APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT
(33 CFR 325)

OMB APPROVAL NO. 0710-003
Expires December 31, 2004

Public reporting burden for this collection of information is estimated to average 10 hours per response, although the majority of applications should require 5 hours or less. This includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302; and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authority: Rivers and Harbors Act, Section 10, 33 USC 403: Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research and Sanctuaries Act, 33 USC 1413, Section 103. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME North Carolina Department of Transportation Project Development & Environmental Analysis	8. AUTHORIZED AGENT'S NAME AND TITLE (an agent is not required) N/A
6. APPLICANT'S ADDRESS 1548 Mail Service Center Raleigh, NC 27699-1548	9. AGENT'S ADDRESS N/A
7. APPLICANT'S PHONE NOs. W/AREA CODE a. Residence b. Business 919-715-1335	10. AGENT'S PHONE NOs. W/AREA CODE a. Residence b. Business

11. **STATEMENT OF AUTHORIZATION**

I hereby authorize, _____ to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

_____ APPLICANT'S SIGNATURE

_____ DATE

NAME, LOCATION, AND DESCRIPTION OR PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions

Murphy Bypass; US 64 Relocation from US 19-74-129 in Murphy to east of NC 141 in Peachtree; Cherokee County, TIP No. R-0977A

13. NAME OF WATERBODY, IF KNOWN (if applicable) Hiwassee River Hampton Creek and tributaries Martin Creek and tributaries Tributaries to McCombs Creek	14. PROJECT STREET ADDRESS (if applicable)

15. LOCATION OF PROJECT

Cherokee	NC
COUNTY	STATE

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions) **Section, Township, Range, Lat/Lon, and/or Accessors's Parcel Number, for example.**

17. DIRECTIONS TO THE SITE

From Asheville, travel Interstate 40 West to the junction of U.S. Highways 19/74. Travel west on US 19/74 to Murphy.

18. Nature of Activity (Description of project, include all features)

The North Carolina Department of Transportation (NCDOT) proposes to improve existing US 64 by relocating a segment south of the Hiwassee River between US 19-74-129 in Murphy and SR 1547 east of NC 141 in Peachtree, Cherokee County, North Carolina (Murphy Bypass). As proposed, the Murphy Bypass will be 4.9 miles long and crosses several surface waters, including the Hiwassee River.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

Public transportation; to improve traffic flow and increase safety. See Cover Letter for Purpose and Need.

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Highway Fill

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards

See attached application and summary sheet for details

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

The proposed Murphy Bypass will impact eight jurisdictional wetlands for a total of 0.82 acres of permanent impact. No temporary impacts to wetlands are anticipated. Impacts to wetlands include fill and excavation. Jurisdictional streams will be impacted at nineteen sites including 0.79 acres of permanent impact and less than 0.02 acres of temporary impact. A total of 6,812 linear feet of stream will be permanently impacted by the project, although 801 feet of stream will be restored utilizing natural stream design.

See permit drawings for wetland and surface water impacts by site.

23. Is Any Portion of the Work Already Complete? Yes ___ No _X_ IF YES, DESCRIBE THE COMPLETED WORK

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

See attached Permit Drawings for a list of Landowners.

25. List of Other Certifications or Approvals/Denials Received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

Would include but is not restricted to zoning, building, and flood plain permits

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT	DATE	SIGNATURE OF AGENT	DATE
	9/27/04		

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

September 29, 2004

U.S. Army Corps of Engineers
Asheville Regulatory Field Office
151 Patton Avenue, Room 208
Asheville, North Carolina 28801-5006

ATTN: Ms. Angie Pennock
NCDOT Coordinator

Dear Ms. Pennock:

Subject: **Application for Individual Section 404 and 401 Permits;** Cherokee County; Murphy Bypass; US 64 Relocation from US 19-74-129 in Murphy to east of NC 141 in Peachtree; State Project No. 8.1910203; Federal Aid Project No. FR-14-1(1); TIP No. R-0977A.

The North Carolina Department of Transportation (NCDOT) proposes to improve highway US 64 by relocating a segment of the road south of the existing alignment between US 19-74-129 in Murphy and SR 1547 east of NC 141 in Peachtree, Cherokee County, North Carolina, Transportation Improvement Program number R-0977A (Murphy Bypass). As proposed, the Murphy Bypass is 4.9 miles long and crosses several surface waters, including two crossings of the Hiwassee River. A vicinity map showing the project location is provided with the permit drawings in Appendix A.

This correspondence serves as an application for Section 404 and 401 permits for the Murphy Bypass. The application package includes this cover letter, ENG form 4345 and the following appendices: 8.5x11 permit drawings (Appendix A), Natural Stream Design and Special Culvert Design Drawings (Appendix B), Bridge/Culvert Hydraulic Design Reports (Appendix C), Ecosystem Enhancement Program (EEP) Acceptance Letter (Appendix D), Original Design Drawings (Appendix E), Sulfidic Rock Data and Special Provisions (Appendix F), and Indirect and Cumulative Effects Report (Appendix G). Half size plan sheets have been included as an attachment. A summary of the impacts and proposed mitigation is provided below. Specific details of the project are provided in the following sections.

Summary of Impacts. The proposed Murphy Bypass will impact eight jurisdictional wetlands for a total of 0.82 acre of permanent impact. No temporary impacts to wetlands are anticipated.

Jurisdictional streams will be impacted at nineteen sites including 0.79 acre of permanent impact and less than 0.02 acre of temporary impact. A total of 6,812 linear feet of stream will be permanently impacted, although 1,150 feet of stream will be restored utilizing natural stream design.

Summary of Mitigation. During the design of this project, NCDOT has avoided or minimized impacts to the extent practicable, including redesign of the two Hiwassee River crossings and the Martin Creek crossing. NCDOT is also restoring 801 feet of natural stream channel impacted by the project for which they are seeking 1:1 on-site mitigation credit. The remaining, unavoidable impacts to 0.82 acre of jurisdictional wetlands and to 6,011 (6,812-801) linear feet of jurisdictional streams will be offset by compensatory mitigation provided by the EEP.

PROJECT DESCRIPTION

The proposed roadway will be a two-lane facility constructed on a four-lane right-of-way (ROW). The entire four-lane ROW will be graded and filled, although only two-lanes will actually be completed at this time. The preferred alignment crosses the Hiwassee River at River Mile 102 (East Crossing) and again at River Mile 97 (West Crossing). A 46-foot median is proposed for the cross section and ROW width varies from 170 feet to 500 feet.

Project Purpose and Need

The purpose of this project is to provide a safe, efficient, and direct route for traffic traveling east-west through Cherokee County with provisions for additional capacity as traffic volumes grow. The project will serve as an alternative to the substandard route east of the Town of Murphy and will ease traffic congestion in the downtown area.

The predominant east-west route through the southern portion of Cherokee County and western North Carolina is along US 64. Currently, traffic traveling along the segment between US 19-74-129 and SR 1547 (Clayton Road) east of NC 141 must navigate dangerous curves that well exceed the recommended maximum design for horizontal curves in the area, as well as steep grades, all within very limited sight distance on a road way with little to no shoulders. This substandard geometry severely restricts operating speeds, thereby reducing the capacity of the roadway. These factors, result in a hazardous stretch of highway with few areas to pass or pull over.

The project segment of US 64 carried 5,500 vehicles per day (vpd) in 1993. The 1994 Environmental Assessment predicted the "No-Build" traffic volumes would increase to 5,700 vpd by 1996 and to between 10,700 and 11,400 vpd by 2016. This amounts to an overall increase of 100 percent in traffic volumes over a 20-year period. This doubling of traffic would substantially reduce the levels of service (LOS) of the roadway (LOS E in 2016 on an A to F scale) and seriously increase the accident potential.

Currently, accident rates on existing US 64 are higher than the statewide averages for similar two-lane rural roadways. During the four-year period from July 1, 1988 to July 31, 1992, this section of US 64 experienced an accident rate of 198 accidents per 100 million vehicle miles of travel. The 1990-1992 statewide average accident rate for rural, two-lane undivided roadways was 167 accidents per 100 million vehicle miles of travel. The accident rate on US 64 was 12 percent higher than the statewide average. The majority of these accidents involved rear-end

collisions and vehicles running off the road, which is indicative of substandard design that results in reduced sight and stopping distance.

East of the project area, US 64 provides access through the waterfalls area of the state, a popular tourist attraction, and continues east to the interchange with I-26/US 74 in Hendersonville. West of Murphy, US 64 continues to Cleveland, Tennessee and merges with I-75, providing access to major metropolitan areas north, south and west, including Chattanooga, Nashville, Knoxville, Birmingham, and Atlanta. The major north-south traffic in Cherokee County is served by US 19-74-129 which meets US 64 near the western terminus of the project in downtown Murphy. The proposed improvements would provide safer, more efficient vehicle operation, reduce travel times, and result in road user cost savings for motorists traveling through western North Carolina.

Project History

U.S. Highway 64 in Cherokee County was constructed on its present alignment in 1933 on an existing roadbed. Other than resurfacing and widening short segments, no major improvements have been made. This section of US 64 was determined to be substandard and unable to handle existing levels of service based on current traffic volumes and NCDOT future projections. Subsequently, NCDOT proposed improvements to the existing alignment of US 64 as part of the Transportation Improvement Program (TIP). In 1986 the U.S. Department of Transportation, Federal Highway Administration (FHWA), and NCDOT prepared an Environmental Assessment (EA) for the proposed improvements. In September of that year, a Finding of No Significant Impact (FONSI) was issued.

However, preliminary design studies indicated that improvements to US 64 were not feasible due to geometric restrictions, environmental concerns, and construction costs. One of the environmental concerns was acidification potential of exposed rock or "hot rock". The underlying geologic formation was known to contain hot rock that when exposed to the elements could produce acidic runoff that would reach waterways crossed by the project. Since widening the existing alignment would require exposing rock, adverse impacts were expected. Coupled with concerns raised by the Town of Murphy, this caused NCDOT to abandon plans for improving US 64 on its existing alignment. Instead, NCDOT proposed to relocate the portion of US 64 between Murphy and the town of Peachtree. In 1990, design and environmental studies were initiated for the proposed relocation.

In July 1994, a new EA was prepared for the proposed relocation. In addition to the "No Build" Alternative, NCDOT evaluated eight build alternatives (A, B, C1, C2, D1, D2, D3 and E) in the EA. Based on information detailed in the EA, the B, D1, D2, D3 and E alternatives were eliminated from further consideration. Alternatives A, C1, and C2 were determined to be the only feasible alternatives. Alternative C1 was subsequently selected as the preferred alternative, and a FONSI was issued in February of 1995. Preliminary design was approved and hydraulic design of the project initiated. After the design phase was completed, NCDOT submitted an Individual Section 404 Permit application for the proposed project with a cover letter dated August 4, 1998. The application was put on public notice in March of 1999.

In response to the public notice, the U.S. Fish and Wildlife Service (USFWS) indicated that two Federal Species of Concern[1] (FSC), the Tennessee clubshell (*Pleurobema oviforme*) and the sicklefin redhorse (*Moxostoma* sp.), may be impacted by the project. The USFWS has recognized these two species since issuance of the FONSI. Therefore, additional surveys were completed in the fall of 2000. Based on these surveys and concerns over other natural resource impacts raised during the interagency meetings held in May of 2000, further design studies were conducted on the preferred alternative identified in the FONSI. Additionally, State and Federal review agencies requested that three of the alternative alignments that were first detailed in the July 1994 EA, (D1, D2 and D3) be re-evaluated in greater detail.

In October of 2001, an interagency meeting was held to present findings of the additional alternative studies. During this meeting, the USFWS raised concerns regarding potential impacts to mussels and to the sicklefin redhorse. They further stated that the FSCs could become listed prior to completion of this project. This required additional survey work and review of alternative designs to avoid and/or minimize potential impacts. Subsequent interagency meetings have been held to review updated designs and project status. Since potential impacts to species that may become listed prior to project completion may not be avoided, a Biological Assessment (BA) was completed by NCDOT and submitted to the USFWS concurrently with this permit application.

NEPA Status

In order to comply with National Environmental Policy Act (NEPA) guidelines, the US Department of Transportation, FHWA and NCDOT prepared and submitted an EA in July, 1994. The EA explains the purpose and need for the project, provides a description of alternatives considered, and characterizes social, economic, and environmental effects. The EA was approved and circulated to federal, state, and local agencies. In February of 1995, a FONSI was issued. However, as described in the project history above, additional issues regarding potential impacts to the Tennessee clubshell and the sicklefin redhorse required further study. In response, NCDOT agreed to treat both species as if they were listed as threatened or endangered and completed a BA in 2004.

Independent Utility

Murphy Bypass (R-0977A) is in compliance with 23 CFR Part 771.111(f) which lists the FHWA characteristics of independent utility of a project as:

1. the project has logical termini and independent utility and is of sufficient length to address environmental matters on a broad scope,
2. the proposed project is a reasonable expenditure of funds even if no other improvements are made;
3. The proposed project does not preclude reasonable alternatives for consideration as other projects are developed.

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[1] **Federal Species of Concern (FSC)** are defined as species that are under consideration for listing for which there is insufficient information to support listing. FSCs are not afforded federal protection under the Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. However, since the status of these species is subject to change, FSCs should be included for consideration during the planning process of a project in order to prevent delays should they become listed.

RESOURCE STATUS

Waters of the US

Delineations. Wetland and stream delineations were conducted during field work for the 1996 EA using the criteria specified in the 1987 Corps of Engineers Wetland Delineation manual. In addition to wetland delineations, jurisdictional streams impacted by the project were also characterized. Additional wetland and stream delineations were conducted for various alternatives in 2001. Delineations for the proposed route were re-verified by NCDOT and other agency personnel in August of 2003. A subsequent field visit in July 2004 by NCDOT identified additional jurisdictional impacts. Based on the information in this correspondence, NCDOT believes that all wetland and stream delineations are accurate, current, and properly detailed in the attached permit drawings (Appendix A).

Wetlands. A total of eight jurisdictional wetlands will be impacted by the proposed project. The eight wetlands are located along tributaries to, or within floodplain areas of the Hiwassee River. Hydrology of these wetlands include groundwater seepage as well as overland flow from adjacent streams. Most of these wetlands occur as depressional areas within floodplains and are dominated by herbaceous vegetation, although woody vegetation is encroaching within some wetlands.

Common vegetation in these wetland areas included, common rush (*Juncus effusus*), smartweed (*Polygonum* sp.), velvet panicum (*Dichanthelium scoparium*), jewelweed (*Impatiens capensis*), shallow sedge (*Carex lurida*) and joepyeweed (*Eupatorium maculatum*). Common woody vegetation included boxelder (*Acer negundo*), river birch (*Betula nigra*), tag alder (*Alnus serrulata*), and American sycamore (*Platanus occidentalis*).

Streams. Jurisdictional streams will be impacted at 19 sites. Major streams crossed by the project include Martin Creek (DWQ No. 1-49-(0.5), Hampton Creek (DWQ No. 1-(48)), and two separate crossings of the Hiwassee River (DWQ No. 1-43). Both Martin and Hampton Creeks are classified as Class C waters by DWQ. The Hiwassee River within the project area has multiple DWQ classifications. From the confluence of McComb Branch to 0.1 miles downstream (which is at the Murphy water supply intake), The Hiwasse River is classified as WS-IV, CA. "CA" stands for critical area which is a designation given to an area adjacent to a water supply intake. From the intake to 0.3 miles downstream of the confluence with Martin Creek, the Hiwassee is classified as WS-V, and from that point to Laurel Creek the river is Class C. As part of the avoidance measures, Martin Creek and the two Hiwassee River crossings will be bridged.

Impacts. Permanent impacts to jurisdictional wetlands are summarized in Table 1 as well as sheet 34 of the permit drawings located in Appendix A. Wetlands will be impacted at eight separate sites for a total of 0.82 acre of permanent impact, which includes fill and excavation in wetlands. As planned, no temporary fill will be placed in wetlands during the construction of this project.

The majority of the wetland impacts consist of fill. At Site 3A, however, the impact consists of excavation. As shown on sheet 6 of the permit drawings, a stream impacted by the project is being relocated (Site 4) through the wetland at Site 3A. Relocating the stream to avoid the wetland was not feasible, and while only a small portion of the 0.22 acre wetland will be

excavated, the entire wetland will probably be impacted by the relocated stream and is therefore considered a total loss.

Table 1. Summary of Permanent Wetland Impacts

Site Number	Wetland Impacts	
	Fill (acre)	Excavation (acre)
1	0.12	<0.01
3	0.17	
3A		0.22
4	0.02	
11	0.05	0.05
17	0.12	
18	0.07	
21	<0.01	<0.01
Totals	**0.55**	**0.27**

Impacts to jurisdictional streams are summarized in Table 2, as well as sheet 39 of the permit drawings located in Appendix A. Streams will be impacted at 19 sites for a total of 0.79 acre of permanent fill or approximately 6,812 linear feet of impact. Less than 0.02 acre of surface water will be temporarily filled during construction. Additionally, 1,150 linear feet of stream will be restored using natural stream design as detailed in the drawings provided in Appendix B. However, due to landowner constraints, only 801 feet of the restored stream will contain adequate buffer to count towards on-site mitigation.

No permanent impacts will occur to the two Hiwassee crossings or Martin Creek crossing since they will be bridged. As proposed, non-destructive temporary work bridges will be placed within the Hiwassee at the west crossing location. It is anticipated that footings for the temporary bridges will require shallow drilled shafts to secure the temporary bridges, causing temporary impacts. The east crossing of the Hiwassee is narrower and can be constructed without the use of temporary work bridges.

At Martin Creek, a temporary bridge will be installed to aid construction. This bridge will span the channel resulting in no impacts to the stream itself. As proposed, the temporary bridges at these three crossings are not expected to hinder stream flow or aquatic life movements during construction. Please refer to sheets 7, 8, 11, 12, 13, and 27 of the permit drawings located in Appendix A for plan and profile views of the Hiwassee River crossings and the Martin Creek crossing.

Wild and Scenic Rivers. The project will not impact any Designated Wild and Scenic Rivers or any other rivers included in the list of study rivers (Public Law 90-542, as amended).

Essential Fish Habitat. While no Essential Fish Habitat is present in the project corridor, NCDOT is committed to ensure that the project will have no disturbance to aquatic life movements. Structures impacting waters on the project will be designed to ensure fish and other aquatic life passage.

Table 2. Summary of Surface Water Impacts

Site Number	Stream Impacts			Stream Name
	Fill (acre)	Temp. (acre)	Linear (feet)	
1	<0.01		66	Ut[1] to Hiwassee River
4	0.07		354	Ut to Hiwassee River
4A		<0.01		Hiwasse River
5	<0.01		113	Ut to Hiwassee River
5A	0.12		518	Ut to Hiwassee River
6	No Impact			Martin Creek
7	<0.01		22	Ut to Martin Creek
8	<0.01		89	Ut to Hampton Creek
9	0.25		971	Hampton Creek
10	0.05		725	Ut to Hampton Creek
11	0.15	<0.01	1598	Ut to Hiwassee River
12	<0.01		220	Ut to Hiwassee River
14	0.02		358	Ut to Hiwassee River
15	0.02		125	Ut to Hiwassee River
16	0.02		453	Ut to Hiwassee River
16A	No Impact			Hiwassee River
18	0.02		381	Ut to McComb Branch
19	<0.01		151	Ut to McComb Branch
20	0.07		504	Ut to McComb Branch
21	<0.01		105	Ut to McComb Branch
22	<0.01		59	Ut to McComb Branch
Totals	**0.79**		**6,812**	

[1]Unnamed tributary (Ut)

Sulfidic Rock (Hot Rock) Impacts. According to the NC Geological Survey, two rock formations, the Mineral Bluff Formation and particularly the Nantahala Formation that underlie or are in close proximity to the project area, are known to contain sulfur-rich minerals. When exposed to the atmosphere and rain, this rock (known as "hot rock") may produce damaging acid levels in leachate which could in turn runoff into jurisdictional surface waters.

Due to the potential for "hot rock" within the Murphy Bypass project area, the NCDOT Geotechnical unit sampled hard rock underlying the project area. Rock core samples were obtained at intervals along the project corridor and analyzed by NCDOT Materials and Test Unit in order to determine the acid potential of the rock. Acid producing potential is measured as Net Neutralization Potential (NNP). NNP values less than negative five are considered to be "hot" meaning they have high potential for producing acidic drainage.

Test results for the rock samples taken along the Murphy bypass project corridor are listed in Appendix F. These results indicate that two of the samples have NNP values well below the -5.0 "hot" rock threshold, Sample 1: -22.6 NNP and Sample 5: -19.6 NNP. The two samples were located on the same core taken at Station 24 + 64, which is in the vicinity of the Martin

Creek crossing. The NNP values for the rock underlying the remainder of the project corridor are all positive and therefore indicate a low potential for producing acid drainage.

In order to avoid and minimize impacts from potential acid producing rock, the NCDOT Geotechnical Unit developed special provisions to be used during construction. These provisions outline plans for weekly testing and monitoring of runoff from erosion control basins in the active construction areas in order to evaluate pH and sulfate values. If pH values are below 6.0, a pre-approved mitigation plan will be chosen within 72 hours. A copy of the special provisions document is included in Appendix F. Additional discussion concerning "hot rock" and potential impacts to sensitive aquatic species is included in the BA submitted to USFWS.

Cultural Resources. During the NEPA process, cultural and historical resources were identified within the project corridor. Two of the alternatives studied in the EA were eliminated partially due to potential impacts to historic resources. Along the preferred route, the EA identified eight potential archaeological sites and no historical sites. Additional survey work was recommended at the archaeological sites.

The additional surveys were conducted between 1999 and 2001, and NCDOT presented the results to the North Carolina Department of Cultural Resources, State Historic Preservation Office (SHPO). Some sites previously identified in the EA were determined not to be eligible for listing on the National Register of Historic Places (NRHP). For those sites considered eligible, the SHPO approved a data recovery plan to mitigate for impacts from construction.

Data recovery began in 2000 and was completed in 2001. Reports were submitted to SHPO in April, 2000; July, 2000 and May, 2001. The SHPO provided concurrence in October, 2001 that full data recovery has been completed within the proposed right-of-way and that no further archaeological work be conducted. The SHPO further added that with the data recovery completed, the project will not affect significant archaeological resources.

However, the SHPO indicated that if project plans change, their office should be notified in order to review updated plans for potential to impact cultural or historical resources. In January 2004, the Geotechnical Engineering Unit of NCDOT contacted the SHPO via e-mail to determine if additional work relating to relocated proposed bridges would impact archaeological sites. The SHPO responded by simply referring to their previous October, 2001 clearance. Therefore, NCDOT does not expect this project to adversely impact cultural or historical resources. NCDOT will continue to consult with the SHPO if project plans change.

FEMA. The Hiwassee River is the only Federal Emergency Management Agency (FEMA) regulated stream crossed by the project. Both crossings have been designed so that the 100 year flood elevation will not change, as required to comply with FEMA regulations.

Utility Impacts. No utility impacts to jurisdictional resources are anticipated from construction of this project. Utility Relocations that occur within "hot rock" areas will also abide by the special provisions listed in Appendix F.

THREATENED AND ENDANGERED SPECIES

Plants and animals with federal classification of Endangered, Threatened, Proposed Endangered, and Proposed Threatened are protected under provisions of Section 7 and Section 9 of the Endangered Species Act of 1973, as amended. As of January 29, 2003 USFWS lists five federally protected species for Cherokee County (Table 3).

Table 3. Federally Protected Species in Cherokee County

Common Name	Scientific Name	Federal Status	Biological Conclusion
Bog turtle	*Clemmys muhlenbergii*	T(S/A)	*Not Subject to Section 7 Consultation*
Indiana Bat	*Myotis sodalis*	E	*May Affect, Not Likely to Adversely Affect*
Cumberland bean	*Villosa trabalis*	E	*Unresolved*
Little-wing pearly mussel	*Pegias fabula*	E	*Unresolved*
Small-whorled pogonia	*Isotria medeoloides*	T	*May Affect, Not Likely to Adversely Affect*

E= a species that is in danger of extinction throughout all or a significant portion of its range.
T= a species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
T(S/A) = Threatened due to similarity of appearance with other rare species and is listed for its protection.

Initial species surveys were conducted during preparation of the EA. Subsequent surveys were conducted as additional alternatives were studied. Initial surveys for small-whorled pogonia and Indiana bat concluded ***May Affect, Not Likely to Adversely Affect***. Since initial surveys for both of these species had expired, additional site visits were conducted in the summer of 2004.

