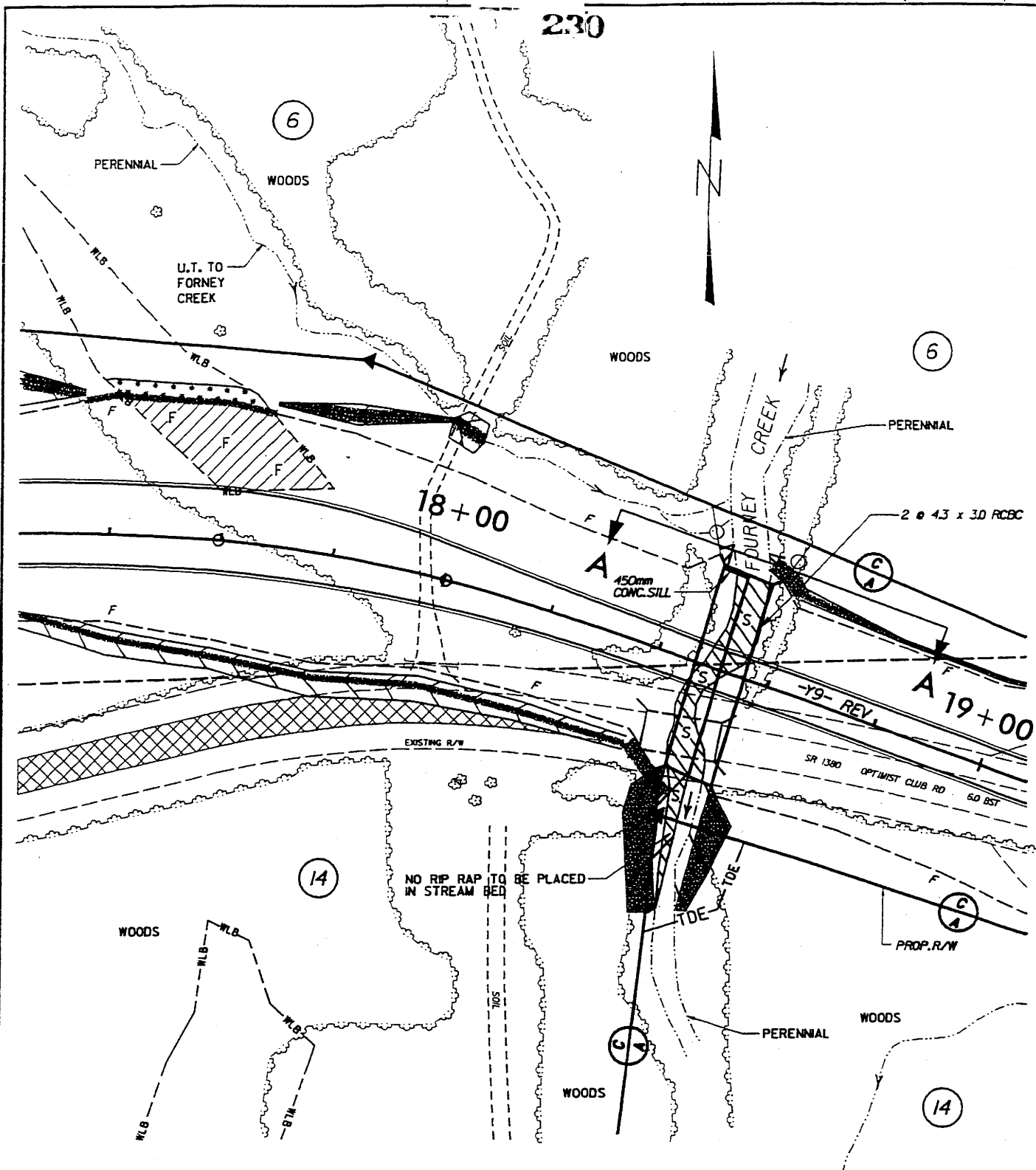


**PLAN VIEW  
SITE 13B**

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
LINCOLN COUNTY  
PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS  
SHEET 21 OF 35

DENOTES SURFACE WATER  
IMPACT (NATURAL)



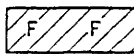


**PLAN VIEW  
SITE 14B**

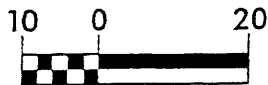
DENOTES MECHANIZED CLEARING



DENOTES FILL IN WETLANDS



DENOTES SURFACE WATER IMPACT (NATURAL)



**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

**LINCOLN COUNTY**

**PROJECT: 81830501 (R-2206B)  
NC-16 BYPASS**

**SHEET 22 OF 35**

1/16/04

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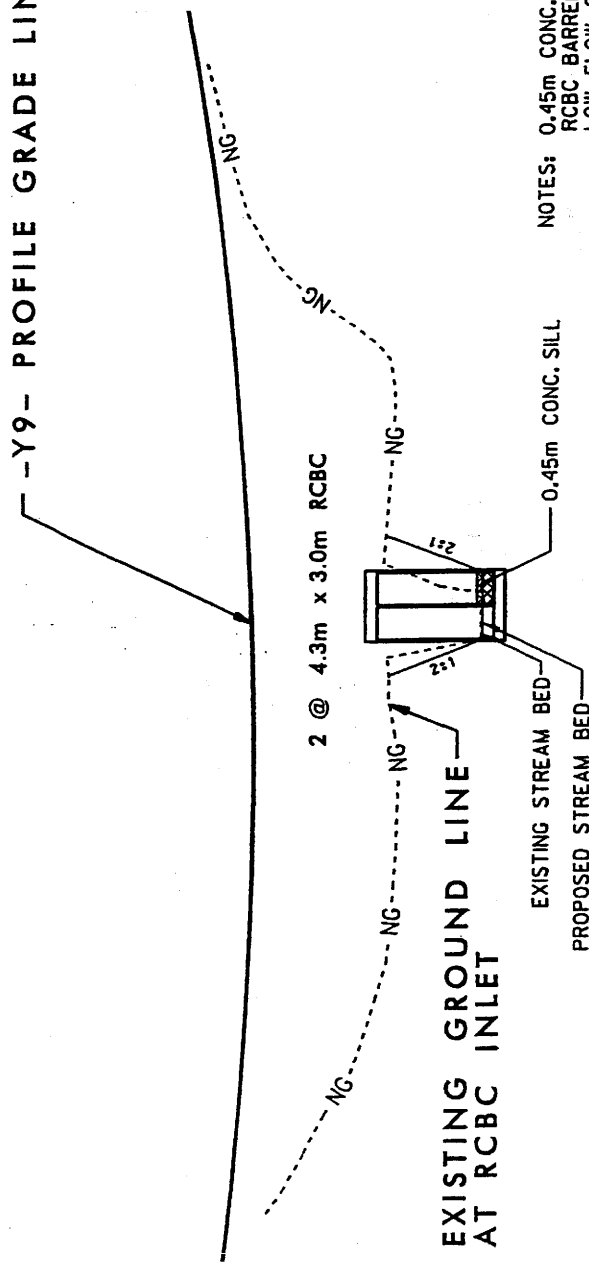
215

215

210

210

--Y9-- PROFILE GRADE LINE (PROPOSED)



EXISTING GROUND LINE AT RCBC INLET

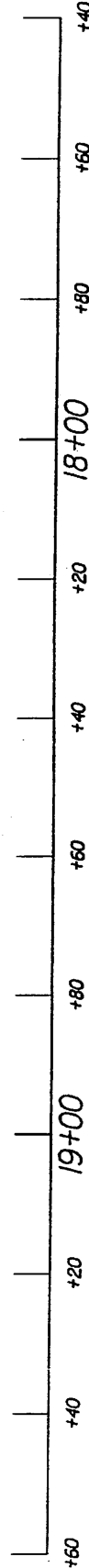
EXISTING STREAM BED

PROPOSED STREAM BED

NOTES:

0.45m CONC. SILL PROVIDED IN RIGHT RCBC BARREL TO RETAIN NATURAL LOW FLOW CHANNEL WIDTH.

INVERTS OF CULVERT ARE SET 0.3m (1.0') BELOW STREAM TO ALLOW FORMATION OF NATURAL BED.



HORIZONTAL SCALE



VERTICAL SCALE

# PROFILE SITE 14B

NC. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1850501 (R-2206B)  
NC-16 BYPASS

SHEET 23 OF 35

1/16/04



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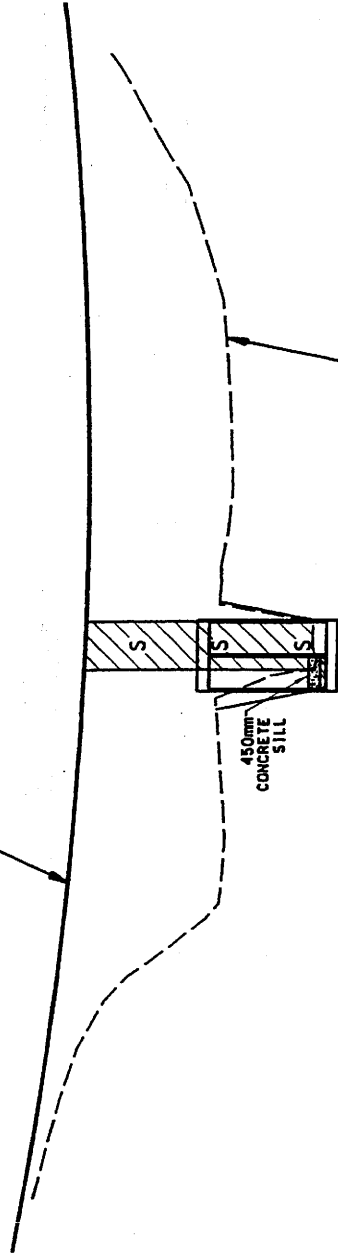
220

215

210

-Y9-REV PROFILE GRADE LINE

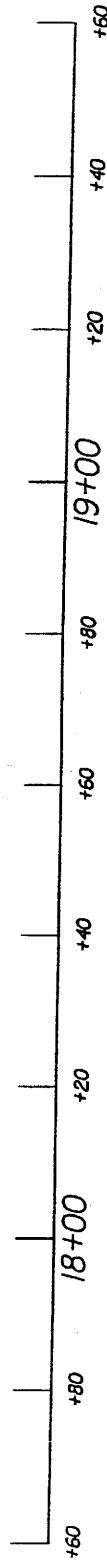
EXISTING GROUND LINE



2 @ 4.3m x 3.0m RCBC

450mm  
CONCRETE  
SILL

PROPOSED PROFILE  
 P1 = 18+65.000 -Y9- REV  
 ELEV = 219.960  
 VC = 236m  
 G1 = (-)14.5000%  
 G2 = (+)14.2070%



HORIZONTAL SCALE



VERTICAL SCALE

SECTION A-A  
 SITE 14B

 DENOTES SURFACE WATER  
 IMPACT (NATURAL)

N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2306B)  
 NC-16 BYPASS

SHEET 24 OF 35

1/16/04

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**IMPACT SUMMARY (ENGLISH)**

Site No.	Station (From/To)	Structure Size	WETLAND IMPACTS				SURFACE WATER IMPACTS					
			Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation In Wetlands (ac)	Mechanized Clearing (Method III) (ac)	Fill In SW (Natural) (ac)	Fill In SW (Pond) (ac)	Temp. Fill In SW (ac)	Existing Channel Impacted (ft)	Natural Stream Design (ft)	
1B	-Y12- 15+81 Lt to 106+25 Rt	900mm	0.099			0.010	0.027			377.6		
2B	-L- 114+65 Lt to 115+27 Rt	900mm					0.025			429.8		
3B	-L- 121+69 Rt to 122+44 Rt	1650mm					0.104			678.5		
4B	-L- 132+03 Rt to 133+12 Lt	1 @ 2.1m x 1.5m RCBC					0.136			834.3		
6B	-L- 139+59 Rt to 140+01 Lt	1050mm					0.027			355.3		
7B	-L- 142+91 Lt to 143+36 Rt	1050mm					0.022			299.2		
8B	-L- 145+50 Rt to 145+88 Lt	1050mm					0.030			382.2		
9B	-L- 150+96 Rt to 151+55 Lt	1200mm	0.173			0.020	0.039			531.8		
10B	-L- 156+75 Rt to 157+75 Rt	1 @ 2.7m x 1.8m RCBC	3.116 [2]						3.267 [1]			459.3
	-L- 157+94 Rt to 160+37 Lt											242.8
11B	-L- 169+69 Lt to 170+01 Rt	1050mm					0.042			563.3		
12B	-L- 172+55 Lt to 173+39 Rt	750mm					0.052			660.7		
13B	-L- 177+58 Rt to 179+75 Lt	1350mm					0.101			1345.8		
14B	-Y9-REV 18+46 Rt to 18+56 Lt	2 @ 4.3m x 3.0m RCBC	0.084			0.020	0.059			209.3		
<b>PROJECT TOTALS</b>			<b>3.472</b>	<b>0.000</b>	<b>0.000</b>	<b>0.050</b>	<b>0.664</b>	<b>3.267</b>	<b>0.000</b>	<b>6667.8</b>	<b>702.1</b>	

**NOTES:**

- Site 5B Removed Due To No Impact
- [1] Denotes Draining Of Pond Impact.
- [2] Denotes Draining Of Wetland Impact.

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501  
NCDOT T.I.P. No: R-2206B

SHEET 25 OF 35

1/16/2004

NCDOT Project I.D. R-2206B  
Lincoln / Catawba County, NC  
NC 16 Bypass from North of NC 73 to North of  
SR 1386 (St. James Church Road)

**NATURAL STREAM DESIGN**  
**UNNAMED TRIBUTARY TO FORNEY CREEK**  
Right of -L- Project Station 158+40  
Left of -L- Project Station 159+60

Prepared by: TranSite Consulting Engineers, Inc.  
1300 Paddock Dr.  
Raleigh, NC 27609

**NATURAL STREAM DESIGN**  
**UNNAMED TRIBUTARY TO FORNEY CREEK**

Right of -L- Project Station 158+40

Left of -L- Project Station 159+60

The construction of NC 16 North of NC 73 to North of SR 1386 will require that a portion of an unnamed tributary to Forney Creek be relocated right of -L- Station 158+40 and left of -L- Station 159+60. The total length of stream to be relocated will be 214 meters (702') starting left of -L- Station 160+35± and continue 140 meters (459') downstream to the inlet of the proposed 1 @ 2.7m x 1.8m (1 @ 9'x 6') RCBC. The stream will begin again at the outlet of the proposed RCBC and continue downstream an additional 74 meters (243') intersecting the existing stream on the downstream side of an existing soil road. The proposed stream relocation is designed according to "natural channel" design principles proposed by Dave Rosgen.

This tributary of Forney Creek drains 1.00 km<sup>2</sup> (0.39 mi<sup>2</sup>) in Lincoln County and is located within the Piedmont Physiographic Region. Existing land use in the drainage basin is predominantly agriculture, low density residential and undeveloped. The Lincoln County Land Use Plan shows that the future land use is predominantly low density residential.

There is no hydraulic data available on this stream. Discharges were estimated using procedures outlined in USGS Water-Resources Report 96-4084, Estimation of Flood-Frequency Characteristics of Small Urban Watersheds in North Carolina.

EXISTING CHANNEL

The existing conditions at the proposed stream relocation sites are two ponds in series totaling 1.32 hectares (3.26 acres) of surface area. The ponds will be drained prior to construction and the proposed streams constructed through the natural bottoms.

**REFERENCE STREAM**

A 30 meter section of stream upstream of the existing ponds was surveyed in detail to determine it's morphological characteristics. Those characteristics include bankfull discharge, width, depth and area. The reach begins approximately 140 meters upstream of the upstream pond and was chosen to be used as the reference reach because it is stable and undisturbed.

The reference streambed was found to be fine to medium sand. Therefore, a pebble count was not feasible. Velocities, stream power and shear were obtained using the HEC-RAS computer model. Based on the field survey data gathered, this stream reach was classified as an C5 stream.

**PROPOSED STREAM**

The proposed stream will be excavated in the natural bottoms of the drained ponds and is designed to have a C5 classification. The upstream stream gradient is controlled by the tie to the existing stream 115 meters (377') left of -L- Sta. 160+35± and the invert in of the proposed 1 @ 2.7m x 1.8m (1 @ 9'x 6') RCBC. The downstream gradient is controlled by the invert out of the proposed RCBC and the tie to the existing stream 80 meters (262') right of -L- Sta. 157+95±. The RCBC will be buried a minimum of 0.3 meters (1.0') upstream and downstream to provide formation of a natural streambed through its entire length.

Proposed channel stabilization is shown on the attached detail sheet. It is anticipated that the channel banks will be planted with native trees and shrubs above bankful depth. In addition, cross vanes will be placed in the channel for grade control and coir fiber mat will be placed along the entire channel while rootwads will be placed along the outside of the channel bends. The channel bottom will match the characteristics of the existing channel.

**SEDIMENT TRANSPORT ANALYSIS**

The proposed stream has a bankfull stream power of 0.78 lb/ft-s and a shear stress of 0.30 lb/ft<sup>2</sup> as compared to 0.83 lb/ft-s and 0.31 lb/ft<sup>2</sup> for the existing stream. These values indicate that the proposed stream will transport the current sediment load without aggrading or degrading the streambed or banks. Additionally, 2-yr and 10-yr velocities and shear stresses were evaluated and found to be within acceptable limits.