Surveys for small-whorled pogonia were conducted June 9-11 and July 8-9, 2004. Areas of appropriate habitat were searched, but no individuals were found. Surveys for Indiana bat were conducted in areas of appropriate habitat within the project corridor using mist-netting techniques on July 30-31 and August 3, 2004. No individuals were captured. Based on these updated surveys, construction of the project is not expected to adversely impact either species. Therefore, the biological conclusion remains ***May Affect, Not Likely to Adversely Affect*** for small-whorled pogonia. Since Indiana bats may utilize the project area for foraging, the biological conclusion remains ***May Affect, Not Likely to Adversely Affect***. Additional detail regarding these species is presented in the BA. A copy of the BA is available upon request.

Mussel surveys were last conducted in the project corridor in 2000. Results of the surveys concluded that while there are high-quality mussel beds in the Hiwassee River and Martin Creek within the project corridor, none of the federally listed species shown in Table 3 were located. Therefore, the biological conclusions for Cumberland bean and little-wing pearlymussel are ***Not Likely to Adversely Affect***. However, since the surveys are more than two years old, USFWS has requested additional surveys. NCDOT has committed to re-survey the project prior to start of construction. Pre-construction mussel surveys are currently scheduled for October 2004, conditions permitting. The results of this survey will be forwarded to the USFWS prior to the project being let.

In addition to the species listed above, the USFWS raised concerns regarding two FSC species, the Tennessee clubshell and the sicklefin redhorse. These species were discovered within the project corridor during the mussel surveys conducted in 2000. As discussed in the project history section, the USFWS expects that both species will be officially listed prior to completion of the Murphy Bypass. NCDOT agreed to treat the project as if both species were already listed, thus avoiding lengthy and costly delays during project construction.

NCDOT conducted further design studies to avoid and/or minimize potential impacts to these FSC species. The results of these efforts are detailed in the BA. Despite these avoidance/minimization efforts, impacts to both species resulting from the project may not be completely avoided, thus the BA concludes that the Tennessee clubshell and sicklefin redhorse ***Will be Adversely Affected*** by the Murphy Bypass. However, as stated above and listed in more detail in the following sections, NCDOT has redesigned both Hiwassee River crossings and the Martin Creek crossing to avoid/minimize impacts to these species. Additionally, NCDOT will employ mitigation measures such as Best Management Practices (BMPs) and mussel relocation to offset impacts to these species. Additional details regarding mitigation measures are included in the BA.

INDIRECT AND CUMMULATIVE IMPACT ANALYSIS

As part of the NEPA process, an Indirect and Cumulative Effects (ICE) assessment was completed on April 8, 2003. The ICE concluded that construction of the Murphy Bypass will likely induce commercial development (i.e. convenience stores, gas stations, restaurants, etc.) at major intersections along the relocated roadway. Likewise, the report states that the roadway will potentially increase residential development along the corridor.

However, the ICE also concludes that if the proposed project is not built, future land use development that would have been induced by the relocated highway will probably be directed along the existing US 64 corridor. This could potentially cause even more strain on vehicular movement and an increase in traffic accidents. A copy of the ICE report has been included in Appendix G.

MITIGATION

The USACE has adopted through the Council on Environmental Quality (CEQ), a wetland mitigation policy that embraces the concept of "no net loss of wetlands" and sequencing. The purpose of this policy is to restore and maintain the chemical, biological, and physical integrity of the Waters of the United States. Mitigation of wetland and surface water impacts has been defined by the CEQ to include avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts (40 CFR 1508.20). Executive Order 11990 (Protection of Wetlands) and US Department of Transportation Order 5660.1A (Preservation of the Nation's Wetlands), emphasize protection of the functions and values provided by wetlands. These directives require that new construction in wetlands be avoided as much as possible and that all practicable measures are taken to minimize or mitigate impacts to wetlands.

NEPA Commitments

During the NEPA process, NCDOT made various commitments to reduce or eliminate the environmental impact of the Murphy Bypass. Many were made to minimize or avoid impacts and are listed in the following section. Other commitments, such as completing sensitive species surveys have been discussed earlier.

NCDOT has made the following commitments that have not been addressed elsewhere in this document.

- NCDOT will adhere to its "Best Management Practices for the Protection of Surface Waters" during construction of the Murphy Bypass. Specifically NCDOT has designed hazardous spill basins at the Hiwassee bridge crossings to help safeguard water quality and aquatic organisms and utilized "Design Standards in Sensitive Watersheds" since a portion of the Hiwassee is designated as a CA.
- Mitigation for adverse visual impacts was considered during the design phase of the project.
- NCDOT will coordinate with the Tennessee Valley Authority to determine if relocation of transmission line structures is necessary to accommodate the new roadway.

In addition, NCDOT has agreed to the following commitments as outlined in the BA document.

- **Agency Coordination**: NCDOT will invite representatives from the USACE, USFWS, and the North Carolina Wildlife Resource Commission to the pre-construction meetings for this project, as well as subsequent field inspections prior to construction, to help insure compliance with special project commitments.
- **Bridge Drainage**: Deck drains will be placed at the ends of each planned bridge and run into grassed swales so no direct stormwater discharge will occur over the Hiwassee River or Martin Creek. This commitment has been incorporated in the Structure Design Plans.
- **Preconstruction Survey**: NCDOT will conduct pre-construction aquatic surveys in the project's footprint impacting waters known to contain protected species. NCDOT anticipates that few individual protected mussels will be found in surveys of the project footprint and is proposing to relocate these mussels to appropriate upstream habitat. The preconstruction survey will be incorporated into the relocation plan that will be developed prior to construction. Pre-construction surveys are currently scheduled for October 2004, conditions permitting. Relocation will be conducted right before footers are set for the temporary bridge.

Avoidance/Minimization

NCDOT has utilized many avoidance and minimization strategies during the planning stages of the Murphy Bypass project. Through the NEPA process, input from review agencies and public comments have also been incorporated into the design to avoid or minimize potential impacts. In addition, NCDOT conducted interagency project review meetings in May 2000, October 2001, April 2002, January 2004, and March 2004 to facilitate resource agency comments. Through these meetings, additional avoidance and minimization measures were developed. The following list summarizes specific avoidance/minimization efforts incorporated by NCDOT in the design of this project.

1. *West Hiwassee River Crossing (4A)* – Originally, this alignment crossed the river further east (upstream) with a more angled crossing. This crossing would have resulted in a longer bridge with numerous bents located in the river and floodplain, subsequently causing more potential impact to the aquatic habitat, specifically mussels. Through agency review and comment, the bridge alignment was shifted further westward

(downstream). The proposed alignment allows for a shorter span with less skew (i.e. more perpendicular to the river), and no proposed bents being located in the river (i.e. full span). The new alignment avoids sensitive mussel habitat and eliminates permanent impact to the river channel. Original design drawings are included in Appendix E for comparison with the proposed bridge.

2. *Martin Creek Crossing (Site 6)* – Originally the proposed crossing consisted of installing a triple barrel box culvert, almost in the shape of a horseshoe. The culvert would have impacted approximately 770 feet of streambed. As proposed, NCDOT will install a bridge resulting in no permanent stream impacts.

3. *Hampton Creek Crossing (Site 9)* – As proposed, this crossing consists of installing a double barrel box culvert. In order to address agency concerns, the culvert is being designed with low flow sills and a trout flow channel. These design changes minimize impacts to aquatic life movements. (Appendix B)

4. *Harshaw Road (Site 11)* – The proposed roadway bridge was lengthened in order to avoid impacting the Ut to the Hiwassee River that parallels the alignment. The design change lessened the direct stream impact by approximately 475 feet. In addition, NCDOT has proposed to restore this stream utilizing natural channel design as part of on-site compensatory mitigation for the Murphy Project. However, due to landowner constraints, a 50-foot buffer will not exist along the entire length of stream proposed for restoration, therefore only 801 feet of the restored stream is being included as mitigation. (Appendix B)

5. *East Hiwassee Crossing (Site 16A)* – Originally the bridge was designed with 2 bents placed in the river channel. The original design included temporary impacts due to use of a temporary causeway. As now proposed, the bridge will span the entire river channel, resulting in no permanent in-water bents and no need for a temporary causeway. Original design drawings are included in Appendix E for comparison.

6. *Wetland Sites* – In order to minimize impacts to wetland areas, 2:1 fill slopes were used where possible.

7. *Water Intake* – At the request of the Town of Murphy, NCDOT assisted in relocating the town's raw water intake and incorporated the town's concerns regarding protection of their water supply into design of the east Hiwassee River crossing.

8. *Deck Drains* – Deck drains will be installed at the ends of each planned bridge so that no direct stormwater discharge from the roadway will occur into the Hiwassee River or Martin Creek.

9. *Cross Vanes* – Cross vanes/splash pools will be constructed at the outlet of every pipe and culvert where possible.

10. *Site 4 & 5A* – NCDOT investigated relocating streams at Site 4 and Site 5A utilizing natural stream design. However, as discussed at interagency review meetings there were constraints that did not allow this. At Site 4 the existing relief and resulting grade of the relocation warrants use of riprap to protect the channel. At Site 5, it was determined that the stretch of stream was simply to short to make it feasible for natural stream design.

Compensation

The primary emphasis of the compensatory mitigation is to re-establish a condition that would have existed if the project were not built. Mitigation is limited to reasonable expenditures and practicable considerations related to highway operation. Mitigation is generally accomplished through a combination of methods designed to replace wetland functions and values lost as a result of construction of the project. These methods consist of creation of new wetlands from uplands, borrow pits, and other non-wetland areas; restoration of wetlands; and enhancement of existing wetlands. Where such options may not be available, or when existing wetlands and wetland-surface water complexes are considered to be important resources worthy of preservation, consideration is given to preservation as at least one component of a compensatory mitigation proposal.

Based upon the agreements stipulated in the "Memorandum of Agreement Among the North Carolina Department of Environment and Natural Resources, the North Carolina Department of Transportation, and the US Army Corps of Engineers, Wilmington District" (MOA), it is understood that the EEP will assume responsibility for satisfying the federal Clean Water Act compensatory mitigation requirements for NCDOT projects that are listed in Exhibit 1 of the subject MOA during the EEP transition period which ends on June 30, 2005.

Because the subject project is listed in Exhibit 1, the necessary compensatory mitigation to offset unavoidable impacts to waters that are jurisdictional under the federal Clean Water Act will be provided by the EEP. The NCDOT has avoided and minimized impacts to jurisdictional resources to the greatest extent possible as described above. The remaining, unavoidable impacts to 0.82 acres of jurisdictional wetlands and to 6,011 linear feet of jurisdictional streams will be offset by compensatory mitigation provided by the EEP program. A copy of the acceptance letter from the EEP is included in Appendix D of this application.

FHWA Step Down Compliance

All compensatory mitigation must be in compliance with 23 CFR Part 777.9, "Mitigation of Impacts", which describes the actions that should be followed to qualify for Federal-aid highway funding. This process is known as the FHWA "Step Down" procedures:

1. Consideration must be given to mitigation within the right-of-way and should include the enhancement of existing wetlands and the creation of new wetlands in the highway median, borrow pit areas, interchange areas and along the roadside.
2. Where mitigation within the right-of-way does not fully offset wetland losses, compensatory mitigation (enhancement, creation, and/or preservation) may be conducted outside the right-of-way.

NCDOT has followed this process and believes this project to be in compliance with the FHWA step down procedures.

REGULATORY APPROVALS

Application is hereby made for a Department of Army Section 404 Individual Permit as required for the above-described activities. We are also requesting a 401 Water Quality Certification from the Division of Water Quality. In compliance with Section 143-215.3D(e) of the NCAC,

we will provide $475.00 to act as payment for processing the Section 401 permit application previously noted in this application (see Subject line). We are providing seven copies of this application to the NC Department of Environment and Natural Resources (NCDENR), Division of Water Quality (DWQ), for their review.

If you have any questions or need additional information please call Chris Manley at (919) 715-1487.

Sincerely,

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

The "cc" List:

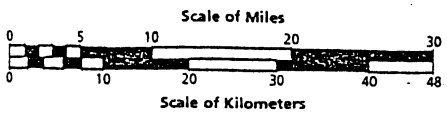
W/attachment

Mr. John Hennessy, Division of Water Quality (7 copies)
Ms. Marella Buncick, USFWS
Ms. Marla Chambers, NCWRC
Ms. Becky Fox, USEPA-Whitter, NC
Mr. Ronald Mikulak, USEPA – Atlanta, GA
Mr. Harold Draper, TVA
Mr. David Chang, P.E., Hydraulics
Mr. Greg Perfetti, P.E., Structure Design
Mr. Ron Watson, P.E., Division Engineer
Mr. Mark Davis, DEO

W/o attachment

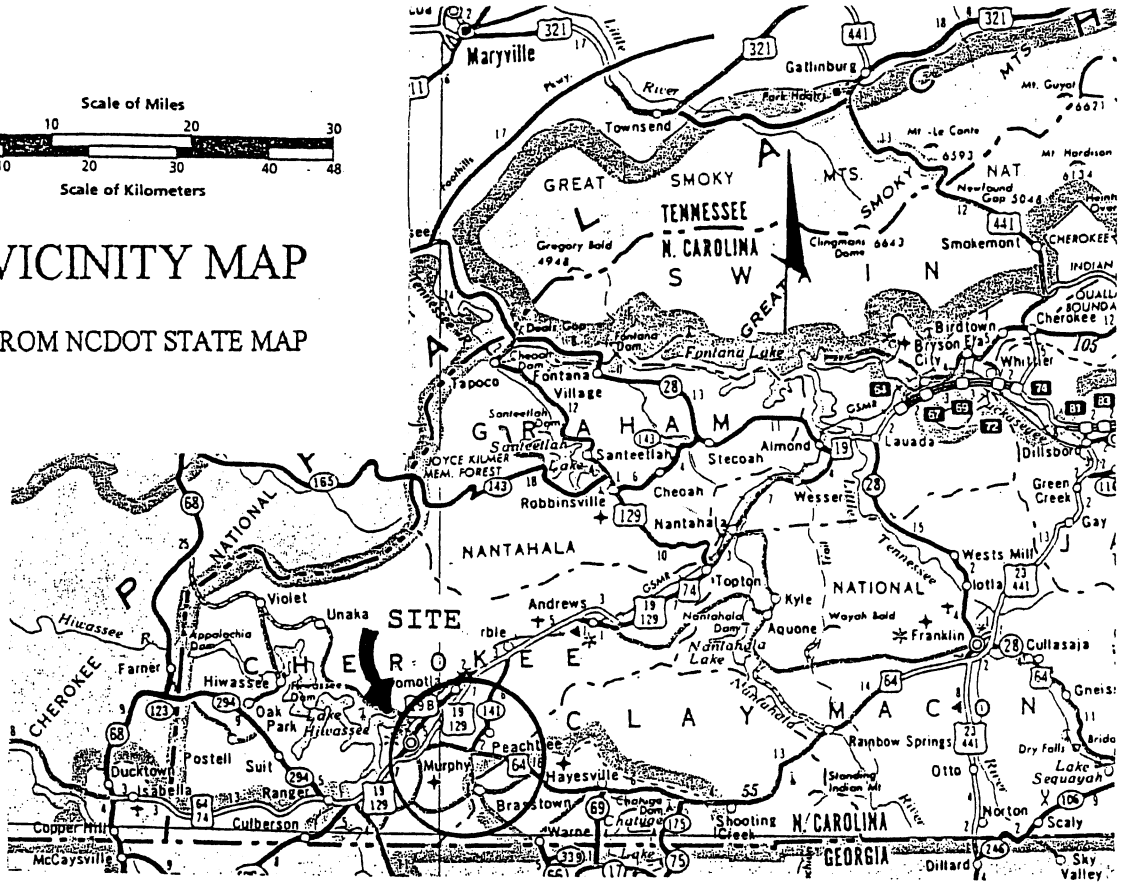
Mr. Jay Bennett, P.E., Roadway Design
Mr. Omar Sultan, Programming and TIP
Mr. Art McMillan, P.E., Highway Design
Mr. Mark Staley, Roadside Environmental
Mr. David Franklin, USACE, Wilmington
Ms. Beth Harmon, EEP
Ms. Theresa Ellerby, PDEA

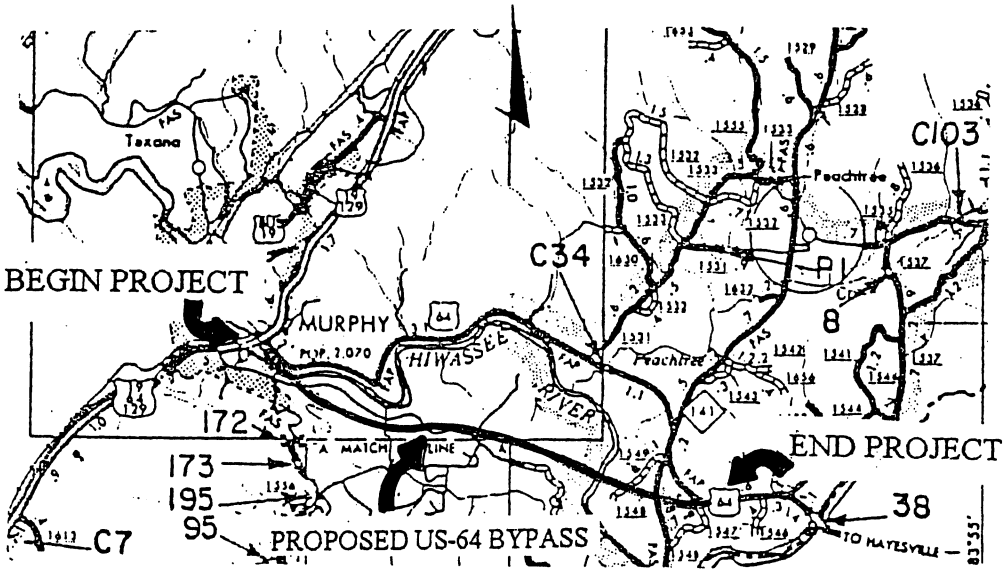
APPENDIX A
Permit Drawings

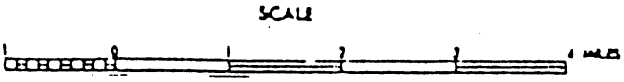


VICINITY MAP

FROM NCDOT STATE MAP







VICINITY MAP

FROM NCDOT BRIDGE LOCATION MAP

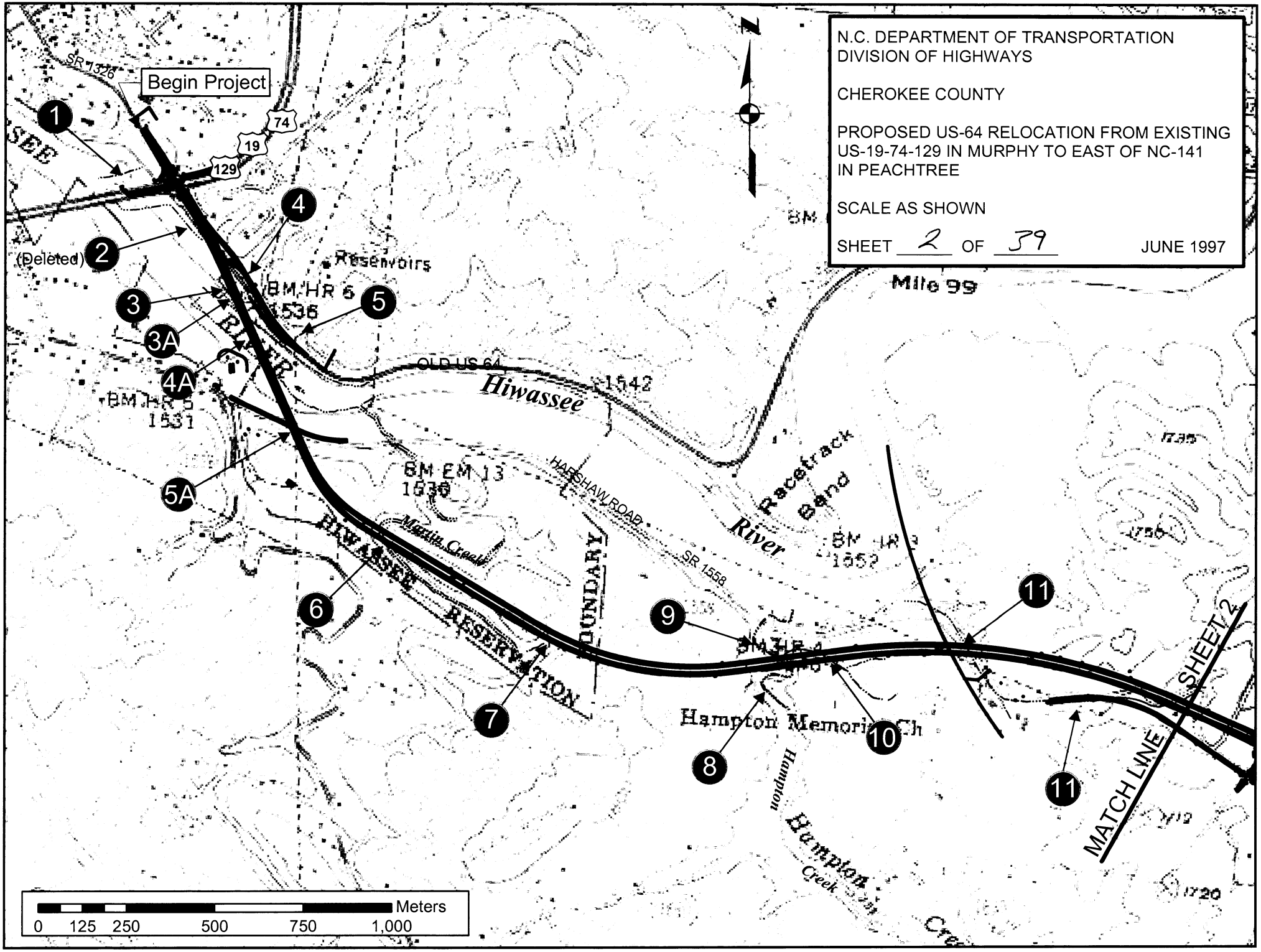
N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