## Appendix B

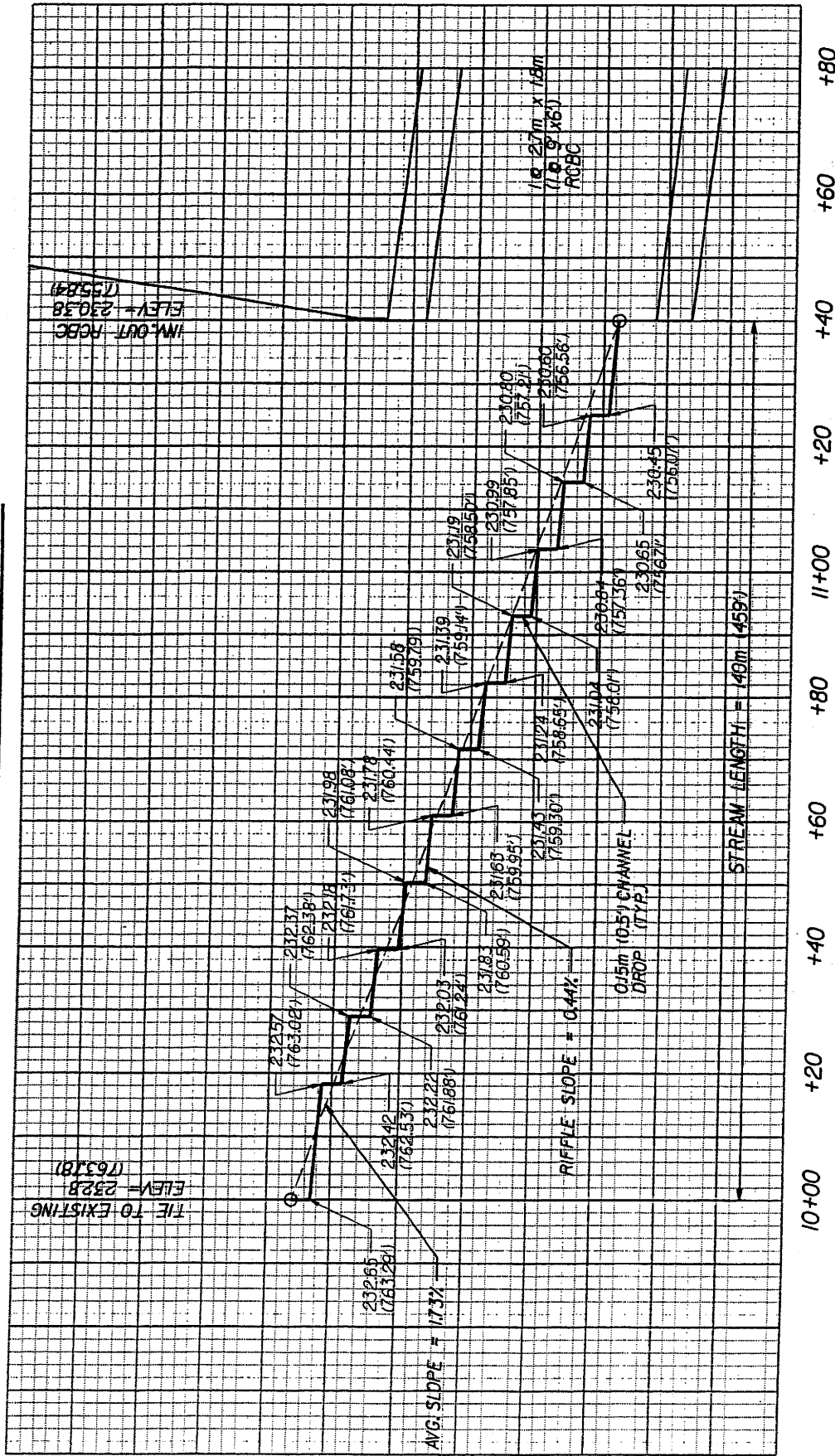
Morphological Measurement Table  
R-2206B, Lincoln County

Variables	Existing Channel	Proposed Reach	USGS Station	Reference Reach
1. Stream Type	N/A -(2) Ponds	C5	N/A	C5
2. Drainage Area (D.A.)	1.00 km <sup>2</sup> / 0.39 mi <sup>2</sup>	1.00 km <sup>2</sup> / 0.39 mi <sup>2</sup>	-	1.00 km <sup>2</sup> / 0.39 mi <sup>2</sup>
3. Bankfull Width ( $W_{bkd}$ )	N/A	4.11 m / 13.5 ft	-	4.45 m / 14.6 ft
4. Bankfull Mean Depth ( $d_{bkd}$ )	-	0.35 m / 1.14 ft	-	0.32 m / 1.04 ft
5. Width/Depth Ratio ( $W_{bkd}/d_{bkd}$ )	-	11.84	-	14.00
6. Bankfull Cross-Sectional Area ( $A_{bkd}$ )	-	1.43 m <sup>2</sup> / 15.34 ft <sup>2</sup>	-	1.41 m <sup>2</sup> / 15.2 ft <sup>2</sup>
7. Bankfull Mean Velocity ( $V_{bkd}$ )	-	0.80 m/s / 2.61 ft/s	-	0.80 m/s / 2.64 ft/s
8. Bankfull Discharge ( $Q_{bkd}$ )	-	1.13 m <sup>3</sup> /s / 40.0 ft <sup>3</sup> /s	-	1.13 m <sup>3</sup> /s / 40.0 ft <sup>3</sup> /s
9. Bankfull Max Depth ( $d_{mbkd}$ )	-	0.45 m / 1.50 ft	-	0.52 m / 1.69 ft
10. Width of Floodprone Area ( $W_{fpa}$ )	-	21.7 m / 71.3 ft	-	54.9 m / 180 ft
11. Entrenchment Ratio ( $W_{fpa}/W_{bkd}$ )	-	5.28	-	12.33
12. Meander Length ( $L_m$ )	-	20 m / 41 ft	-	20-26 m / 41-85 ft
13. Ratio of Meander Length to Bankfull Width ( $L_m/W_{bkd}$ )	-	3.04	-	2.80 - 5.82
14. Radius of Curvature ( $R_c$ )	-	9.0 m / 29.5 ft	-	9.0-12.0 m/29.5-39.4 ft
15. Ratio of Radius of Curvature to Bankfull Width ( $R_c/W_{bkd}$ )	-	2.19	-	2.02 - 2.70
16. Belt Width ( $W_{bt}$ )	-	6.5 m / 21.3 ft	-	6.0 m / 19.7 ft
17. Meander Width Ratio ( $W_{bt}/W_{bkd}$ )	-	1.58	-	1.35
18. Sinuosity (K) (stream length/valley length)	-	1.05	-	1.06
19. Valley Slope (VS)	-	1.87%	-	0.20%
20. Average Slope (CS)	-	1.73%	-	0.23%
21. Pool Slope	-	0.00%	-	0.00%
22. Ratio of Pool Slope to Average Slope	-	0.00	-	0.00
23. Maximum Pool Depth ( $d_{pmax}$ )	-	0.45 m / 1.48 ft	-	0.54 m / 1.77 ft
24. Ratio of Pool Depth to Average Bankfull Depth ( $d_p/d_{bkd}$ )	-	1.30	-	1.70
25. Pool Width ( $W_p$ )	-	4.25 m / 13.94 ft	-	4.50 m / 14.76 ft
26. Ratio of Pool Width to Bankfull Width ( $W_p/W_{bkd}$ )	-	1.03	-	1.01
27. Pool to Pool Spacing	-	8.0 m / 26.2 ft	-	4.0-8.0 m / 13.1-26.2 ft
28. Ratio of Pool to Pool Spacing to Bankfull Width	-	1.94	-	0.90 - 1.79
29. Ratio of Lowest Bnk Height to Bankfull Height (or Max Bankfull Depth) ( $B_{hlow}/d_{mbkd}$ )	-	1.00	-	0.86





# PROPOSED THALWEG PROFILE



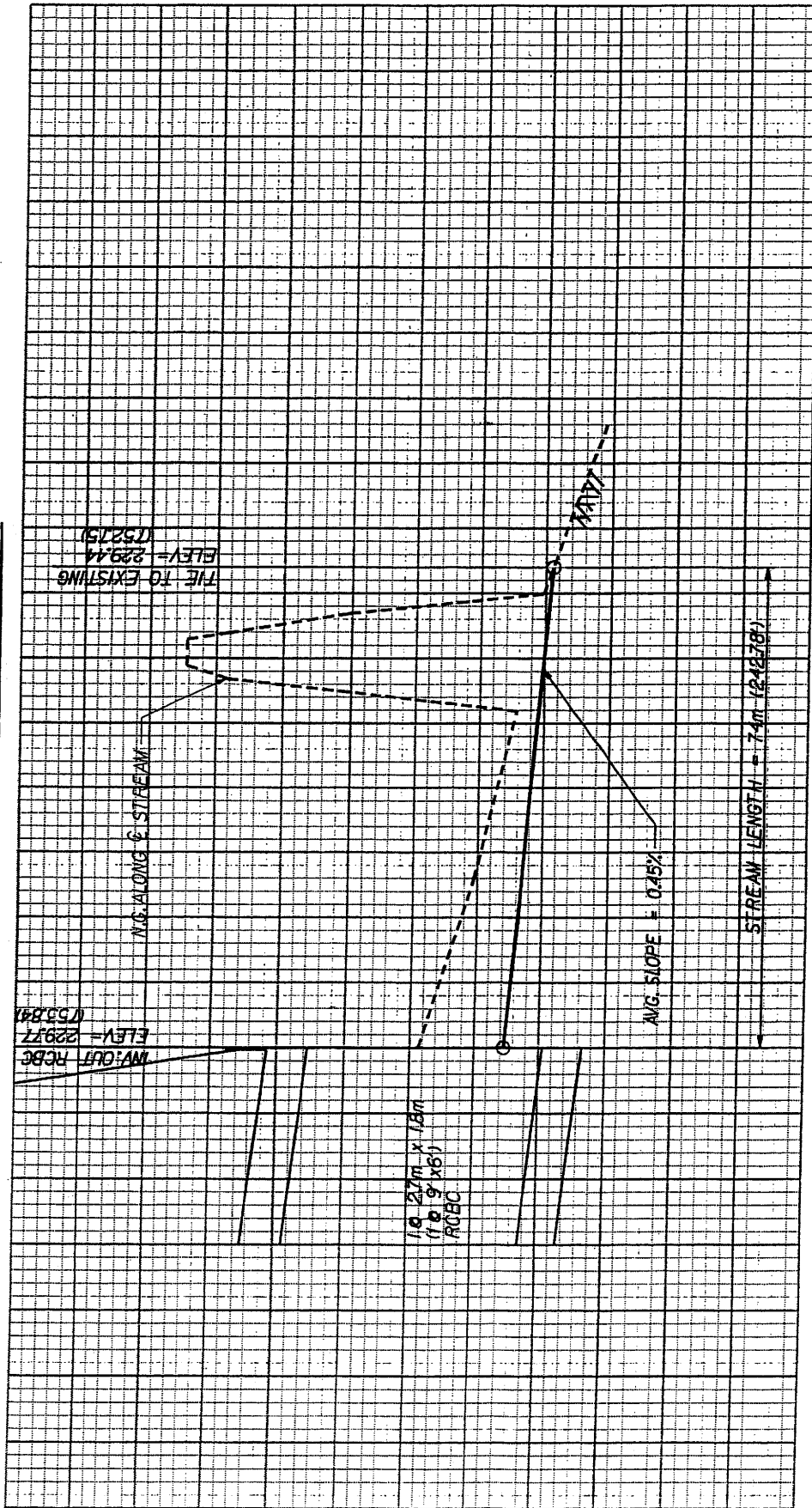
N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
 NC-16 BYPASS

NOTE: ELEVATIONS IN ( ) ARE IN FEET.  
 ALL OTHER STATION AND ELEVATION  
 DATA ARE IN METERS.

PROPOSED THALWEG PROFILE



233

232

231

230

229

228

10+00 +20 +40 +60 +80 11+00

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN COUNTY

PROJECT: 8.1830501 (R-2206B)  
NC-16 BYPASS

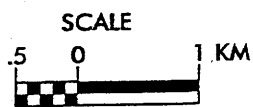
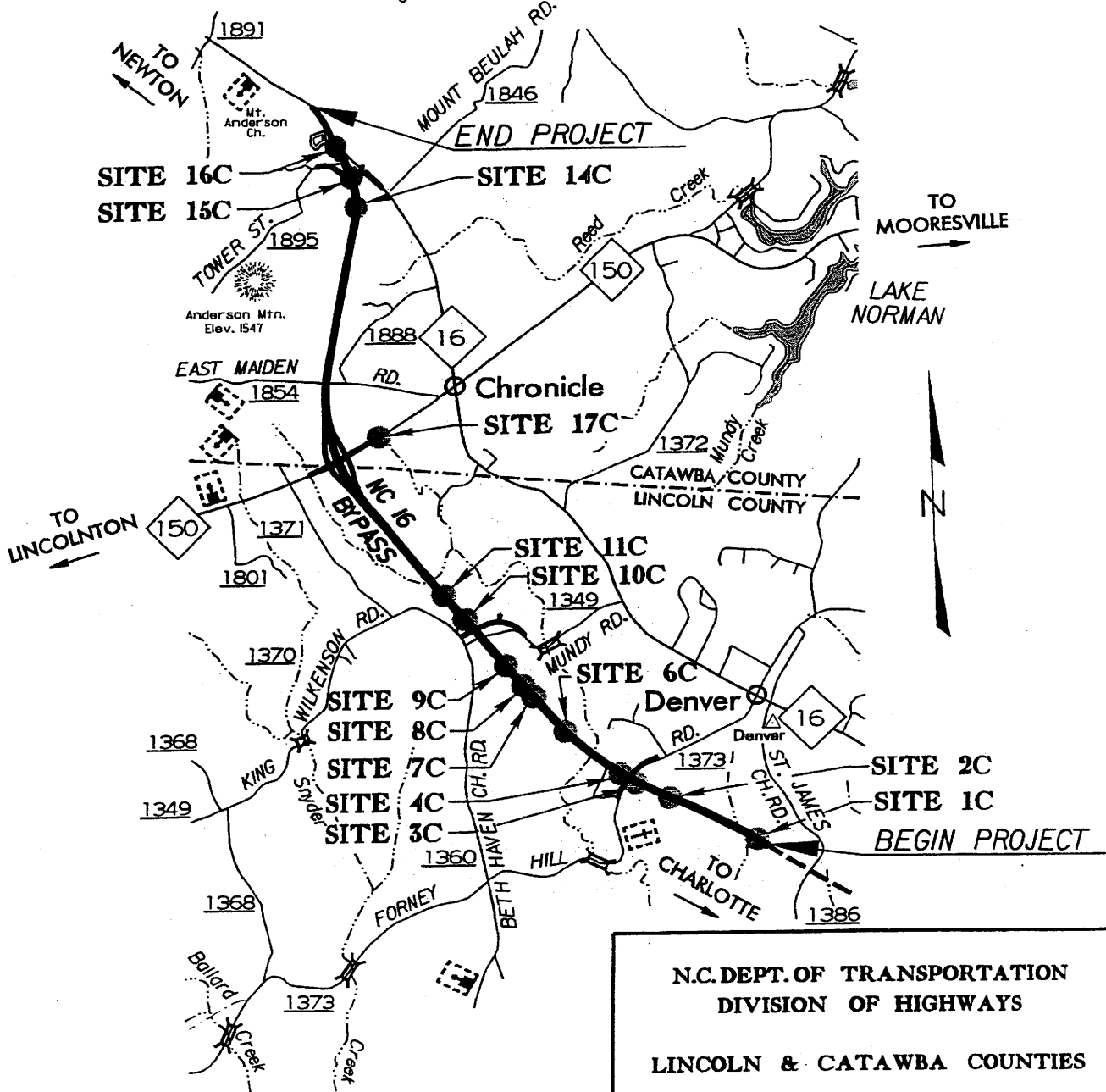
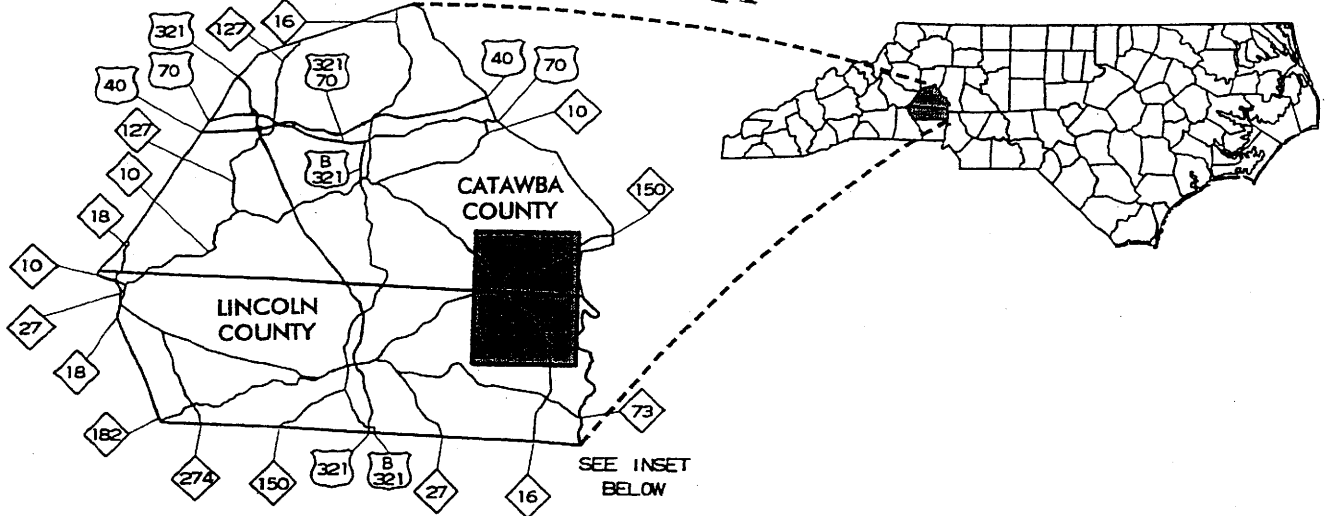
SHEET 33 OF 35

10/10/03

NOTE: ELEVATIONS IN ( ) ARE IN FEET.  
ALL OTHER STATION AND ELEVATION  
DATA ARE IN METERS.







**LOCATION MAP**  
 NOTE: SITES 5C, 12C & 13C  
 REMOVED DUE TO NO IMPACT

**N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS**  
**LINCOLN & CATAWBA COUNTIES**  
**PROJECT: 34383.1.1 (R-2206C)  
 NC-16 BYPASS**  
 SHEET 1 OF 35 1/16/04

**Item 22**

Site	Fill in Wetlands (acres)	Excavation in Wetlands (acres)	Mechanized Clearing in Wetlands [Method III] (acres)	Fill in Surface Waters [Natural] (acres)	Fill in Surface Waters [Pond] (acres)	Existing Channel Impacted (feet)	Natural Stream Design (feet)
1B	0.100		0.010	0.027		337.62	
2B				0.025		429.79	
3B				0.104		678.48	
4B				0.136		834.32	
6B				0.027		355.31	
7B				0.022		299.21	
8B				0.030		382.22	
9B	0.173		0.020	0.040		531.82	
10B	3.116				3.267 <sup>1</sup>		702.10
11B				0.042		563.32	
12B				0.052		660.76	
13B				0.101		1345.80	
14B	0.084		0.020	0.059		209.32	
1C				0.148		1686.02	164.04
2C				0.069		912.73	
3C	0.012			0.012		145.01	
4C	0.007			0.017		230.31	
6C				0.042		571.85	
7C				0.017		229.99	
8C				0.005		51.51	
9C				0.079		538.38	
10C	0.089		0.007	0.022		303.48	
11C	0.101		0.022				
14C	0.665			0.072		631.56	
15C	1.515	0.057	0.121	0.072		916.99	
16C	0.072	0.027	0.002	0.025	1.199	334.65	
17C					0.012 <sup>2</sup>	100.72 <sup>3</sup>	

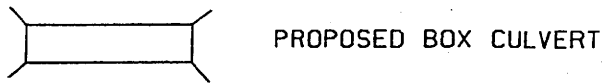
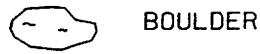
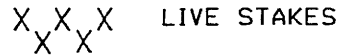
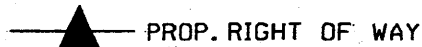
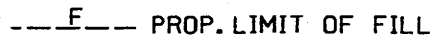
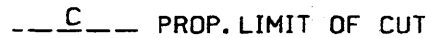
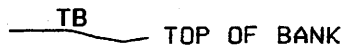
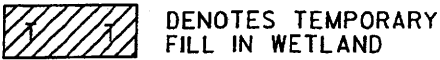
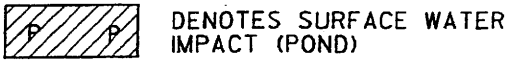
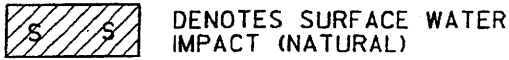
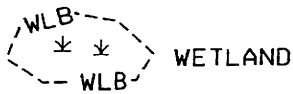
1 = Denotes draining of pond

2 = 0.002 acres of impact will be for a detour and is temporary

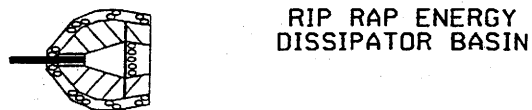
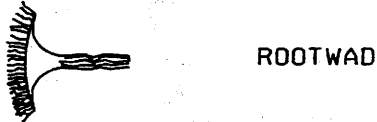
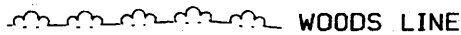
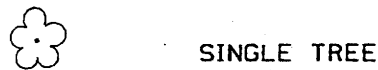
3 = 44.62 feet will be for a detour and is temporary

# LEGEND 246

---WLB--- WETLAND BOUNDARY



(DASHED LINES DENOTE EXISTING STRUCTURES)



**N.C. DEPT. OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
  
**LINCOLN & CATAWBA COUNTIES**  
  
**PROJECT: 34383.11 (R-2206C)**  
**NC-16 BYPASS**  
  
 SHEET 2 OF 35 1/16/04







255

255

250

250

245

245

240

240

235

235

+1.6161%

PVT STA. 184+20.000 -L-  
EL. = 255.135

--L- PROFILE GRADE LINE

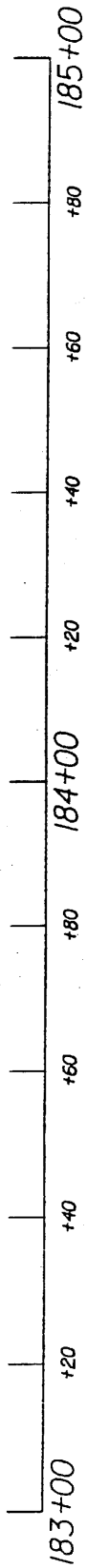
1 @ 1.5m x 1.5m RCBC

EXISTING GROUND LINE  
AT RCBC INLET

EXISTING STREAM BED

PROPOSED STREAM BED

NOTE: INVERTS OF CULVERT ARE SET 0.3m (1.0')  
BELOW STREAM TO ALLOW FORMATION OF  
NATURAL BED



# PROFILE SITE 1C

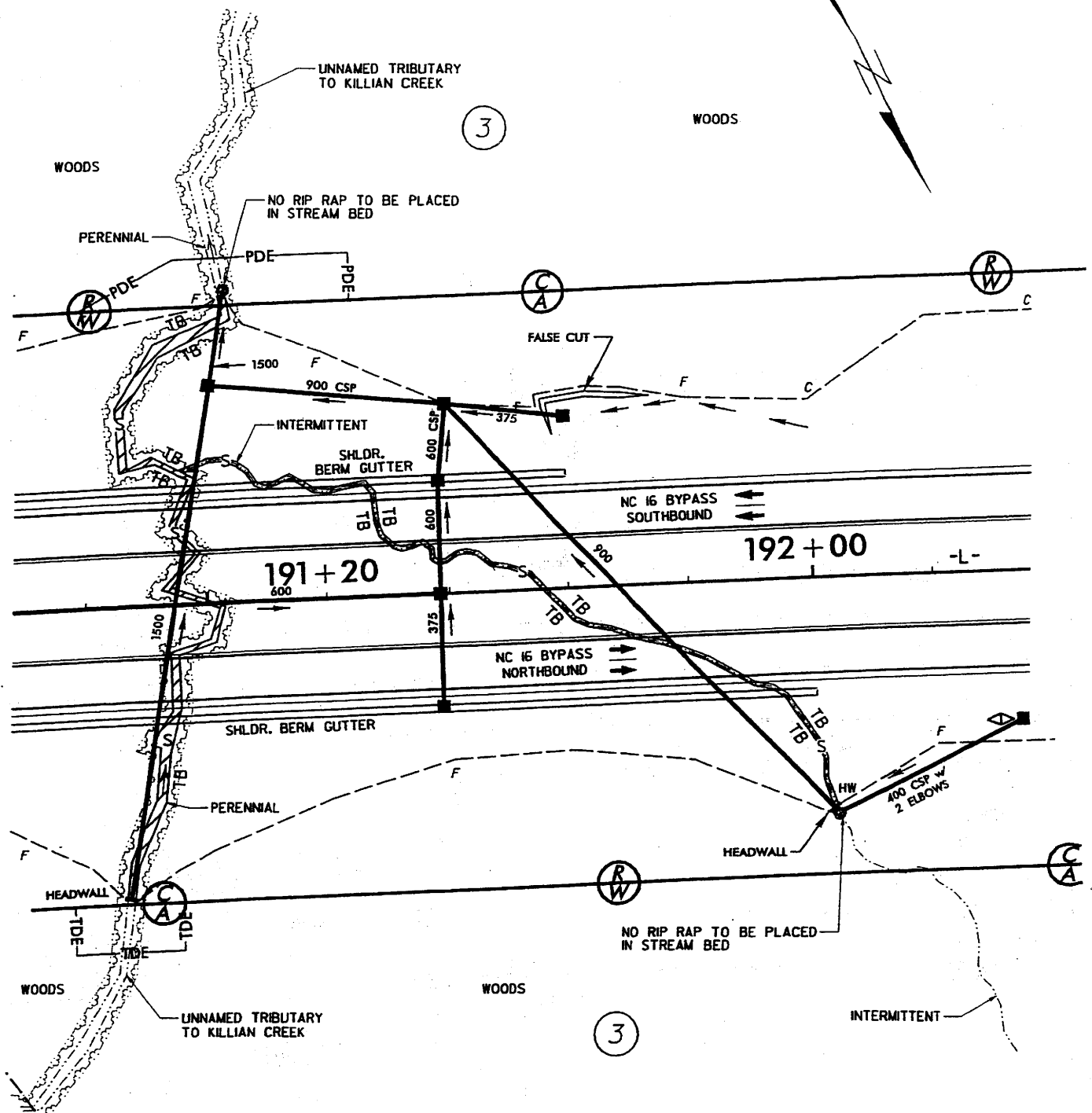


N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

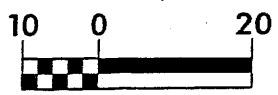
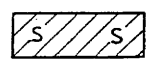
PROJECT: 34383.1.1 (R-2206C)  
NC-16 BYPASS

SHEET 5 OF 35 1/16/04



**PLAN VIEW  
SITE 2C**

DENOTES SURFACE WATER  
IMPACT (NATURAL)



**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

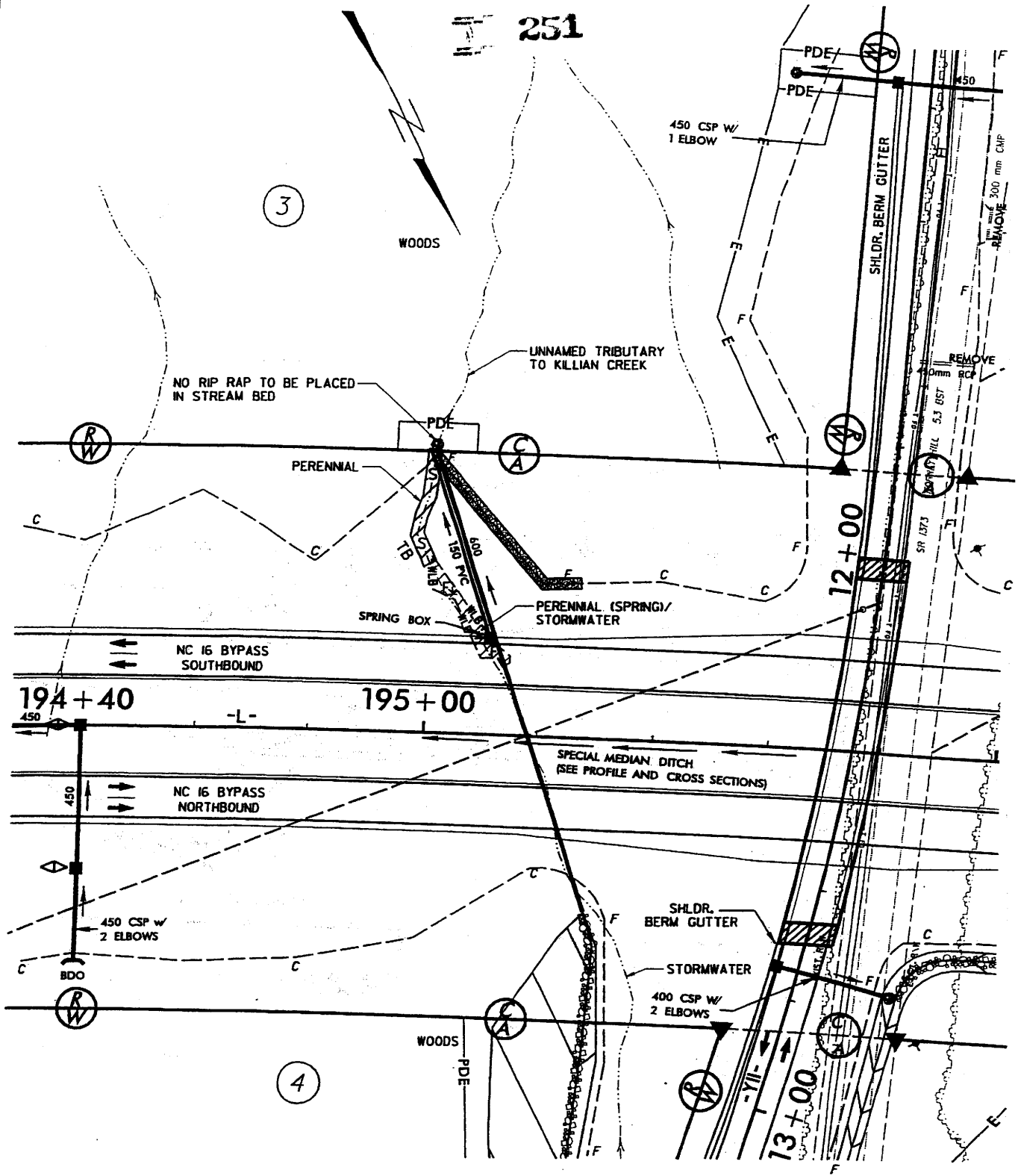
**LINCOLN & CATAWBA COUNTIES**

**PROJECT: 34383.11 (R-2206C)  
NC-16 BYPASS**

SHEET 6 OF 35

1/16/04  
REVISED 4/29/04

251

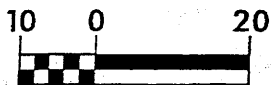
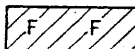


**PLAN VIEW  
SITE 3C**

DENOTES SURFACE WATER  
IMPACT (NATURAL)



DENOTES FILL IN  
WETLANDS



**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

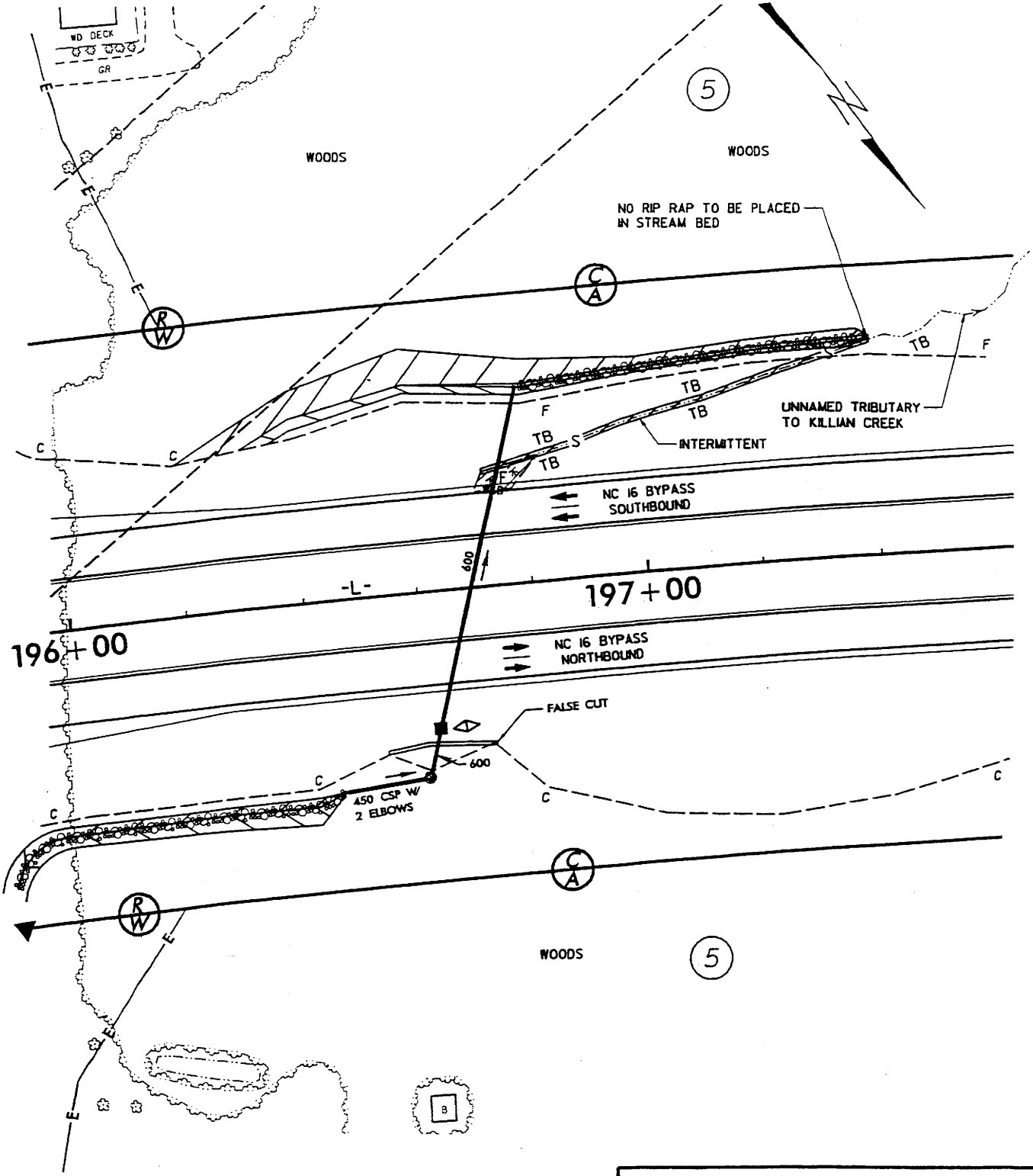
**LINCOLN & CATAWBA COUNTIES**

**PROJECT: 34383.11 (R-2206C)  
NC-16 BYPASS**

**SHEET 7 OF 35**

**1/16/04**

**REVISED 4/29/04**

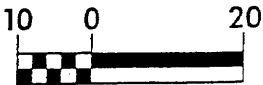
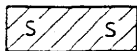


**PLAN VIEW  
SITE 4C**

DENOTES FILL IN  
WETLANDS



DENOTES SURFACE WATER  
IMPACT (NATURAL)



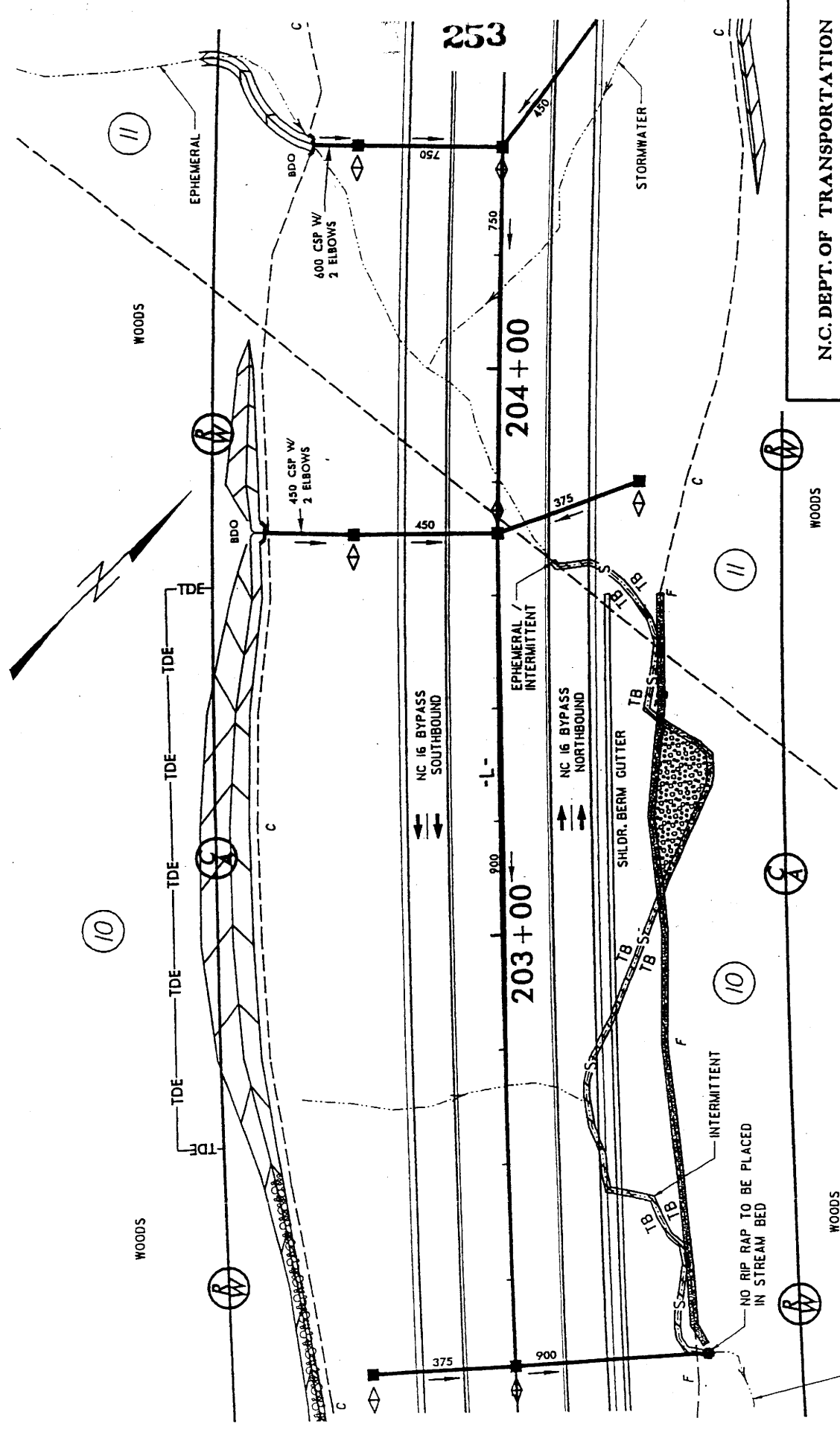
**N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS**