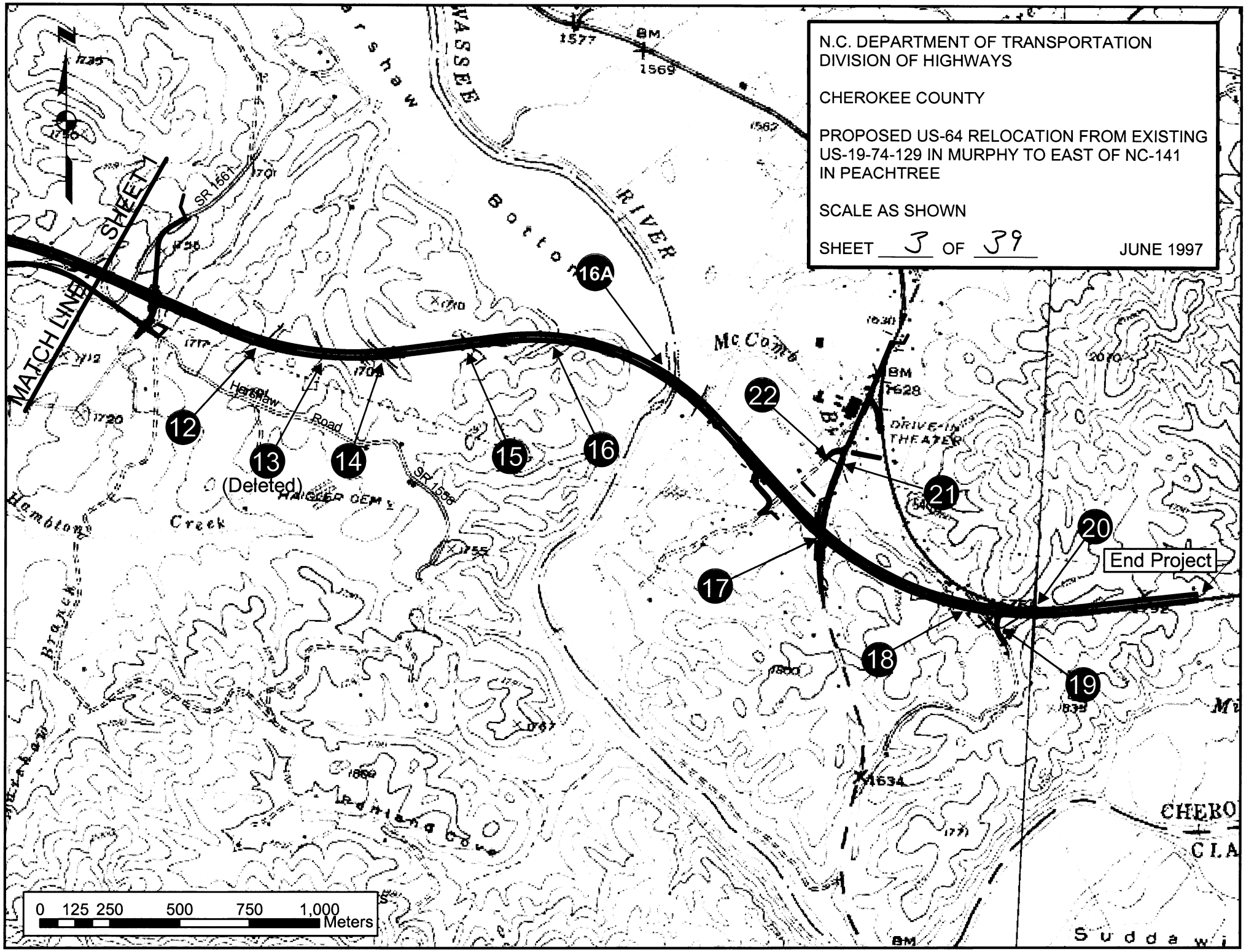
CHEROKEE COUNTY

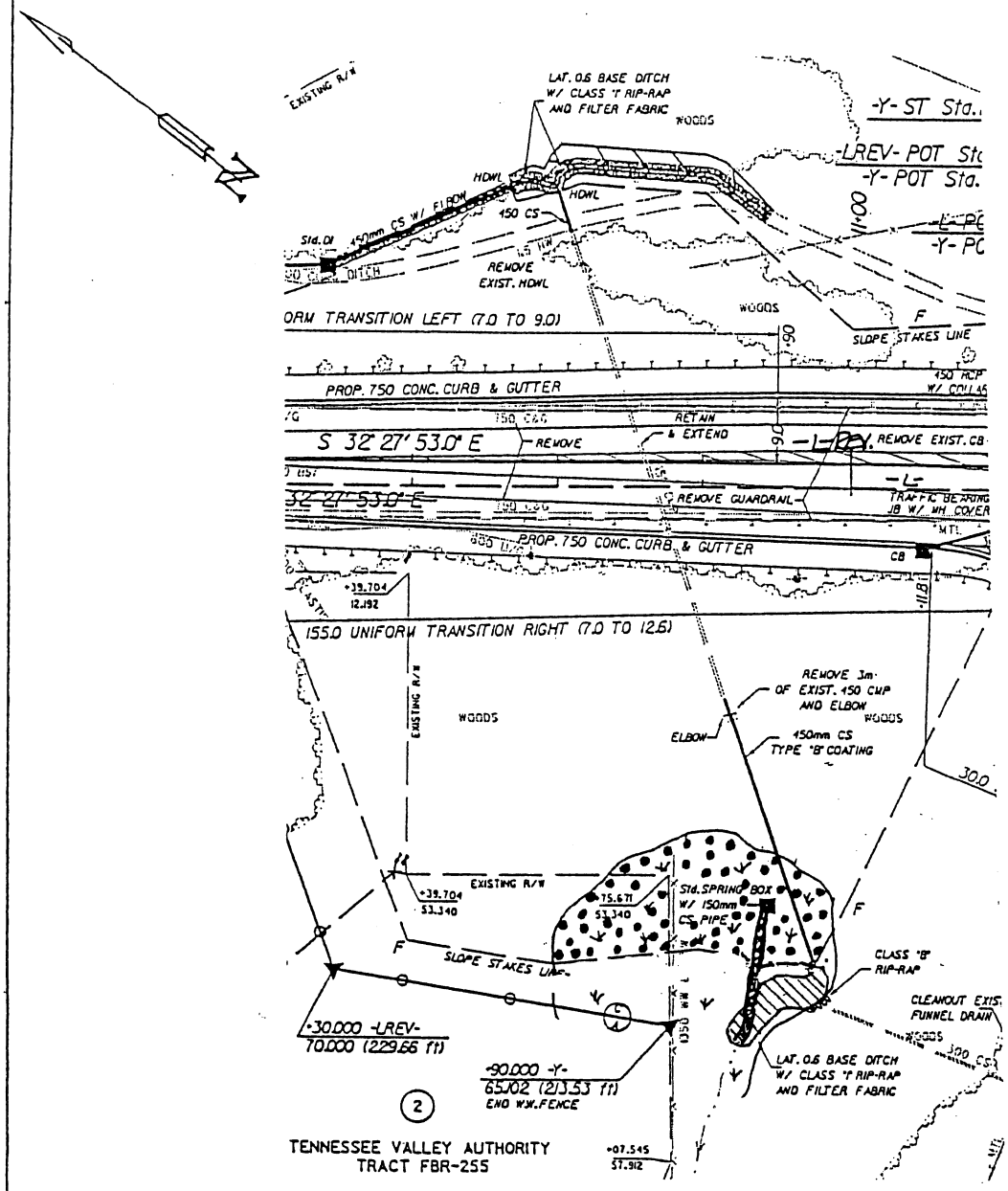
PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 1 OF 39 JUNE 1997


N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
CHEROKEE COUNTY
PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE
SCALE AS SHOWN
SHEET 2 OF 39
JUNE 1997
Begin Project
(Deleted)
SR 1328
74
19
129
Reservoirs
BM HR 6
1536
OLD US 64
Hiwassee
1542
BM HR 5
1531
BM EM 13
1636
HARSHAW ROAD
SR 1558
Marlin Creek
HIWASSEE RESERVATION BOUNDARY
Racetrack Bend
River
BM HR 4
1552
Mile 99
Hampton Memorial Ch
Hampton Creek
MATCH LINE
SHEET 2
Meters
0 125 250 500 750 1,000


N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
CHEROKEE COUNTY
PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE
SCALE AS SHOWN
SHEET 3 OF 39
JUNE 1997
MATCH LINE
SHEET 1
SR 1561
Hartshaw Road
SR 1596
Hambton Creek
Hartshaw Branch
Bottom
RIVER
McCombs
DRIVE-IN THEATER
12
13
(Deleted)
14
15
16
16A
17
18
19
20
21
22
End Project
0 125 250 500 750 1,000
Meters



SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

FILL IN WETLANDS

SITE No. 1

EXCAVATION IN WETLANDS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

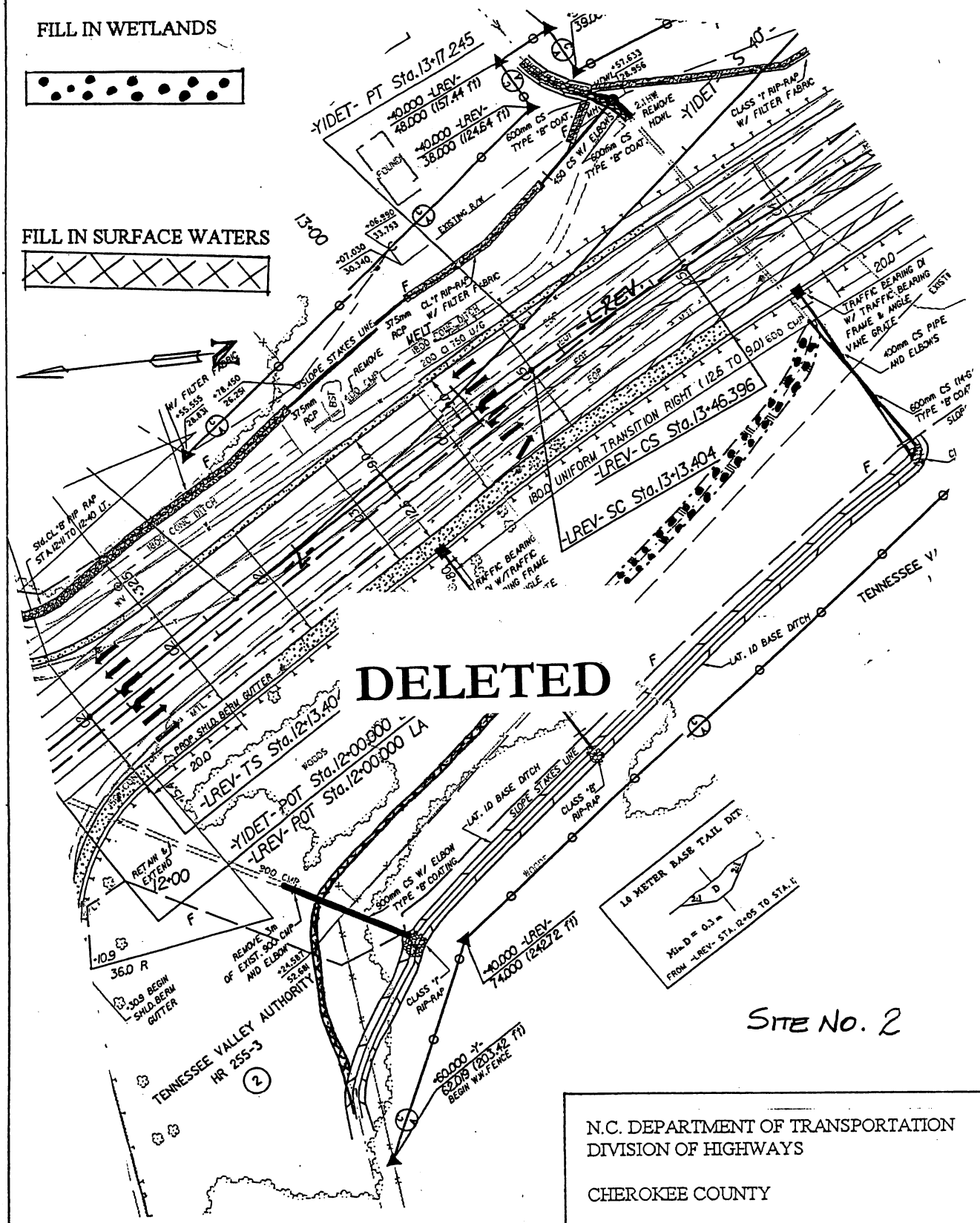
SCALE AS SHOWN

SHEET 4 OF 39

JUNE 1997

FILL IN WETLANDS

FILL IN SURFACE WATERS



SCALE

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N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

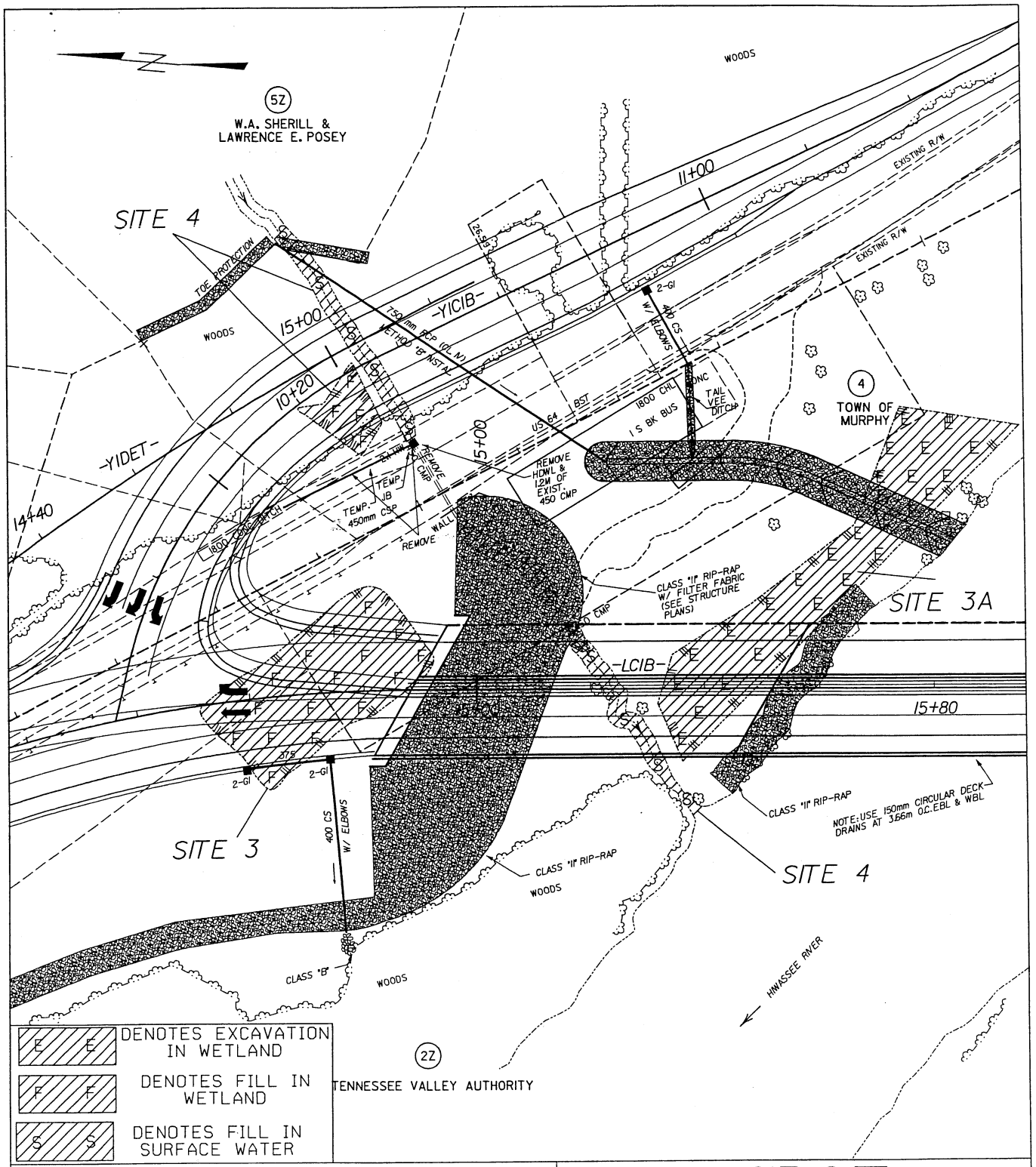
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 5 OF 39

JUNE 1997



PLAN VIEW STREAM & WETLAND IMPACTS SITES 3, 3A, & 4

SCALE - 1:1000

NCDOT

DIVISION OF HIGHWAYS

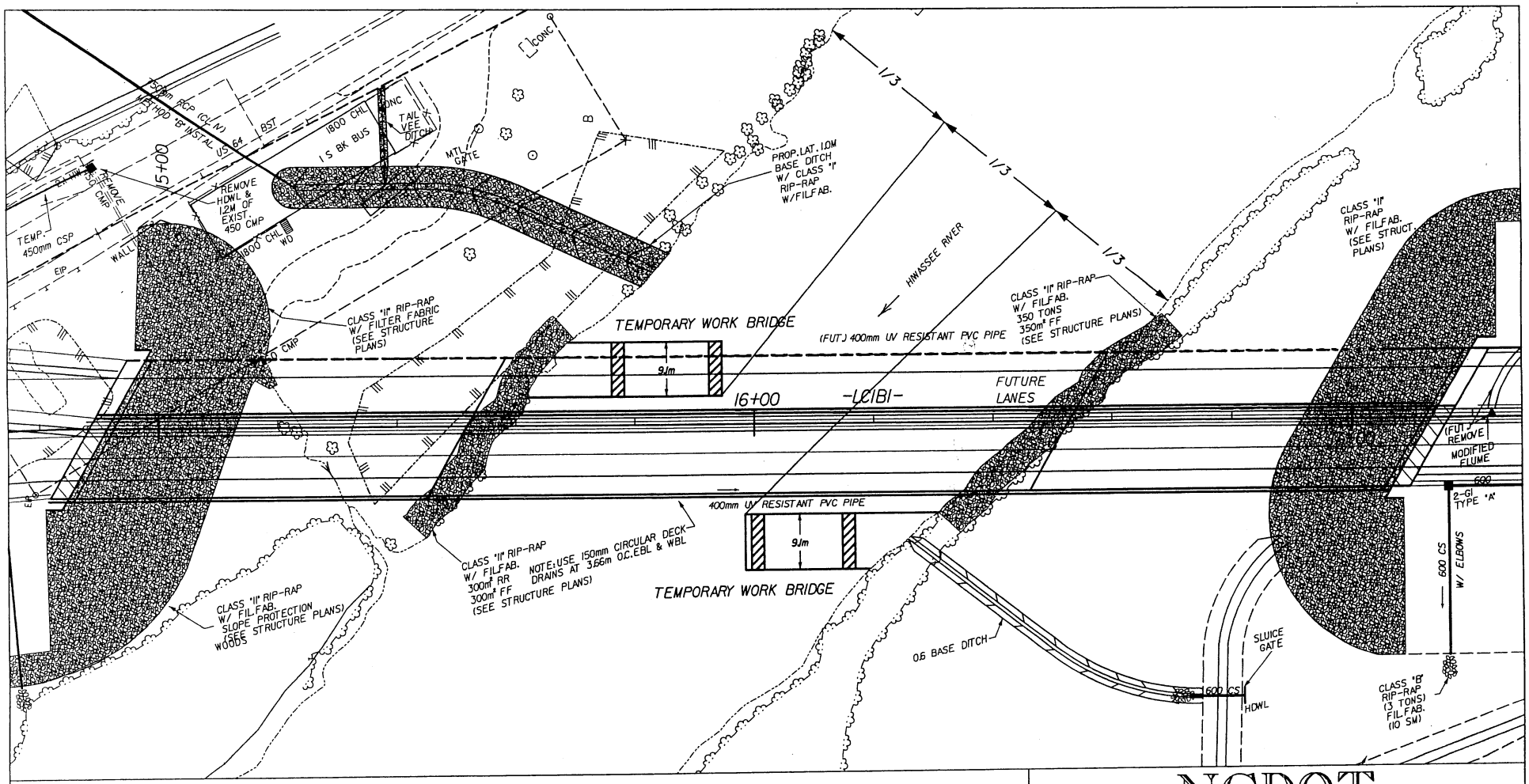
CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 6 OF 39

8/17/04



PLAN VIEW
TEMPORARY WORK BRIDGE
SITE 4A
SCALE 1:1000

NCDOT

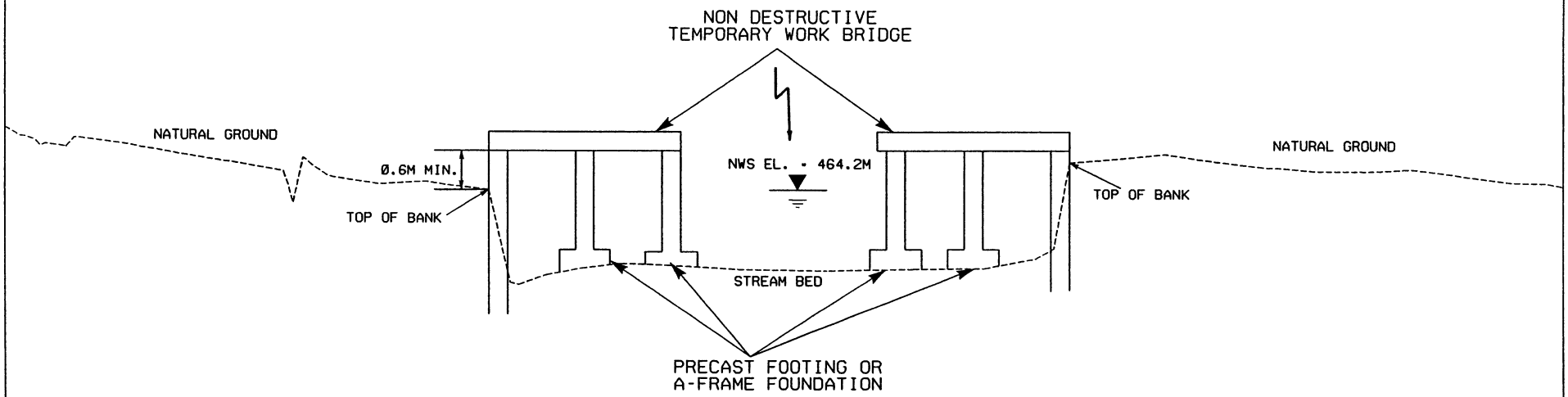
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 7 OF 39 **8/17/04**



AREA OF TEMPORARY IMPACTS DUE TO TEMPORARY FOOTING/ FOUNDATIONS = $28M^2$

PROFILE VIEW
TEMPORARY WORK BRIDGE
SITE 4A
NOT TO SCALE

NCDOT

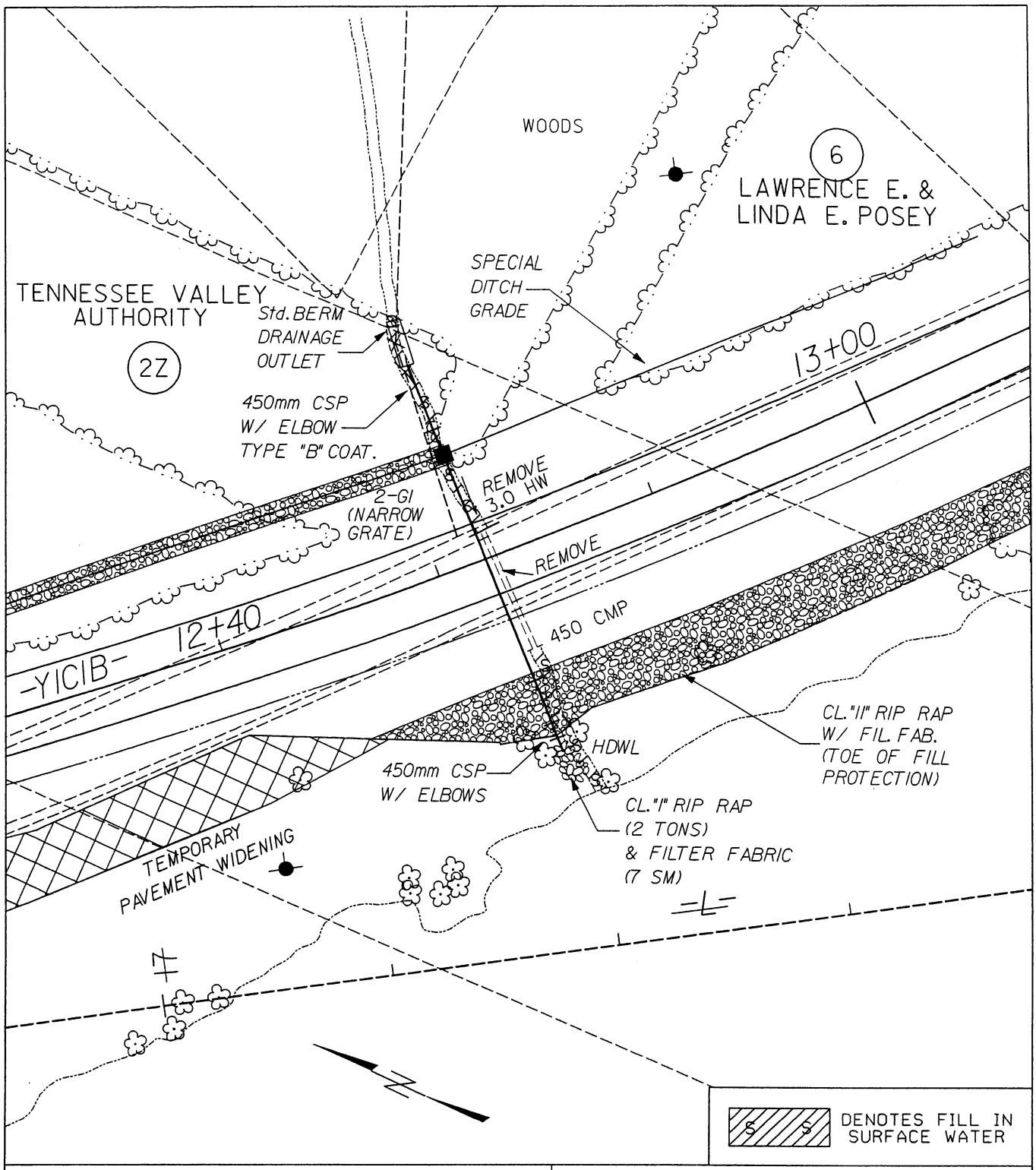
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 8 OF 39 **5/20/04**