**LINCOLN & CATAWBA COUNTIES**

**PROJECT: 34383.11 (R-2206C)  
NC-16 BYPASS**

**SHEET 8 OF 35**

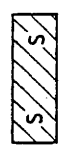
1/16/04



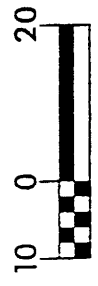
**PLAN VIEW  
SITE 6C**

UNNAMED TRIBUTARY  
TO KILLIAN CREEK

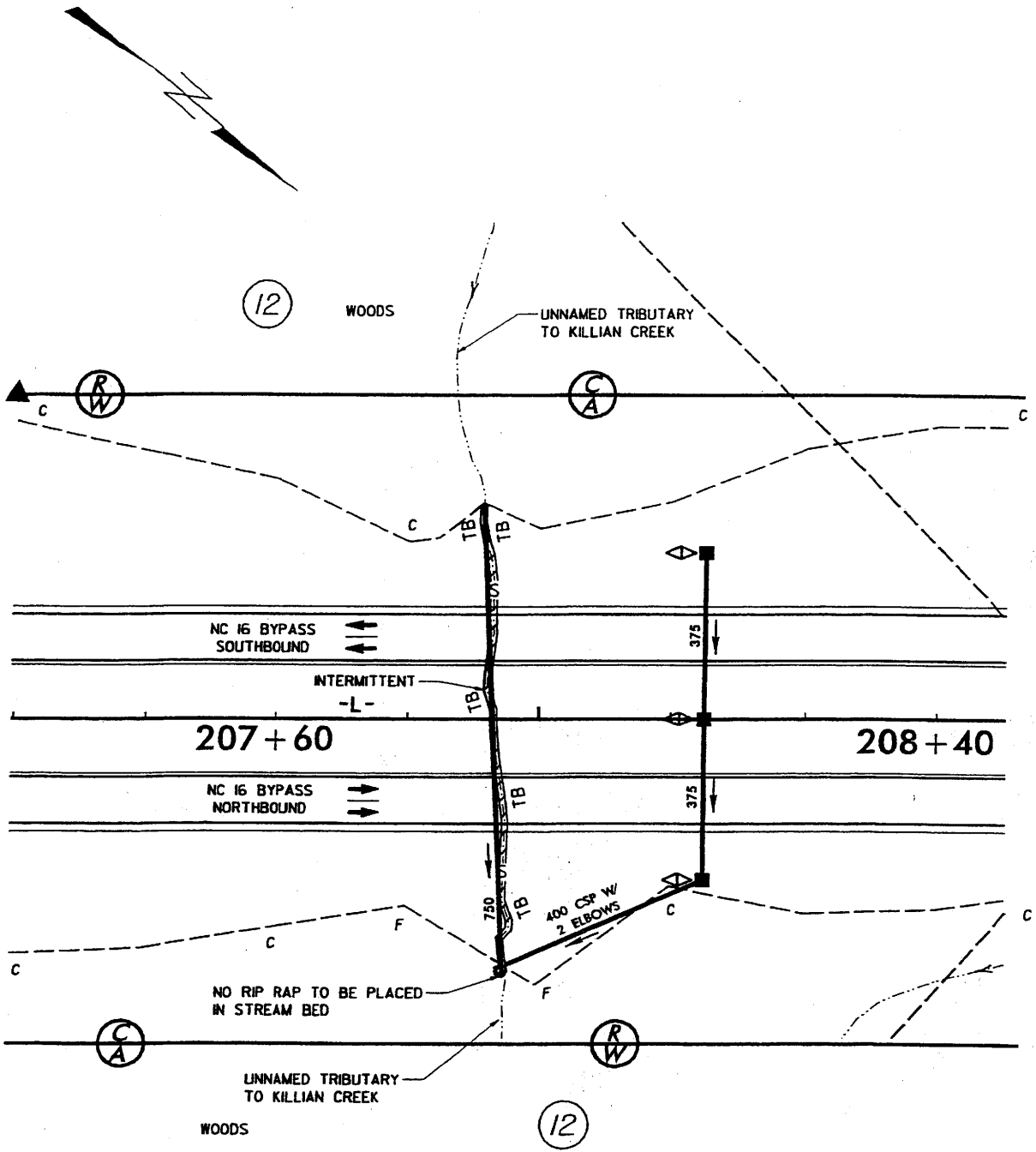
NO RIP RAP TO BE PLACED  
IN STREAM BED



Denotes SURFACE WATER  
IMPACT (NATURAL)

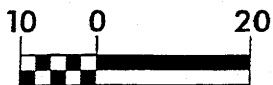


N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
LINCOLN & CATAWBA COUNTIES  
PROJECT: 34385.1.1 (R-2206C)  
NC-16 BYPASS  
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1/16/04



**PLAN VIEW  
SITE 7C**

DENOTES SURFACE WATER  
IMPACT (NATURAL)



N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

PROJECT: 34383.11 (R-2206C)  
NC-16 BYPASS

SHEET 10 OF 35 1/16/04

255

WOODS

WOODS



14

EPHEMERAL

C  
A

R  
W

450 CSP W/  
2 ELBOWS

BDO

NC 16 BYPASS  
SOUTHBOUND

12

375

600

208 + 40

209 + 00

-L-

600

EPHEMERAL /  
PERENNIAL (SPRING)

NC 16 BYPASS  
NORTHBOUND

SPRING BOX

150 MC/TB  
TB

EPHEMERAL

375

NO RIP RAP TO BE PLACED  
IN STREAM BED

12

C  
A

R  
W

UNNAMED TRIBUTARY  
TO KILLIAN CREEK

PERENNIAL

14

WOODS

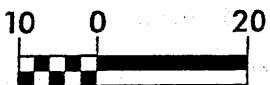
13

# PLAN VIEW SITE 8C

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

PROJECT: 34383.11 (R-2206C)  
NC-16 BYPASS



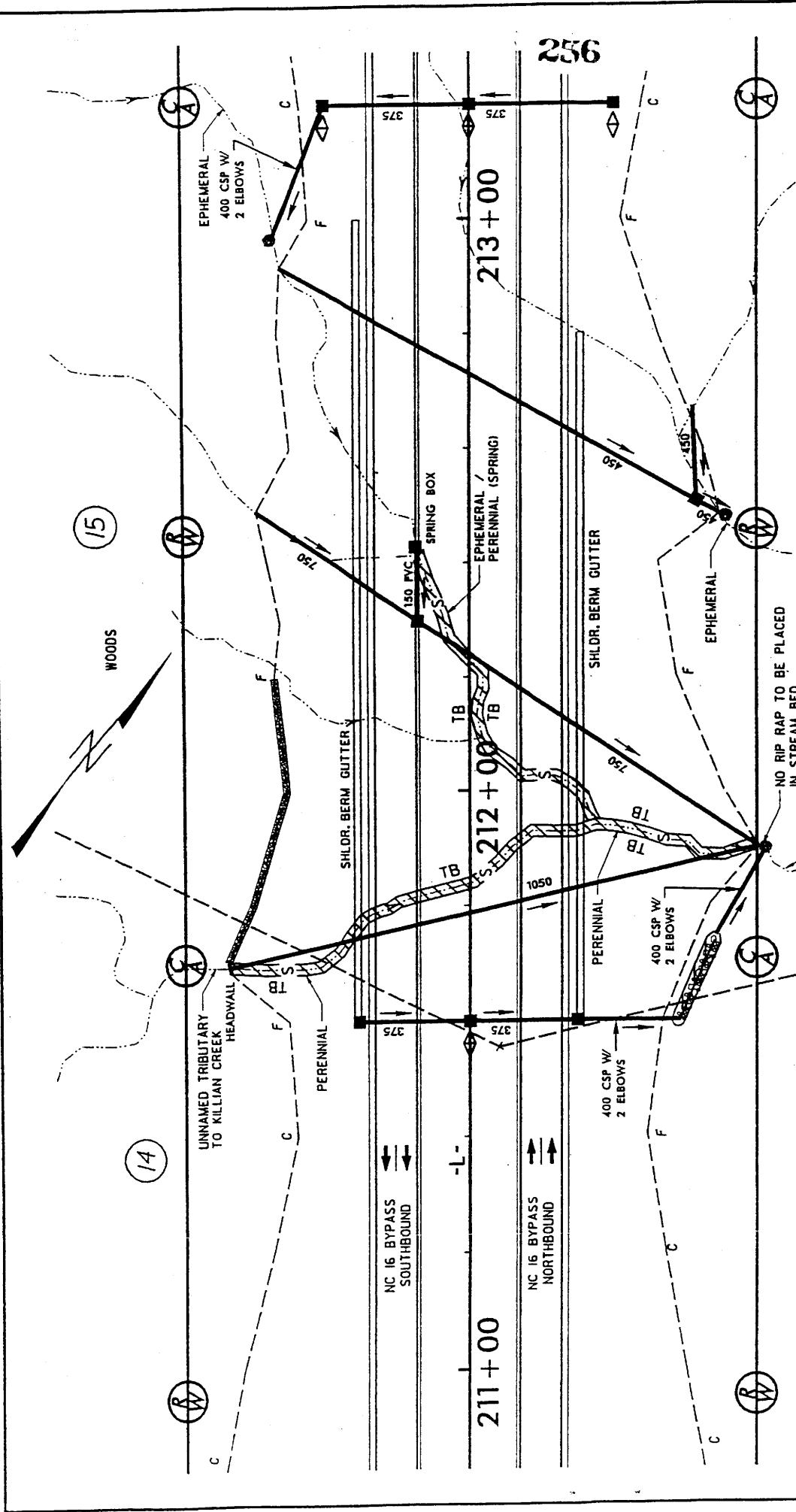
DENOTES SURFACE WATER  
IMPACT (NATURAL)



SHEET 11 OF 35

1/16/04





N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS

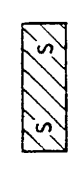
LINCOLN & CATAWBA COUNTIES

PROJECT: 3483.1.1 (R-2206C)  
 NC-16 BYPASS

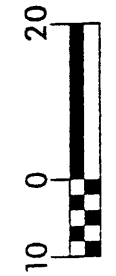
SHEET 12 OF 35

1/16/04  
 REVISED 4/29/04

PLAN VIEW  
 SITE 9C



DENOTES SURFACE WATER  
 IMPACT (NATURAL)



NC 16 BYPASS  
 SOUTHBOUND

NC 16 BYPASS  
 NORTHBOUND

NO RIP RAP TO BE PLACED  
 IN STREAM BED

UNNAMED TRIBUTARY  
 TO KILLIAN CREEK

UNNAMED TRIBUTARY  
 TO KILLIAN CREEK  
 HEADWALL

EPHEMERAL  
 400 CSP W/  
 2 ELBOWS

PERENNIAL  
 400 CSP W/  
 2 ELBOWS

EPHEMERAL /  
 PERENNIAL (SPRING)

130 PVC  
 SPRING BOX

SHLDR. BERM GUTTER

SHLDR. BERM GUTTER

15

15

14

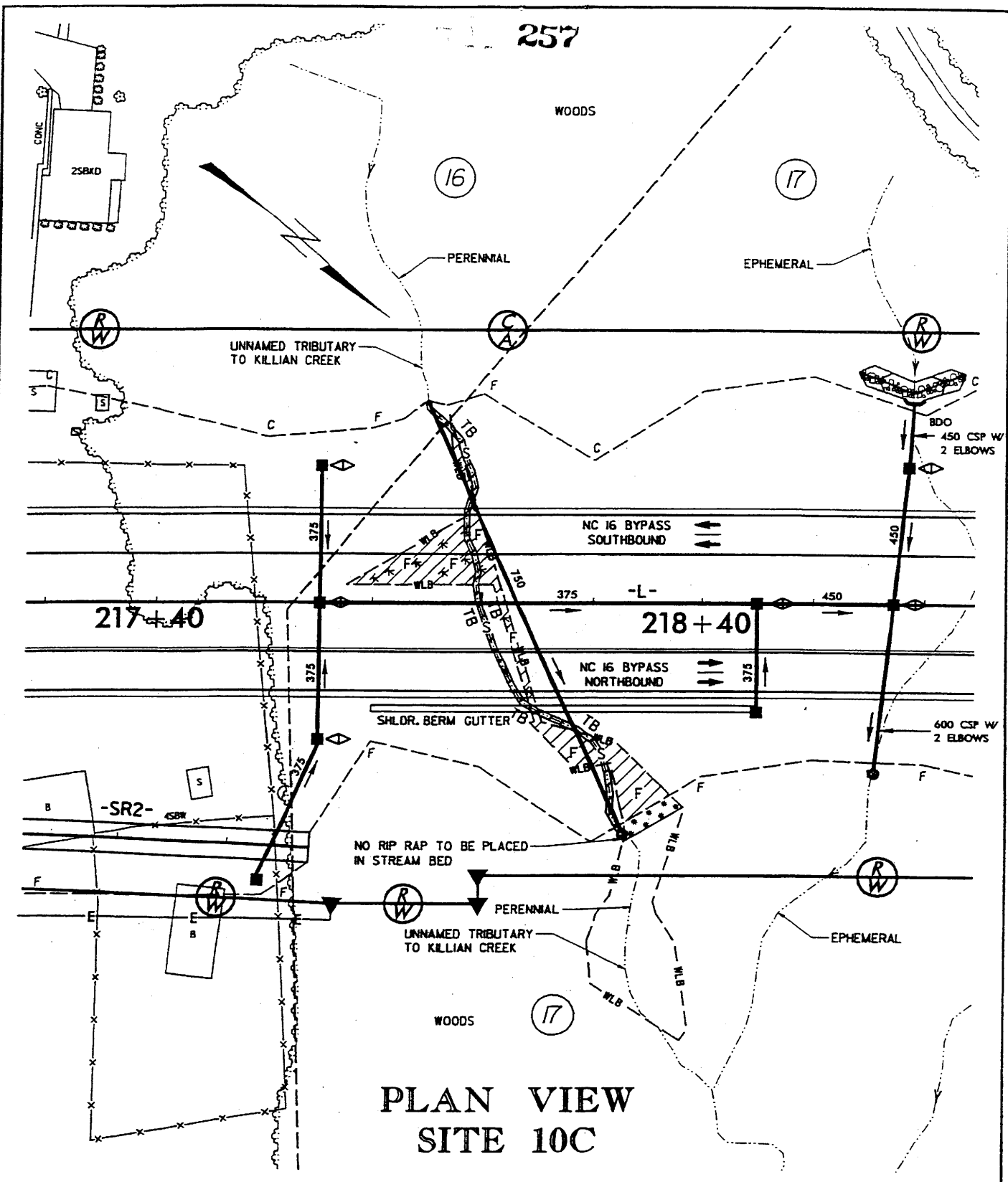
14

211+00

212+00

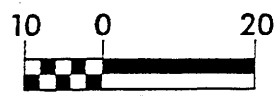
213+00

256



**PLAN VIEW  
SITE 10C**

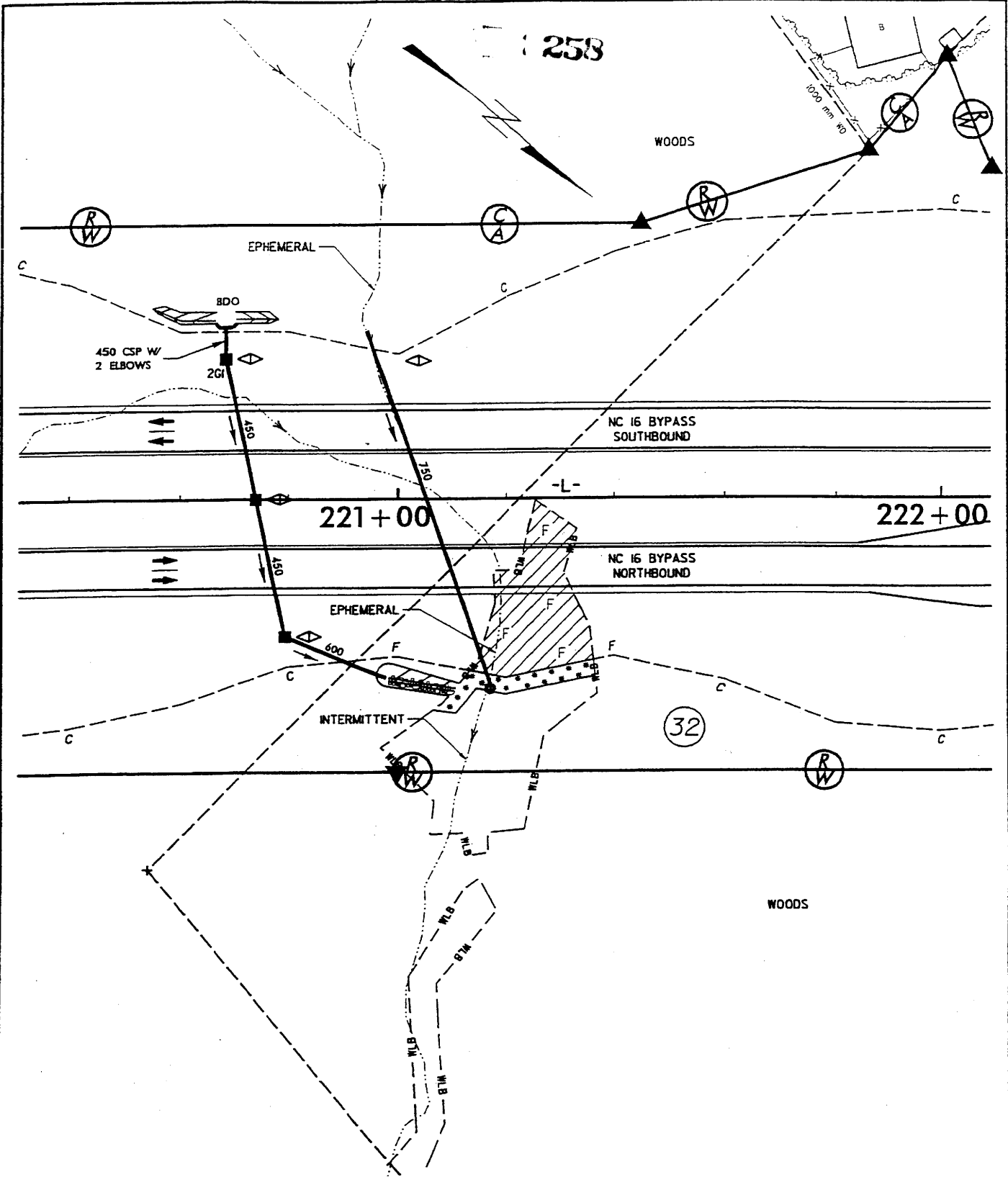
- DENOTES MECHANIZED CLEARING
- DENOTES FILL IN WETLANDS
- DENOTES SURFACE WATER IMPACT (NATURAL)



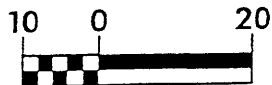
**N.C. DEPT. OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**LINCOLN & CATAWBA COUNTIES**  
**PROJECT: 34383.11 (R-2206C)**  
**NC-16 BYPASS**

SHEET 13 OF 35

1/16/04  
 REVISED 4/99/04



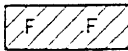
**PLAN VIEW  
SITE 11C**



DENOTES MECHANIZED  
CLEARING



DENOTES FILL IN  
WETLANDS



N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

PROJECT: 34383.L1 (R-2206C)  
NC-16 BYPASS

SHEET 14 OF 35

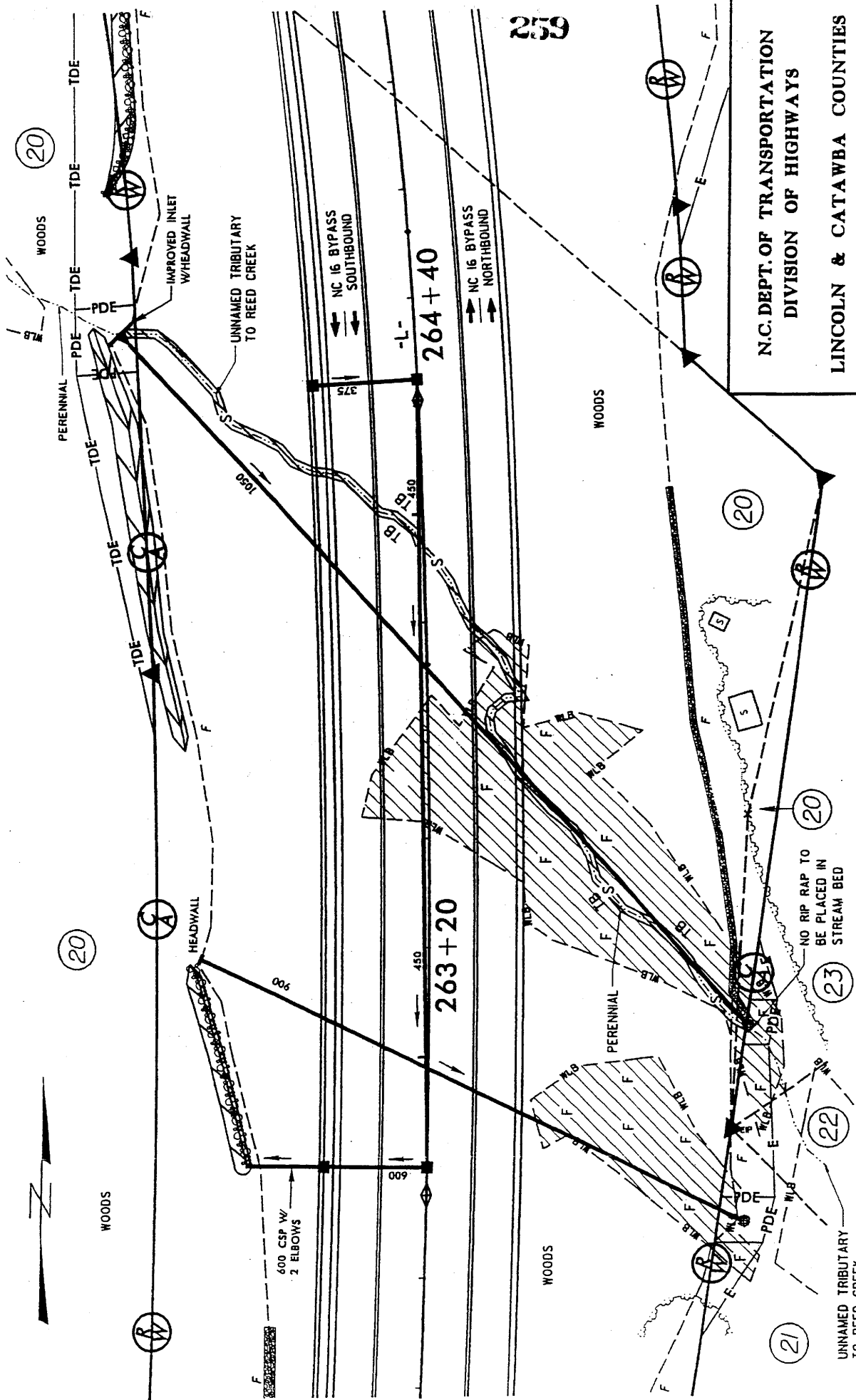
1/16/04  
REVISED 4/29/04



WOODS

(20)

(20)



259

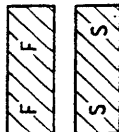
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

PROJECT: 34363.1.1 (R-2206C)  
NC-16 BYPASS

SHEET 15 OF 35

1/16/04  
REVISED 4/29/04



DENOTES FILL IN WETLANDS  
DENOTES SURFACE WATER IMPACT (NATURAL)

# PLAN VIEW SITE 14C



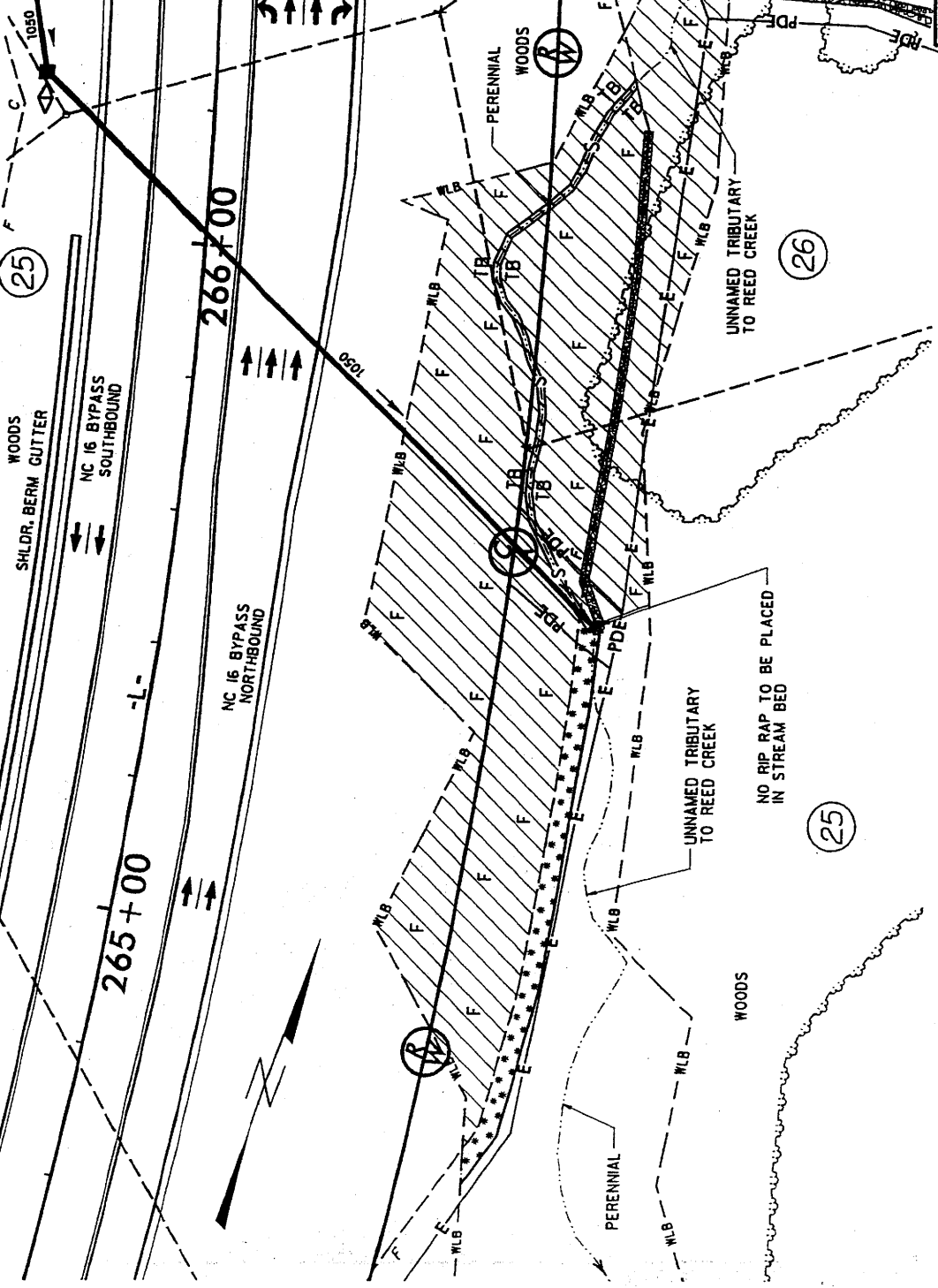
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

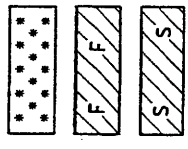
PROJECT: 34583.1.1 (R-2206C)  
NC-16 BYPASS

SHEET 16 OF 35 1/16/04

MATCHLINE -L- STA. 266+38



### PLAN VIEW SITE I5C

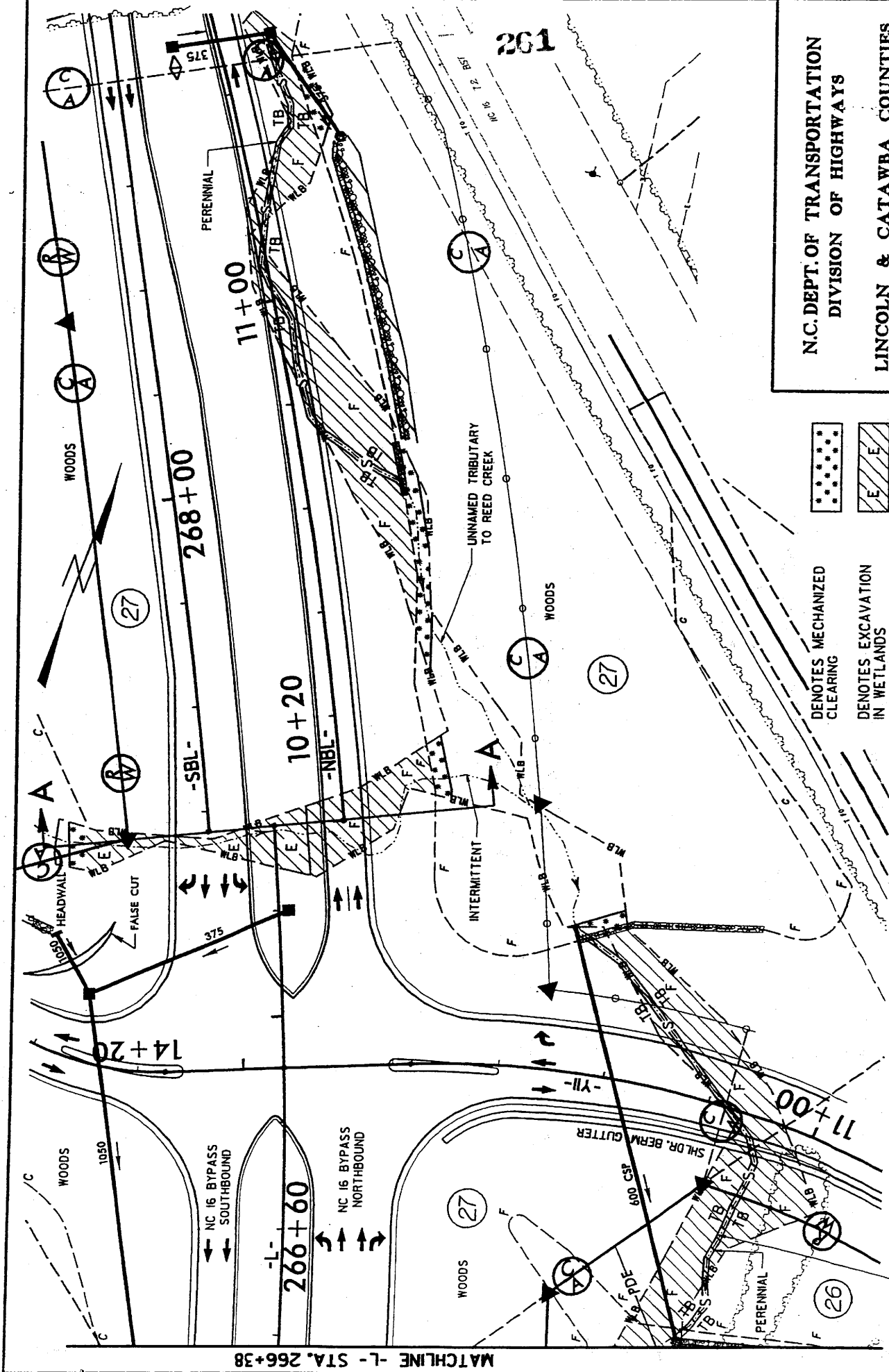


DENOTES MECHANIZED CLEARING

DENOTES FILL IN WETLANDS

DENOTES SURFACE WATER IMPACT (NATURAL)









MATCHLINE -L- STA. 266+38

N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
 LINCOLN & CATAWBA COUNTIES  
 PROJECT: 34383.11 (R-2206C)  
 NC-16 BYPASS

SHEET 17 OF 25  
 1/16/04  
 REVISED 4/29/04

-  DENOTES MECHANIZED CLEARING
-  DENOTES EXCAVATION IN WETLANDS
-  DENOTES FILL IN WETLANDS
-  DENOTES SURFACE WATER IMPACT (NATURAL)

PLAN VIEW  
 SITE 15C

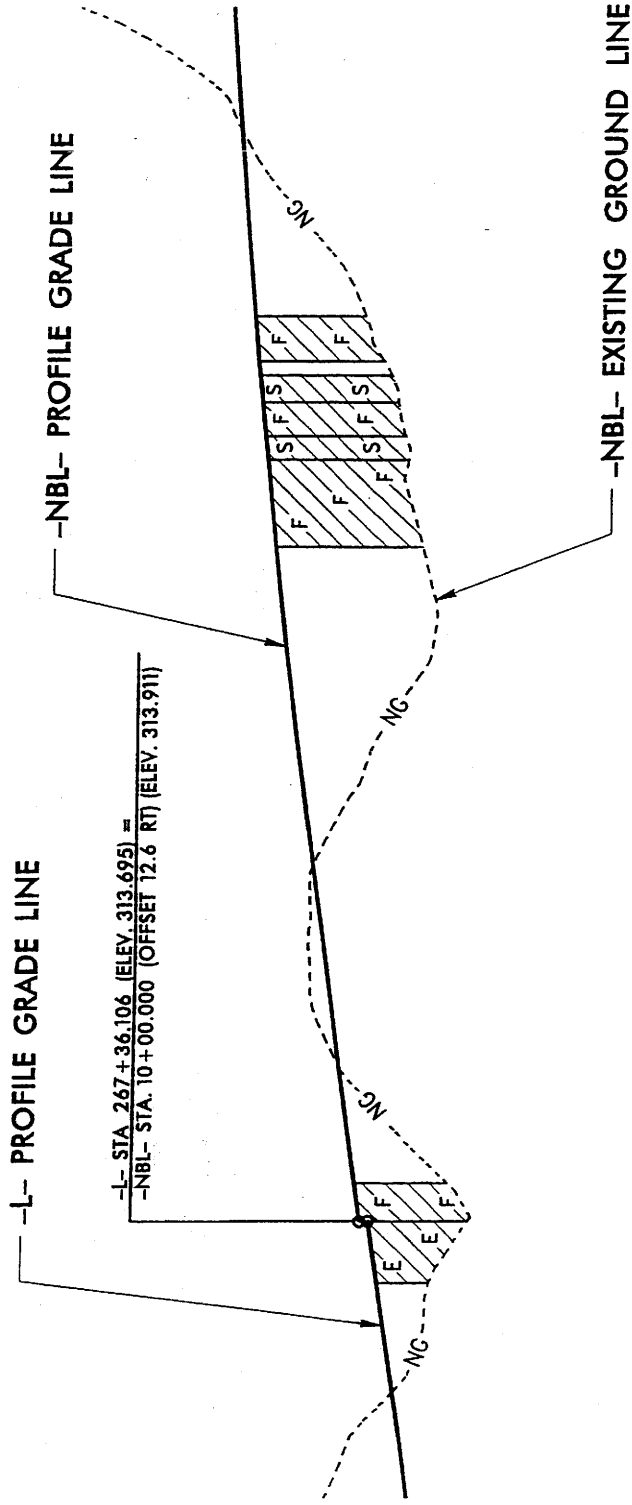


-L- PROFILE GRADE LINE

-NBL- PROFILE GRADE LINE

-NBL- EXISTING GROUND LINE

-L- STA 267+36.106 (ELEV. 313.695) =  
-NBL- STA. 10+00.000 (OFFSET 12.6 RT) (ELEV. 313.911)