PLAN VIEW
STREAM
IMPACTS
SITE 5
SCALE - 1:500

NCDOT

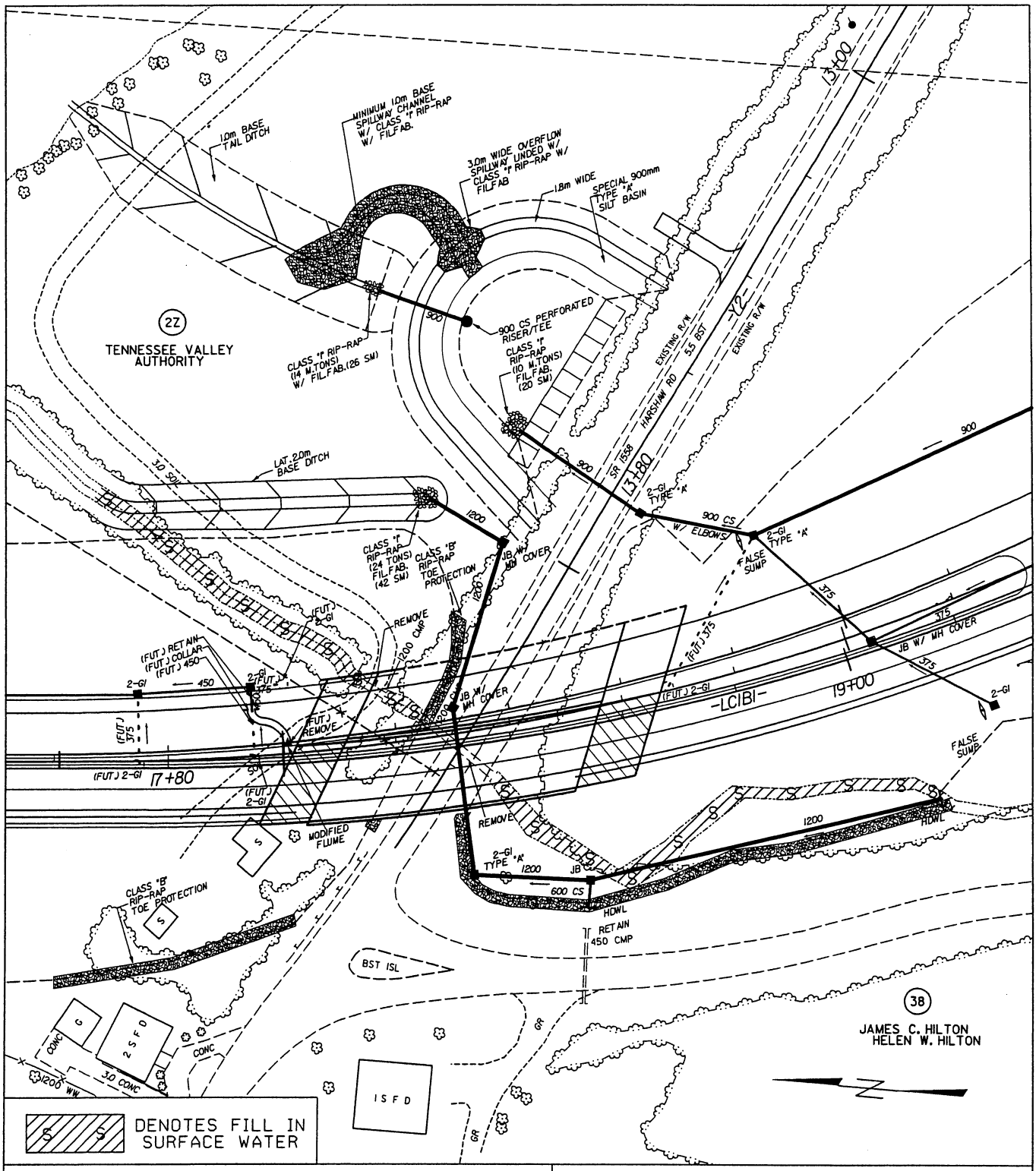
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 9 OF 39 **2/25/04**



PLAN VIEW STREAM IMPACTS SITES 5A

SCALE - 1:1000

NCDOT

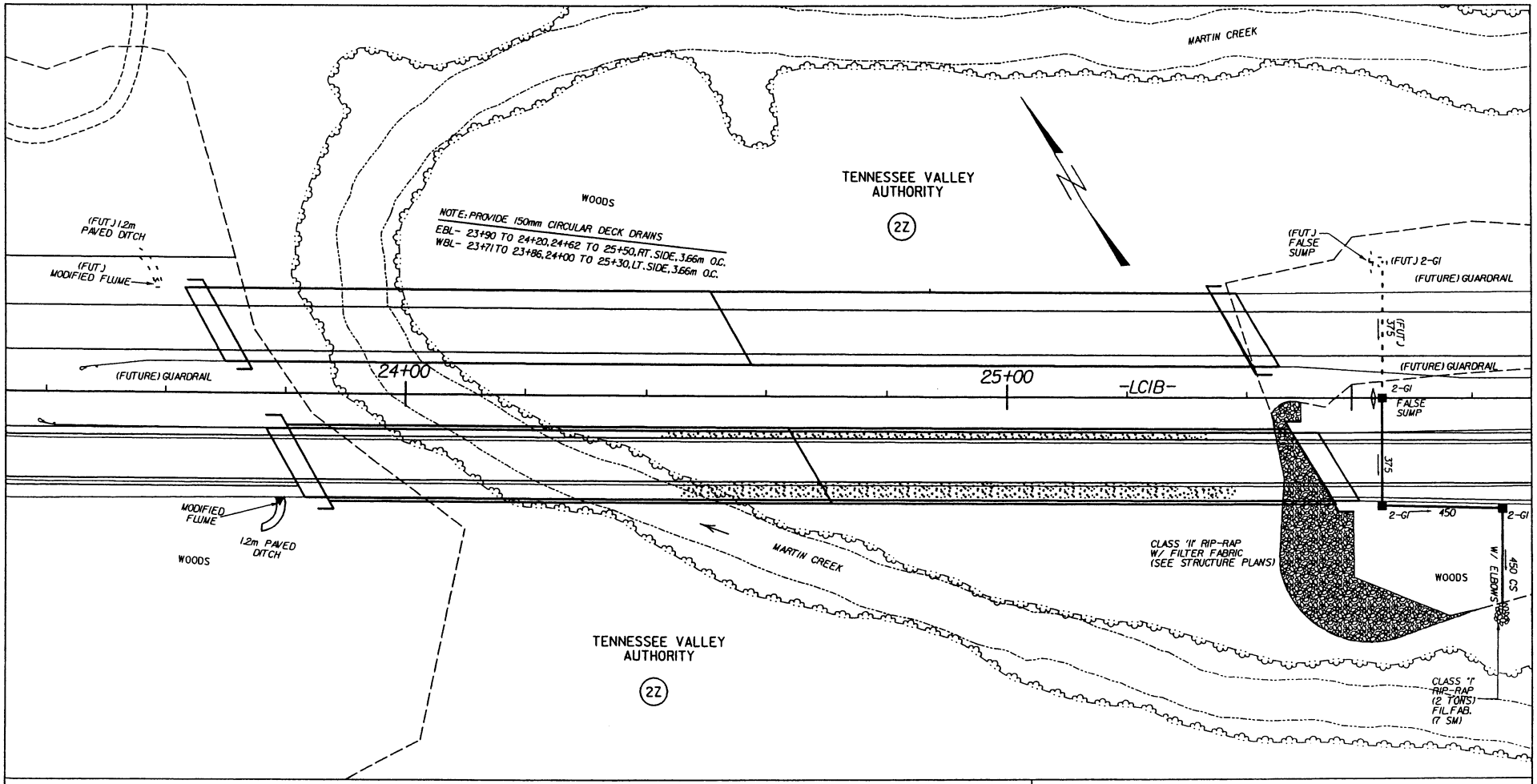
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 10 OF 39 **5/20/04**



PLAN VIEW
NO
IMPACTS
SITE 6
SCALE 1:1000

NCDOT

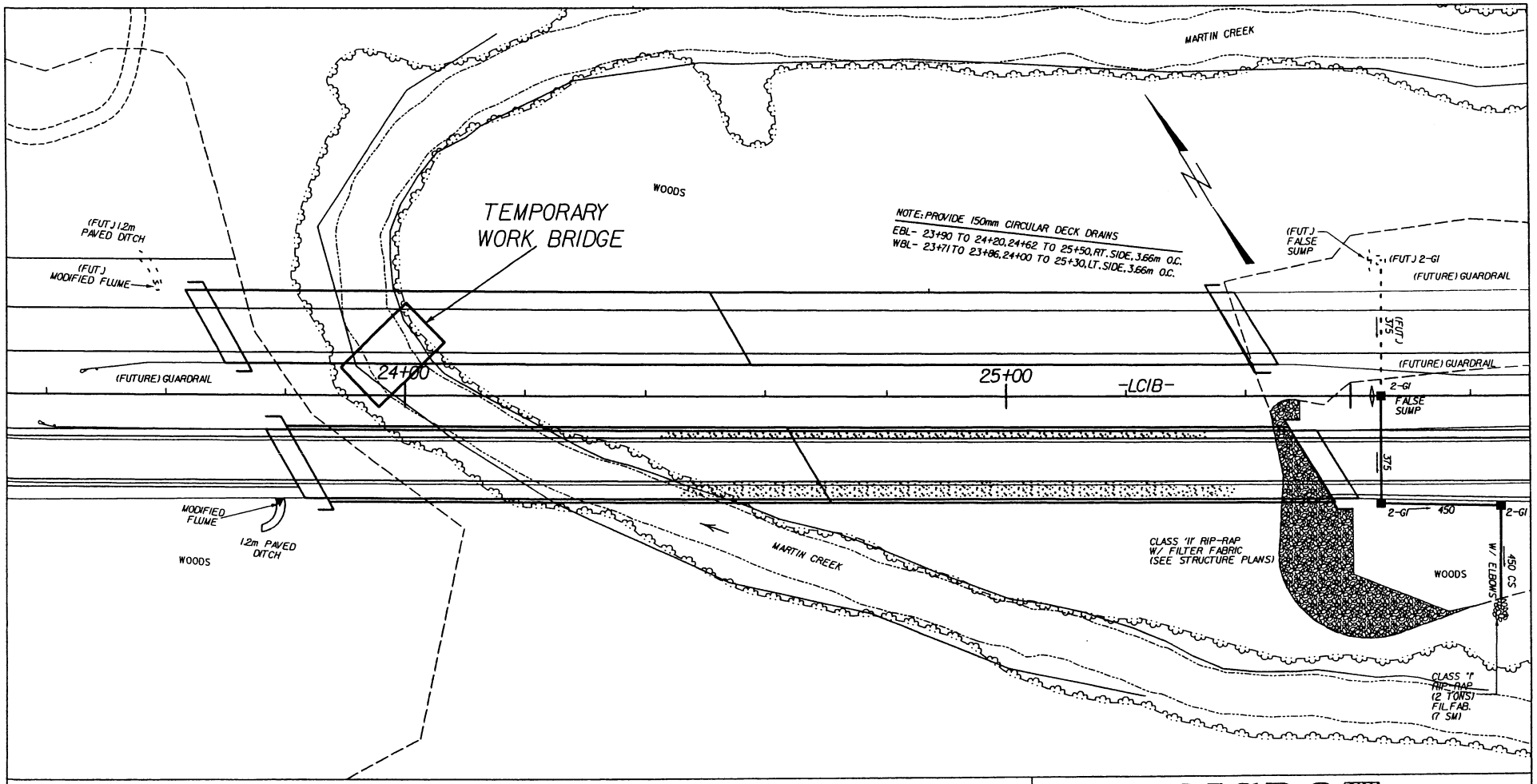
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 11 OF 39 **2/25/04**



PLAN VIEW
TEMPORARY WORK BRIDGE
AT MARTINS CREEK
NO IMPACTS
SCALE 1:1000

NCDOT

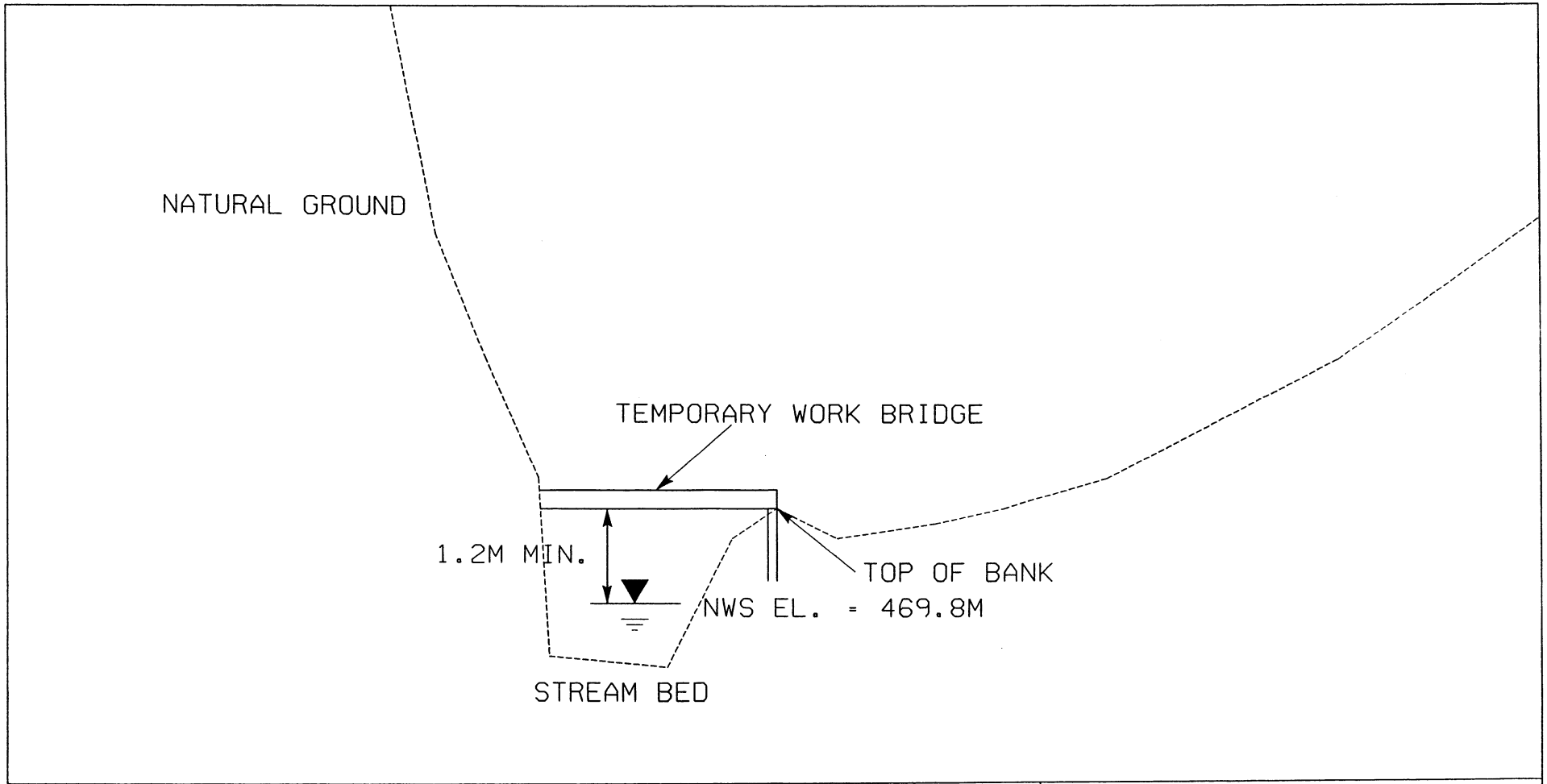
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 12 OF 39 **2/25/04**



PROFILE VIEW
TEMPORARY WORK BRIDGE
AT MARTINS CREEK
NO IMPACTS
NOT TO SCALE

NCDOT

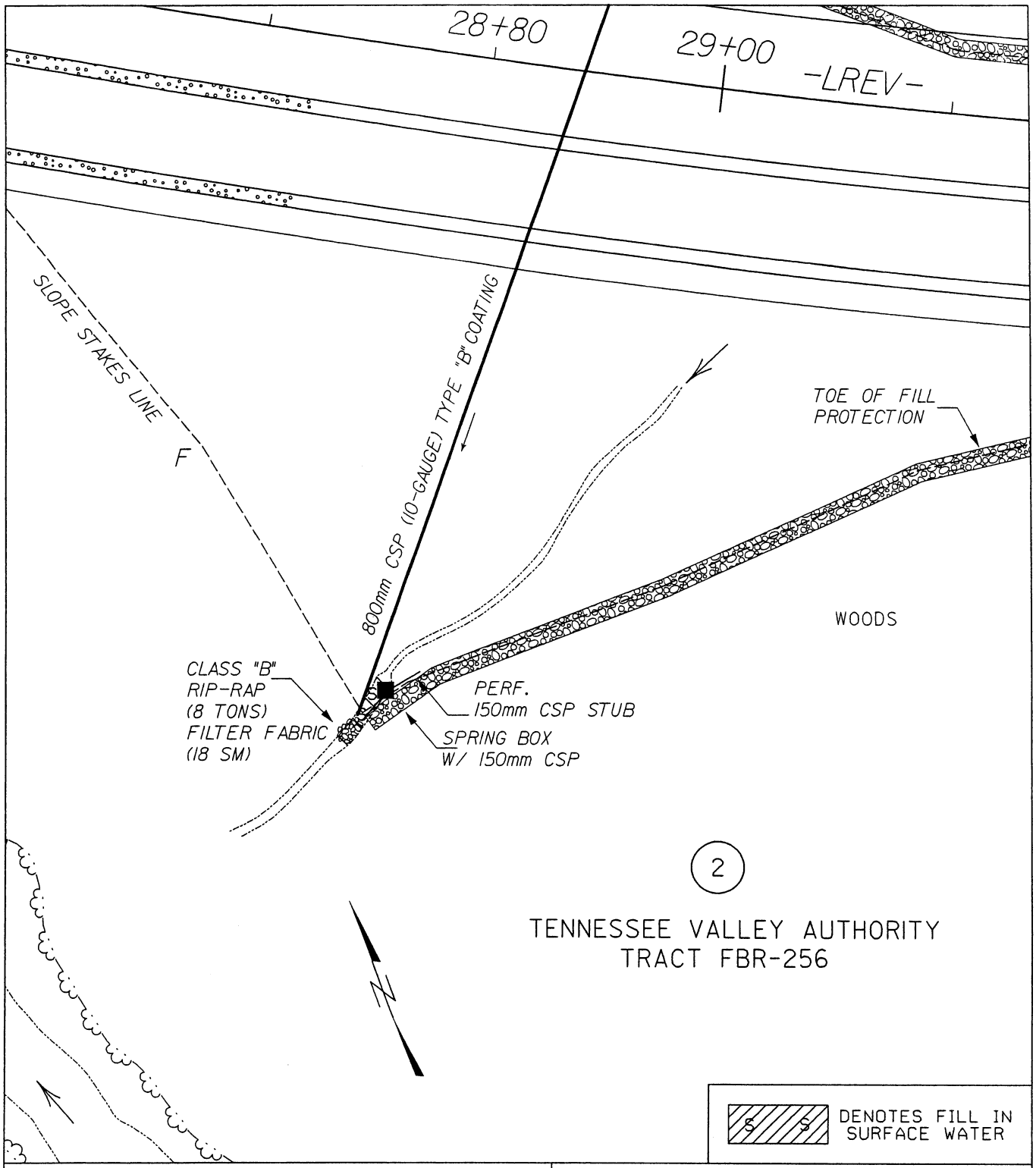
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 13 OF 39 **2/25/04**



PLAN VIEW STREAM IMPACTS SITE 7

SCALE - 1:500

NCDOT

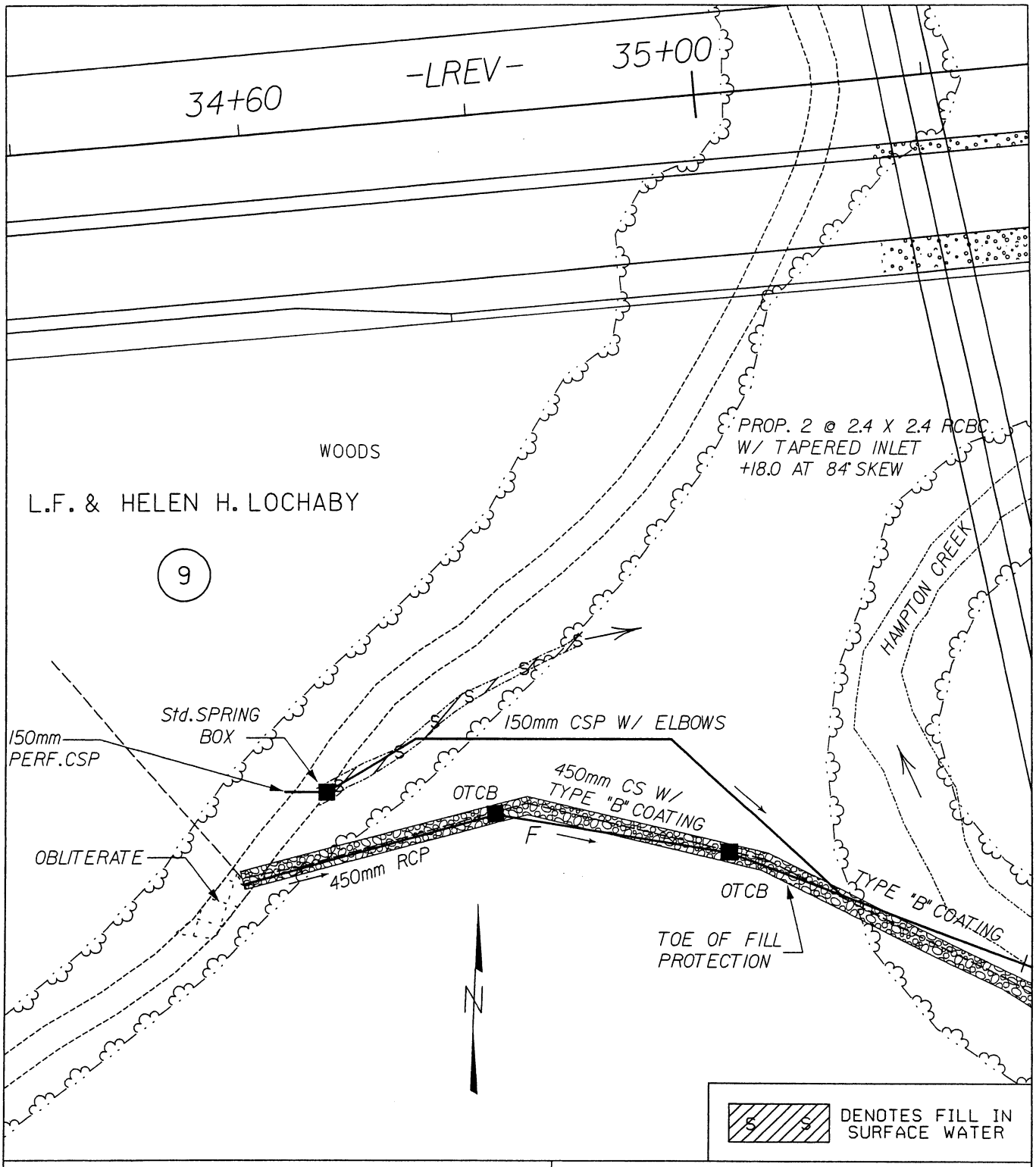
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 14 OF 39 **2/25/04**



PLAN VIEW
STREAM
IMPACTS
SITE 8
SCALE - 1:500

NCDOT

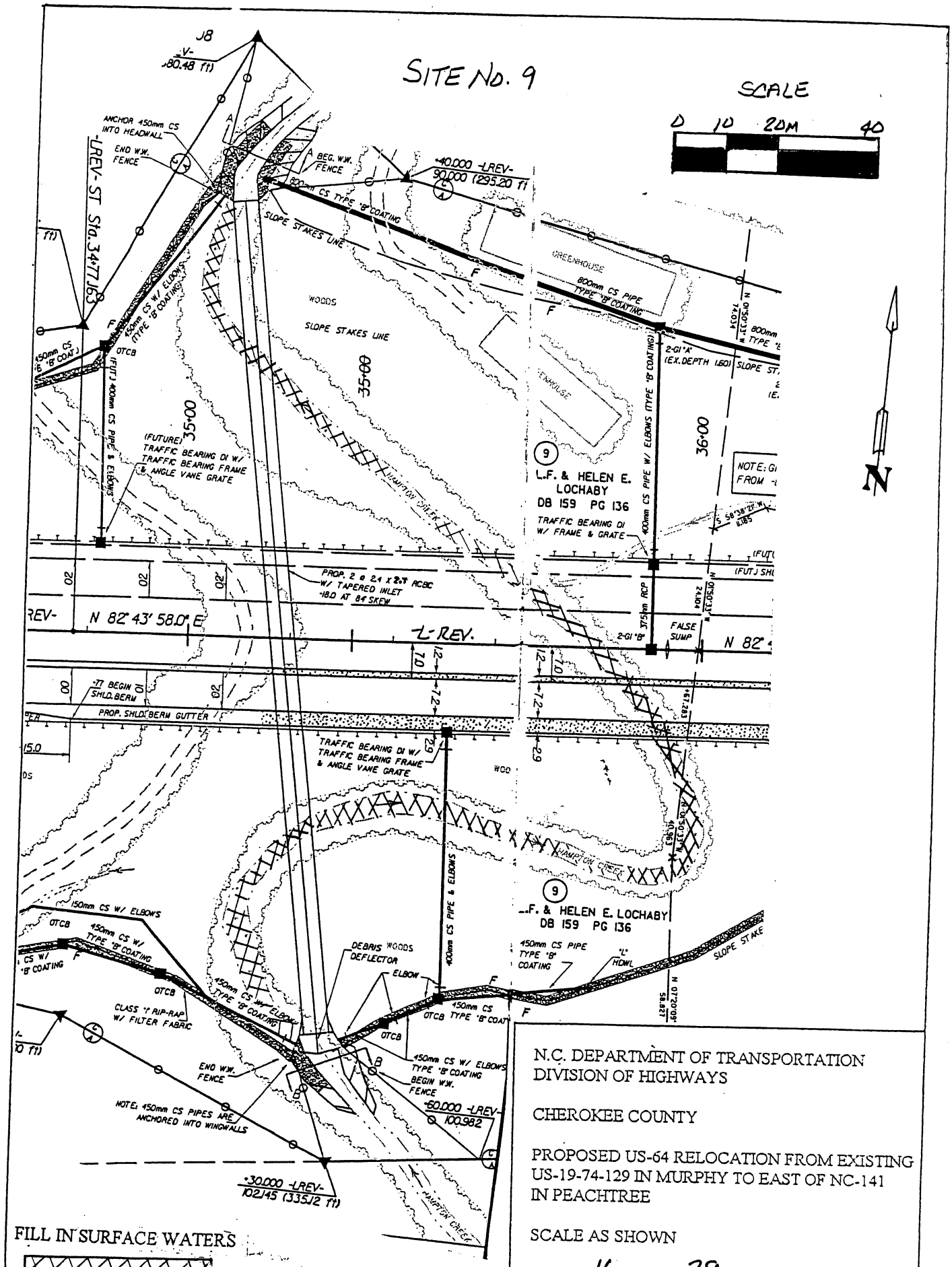
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 15 OF 39 **2/25/04**