320

315

310

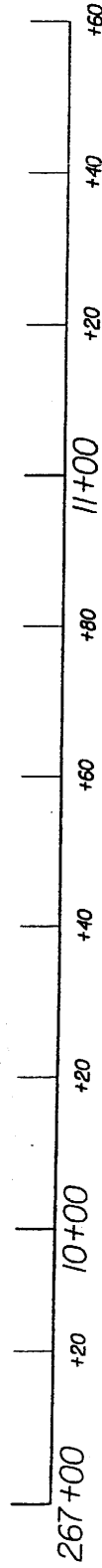
305

320

315

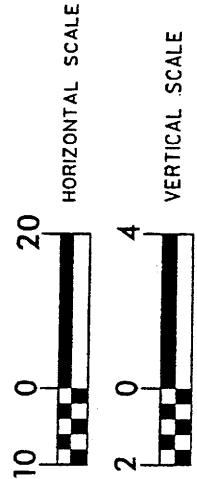
310

262



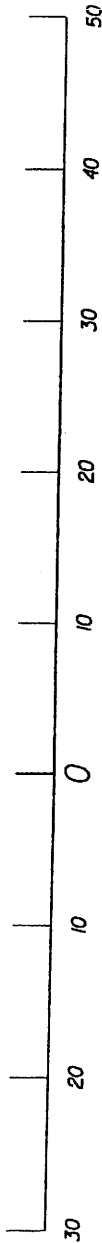
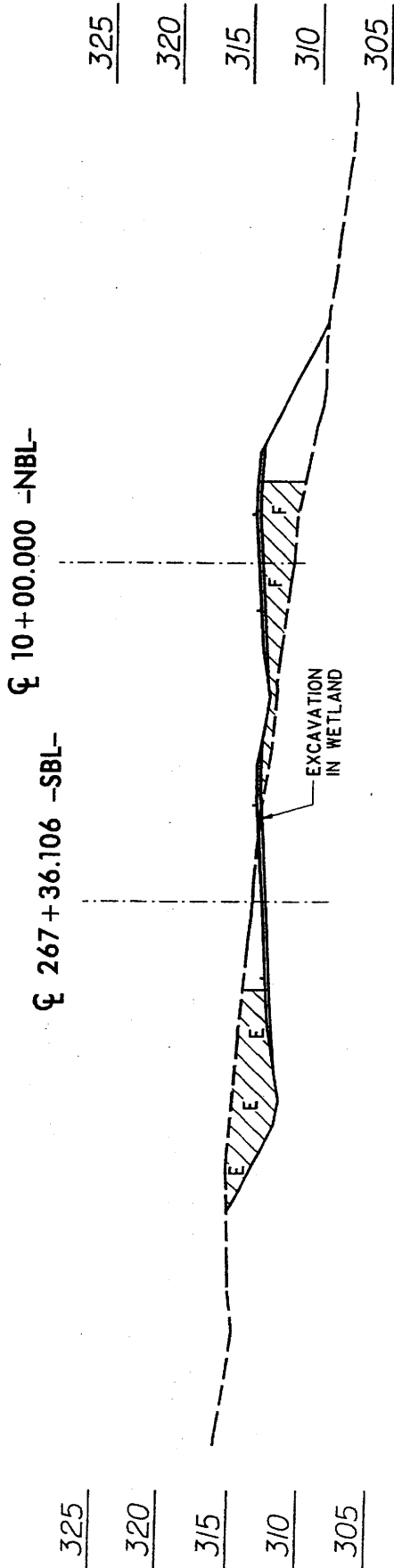
# PROFILE SITE 15C

- DENOTES EXCAVATION IN WETLANDS
- DENOTES FILL IN WETLANDS
- DENOTES SURFACE WATER IMPACT (NATURAL)



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DIVISION OF HIGHWAYS  
LINCOLN & CATAWBA COUNTIES  
PROJECT: 34583.1.1 (R-2206C)  
NC-16 BYPASS

SHEET /8 OF 35 1/16/04



SECTION A-A  
SITE 15C

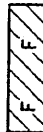


HORIZONTAL SCALE

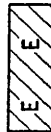


VERTICAL SCALE

DENOTES FILL IN WETLANDS



DENOTES EXCAVATION IN WETLANDS



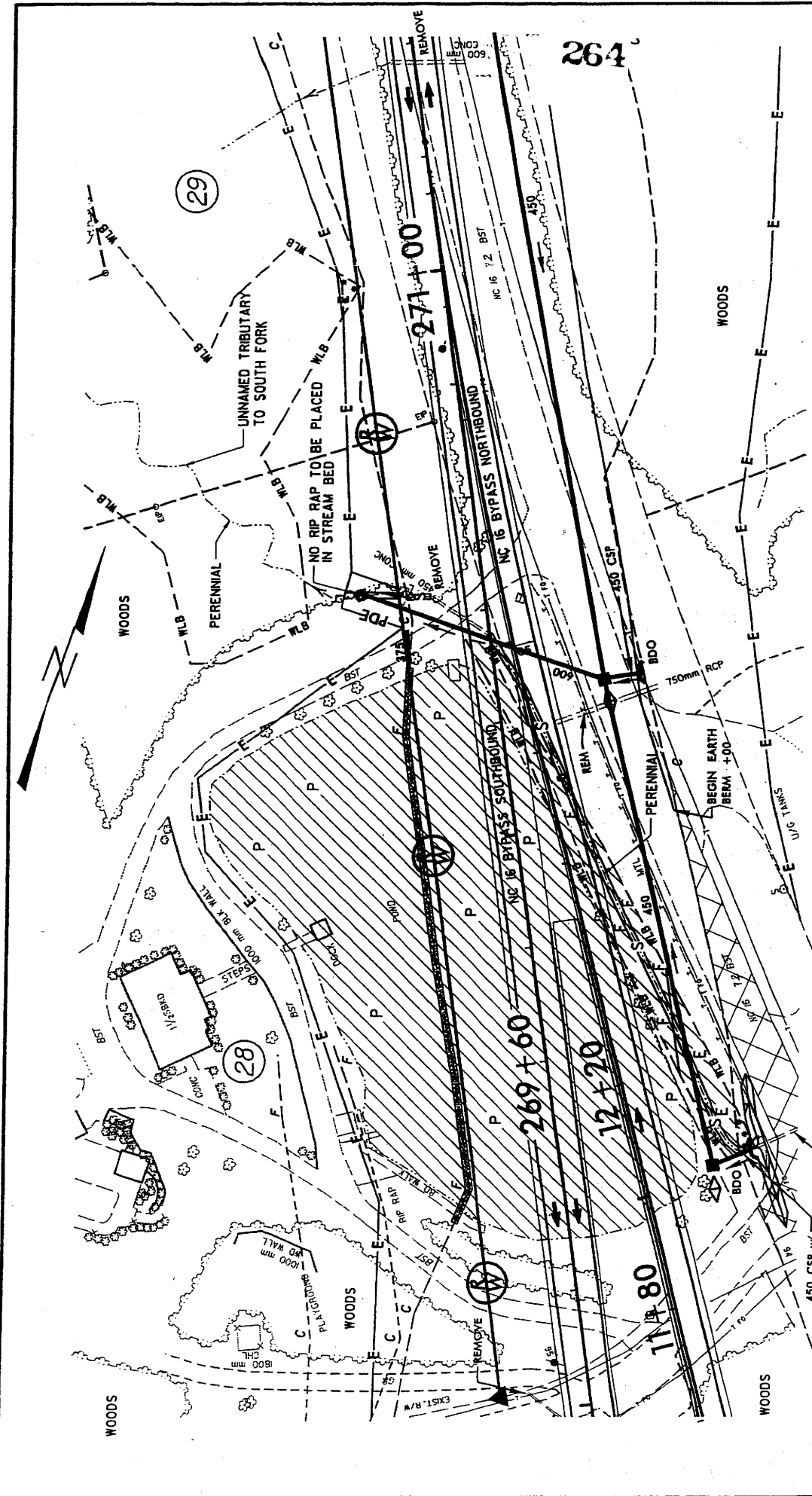
N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS



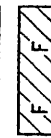


LINCOLN & CATAWBA COUNTIES

PROJECT: 34383.1.1 (R-2206C)  
NC-16 BYPASS

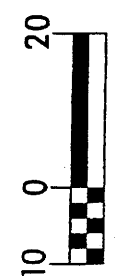
SHEET 19 OF 35 1/16/04



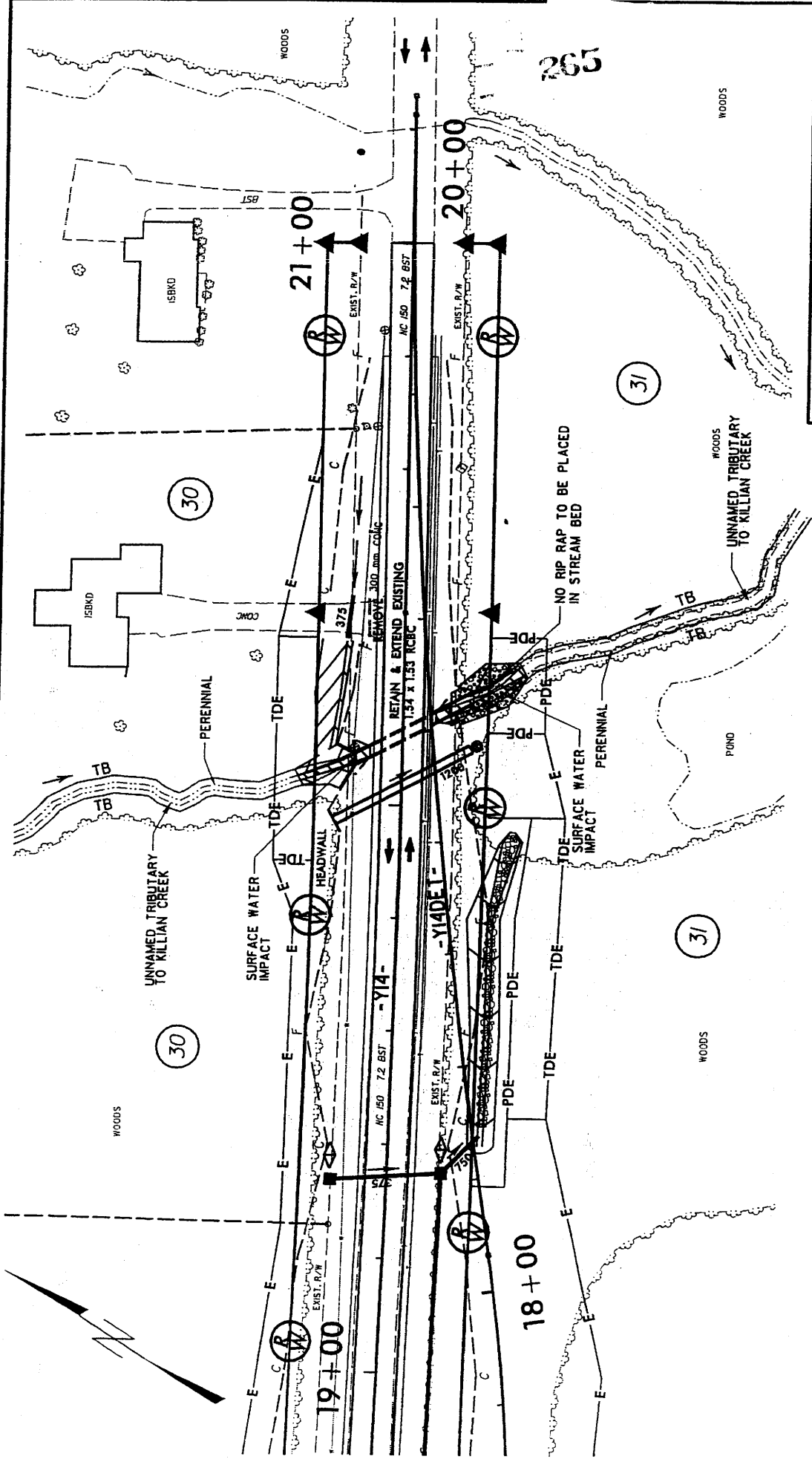


- 
 DENOTES MECHANIZED CLEARING
- 
 DENOTES EXCAVATION IN WETLANDS
- 
 DENOTES FILL IN WETLANDS
- 
 DENOTES SURFACE WATER IMPACT (NATURAL)
- 
 DENOTES SURFACE WATER IMPACT (POND)

## PLAN VIEW SITE 16C



N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
 LINCOLN & CATAWBA COUNTIES  
 PROJECT: 34583.1.1 (R-2206C)  
 NC-16 BYPASS



N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
 LINCOLN & CATAWBA COUNTIES

PROJECT: 34363.11 (R-2206C)  
 NC-16 BYPASS

SHEET 21 OF 25

1/16/04

REVISED 4/29/04

PLAN VIEW  
 SITE 17C



DENOTES SURFACE WATER  
 IMPACT (NATURAL)

266

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

PROJECT: 34883.11 (R-2206C)  
NC-16 BYPASS

SHEET 22 OF 35

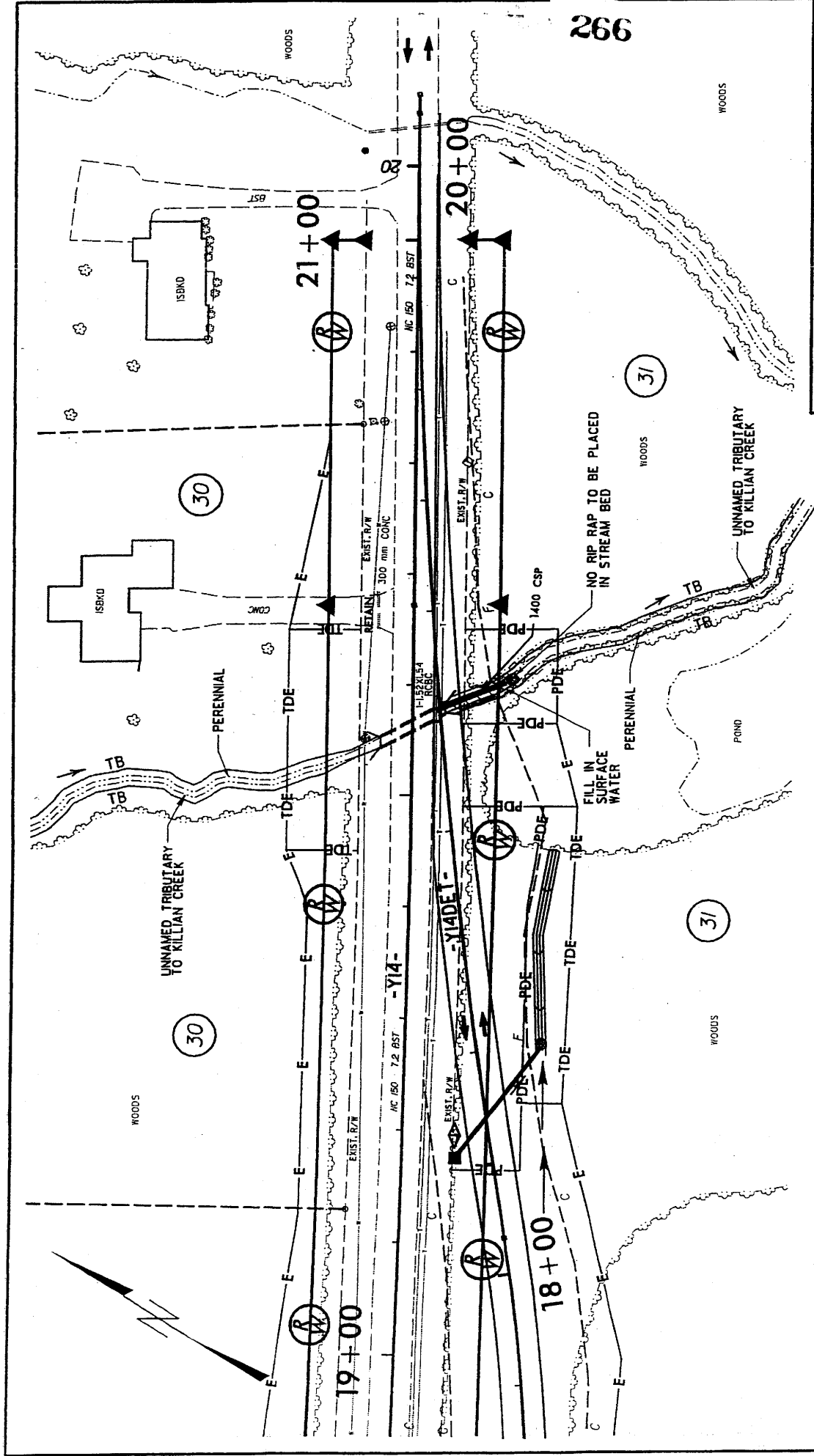
1/16/04

REVISED 4/29/04

# PLAN VIEW SITE 17C



DENOTES SURFACE WATER  
IMPACT (NATURAL)



IMPACT SUMMARY (ENGLISH)

Site No.	Station (From/To)	Structure Size	WETLAND IMPACTS				SURFACE WATER IMPACTS						
			Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation In Wetlands (ac)	Mechanized Clearing (Method III) (ac)	Fill In SW (Natural) (ac)	Fill In SW (Pond) (ac)	Temp. Fill In SW (ac)	Existing Channel Impacted (ft)	Natural Stream Design (ft)		
1C	-L- 181+48 Rt to 181+74 Lt	750mm					0.017					220.1	
	-L- 182+23 Rt to 182+49 Lt	1200mm					0.032					425.5	
	-L- 181+92 Lt to 183+99 Rt	1 @ 1.5m x 1.5m RCBC					0.099					1040.3	184.0
2C	-L- 190+86 Lt to 191+05 Rt	1500mm					0.044					447.8	
	-L- 190+96 Lt to 192+03 Rt	900mm					0.025					464.9	
3C	-L- 194+96 Lt to 195+14 Lt	600mm	0.012				0.012					145.0	
4C	-L- 196+71 Lt to 197+40 Lt	600mm	0.007				0.017					230.3	
6C	-L- 202+25 Rt to 203+66 Rt						0.042					571.8	
7C	-L- 207+91 Rt to 207+96 Rt	750mm					0.017					230.0	
8C	-L- 208+89 Rt to 209+04 Rt						0.005					51.5	
9C	-L- 211+68 Lt to 211+95 Rt	1050mm					0.049					335.0	
	-L- 211+95 Rt to 212+42 Lt	750mm					0.030					203.4	
10C	-L- 217+75 Lt to 218+37 Rt	750mm	0.099				0.007					303.5	
11C	-L- 221+11 Rt to 221+37 Rt		0.101				0.022						
14C	-L- 262+64 Rt to 263+00 Rt	900mm	0.173										
	-L- 262+93 Rt to 264+38 Lt	1050mm	0.492				0.072					631.6	
<b>SHEET TOTAL</b>			<b>0.874</b>	<b>0.000</b>	<b>0.000</b>	<b>0.029</b>	<b>0.483</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>5300.7</b>	<b>184.0</b>

NOTE: Sites 5C, 12C and 13C Removed Due To No Impact.