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

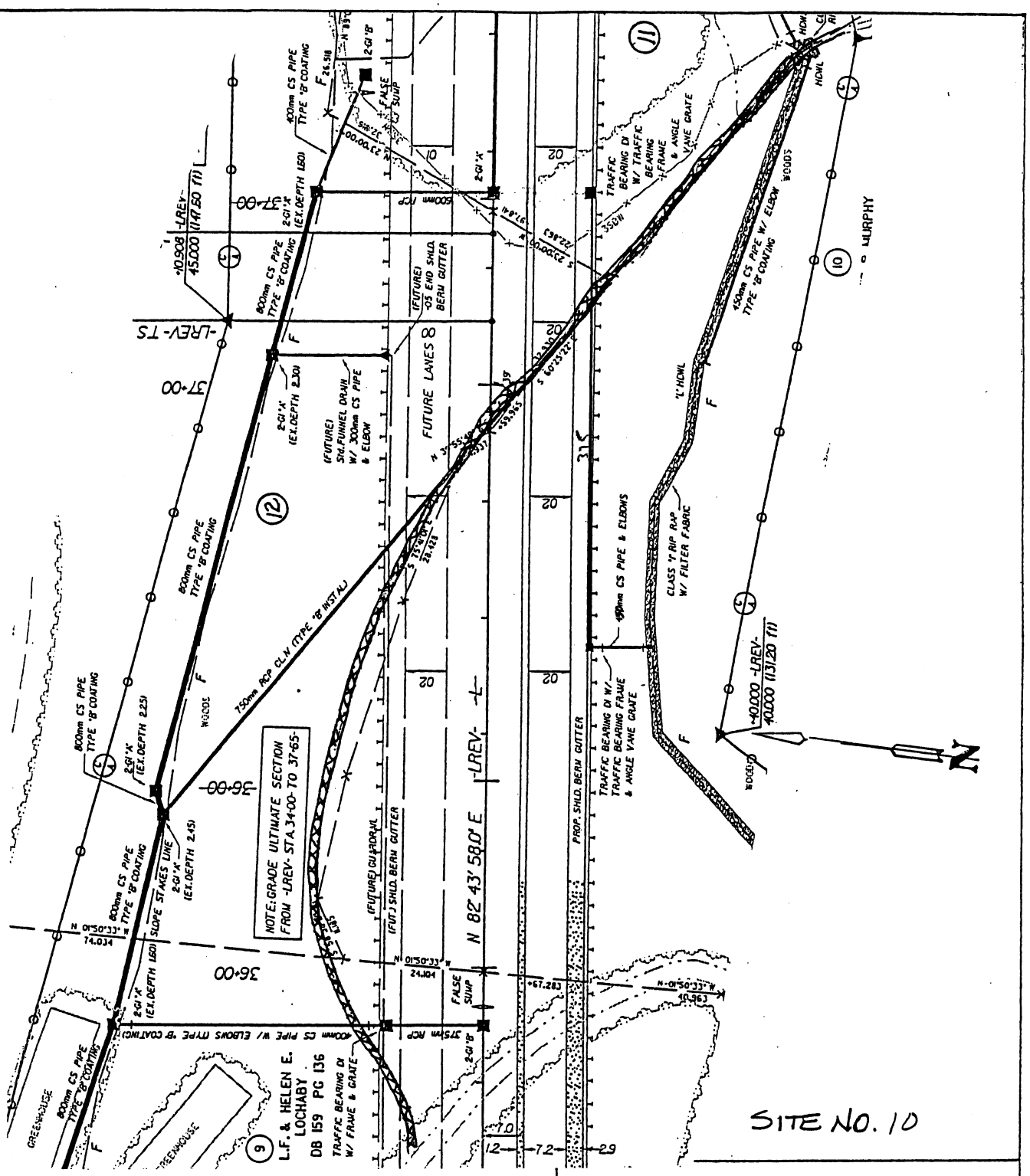
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16 OF 39

JUNE 1997



SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

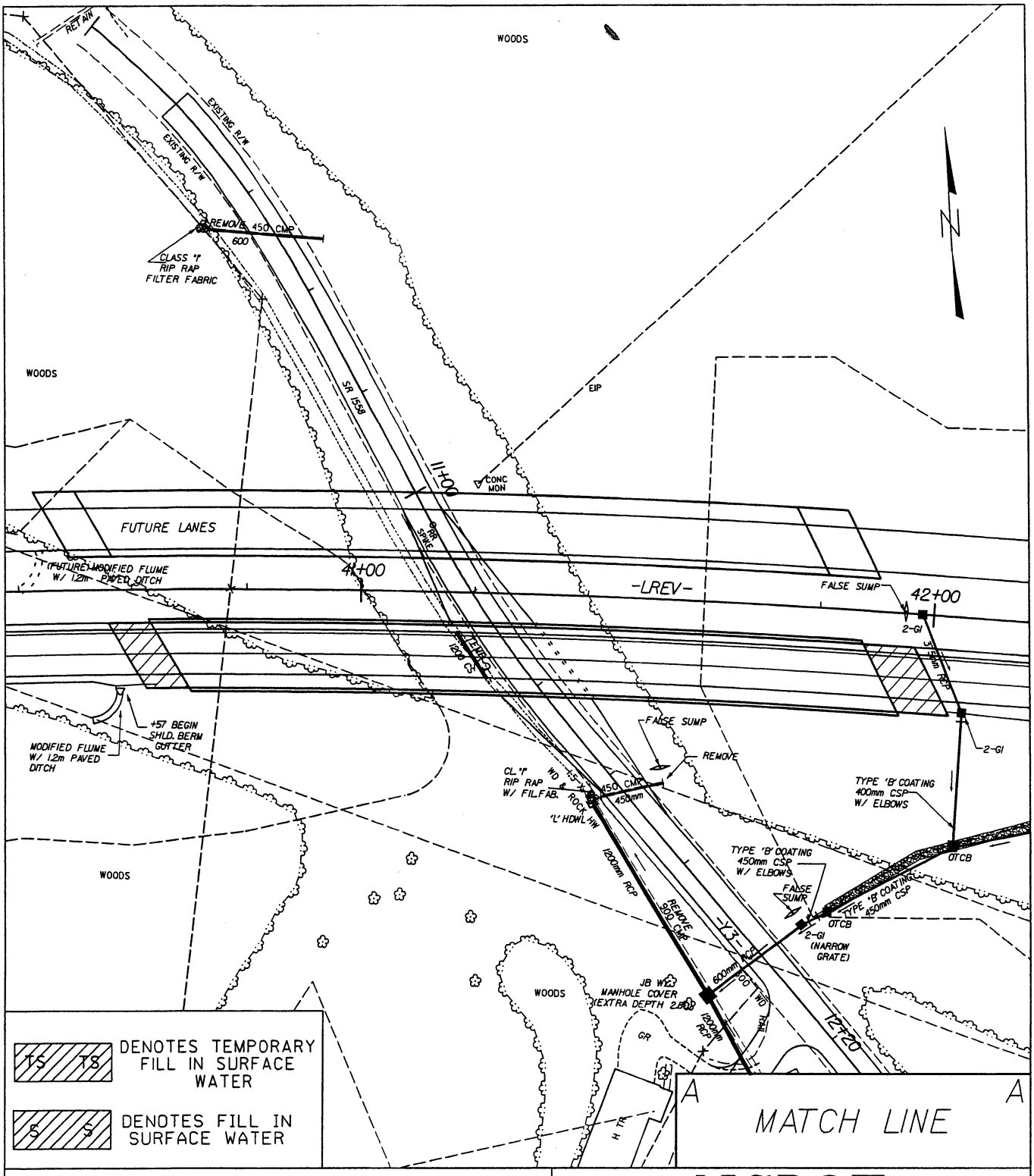
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 17 OF 39

2/25/04



PLAN VIEW STREAM IMPACTS SITE 11

SCALE - 1:1000

NCDOT

DIVISION OF HIGHWAYS

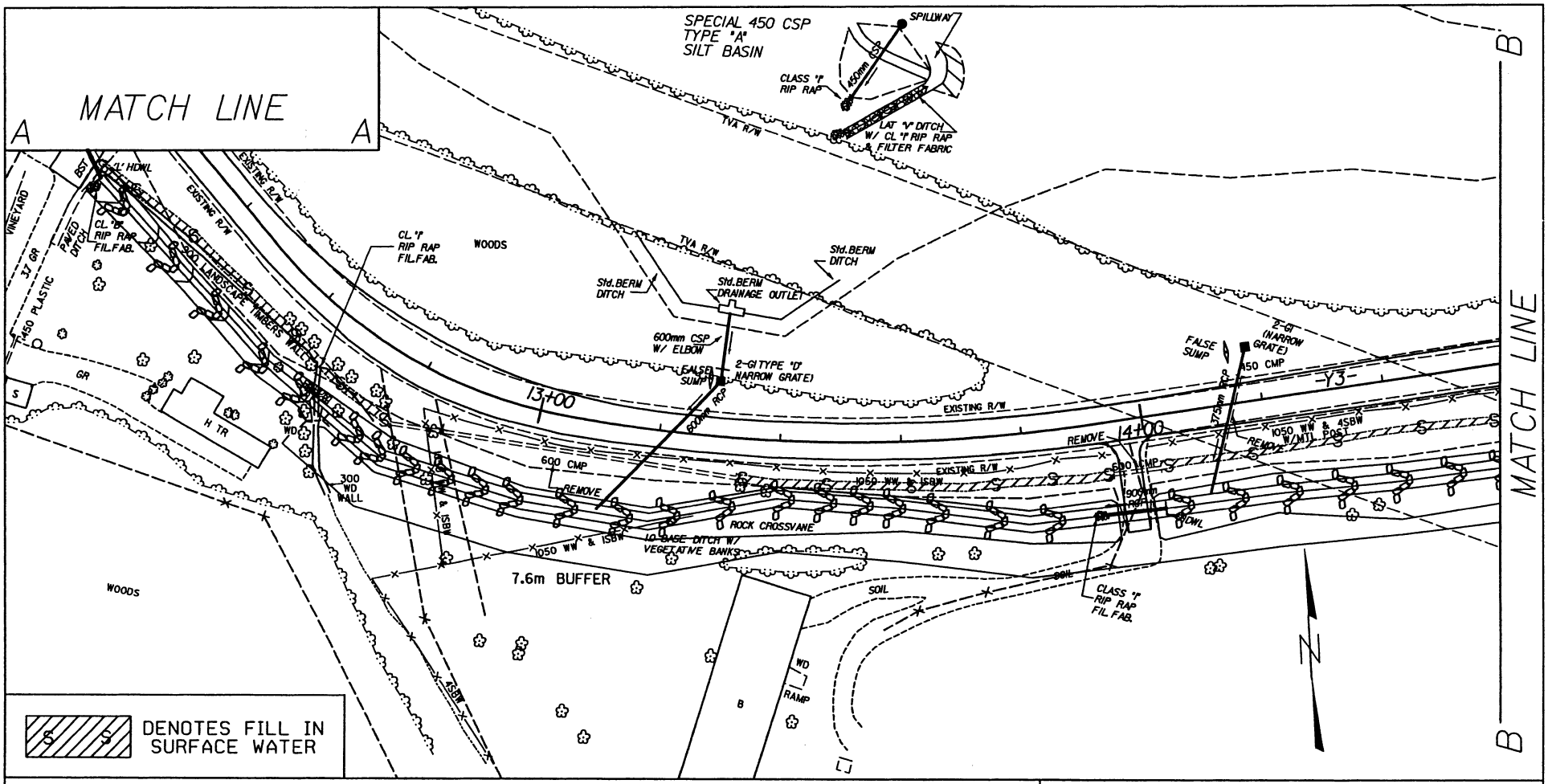
CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 18 OF 39

5/20/04



PLAN VIEW
STREAM
IMPACTS
SITE 11
SCALE 1:1000

NCDOT

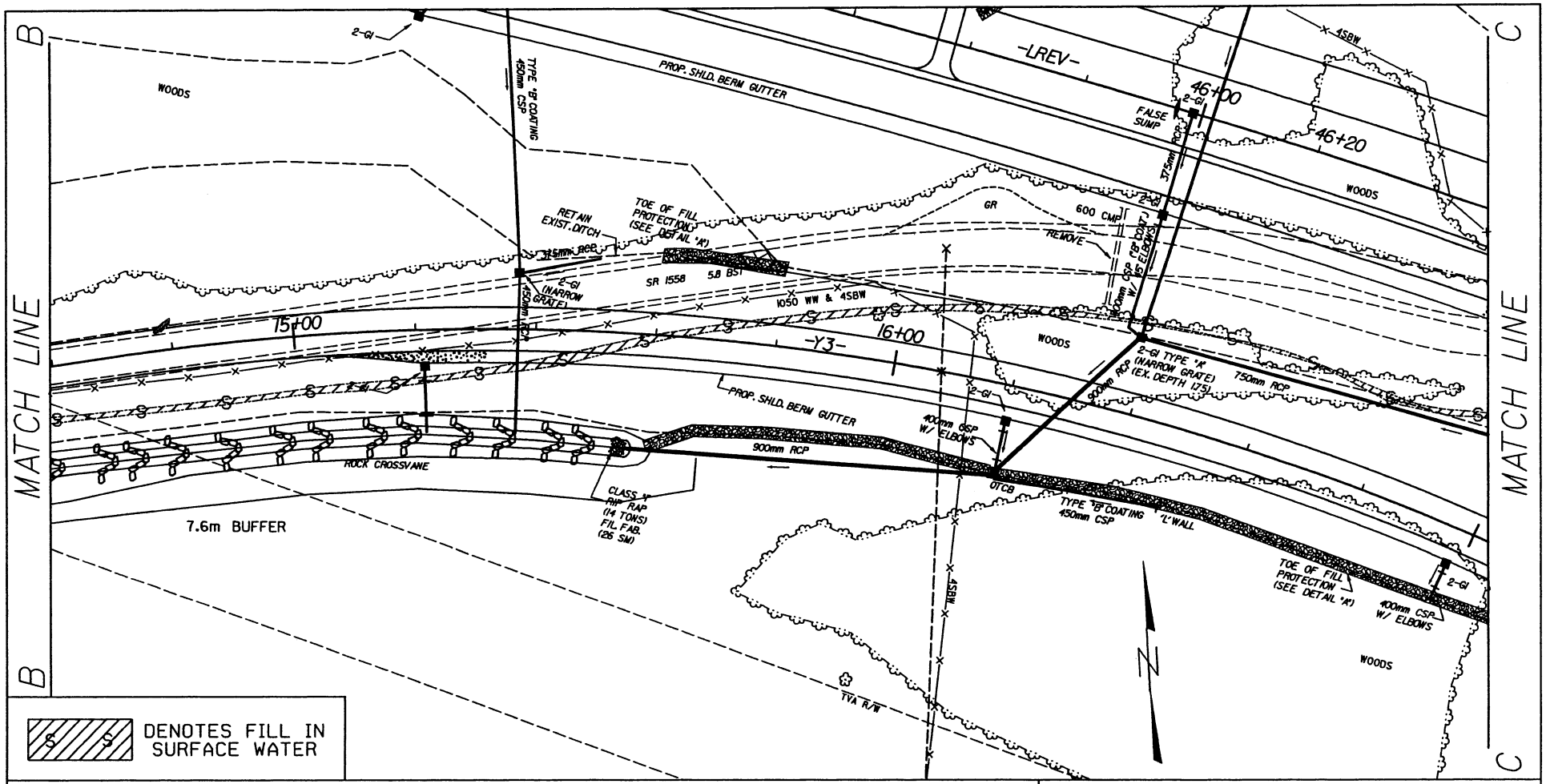
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 19 OF 39 **5/24/04**



PLAN VIEW
STREAM
IMPACTS
SITE 11
SCALE 1:1000

NCDOT

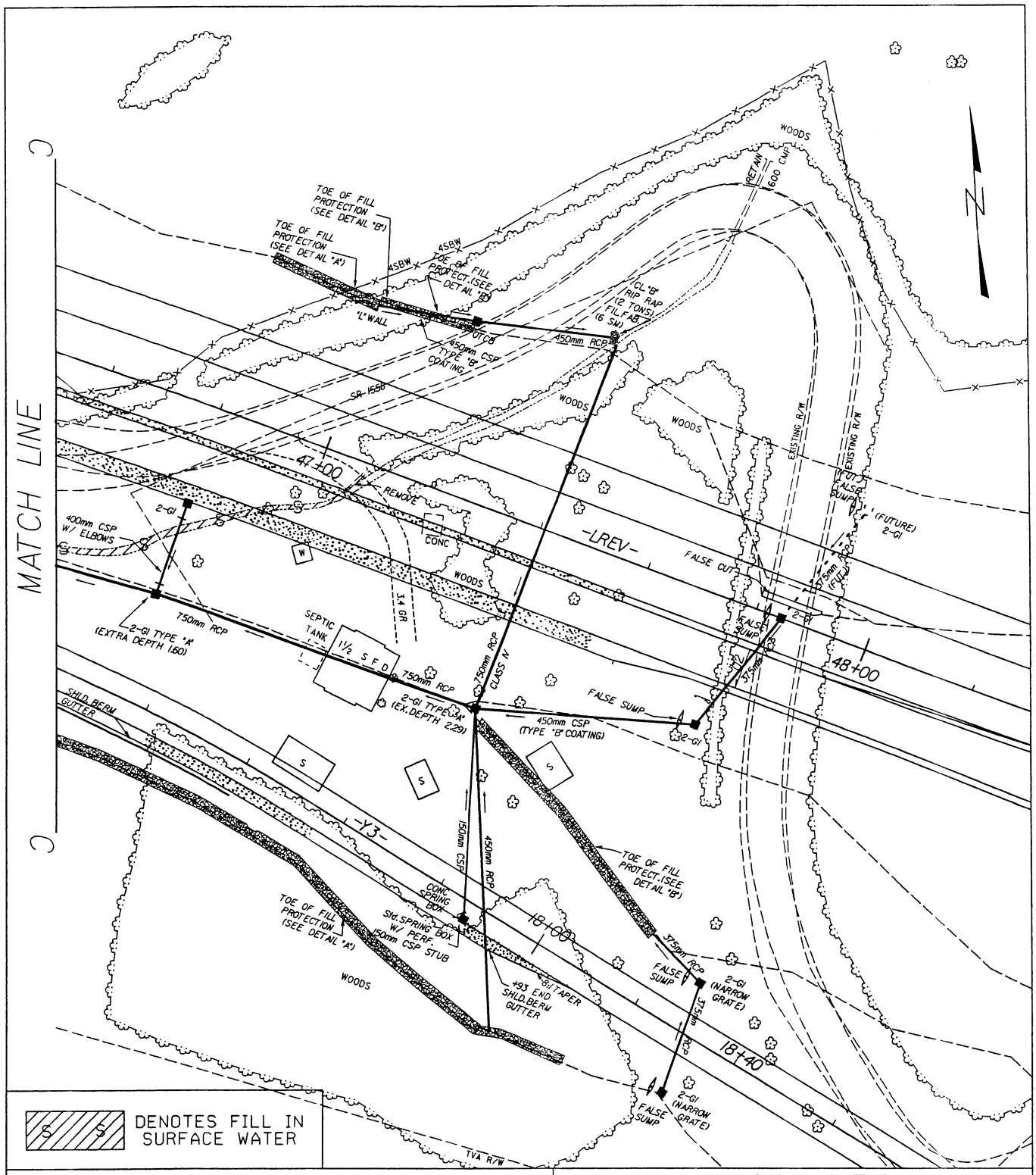
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 20 OF 39 **5/24/04**



PLAN VIEW STREAM IMPACTS SITE 11

SCALE - 1:1000

NCDOT

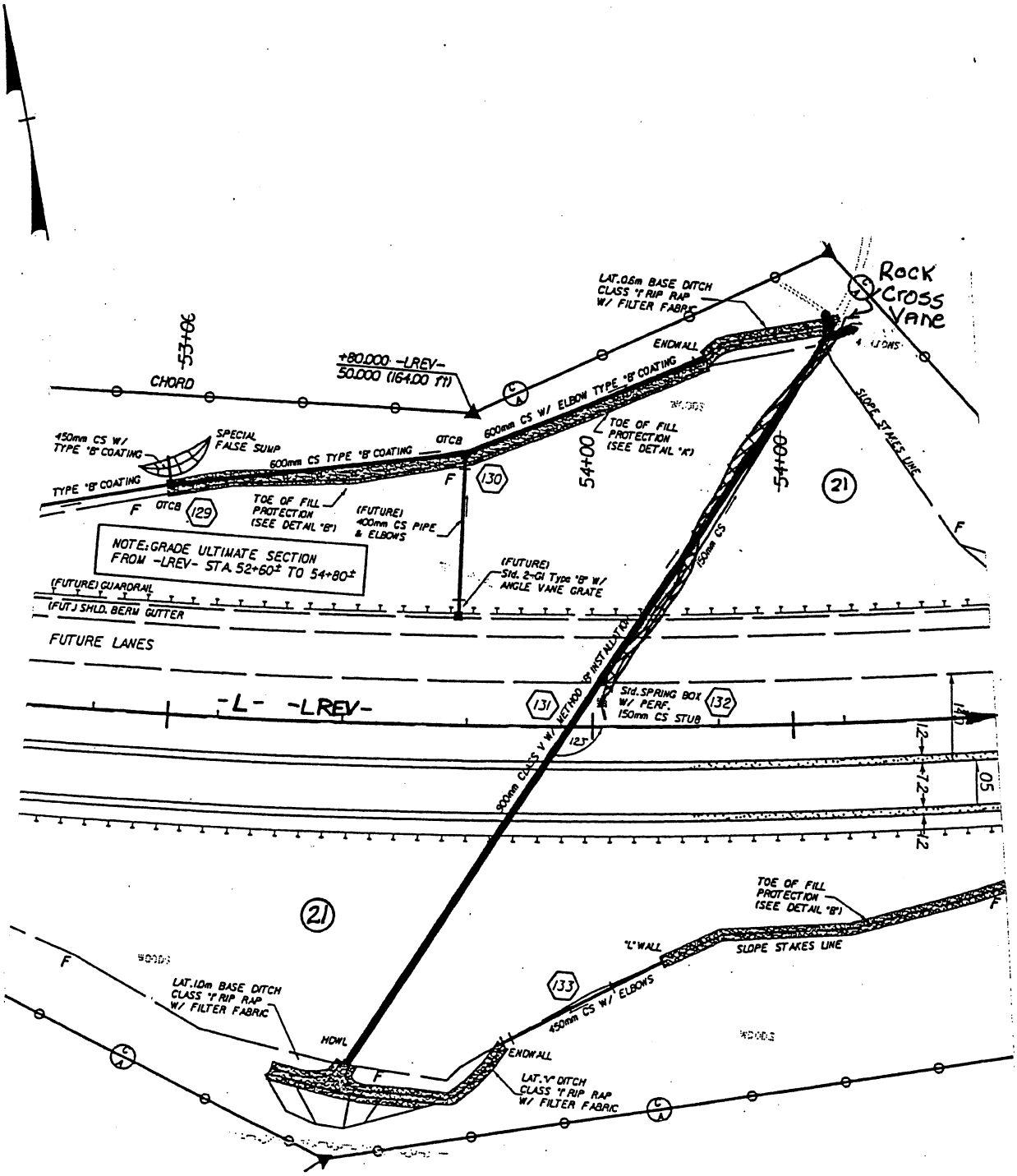
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 21 OF 39 5/20/04