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN / CATAWBA COUNTIES

PROJECT: 34983.1.1  
NCDOT T.I.P. No: R-2206C

SHEET 23 OF 35

1/16/04



**Property Owner List**

Property NO.	Name DB and Pg	Address
①	JOY L. BLANTON FLOYD LORETTA & DEANE L. SAIN DB 571 Pg 353	328 E. Congress St. Lincolnton, NC 28092
②	DENROCK COMPANY DB 800 Pg 110	P.O. Box 1006 ECP 12 Charlotte, NC 28201
③	JOHNNY L. ROLLINS DB 514 Pg 23	6740 Pleasant Oaks Circle Charlotte, NC 28216
④	HERBERT G. LEWIS DB 619 Pg 715	7035 Forney Hill Road Denver, NC 28037
⑤	HERBERT G. LEWIS DB 301 Pg 181	7035 Forney Hill Road Denver, NC 28037
⑩	KENNETH F. CARPENTER DB 896 Pg 355	386 Victory Grove Church Road Lincolnton, NC 28092
⑪	MURPHY A. CRONLAND DB 570 Pg 737	1200 Lithia Lane Lincolnton, NC 28092
⑫	MURPHY A. CRONLAND DB 491 Pg 516	1200 Lithia Lane Lincolnton, NC 28092
⑬	LEE B. KILLIAN DEED NOT FOUND	4153 NC 16 N Denver, NC 28037
⑭	FRANCES M. CROOKS DB 1402 Pg 872	5832 Mundy Road Denver, NC 28037

(continued)

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
LINCOLN & CATAWBA COUNTIES  
PROJECT: 34383.1.1 (R-2206C)  
NC-16 BYPASS  
SHEET 25 OF 35  
1/16/04

Project No. 34383.1.1 (R-2206C)

**Property Owner List**

Property NO.	Name DB and Pg	Address
(15)	R. M. THOMPSON, JR DB 1068 Pg 346	2946 Beth Haven Church Road Denver, NC 28037
(16)	JOEL B. BARKER DB 510 Pg 48	5511 Mundy Road Denver, NC 28037
(17)	ELLEN H. SHUFORD DB 336 Pg 671	200 Labans Lane Lincolnton, NC 28092
(32)	JANICE E. ROBINSON DB 504 Pg 47	4919 E. Maiden Road Maiden, NC 28650
(20)	CLIFF-BLAKE ASSOC. DB 1936 Pg 1335	P.O. Box 159 Cornelius, NC 28031
(21)	STEVE R. HOLBROOKS DB 1632 Pg 40	6861 Tommy Sherrill Road Sherrills Ford, NC 28673
(22)	JAMES E. BURGESS DB 1865 Pg 687	5386 Burgess Drive Maiden, NC 28650

(continued)

N.C. DEPT. OF TRANSPORTATION  
DIVISION OF HIGHWAYS

LINCOLN & CATAWBA COUNTIES

PROJECT: 34383.1.1 (R-2206C)  
NC-16 BYPASS

Project No. 34383.1.1 (R-2206C)

Property Owner List

Property NO.	Name DB and Pg	Address
23	JAMES E. BURGESS DB 2002 Pg 1306	5386 Burgess Drive Maiden, NC 28650
24	RIGHT of WAY UNABLE UNKNOWN TO OBTAIN	Not Available
25	TONY KAYE MOORE DB 2062 Pg 1721	4295 Mt. Beulah Road Maiden, NC 28650
26	AMOS BROWN DB 2204 Pg 1581	5480 Pembroke Drive Granite Falls, NC 28630
27	ANTHONY L. DRUM DB 986 Pg 165	Rt. 1 Box 177E Mt. Holly, NC 28120
28	EDDIE D. LAIL DEBRA S. LAIL DB 1397 Pg 816	5295 NC 16 S Maiden, NC 28650
29	GERALD D. GOODSON DB 2239 Pg 980	5151 NC 16 S Maiden, NC 28650
30	SCOTT GILLELAND & OLIVER L. OVERCASH HEIRS DB 2384 Pg 422	1219 Stowehill Lane Catawba, NC 28609
31	ROGER STEVE LEE DB 1218 Pg 786	1995 Captains Way Denver, NC 28037

N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
 LINCOLN & CATAWBA COUNTIES  
 PROJECT: 34383.1.1 (R-2206C)  
 NC-16 BYPASS  
 SHEET 27 OF 35 1/16/04



NCDOT Project I.D. R-2206C

Lincoln / Catawba County, NC

NC 16 from North of SR 1386 in Lincoln County to  
North of SR 1895 near Chronicle in Catawba County

**NATURAL STREAM DESIGN**  
**UNNAMED TRIBUTARY TO KILLIAN CREEK**

Left of -L- Project Station 182+20

Prepared by: TranSite Consulting Engineers, Inc.  
1300 Paddock Dr.  
Raleigh, NC 27609

**NATURAL STREAM DESIGN**  
**UNNAMED TRIBUTARY TO KILLIAN CREEK**

Left of -L- Project Station 182+20

The construction of NC 16 North of NC 73 to North of SR 1386 will require that a portion of an unnamed tributary of Killian Creek be relocated left of -L- Station 182+20. The proposed stream will be 50 meters (164 feet) in length starting at the outlet of the proposed 1 @ 1.5m x 1.5m (1 @ 5'x 5') RCBC and continue downstream intersecting the existing stream in a bend. The proposed stream relocation is designed according to "Natural Channel" design principles proposed by Dave Rosgen.

This tributary of Killian Creek drains 0.44 km<sup>2</sup> (0.18 mi<sup>2</sup>) in Lincoln County and is located within the Piedmont Physiographic Region. Existing land use in the drainage basin is predominantly agriculture, low density residential and undeveloped. The Lincoln County Land Use Plan shows that the future land use is predominantly low density residential.

There is no hydraulic data available on this stream. Discharges were estimated using procedures outlined in USGS Water-Resources Report 96-4084, Estimation of Flood-Frequency Characteristics of Small Urban Watersheds in North Carolina.

**EXISTING / REFERENCE STREAM**

The existing stream was determined to be stable and undisturbed and was therefore used as the reference stream. A 100 meter section of the stream was surveyed in detail to determine it's morphological characteristics. Those characteristics include bankfull discharge, width, depth and area. This information was then compared to reference reach data provided by NCDOT for the Piedmont Region and found to be in general conformity to that of an E4 stream.

Pebble counts were conducted in the pool and riffle sections. Velocities, stream power and shear were obtained using the HEC-RAS computer model and compared to shear stresses predicted from the pebble count. The pebble count confirmed the channel hydraulics by qualifying the velocities that move bed form material. This material has been classified as a medium sand and gravel.

### **PROPOSED STREAM**

The proposed stream is designed to have an E4 classification. The stream gradient is controlled upstream by the proposed 1 @ 1.5m x 1.5m (1 @ 5' x 5') RCBC left of -L- Sta. 182+44± and downstream by the tie to the existing stream left of -L- Sta. 182+10±. The RCBC will be buried a minimum of 0.3 meters both upstream and downstream to provide formation of a natural streambed through its entire length.

Proposed channel stabilization is shown on the attached detail sheet. It is anticipated that the channel banks will be planted with native trees and shrubs above bankfull depth. In addition, cross vanes will be placed in the channel for grade control and coir fiber mat will be placed along the entire channel while rootwads will be placed along the outside of the channel bends. The channel bottom will match the characteristics of the existing channel.

### **SEDIMENT TRANSPORT ANALYSIS**

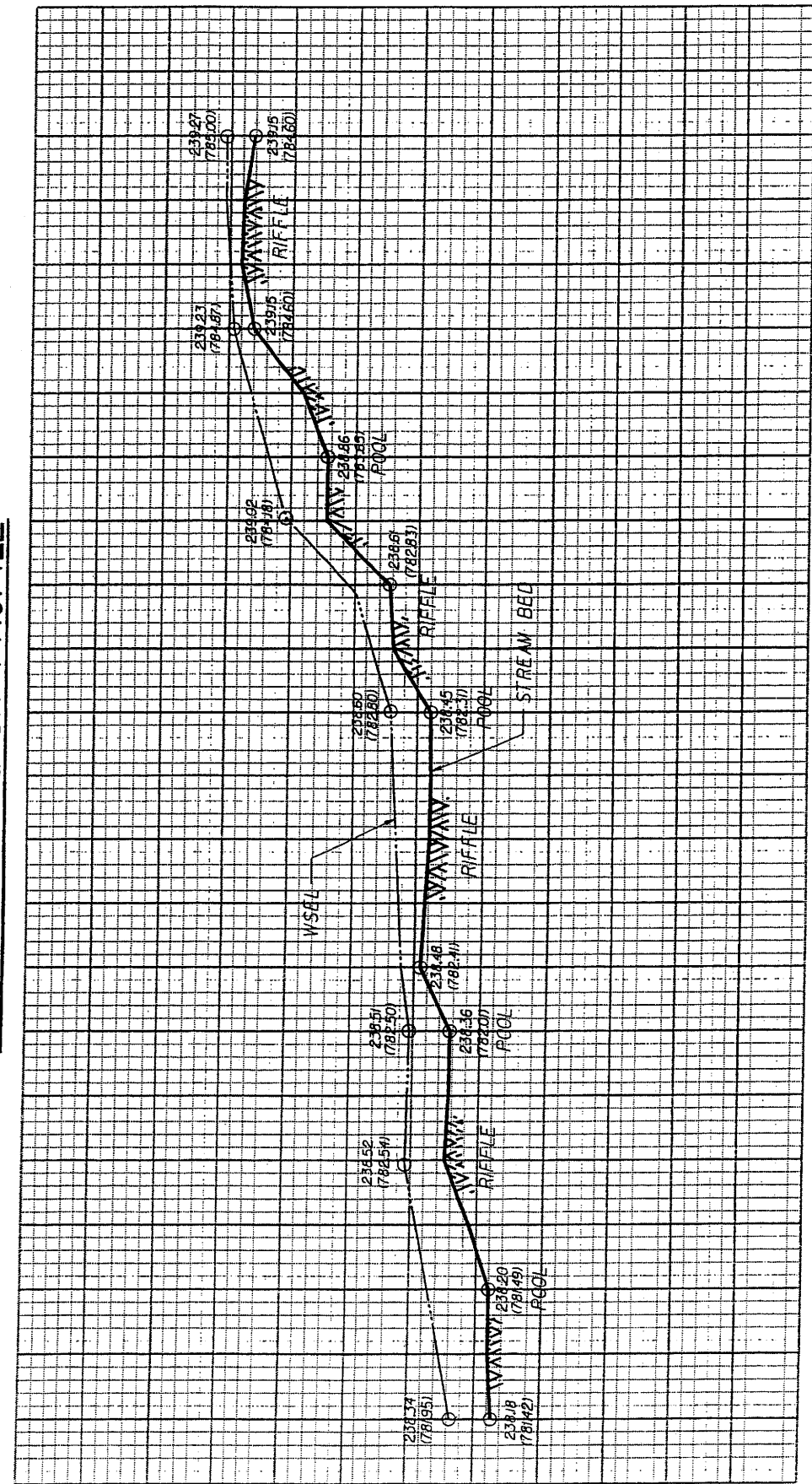
The proposed stream has a bankfull stream power of 2.47 lb/ft-s and a shear stress of 0.94 lb/ft<sup>2</sup> as compared to 3.89 lb/ft-s and 1.25 lb/ft<sup>2</sup> for the existing stream. While these values are less than those of the existing stream, they indicate that the proposed stream will transport the current sediment load without aggrading or degrading the streambed or banks. Additionally, 2-yr and 10-yr velocities and shear stresses were evaluated and found to be within acceptable limits.

## Appendix B

Morphological Measurement Table  
R-2206C, Lincoln / Catawba Cos.

Variables	Existing Channel	Proposed Reach	USGS Station	Reference Reach
1. Stream Type	E4	E4	N/A	E4
2. Drainage Area (D.A.)	0.43 km <sup>2</sup> / 0.17 mi <sup>2</sup>	0.43 km <sup>2</sup> / 0.17 mi <sup>2</sup>	-	0.43 km <sup>2</sup> / 0.17 mi <sup>2</sup>
3. Bankfull Width ( $W_{bkd}$ )	2.33 m / 7.64 ft	3.50 m / 11.50 ft	-	2.33 m / 7.64 ft
4. Bankfull Mean Depth ( $d_{bkd}$ )	0.45 m / 1.50 ft	0.36 m / 1.18 ft	-	0.45 m / 1.50 ft
5. Width/Depth Ratio ( $W_{bkd}/d_{bkd}$ )	5.18	9.69	-	5.18
6. Bankfull Cross-Sectional Area ( $A_{bkd}$ )	1.05 m <sup>2</sup> / 11.3 ft <sup>2</sup>	1.24 m <sup>2</sup> / 13.35 ft <sup>2</sup>	-	1.05 m <sup>2</sup> / 11.3 ft <sup>2</sup>
7. Bankfull Mean Velocity ( $V_{bkd}$ )	0.95 m/s / 3.12ft/s	0.80 m/s / 2.62 ft/s	-	0.95 m/s / 3.12ft/s
8. Bankfull Discharge ( $Q_{bkd}$ )	1.00 m <sup>3</sup> /s / 35.3 ft <sup>3</sup> /s	1.00 m <sup>3</sup> /s / 35.3 ft <sup>3</sup> /s	-	1.00 m <sup>3</sup> /s / 35.3 ft <sup>3</sup> /s
9. Bankfull Max Depth ( $d_{mbkd}$ )	0.63 m / 2.07 ft	0.50 m / 1.64 ft	-	0.63 m / 2.07 ft
10. Width of Floodprone Area ( $W_{fpa}$ )	8.35 m / 27.39 ft (avg.)	8.5 m / 27.89 ft	-	8.35 m / 27.39 ft (avg.)
11. Entrenchment Ratio ( $W_{fpa}/W_{bkd}$ )	3.58	2.43	-	3.58
12. Meander Length ( $L_m$ )	12-20 m / 39-66 ft	24.0 m / 78.74 ft	-	12-20 m / 39-66 ft
13. Ratio of Meander Length to Bankfull Width ( $L_m/W_{bkd}$ )	5.1-8.6	6.86	-	5.1-8.6
14. Radius of Curvature ( $R_c$ )	3.5-7.0 m / 11.5-23.0 ft	6.50 m / 21.33 ft	-	3.5-7.0 m / 11.5-23.0 ft
15. Ratio of Radius of Curvature to Bankfull Width ( $R_c/W_{bkd}$ )	1.5-3.0	1.86	-	1.5-3.0
16. Belt Width ( $W_{bt}$ )	5.0-7.0 m / 16.4-23.0 ft	11.0 m / 36.1 ft	-	5.0-7.0 m / 16.4-23.0 ft
17. Meander Width Ratio ( $W_{bt}/W_{bkd}$ )	2.1-3.0	3.14	-	2.1-3.0
18. Sinuosity (K) (stream length/valley length)	1.11	1.16	-	1.11
19. Valley Slope (VS)	1.11%	1.20%	-	1.11%
20. Average Slope (CS)	0.97%	1.14%	-	0.97%
21. Pool Slope	0.00%	0.00%	-	0.00%
22. Ratio of Pool Slope to Average Slope	0.00	0.00	-	0.00
23. Maximum Pool Depth ( $dp_{max}$ )	0.65 m / 2.13 ft	0.85 m / 2.78 ft	-	0.65 m / 2.13 ft
24. Ratio of Pool Depth to Average Bankfull Depth ( $dp/d_{bkd}$ )	1.44	2.36	-	1.44
25. Pool Width ( $W_p$ )	2.70 m / 8.86 ft	4.9 m / 16.07 ft	-	2.70 m / 8.86 ft
26. Ratio of Pool Width to Bankfull Width ( $W_p/W_{bkd}$ )	1.16	1.40	-	1.16
27. Pool to Pool Spacing	20.0 m / 65.6 ft	14.0 m / 45.9 ft	-	20.0 m / 65.6 ft
28. Ratio of Pool to Pool Spacing to Bankfull Width	8.58	4.00	-	8.58
29. Ratio of Lowest Bnk Height to Bankfull Height (or Max Bankfull Depth) ( $Bh_{low}/d_{mbkd}$ )	0.63	1.00	-	0.63

REFERENCE REACH PROFILE



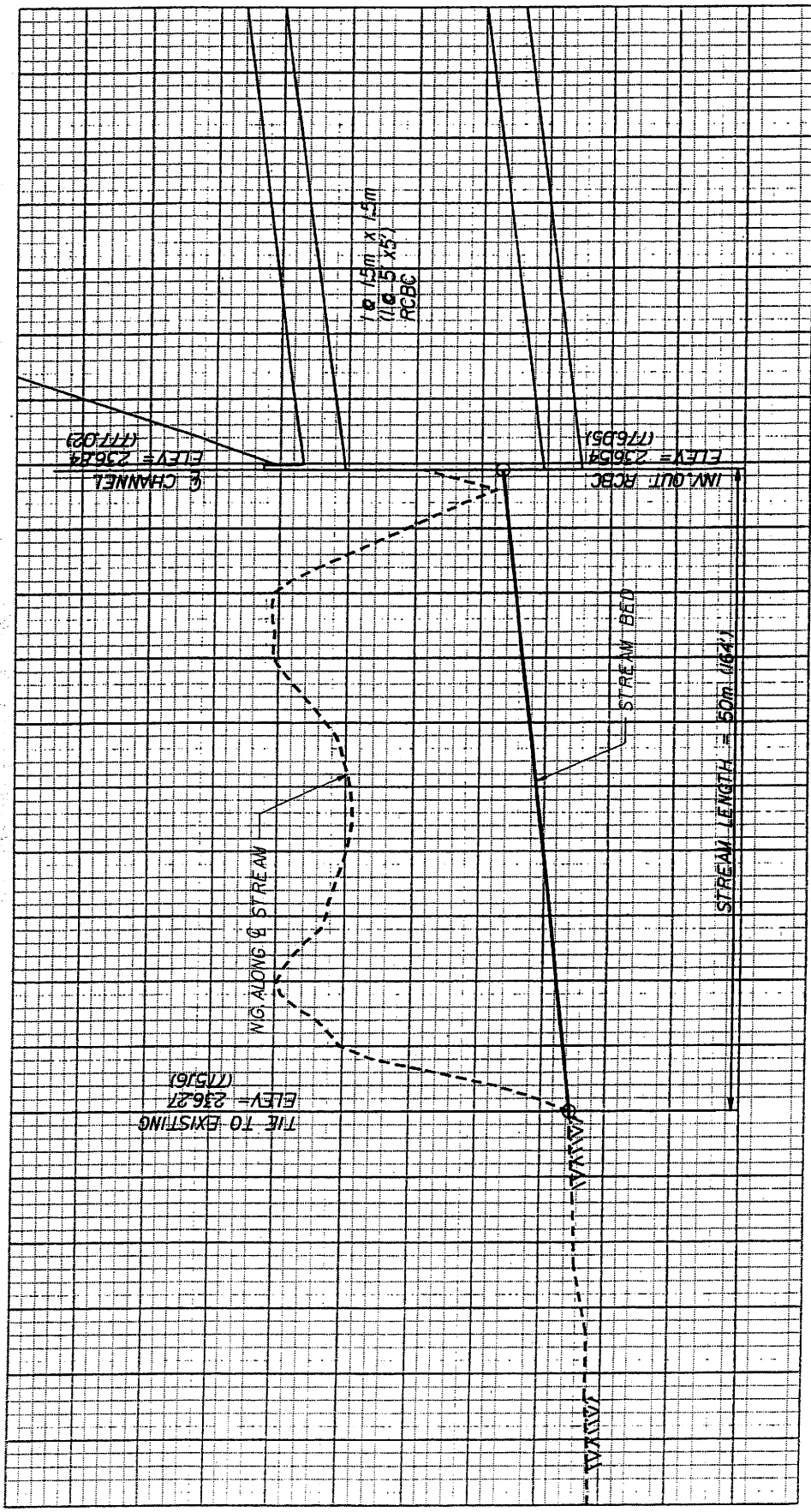
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 239.0  
 238.5  
 238.0  
 237.5  
 237.0

10+00 +10 +20 +30 +40 +50 +60 +70 +80 +90 +100 11+00

# PROPOSED STREAM



240

239

238

237

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10+00 +10 +20 +30 +40 +50 +60 +70 +80 +90 11+00

277

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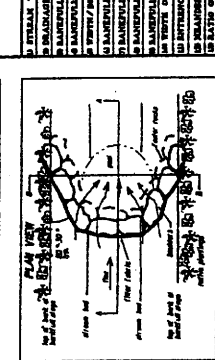
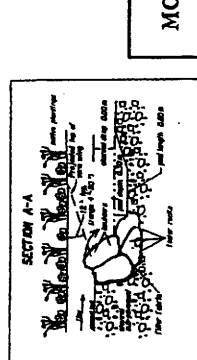
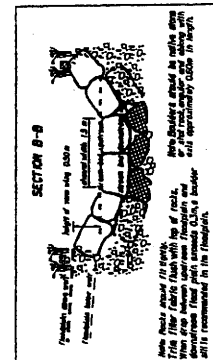
LINCOLN & CATAWBA COUNTIES

PROJECT: 34583.1.1 (R-2206C)  
NC-16 BYPASS

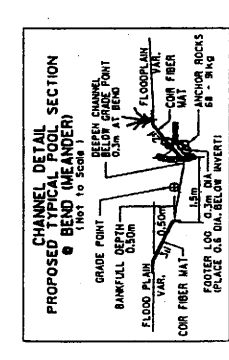
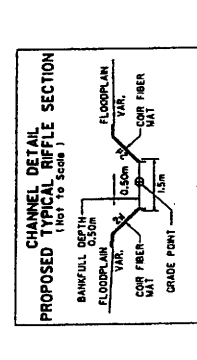
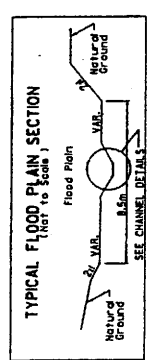
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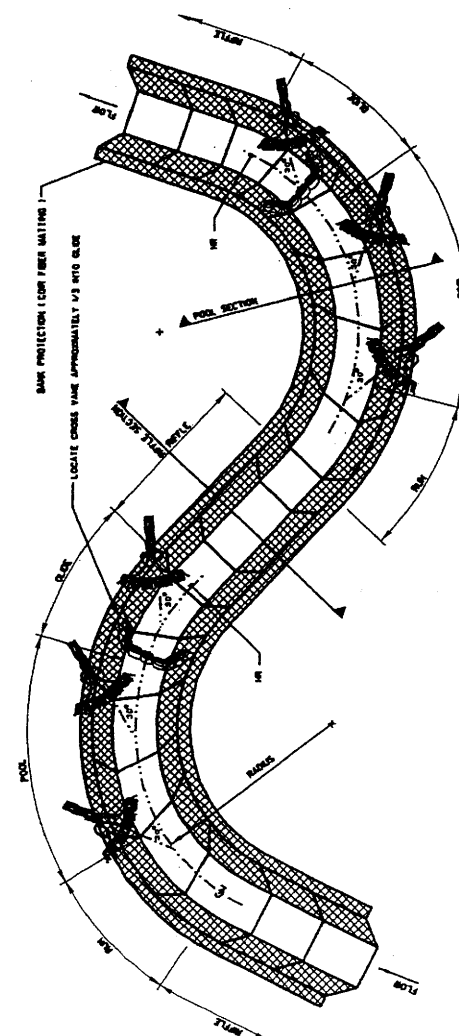
NOTE: ELEVATIONS IN ( ) ARE IN FEET.  
ALL OTHER STATION AND ELEVATION  
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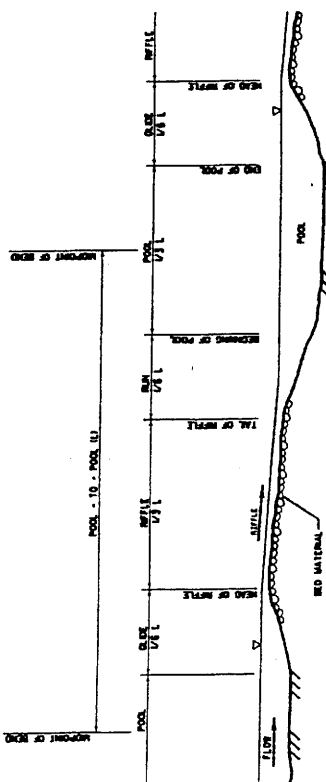
CROSS VANE ROCK WEIR DETAILS



NATURAL CHANNEL DESIGN TYPICALS



TYPICAL PLAN  
NOT TO SCALE



TYPICAL PROFILE  
NOT TO SCALE

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

NOTES:  
1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT BRANDED, SCORING THE CENTER LINE OF THE CHANNEL FOR EACH SECTION. THE CHANNEL SHALL BE LAYOUT BY CONSTRUCTING SUCCESSIVE BENDS WITH STRAIGHT LINE. (R = 5.5m / 21.3 ft.)  
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 VANES ACCORDING TO PLAN SHEET.  
4. NUMBER OF ROOTHAMS INSTALLED TO BE DETERMINED ON SITE.  
5. ROOTHAMS TO BE SPACED 4x DIAMETER OF ROOT BASE.  
6. FOOTER LOG ANCHOR ROCKS TO BE PLACED ON THE DOWNSTREAM END OF EACH FOOTER LOG SO THAT IT IS LEANING AGAINST THE LOG ON THE SIDE AWAY FROM THE CHANNEL.  
7. WHEN BACKFILLING OVER AND AROUND FOOTER LOGS, ROOTHAMS LOGS AND ANCHOR ROCKS FIRMLY SECURE ALL COMPONENTS INCLUDING JOINTS, CONNECTIONS AND GAPS.  
8. PLANTINGS SHOULD BE PLACED ABOVE BANEFULL DEPTH.

MORPHOLOGICAL MEASUREMENT TABLE

VARIABLES	EXISTING CHANNEL	PROPOSED CHANNEL	USGS STATION	USGS REACH
1. STREAM TYPE	U	U	U	U
2. CHANNEL AREA	6.13 m <sup>2</sup> / 682 ft <sup>2</sup>	6.13 m <sup>2</sup> / 682 ft <sup>2</sup>	U	6.13 m <sup>2</sup> / 682 ft <sup>2</sup>
3. BANEFULL AREA	2.12 m <sup>2</sup> / 228 ft <sup>2</sup>	2.12 m <sup>2</sup> / 228 ft <sup>2</sup>	U	2.12 m <sup>2</sup> / 228 ft <sup>2</sup>
4. BANEFULL DEPTH	0.45 m / 1.48 ft	0.45 m / 1.48 ft	U	0.45 m / 1.48 ft
5. BANEFULL WIDTH	U	U	U	U
6. BANEFULL CHANNEL AREA	0.87 m <sup>2</sup> / 93 ft <sup>2</sup>	0.87 m <sup>2</sup> / 93 ft <sup>2</sup>	U	0.87 m <sup>2</sup> / 93 ft <sup>2</sup>
7. BANEFULL CHANNEL VELOCITY	0.58 m/s / 1.31 ft/s	0.58 m/s / 1.31 ft/s	U	0.58 m/s / 1.31 ft/s
8. BANEFULL CHANNEL DISCHARGE	0.50 m <sup>3</sup> / 35.3 ft <sup>3</sup>	0.50 m <sup>3</sup> / 35.3 ft <sup>3</sup>	U	0.50 m <sup>3</sup> / 35.3 ft <sup>3</sup>
9. BANEFULL CHANNEL ENERGY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
10. BANEFULL CHANNEL POWER	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
11. BANEFULL CHANNEL MOMENTUM	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
12. BANEFULL CHANNEL TORQUE	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
13. BANEFULL CHANNEL FORCE	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
14. BANEFULL CHANNEL PRESSURE	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
15. BANEFULL CHANNEL STRESS	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
16. BANEFULL CHANNEL STRAIN	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
17. BANEFULL CHANNEL TENSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
18. BANEFULL CHANNEL COMPRESSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
19. BANEFULL CHANNEL SHEAR	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
20. BANEFULL CHANNEL BENDING	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
21. BANEFULL CHANNEL TORSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
22. BANEFULL CHANNEL VIBRATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
23. BANEFULL CHANNEL RESONANCE	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
24. BANEFULL CHANNEL STABILITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
25. BANEFULL CHANNEL DURABILITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
26. BANEFULL CHANNEL RELIABILITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
27. BANEFULL CHANNEL SAFETY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
28. BANEFULL CHANNEL SECURITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
29. BANEFULL CHANNEL HEALTH	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
30. BANEFULL CHANNEL WELLNESS	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
31. BANEFULL CHANNEL QUALITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
32. BANEFULL CHANNEL QUANTITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
33. BANEFULL CHANNEL VARIETY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
34. BANEFULL CHANNEL UNIFORMITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
35. BANEFULL CHANNEL SIMILARITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
36. BANEFULL CHANNEL REGULARITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
37. BANEFULL CHANNEL ORDER	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
38. BANEFULL CHANNEL SIMPLICITY	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
39. BANEFULL CHANNEL MINIMALISM	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
40. BANEFULL CHANNEL RESTRAINT	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
41. BANEFULL CHANNEL DENIAL	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
42. BANEFULL CHANNEL REPRESSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
43. BANEFULL CHANNEL SUPPRESSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
44. BANEFULL CHANNEL OMISSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
45. BANEFULL CHANNEL EXCLUSION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
46. BANEFULL CHANNEL REJECTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
47. BANEFULL CHANNEL DESTRUCTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
48. BANEFULL CHANNEL ANNIHILATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
49. BANEFULL CHANNEL EXTIRPATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
50. BANEFULL CHANNEL ERADICATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
51. BANEFULL CHANNEL DESTRUCTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
52. BANEFULL CHANNEL ANNIHILATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
53. BANEFULL CHANNEL EXTIRPATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
54. BANEFULL CHANNEL ERADICATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
55. BANEFULL CHANNEL DESTRUCTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
56. BANEFULL CHANNEL ANNIHILATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
57. BANEFULL CHANNEL EXTIRPATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
58. BANEFULL CHANNEL ERADICATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
59. BANEFULL CHANNEL DESTRUCTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
60. BANEFULL CHANNEL ANNIHILATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
61. BANEFULL CHANNEL EXTIRPATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
62. BANEFULL CHANNEL ERADICATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
63. BANEFULL CHANNEL DESTRUCTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
64. BANEFULL CHANNEL ANNIHILATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
65. BANEFULL CHANNEL EXTIRPATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
66. BANEFULL CHANNEL ERADICATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
67. BANEFULL CHANNEL DESTRUCTION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
68. BANEFULL CHANNEL ANNIHILATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
69. BANEFULL CHANNEL EXTIRPATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>
70. BANEFULL CHANNEL ERADICATION	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>	U	0.21 m <sup>3</sup> / 15.1 ft <sup>3</sup>

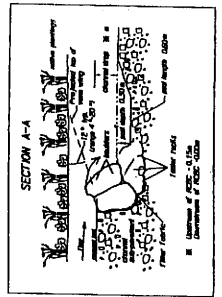
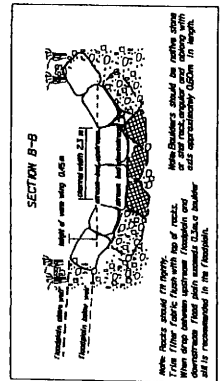
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DIVISION OF HIGHWAYS  
LINCOLN & CATAWBA COUNTIES  
PROJECT: 34385.1.1 (R-2206C)  
NC-16 BYPASS  
SHEET 34 OF 35  
10 / 10 / 03

PROJECT REFERENCE NO. **R-2206**  
 R/W SHEET NO. **3**  
 ROADWAY DESIGN ENGINEER

**METRIX**

CONST. REV.  
 R/W REV.

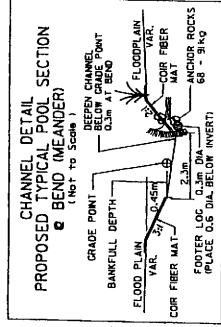
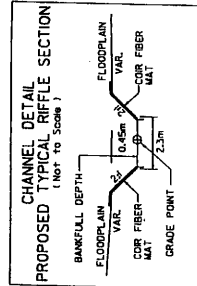
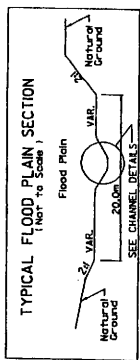
SHEET NO. **3**  
 R/W SHEET NO. **3**  
 ROADWAY DESIGN ENGINEER



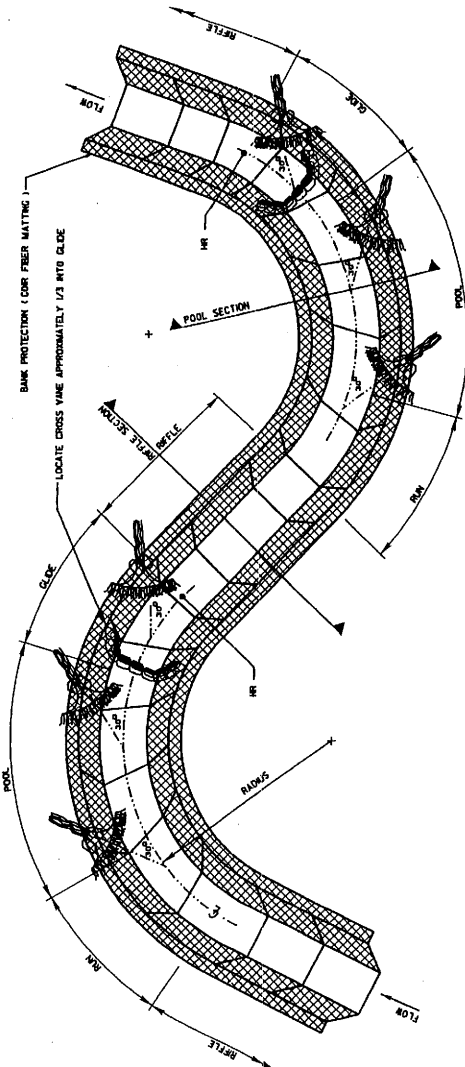
**NOTES:**

- THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT WHICH SHALL CONSIST OF STAKING OUT THE CENTER OF EACH RADIUS, SCORING THE CENTER LINE OF THE CHANNEL FOR EACH BEND USING THE INDICATED RADII, AND SCORING CENTERLINE WITH STRAIGHT LINE. R/S BLANKY / - / 23.5 FT.
- FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO CORRECT FOR OBSTRUCTIONS OR TO ACCOMMODATE EXISTING STAKE-OUT ALIGNMENT SHALL BE REQUIRED PRIOR TO INITIATION OF THE CONSTRUCTION OF THE CHANNEL.
- LOCATE ROCK VANES ACCORDING TO PLAN SHEET.
- NUMBER OF ROOTWAYS INSTALLED TO BE DETERMINED ON SITE.
- ROOTWAYS TO BE SPACED 4x DIAMETER OF ROOT BASE.
- FOOTER LOG ANCHOR ROCK TO BE PLACED ON THE DOWNSTREAM END OF EACH ROOTWAY. FOOTER LOG MAT SHALL BE LAIN AGAINST THE LOG ON THE SIDE AWAY FROM THE CHANNEL.
- WHEN BACKFILLING OVER AND AROUND FOOTER LOGS, ROOTWAY LOGS SHALL BE PROTECTED BY ALL COMPONENTS INCLUDING JOINTS, CONNECTIONS AND CAPS.
- PLANTINGS SHOULD BE PLACED ABOVE BANKFALL DEPTH.

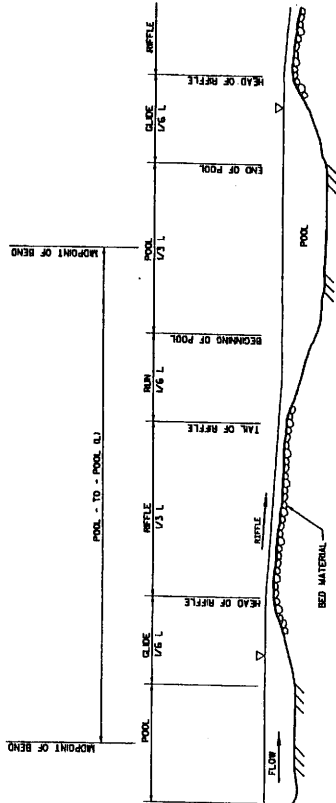
**CROSS VANE WEIR DETAILS**



**NATURAL CHANNEL DESIGN TYPICALS**



**TYPICAL PLAN**  
 NOT TO SCALE



**TYPICAL PROFILE**  
 NOT TO SCALE

**NOTES:**

- 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.
- REFER TO MORPHOLOGICAL MEASUREMENT TABLE AND PLAN SHEET FOR DIMENSIONS.

**MORPHOLOGICAL MEASUREMENT TABLE**

VARIABLES	EXISTING CHANNEL REACH	PROPOSED REACH	USGS REFERENCE STATION
1. CHANNEL TYPE	VA / CR / P	CR	MA
2. CHANNEL AREA	100 m <sup>2</sup> / 0.39 m <sup>2</sup>	100 m <sup>2</sup> / 0.39 m <sup>2</sup>	100 m <sup>2</sup> / 0.39 m <sup>2</sup>
3. BANKFALL VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
4. BANKFALL NEAR VELOCITY	0.35 m / 1.15 ft	0.35 m / 1.15 ft	0.35 m / 1.15 ft
5. VELOCITY / VELOCITY RATIO	1.0	1.0	N/D
6. BANKFALL CROSS-SECTIONAL AREA	100 m <sup>2</sup> / 0.39 m <sup>2</sup>	100 m <sup>2</sup> / 0.39 m <sup>2</sup>	100 m <sup>2</sup> / 0.39 m <sup>2</sup>
7. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
8. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
9. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
10. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
11. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
12. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
13. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
14. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
15. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
16. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
17. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
18. BANKFALL NEAR VELOCITY	0.45 m / 1.5 ft	0.45 m / 1.5 ft	0.45 m / 1.5 ft
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