SITE #12

SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

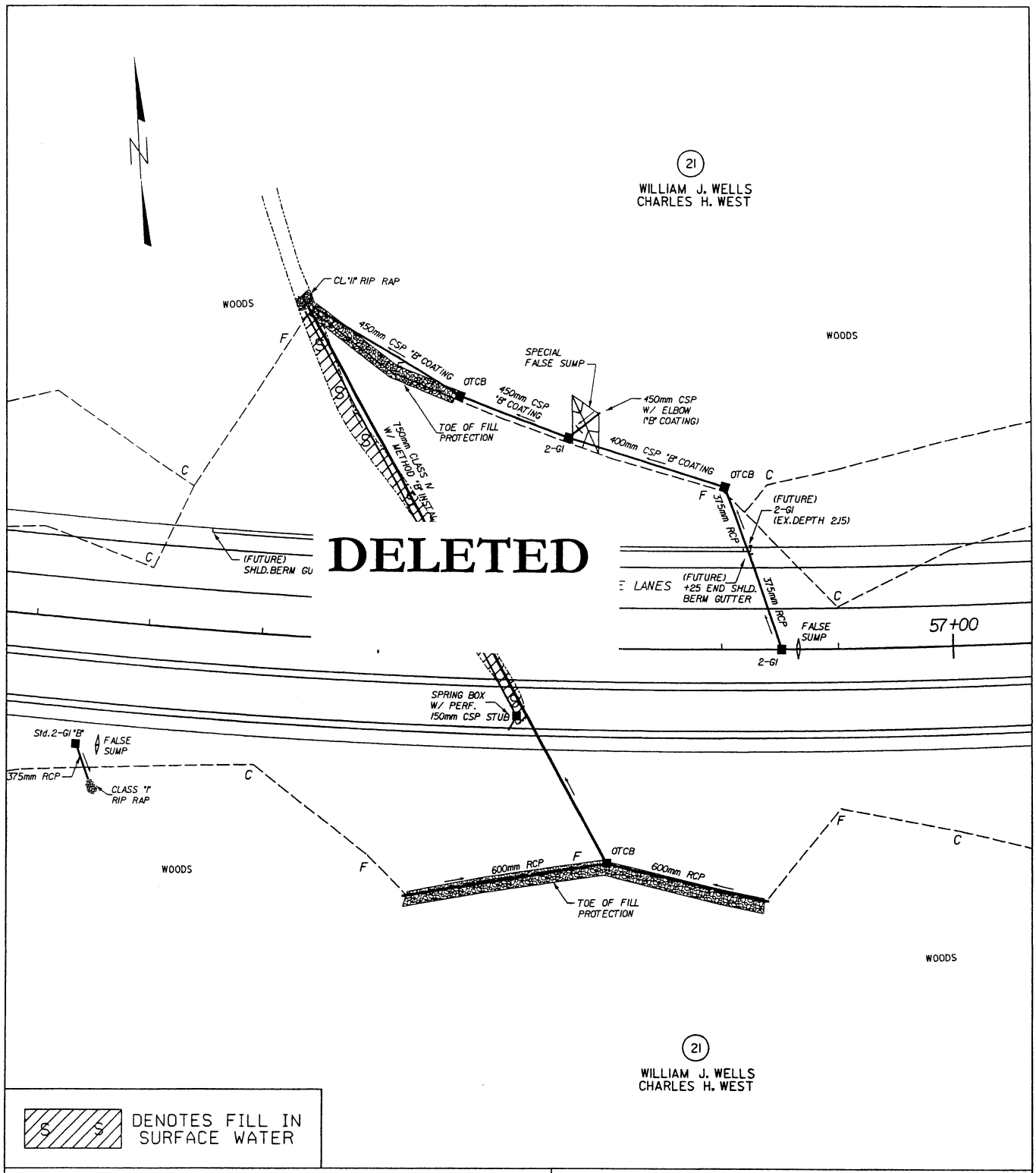
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 22 OF 39

2/25/04



PLAN VIEW STREAM IMPACTS SITE 13

SCALE - 1:1000

NCDOT

DIVISION OF HIGHWAYS

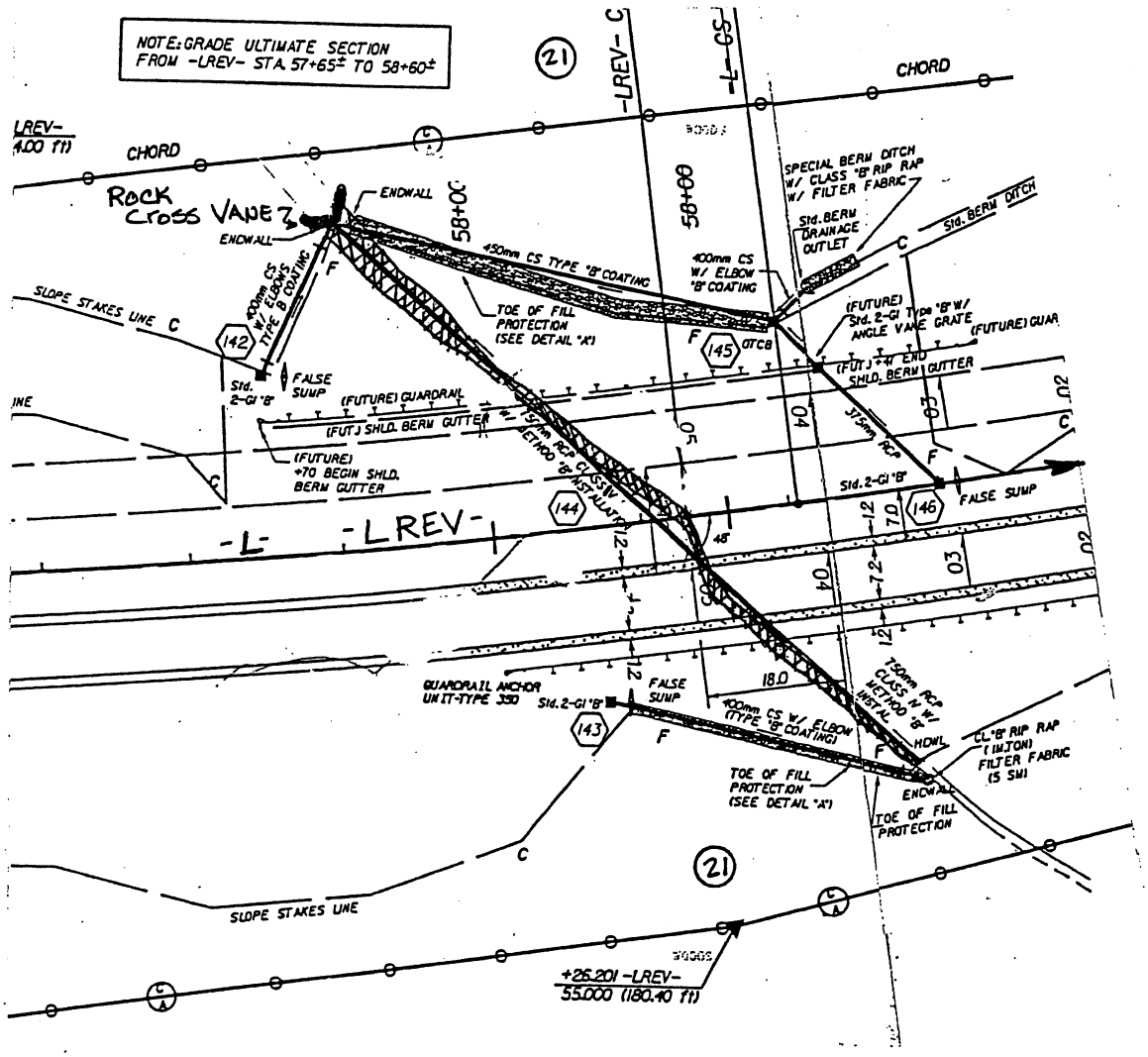
CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 23 OF 39

2/25/04



SITE #14

SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

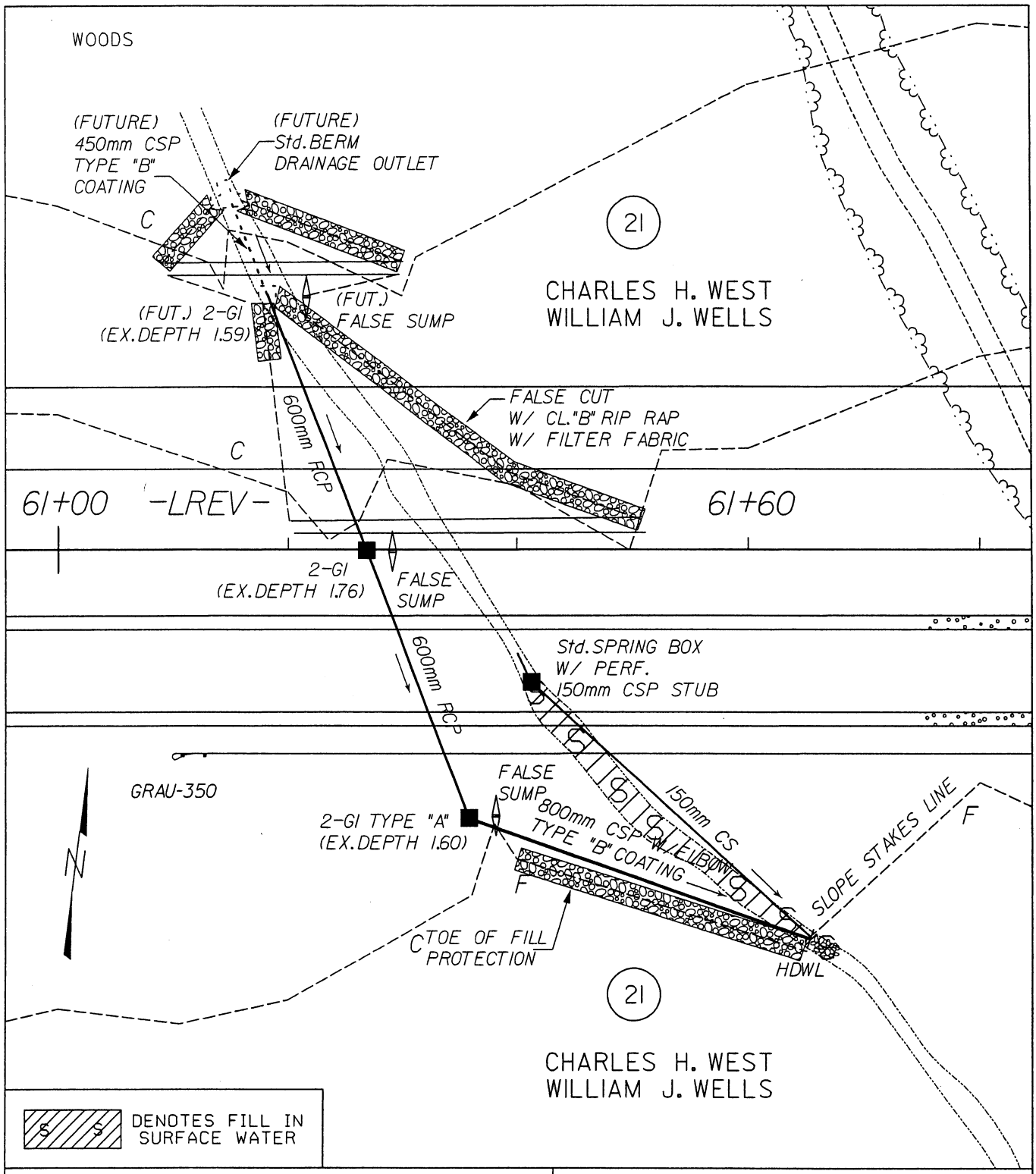
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 24 OF 39

2/25/04



PLAN VIEW STREAM IMPACTS SITE 15

SCALE - 1:500

NCDOT

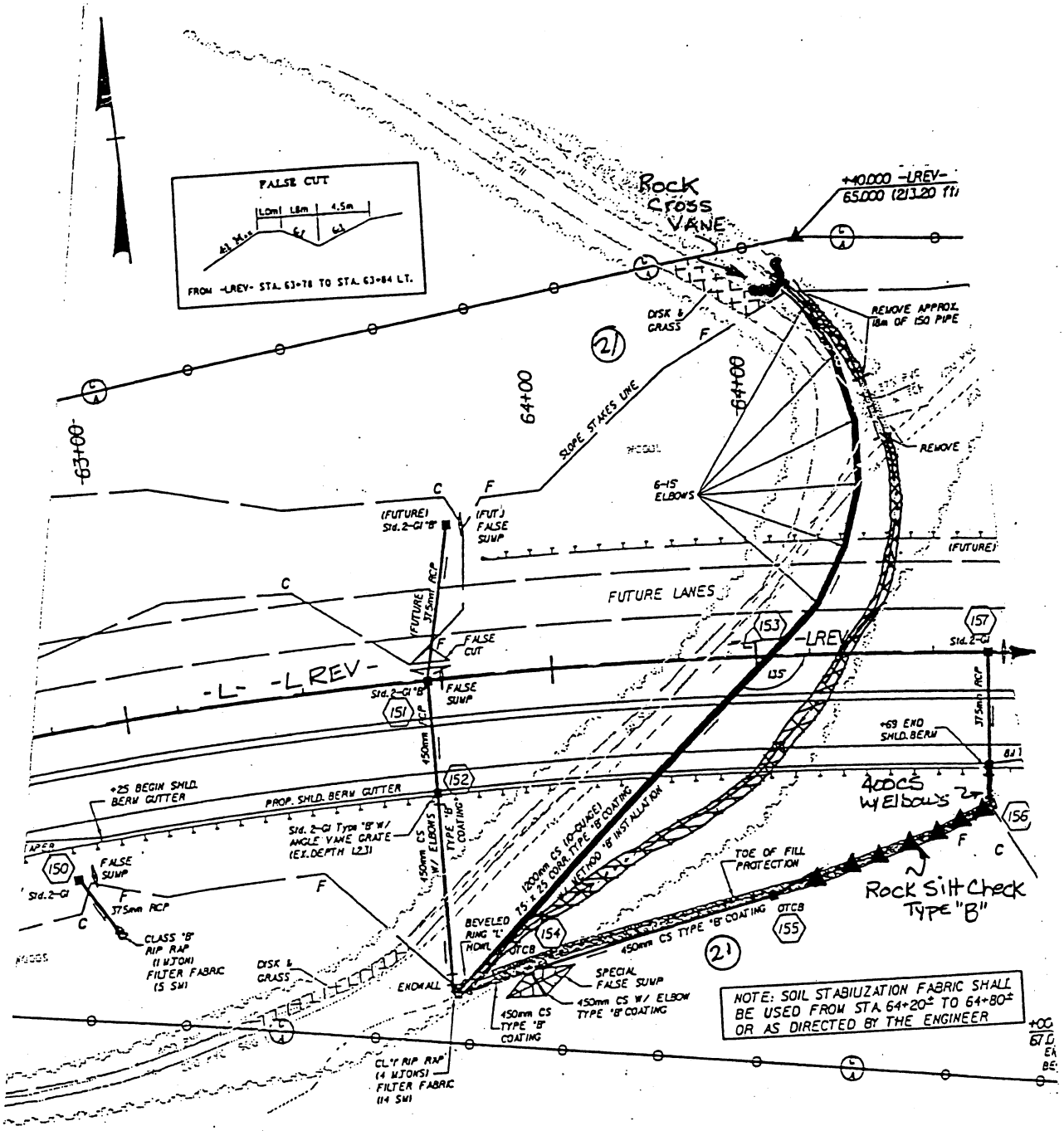
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 25 OF 39 **4/16/04**



SITE #16

SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

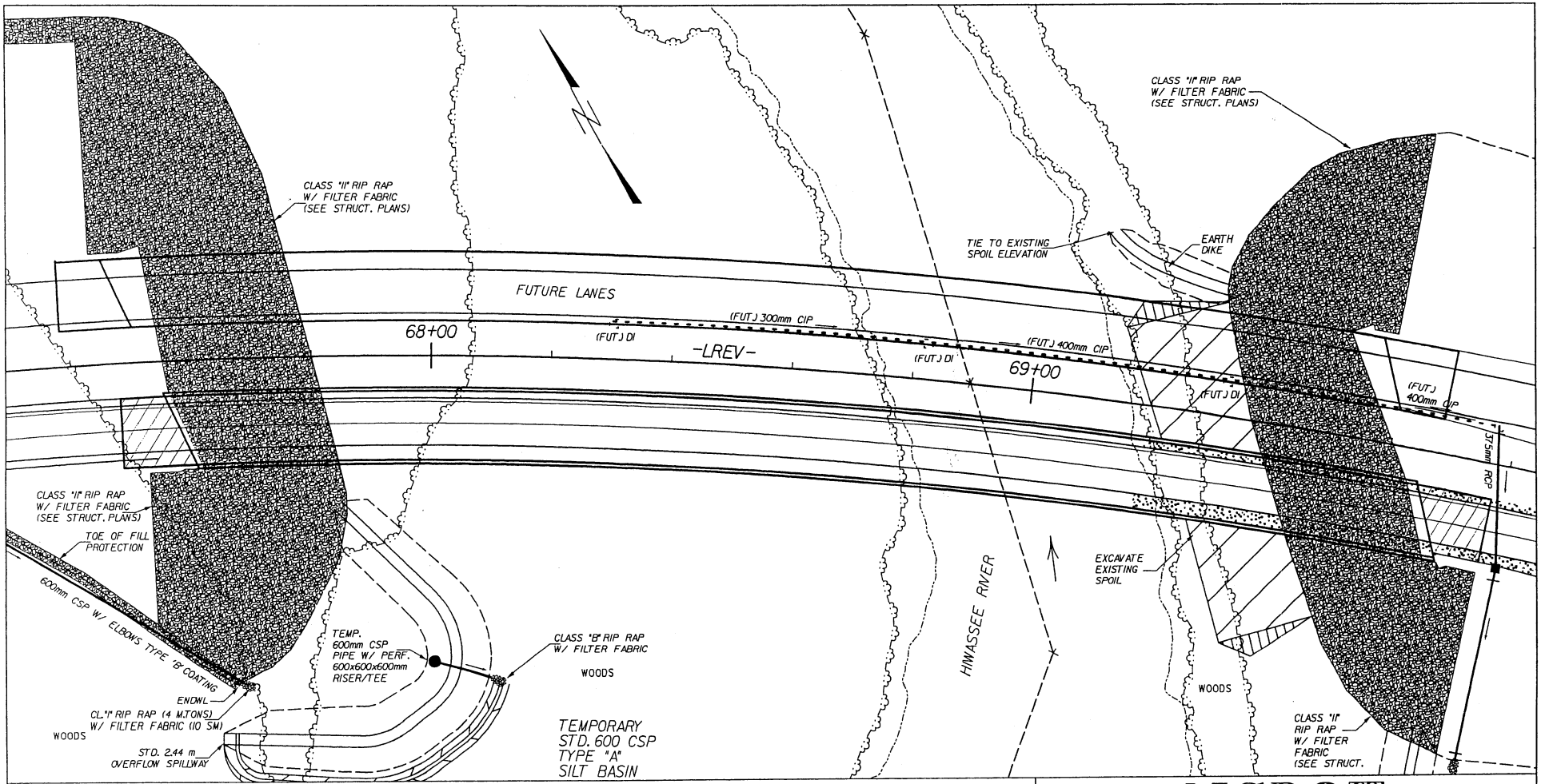
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 26 OF 39

2/25/04



PLAN VIEW
NO
IMPACTS
SITE 16A
SCALE 1:1000

NCDOT

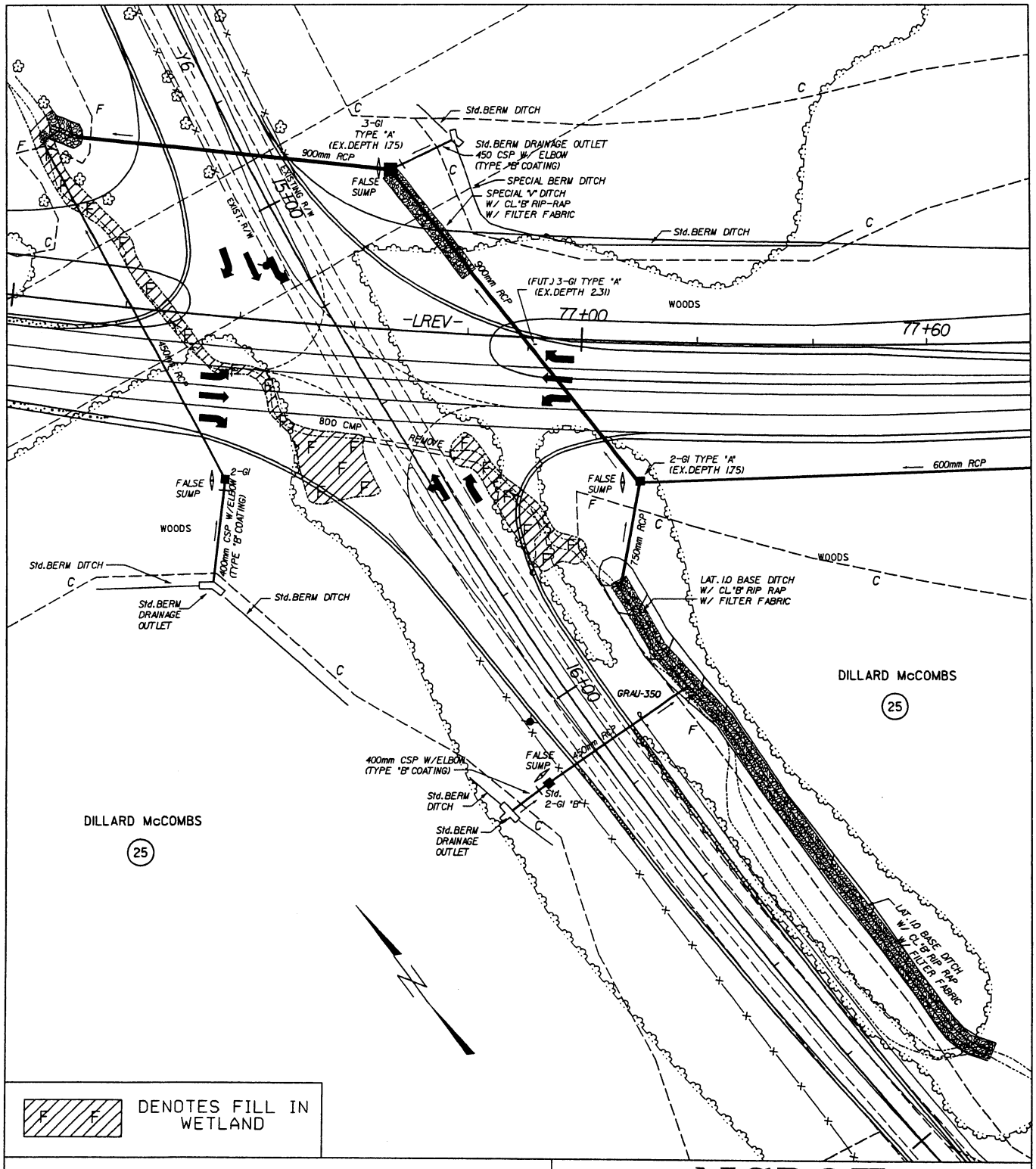
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 27 OF 39 7/1/04



PLAN VIEW WETLAND IMPACTS SITE 17

SCALE - 1:1000

NCDOT

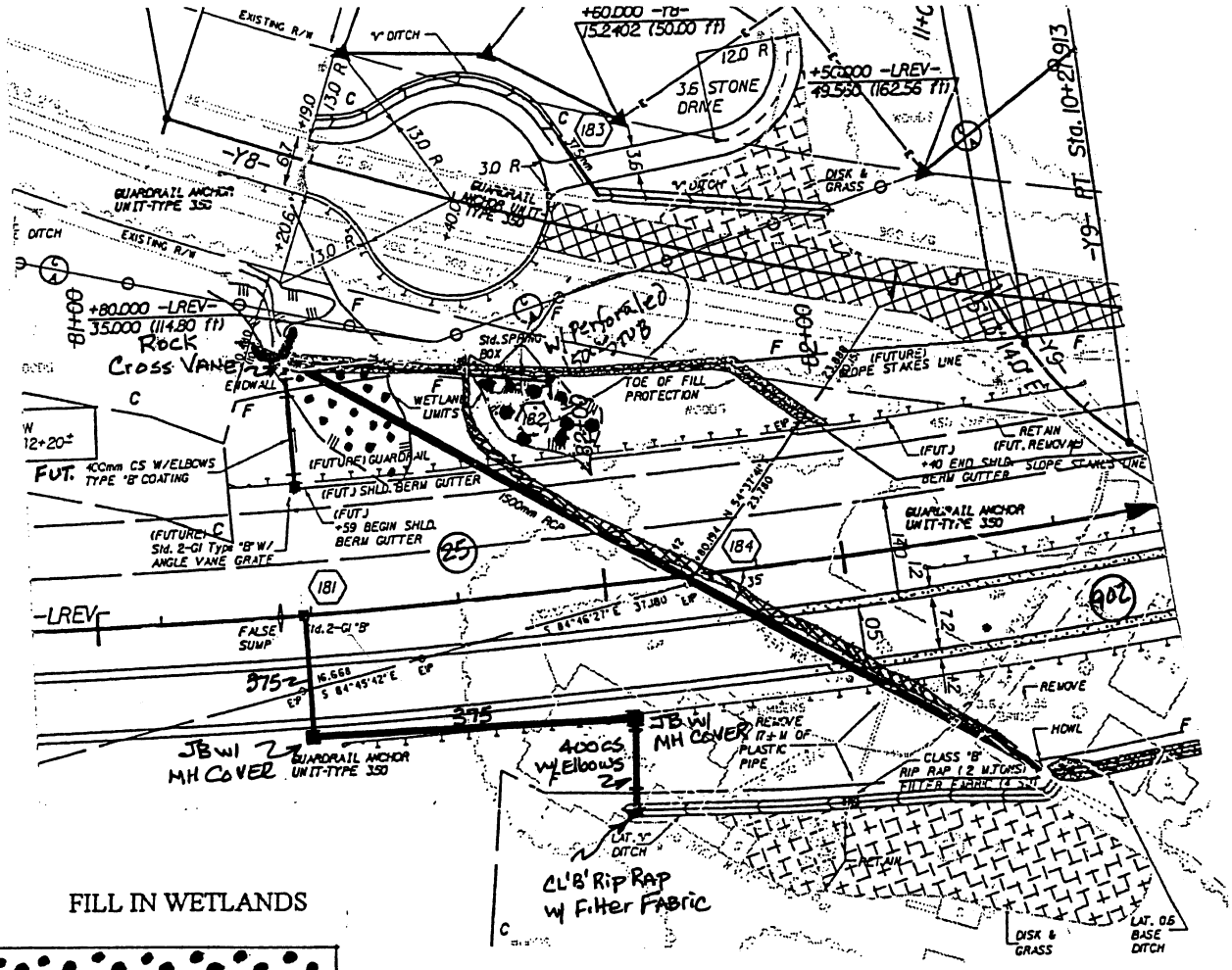
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 28 OF 39 **2/25/04**



FILL IN WETLANDS

SITE#18

SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

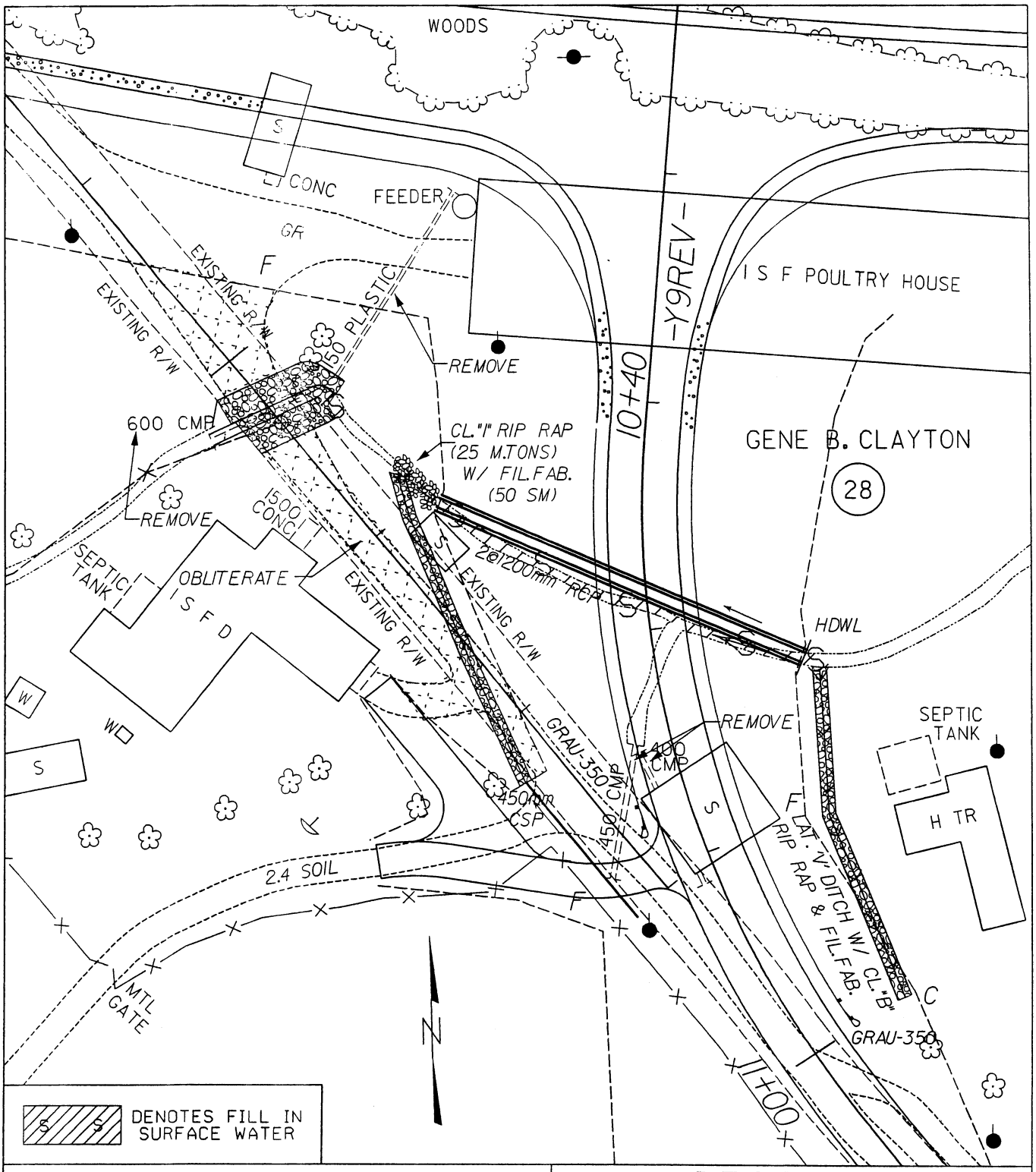
N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 29 OF 39 2/25/04



PLAN VIEW STREAM IMPACTS SITE 19

SCALE - 1:500

NCDOT

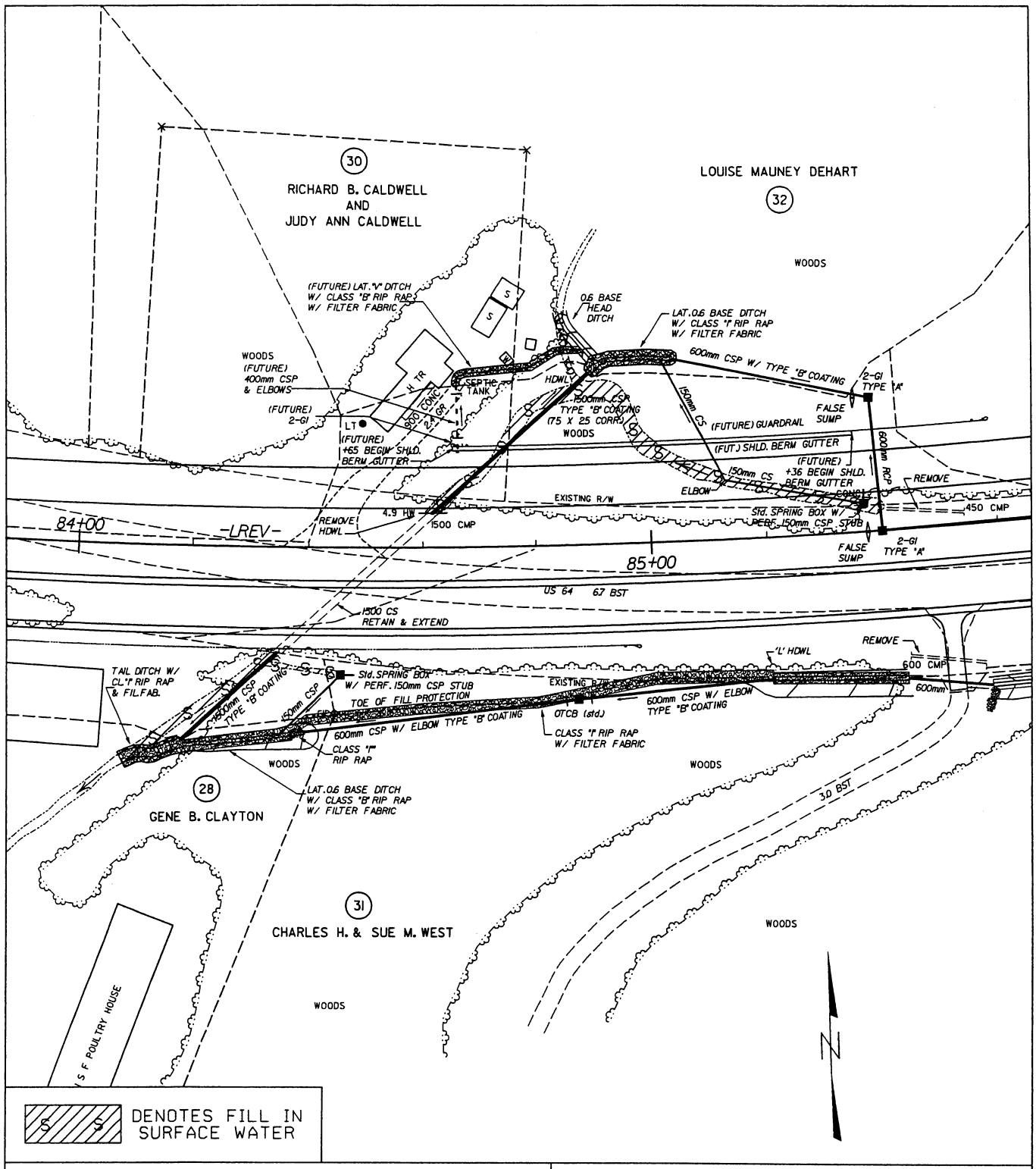
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 30 OF 39 **2/25/04**



PLAN VIEW
STREAM
IMPACTS
SITE 20
SCALE - 1:1000

NCDOT

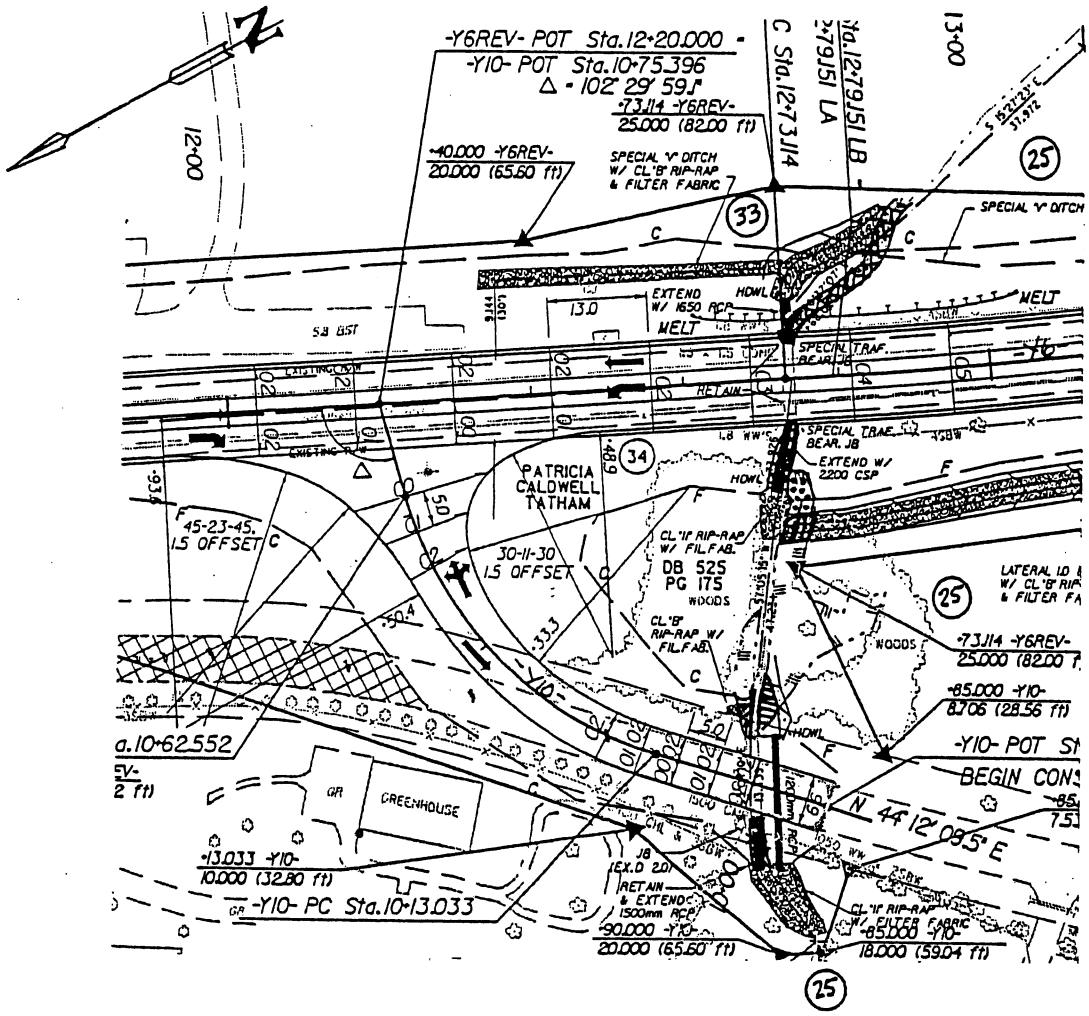
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 31 OF 39 **2/25/04**



SITE NO. 21 & SITE NO. 22

SCALE

0 10 20 30 40 50M

FILL IN SURFACE WATERS

EXCAVATION IN WETLANDS

FILL IN WETLANDS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 32 OF 39 JUNE 1997

PROPERTY OWNERS

NAMES AND ADDRESSES

SITE NO.	PARCEL NO.	NAMES	ADDRESSES
1	N/A	NCDOT	P.O. BOX 252011 RALEIGH, NC 27611
2	N/A	DELETED	
3	2Z	TENNESSEE VALLEY AUTHORITY	801 HIWASSEE ST. MURPHY, NC 28906
	4	TOWN OF MURPHY	P.O. BOX 130 MURPHY, NC 28906
4	2	TENNESSEE VALLEY AUTHORITY	801 HIWASSEE ST. MURPHY, NC 28906
	4	TOWN OF MURPHY	P.O. BOX 130 MURPHY, NC 28906
	5Z	W.A. SHERILL & LAWERENCE E. POSEY	4508 BANKSIDE CT. MARIETTA, GA 30066
5	2Z	TENNESSEE VALLEY AUTHORITY	801 HIWASSEE ST. MURPHY, NC 28906
	6	LAWERENCE & LINDA E. POSEY	4508 BANKSIDE CT. MARIETTA, GA 30066
5A	2Z	TENNESSEE VALLEY AUTHORITY	801 HIWASSEE ST. MURPHY, NC 28906

NCDOT

DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

 2/25/04

PROPERTY OWNERS

NAMES AND ADDRESSES

SITE NO.	PARCEL NO.	NAMES	ADDRESSES
5A	38	JAMES C. HILTON & HELEN HILTON	
6	2Z	TENNESSEE VALLEY AUTHORITY	801 HIWASSEE ST. MURPHY, NC 28906
7	2Z	TENNESSEE VALLEY AUTHORITY	801 HIWASSEE ST. MURPHY, NC 28906
8	9	L.F. & HELEN LOCHABY	501 HARSHAW RD. MURPHY, NC 28906
9	9	L.F. & HELEN LOCHABY	501 HARSHAW RD. MURPHY, NC 28906
10	9	L.F. & HELEN LOCHABY	501 HARSHAW RD. MURPHY, NC 28906
	10	DAVID & WILLIAM MURPHY	P.O. BOX 1033 MURPHY, NC 28906
	11	DAVID R. & WREN L. MURPHY	P.O. BOX 1033 MURPHY, NC 28906
	12	KINCAID HEIRS	587 HARSHAW RD. MURPHY, NC 28906
11	12	KINCAID HEIRS	587 HARSHAW RD. MURPHY, NC 28906

NCDOT

DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

 2/25/04

PROPERTY OWNERS

NAMES AND ADDRESSES

SITE NO.	PARCEL NO.	NAMES	ADDRESSES
11	13	JUD & EVELYN STILES	1094 HARSHAW RD. MURPHY, NC 28906
	14	RONALD EDWIN STILES	HARSHAW RD. MURPHY, NC 28906
	17	HUBERT WINSTON CRAIG	P.O. BOX 97 MURPHY, NC 28906
12	21	CHARLES H. WEST & WILLIAM J. WELL	P.O. BOX 129 MURPHY, NC 28906
13	21	CHARLES H. WEST & WILLIAM J. WELL	P.O. BOX 129 MURPHY, NC 28906
14	21	CHARLES H. WEST & WILLIAM J. WELL	P.O. BOX 129 MURPHY, NC 28906
15	21	CHARLES H. WEST & WILLIAM J. WELL	P.O. BOX 129 MURPHY, NC 28906
16	21	CHARLES H. WEST & WILLIAM J. WELL	P.O. BOX 129 MURPHY, NC 28906
17	25	DILLARD McCOMBS HEIRS	733 PLANTATION EST., DR.312 MATHEWS, NC 28105
18	25	DILLARD McCOMBS HEIRS	733 PLANTATION EST., DR.312 MATHEWS, NC 28105

NCDOT

DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

 2/25/04

PROPERTY OWNERS

NAMES AND ADDRESSES

SITE NO.	PARCEL NO.	NAMES	ADDRESSES
18	902	MURPHY CONGREGATION OF JEHOVAH'S WITNESSESS	US-64 & CLAYTON DR. MURPHY, NC 28906
19	28	GENE B. CLAYTON	148 CLAYTON RD. MURPHY, NC 28906
20	28	GENE B. CLAYTON	148 CLAYTON RD. MURPHY, NC 28906
	31	CHARLES H. & SUE M. WEST	P.O. BOX 129 MURPHY, NC 28906
	30	RICHARD & JUDY CALDWELL	RTE. 1 BOX 448 MURPHY, NC 28906
	32	LOUISE MAUNEY DEHART	P.O. BOX 584 MURPHY, NC 28906
21	25	DILLARD McCOMBS HEIRS	733 PLANTATION EST., DR.312 MATHEWS, NC 28105
	30	RICHARD & JUDY CALDWELL	RTE. 1 BOX 448 MURPHY, NC 28906
	33	RICHARD B. CALDWELL	RTE. 1 BOX 448 MURPHY, NC 28906
	34	PATRICIA CALDWELL TATHAM	RTE. 1 BOX 448 MURPHY, NC 28906

NCDOT

DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 36 OF 39 2/25/04

PROPERTY OWNERS

NAMES AND ADDRESSES

SITE NO.	PARCEL NO.	NAMES	ADDRESSES
22	25	DILLARD McCOMBS HEIRS	733 PLANTATION EST., DR.312 MATHEWS, NC 28105
	34	PATRICIA CALDWELL TATHAM	RTE. 1 BOX 448 MURPHY, NC 28906

NCDOT

DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 37 OF 39 2/25/04

WETLAND PERMIT IMPACT SUMMARY

Site No.	Station (From/To)	Structure Size / Type	WETLAND IMPACTS				SURFACE WATER IMPACTS				
			Fill In Wetlands (ha)	Temp. Fill In Wetlands (ha)	Excavation In Wetlands (ha)	Mechanized Clearing (Method III) (ha)	Fill In SW (Natural) (ha)	Fill In SW (Pond) (ha)	Temp. Fill In SW (ha)	Existing Channel Impacted (m)	Natural Stream Design (m)
1	10+80 -LC1B- RT.	150 CS	0.05		<.01*		<.01*			20	
2	DELETED THIS SITE										
3	14+60 -LC1B-	NONE	0.07								
3A	15+60 -L1CB-	RIP RAP DITCH			0.09						
4	14+80 -LC1B-	750	0.01				0.03			108	
4A	16+00 -L1CB-	NON DESTRUCTIVE WORK BRIDGE							<.01*		
5	12+64 -Y1REV-	450 CS					<.01*			34.3	
5A	18+30 -LC1B-	1200					0.05			158	
6	24+00 -LC1B-	TEMPORARY WORK BRIDGE							0		
7	28+90 -LREV- RT.	800 CS					<.01*			6.6	
8	34+80 -LREV- RT.	150 CS					<.01*			27.2	
9	35+50 -LREV-	2 @ 2.4 X 2.4 RCBC					0.1			296	
10	36+50 -LREV-	750					0.02			221	
11	10+20 TO 15+50 -Y3- RT.	MULTIPLE PIPES	0.02		0.02		0.06		<.01*	487	244
12	54+20 -LREV- LT.	900					<.01*			67	
13	DELETED THIS SITE										
14	58+00 -LREV-	750					0.01			109	
15	61+40 -LREV-	150 CS					0.01			38	
16	64+40 -LREV-	1200 CS					0.01			138	
16A	68+00 -LREV-	BRIDGE									
17	76+40, 76+80 RT. -LREV-	900	0.05								
18	82+00 -LREV-	1500	0.03				0.01			116	
19	10+60 -Y9REV-	2 @ 1200					<.01*			46	
20	85+00 -LREV-	1500 CS					0.03			153.7	
21	12+75 -Y6-	1 @ 1.5 X 1.5 CONCRETE BOX	<.01*		<.01*		<.01*			32	
22	10+00 -Y10-	1 @ 1200, 1 @ 1500					<.01*			18	
TOTALS:			0.23	0	0.11	0	0.33	0	0	2075.8	244

* Used 0 in place of <.01 when calculating totals.

NCDOT

DIVISION OF HIGHWAYS
CHEROKEE COUNTY
PROJECT 8.1910203 (R-977A)
PROPOSED US 64 RELOCATION FROM
EXISTING US 19-74-129 IN MURPHY
TO EAST OF NC 141 IN PEACHTREE

SHEET 38 OF 39 8/17/2004

Form Revised 3/22/01

WETLAND PERMIT IMPACT SUMMARY

Site No.	Station (From/To)	Structure Size / Type	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.)
1	10+80 -LC1B- RT.	150 CS	0.12		<.01*		<.01*			66	
2	DELETED THIS SITE										
3	14+60 -LC1B-	NONE	0.17								
3A	15+60 -L1CB-	RIP RAP DITCH			0.22						
4	14+80 -LC1B-	750	0.02				0.07			354	
4A	16+00 -L1CB-	NON DESTRUCTIVE WORK BRIDGE							<.01*		
5	12+64 -Y1REV-	450 CS					<.01*			113	
5A	18+30 -LC1B-	1200					0.12			518	
6	24+00 -LC1B-	TEMPORARY WORK BRIDGE							0		
7	28+90 -LREV- RT.	800 CS					<.01*			22	
8	34+80 -LREV- RT.	150 CS					<.01*			89	
9	35+50 -LREV-	2 @ 2.4 X 2.4 RCBC					0.25			971	
10	36+50 -LREV-	750					0.05			725	
11	10+20 TO 15+50 -Y3- RT.	MULTIPLE PIPES	0.05		0.05		0.15		<.01*	1598	801
12	54+20 -LREV- LT.	900					<.01*			220	
13	DELETED THIS SITE										
14	58+00 -LREV-	750					0.02			358	
15	61+40 -LREV-	150 CS					0.02			125	
16	64+40 -LREV-	1200 CS					0.02			453	
16A	68+00 -LREV-	BRIDGE									
17	76+40, 76+80 RT. -LREV-	900	0.12								
18	82+00 -LREV-	1500	0.07				0.02			381	
19	10+60 -Y9REV-	2 @ 1200					<.01*			151	
20	85+00 -LREV-	1500 CS					0.07			504	
21	12+75 -Y6-	1 @ 1.5 X 1.5 CONCRETE BOX	<.01*		<.01*		<.01*			105	
22	10+00 -Y10-	1 @ 1200, 1 @ 1500					<.01*			59	
TOTALS:			0.55	0	0.27	0	0.79	0	0	6812	801

* Used 0 in place of <.01 when calculating totals.

Form Revised 3/22/01

NCDOT

DIVISION OF HIGHWAYS
CHEROKEE COUNTY
PROJECT 8.1910203 (R-977A)
PROPOSED US 64 RELOCATION FROM
EXISTING US 19-74-129 IN MURPHY
TO EAST OF NC 141 IN PEACHTREE

8/17/2004

APPENDIX B

Natural Stream Design & Special Culvert Design Drawings

Natural Channel Design Summary
Unnamed Tributary to Hiwassee River
TIP No. R-0977 A
State Project No. 34357.2.1
Cherokee County, North Carolina

Prepared by Mulkey Engineers and Consultants **May 10,2004**

This natural channel design summary is presented to the North Carolina Department of Transportation (NCDOT) as part of on-site compensatory mitigation for the proposed relocation of US 64 in Cherokee County. The relocation of US 64 extends from US 19-74-129 in Murphy to East of NC 141 in Peachtree. As part of construction efforts, approximately 1,150 linear feet (350 meters) of an unnamed tributary (UT) to Hiwassee River situated immediately east of Murphy and parallel to SR 1558 (Harsaw Road) will be relocated southward from its existing location outside of the proposed fill limits. The UT has been identified as a perennial stream and is part of the Hiwassee River Subbasin 04-05-02 (USGS Hydrologic Unit 06020002). A morphological table, complete with existing channel, reference reach, and proposed reach characteristics is attached. In addition, proposed design and detail sheets are also included with this summary. The project is within the Mountain physiographic province.

The headwaters associated with the UT originate near the intersection of SR 1558 and SR 1561, near the project area. The UT flows in a westerly direction approximately 0.75 miles (1.2 kilometers) before converging with Hiwassee River. The drainage area at the project site covers approximately 0.14 square miles (0.36 square kilometers). The reach is rural with evidence of previous and on-going disturbances, particularly vegetation maintenance. The proposed project will require stream relocation to the south due to existing fill slope design requirements. Overall stream length will be reduced and slope will be increased in order to correctly align the new channel with its modified valley type. Natural channel design methodologies are proposed for this relocation.

Existing Channel

A 1143-foot (348-meter) section of the single thread natural channel associated with the UT to Hiwassee River was surveyed during April 2004. This section was located near Sta. 13+00 –Y3- near the proposed US 64 bridge over SR 1558. The surveyed reach exhibited channel characteristics similar to a B4 stream type, as noted by the Rosgen Classification of Natural Rivers. The B4 stream type exhibits low to moderate sinuosities, moderate channel gradients, and moderate channel width/depth ratios. This stream type is typically considered relatively stable due to its low sediment supply (Rosgen and Silvey, 1998); however, no natural pools were observed during the existing channel surveys. Existing conditions were not typical of a stable B4 stream type due to over widening of the channel. Areas of significant aggredation were observed in the existing channel, to the extent that no defined channel was present in several areas. The UT exhibited a bankfull cross sectional area of 5.8 sq. ft (0.54 sq. m), an average slope of 3.69%, and a D50 of 17.8 mm. A detailed summary of existing channel conditions is presented in attached morphological table.

Reference Reach

Due to the existing, unstable condition of the UT, a stable stream (Big Tuni Creek) outside of the project area was selected as the reference reach. This channel was selected based on its watershed components, stream type, and other general characteristics. The reference reach channel is situated in Clay County and classifies as a B4a. The channel is also within the Hiawassee River Basin. It exhibits a drainage area of 2.85 sq. mi (7.38 sq. km) and a bankfull cross sectional area of 38.4 sq. ft. (3.56 sq. m). Based on surveys, the channel is stable and exhibits very low bank height ratios. Its valley characteristics are very comparable with the existing channel. Little to no bank erosion was noted

during the survey. A detailed summary of reference conditions are also presented in the attached morphological table.

Proposed Channel

The proposed channel was based on dimensionless ratios derived from the reference reach survey and data interpretation. The bankfull width will be decreased from 10.8 ft (3.29 m) to 9.2 ft (2.80 m) and the bankfull mean depth will be increased from 0.50 ft (0.15 m) to 0.60 ft (0.18 m). As a result, the width/depth ratio will decrease from the existing 20.0 to a proposed 15.3 ratio. An increase in both the bankfull mean velocity and bankfull discharge is anticipated. The design stream will exhibit additional floodprone area; however, due to site constraints and the B4 channel type, no meanders are proposed. Slopes will be slightly increased due to the loss of overall stream length; however, energy will be dissipated via step/pool morphology characteristic with the B stream type. Rock cross vanes will be the primary method influencing the step/pool morphology. These cross vanes will be established throughout the channel in riffle sections and used to provide grade control, center the thalweg, and protect the stream banks on both sides of the new channel until vegetation is established. The cross vanes will also decrease shear stresses throughout the reach. The riparian zone adjacent to the channel will be planted with native vegetation conducive to wetter, floodplain areas.

Proposed channel stabilization characteristics are presented on the attached detail sheet. It is anticipated that the riparian zone will be planted with native trees and shrubs above bankfull depth and herbaceous species within the channel.

Sediment Transport

Based on pebble counts and bar samples taken along the existing channel, the D50 averages 17.8 mm and the D84 averages approximately 59 mm. The existing channel exhibits a critical shear stress of 1.20 lbs/ft^2 which may entrain up to a 95 mm particle. Based on the design, the proposed channel will exhibit a critical shear stress of 1.4 lbs/ft^2 entraining up to a 140 mm particle. The largest particle found upstream of the relocation was 135 mm. Entrainment calculations on the existing channel indicate aggredation and the bankfull shear stress analysis validates the entrainment. The proposed channel will have a lower width/depth ratio than the existing channel to improve sediment transport. Entrainment calculations on the proposed channel indicate the design depth and slope will neither stimulate degradation nor aggredation. The bankfull shear stress in the proposed channel indicates adequate power to move the largest particle. The proposed cross vanes will assist with energy dissipation, thus reducing the potential for degradation. In addition, these cross vanes, in combination with native plantings, will significantly reduce bank erosion through this reach.

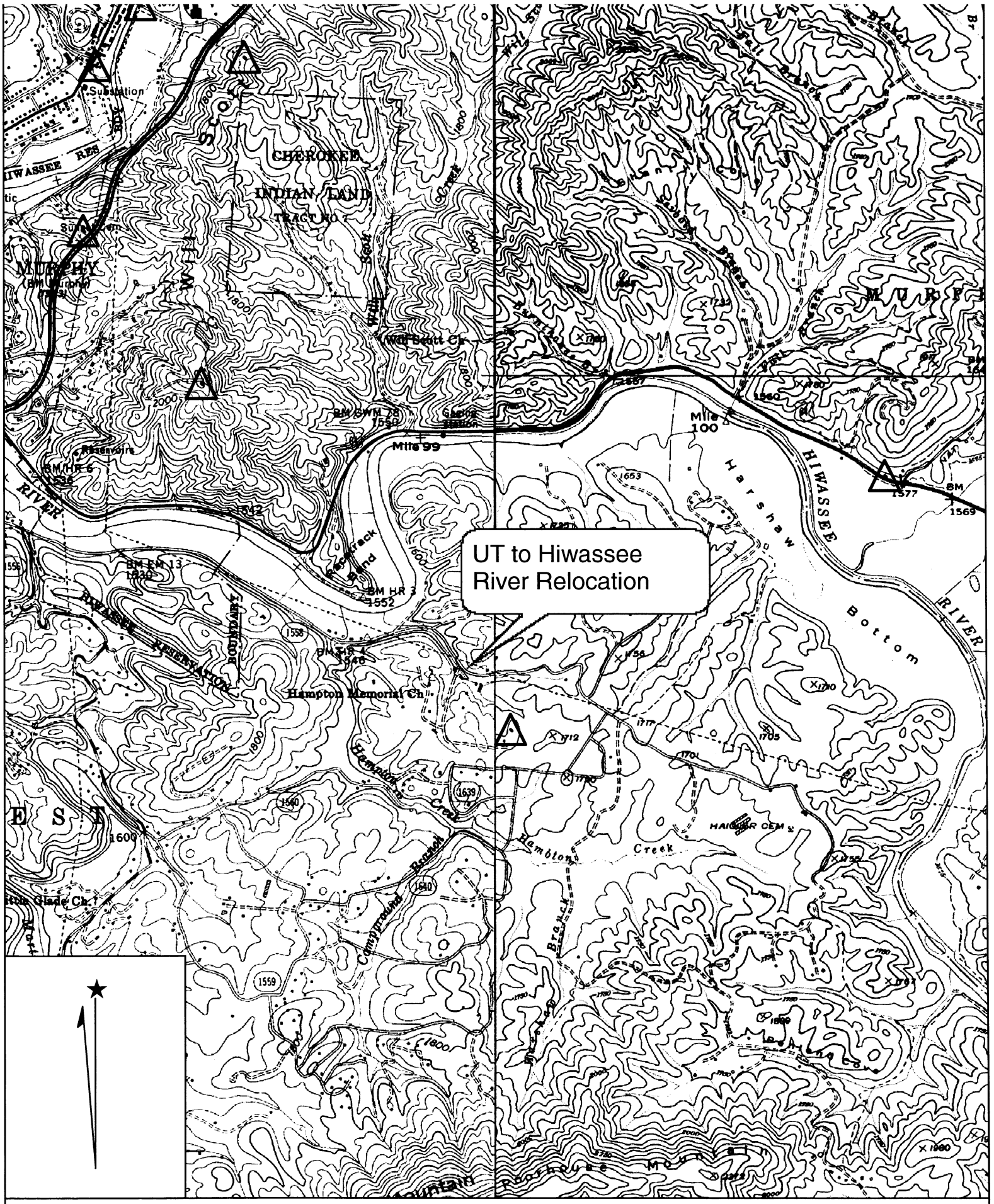
References

North Carolina Department of Environment and Natural Resources (NCDENR), 2000. Water Quality Basinwide Assessment Report, Hiwassee River Basin

Rosgen, D. and L. Silvey, 1998. Field Guide for Stream Classification. Wildland Hydrology, Inc.

Morphological Measurement Table - UT to Hiwassee River

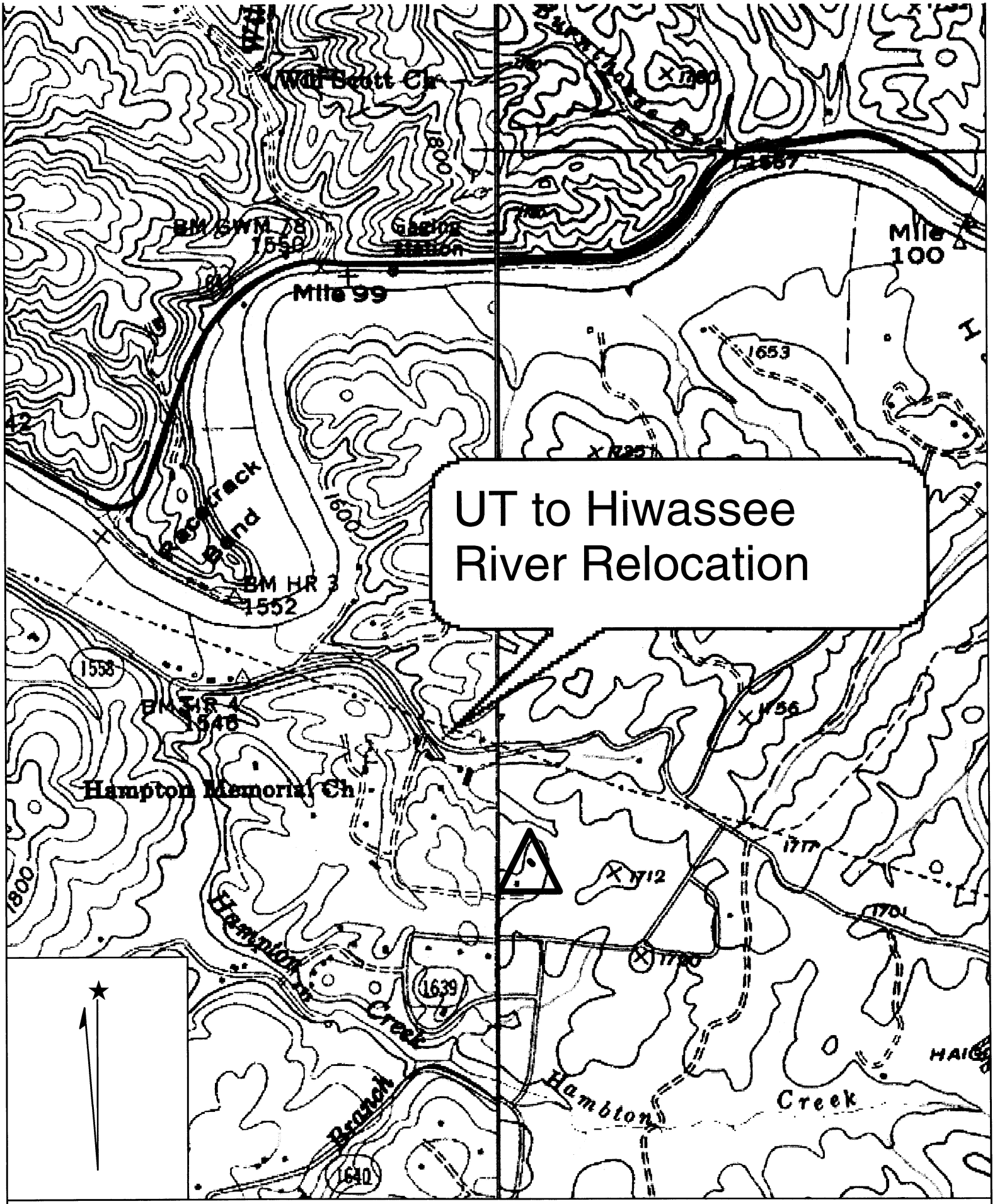
Variables	Existing Channel	Proposed Reach	USGS Station	Reference Reach
1. Stream type	B4	B4		B4a
2. Drainage area	0.14 sq. mi.	0.14 sq. mi.		2.85 sq. mi.
3. Bankfull width	10.8 ft.	9.2 ft.		29.5 ft.
4. Bankfull mean depth	0.5 ft.	0.6 ft.		1.3 ft.
5. Width/depth ratio	21.6	15.3		22.7
6. Bankfull cross-sectional area	5.8 sq. ft	5.7 sq. ft.		38.4 sq. ft.
7. Bankfull mean velocity	3.85 fps	4.9 fps		
8. Bankfull discharge, cfs	22.3 cfs	27.9 cfs		
9. Bankfull max depth	1.1 ft.	0.84 ft.		1.9 ft.
10. Width of floodprone area	18.0 ft.	12.6 ft.		45.0 ft.
11. Entrenchment ratio	1.7	1.4		1.5
12. Meander length	Not applicable	Not applicable		210.0 ft.
13. Ratio of meander length to bankfull width	Not applicable	Not applicable		7.1
14. Radius of curvature	Not applicable	Not applicable		84.3 ft.
15. Ratio of radius of curvature to bankfull width	Not applicable	Not applicable		2.9
16. Belt width	40.0 ft.	25.0 ft.		76.5 ft.
17. Meander width ratio	Not applicable	Not applicable		2.6
18. Sinuosity (stream length/valley length)	1.0	1.0		1.14
19. Valley slope	0.037 ft./ft.	0.04 ft./ft.		0.0485 ft./ft.
20. Average slope	0.037 ft./ft.	0.04 ft./ft.		0.0440 ft./ft.
21. Pool slope	Not applicable	0.0200 ft./ft.		0.0200 ft./ft.
22. Ratio of pool slope to average slope	Not applicable	0.50		0.6
23. Maximum pool depth	Not applicable	1.6 ft.		3.2 ft.
24. Ratio of pool depth to average bankfull depth	Not applicable	2.6		2.6
25. Pool width	Not applicable	9.2 ft.		23.1 ft.
26. Ratio of pool width to bankfull width	Not applicable	1.0		0.7
27. Pool to pool spacing	Not applicable	24.6 ft.		59.1 ft.
28. Ratio of pool to pool spacing to bankfull width	Not applicable	2.7		1.9



Name: PEACHTREE
Date: 4/29/2004
Scale: 1 inch equals 2000 feet

Location: 035° 04' 23.33" N 083° 59' 59.89" W

Copyright (C) 1998, Maptech, Inc.



Name: PEACHTREE
Date: 4/29/2004
Scale: 1 inch equals 1000 feet

Location: 035° 04' 23.33" N 083° 59' 59.89" W

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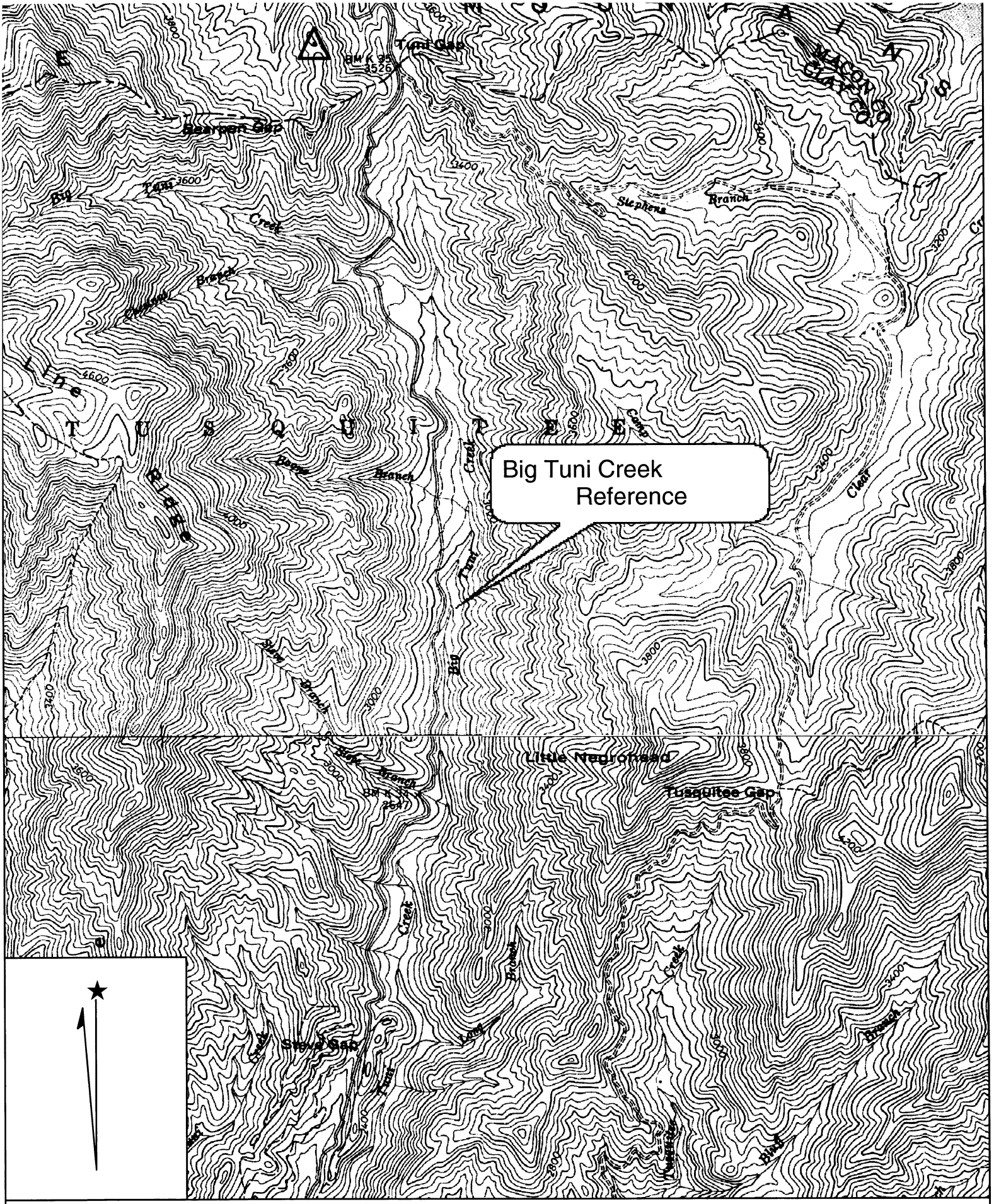

Name: TOPTON
Date: 4/29/2004
Scale: 1 inch equals 2000 feet

Location: 035° 07' 52.46" N 083° 41' 23.55" W

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Entrainment Calculation Form

Project:	R-977A (Existing)	**Location:**	Cherokee County
Stream:	UT to Hiwassee River	**Reach:**	
Date:	5/6/2004	**Observers:**	GLS, HB

Value	Variable	Definition				
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872				
40.5	di mm	D50 from	Riffle	or	Pavement*	*Choose
23	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0509	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
135	mm	Largest Bar Sample Particle in mm				
0.44	Di ft	Largest Bar Sample Particle in ft				
0.0369	Se ft/ft	Bankfull Water Surface Slope				
1.01	dr ft	Bankfulll Mean Depth Required				
0.50	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)				
de/dr=	0.50	if = 1	<1		>1	
Choose one:		Stable	aggrading		Degrading	
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.44	Di ft	Largest Bar Sample Particle				
0.50	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)				
0.0744	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	0.50	if = 1	<1		>1	
Choose one:		Stable	aggrading		Degrading	
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
0.53	R=A/Wp					
5.8	A sq ft	Bankfull Cross-Sectional Area				
11	Wp	Wetted parameter				
0.0369	S ft/ft	Bankfull Water Surface Slope			(2*1.1)+14	
1.21309	Tc lb/sqr ft	Tc = yRS				
135	Di mm	Largest Bar Sample Particle (mm)				
95	mm	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
1.4	lb/ft2	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

Entrainment Calculation Form

Project:	R-977A (Proposed)	**Location:**	Cherokee County
Stream:	UT to Hiwassee River	**Reach:**	
Date:	5/6/2004	**Observers:**	GLS, HB

Value	Variable	Definition				
		Critical Dimensionless Shear Stress: Tci = 0.0834(di/d50)^-0.872				
40.5	di mm	D50 from	Riffle	or	Pavement*	*Choose
23	d50 mm	D50 from	Bar Sample	or	Sub Pavement*	*One*
0.0509	Tci	Critical Dimensionless Shear Stress				
		Bankfull Mean Depth Required for Entrainment of largest particle in Bar Sample: dr = (Tci*1.65*Di)/Se 1.65 = submerged specific weight of sediment				
135	mm	Largest Bar Sample Particle in mm				
0.44	Di ft	Largest Bar Sample Particle in ft				
0.0421	Se ft/ft	Bankfull Water Surface Slope				
0.88	dr ft	Bankfulll Mean Depth Required				
0.60	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)				
de/dr=	0.68	if = 1	<1		>1	
Choose one:		Stable	aggrading		Degrading	
		Bankfull Water Surface Slope Required for Entrainment of largest particle in Bar Sample: Sr = (Tci*1.65*Di)/de 1.65 = submerged specific weight of sediment				
0.44	Di ft	Largest Bar Sample Particle				
0.60	de ft	Bankfull Mean Depth (*From Rifffle Cross Section*)				
0.0620	Sr ft/ft	Bankfull Water Surface Slope Required				
Se/Sr=	0.68	if = 1	<1		>1	
Choose one:		Stable	aggrading		Degrading	
		Sediment Transport Validation - Bankfull Shear Stress Tc = yRS				
62.4	y lbs/cu ft	Density of water				
0.55	R=A/Wp					
5.7	A sq ft	Bankfull Cross-Sectional Area				
10.4	Wp	Wetted parameter				
0.0421	S ft/ft	Bankfull Water Surface Slope			(2*1.1)+14	
1.43982	Tc lb/sqr ft	Tc = yRS				
135	Di mm	Largest Bar Sample Particle (mm)				
140	mm	Moveable Particle size (mm) at Bankfull Shear Stress predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				
1.4	lb/ft2	Predicted Shear Stress Required to move Di (lb/ft2) predicted by the Sheilds diagram, Red field book: p.190; Blue: p.238				

Velocity Comparison Form

Project:	R-977A (Existing)	**Location:**	Cherokee County
Stream:	UT to Hiwassee River	**Reach:**	
Date:	5/6/2004	**Observers:**	GLS, HB

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	5.8 sq ft	Bankfull Mean Depth (Dbkf)	0.5 ft
Bankfull Width (Wbkf)	10.8 ft	Wetted Parameter (WP)	11 ft
D84 (Riffle or pavement)	72 mm	D84 (mm/304.8)	0.24 ft
Bankfull Slope (S)	0.0369 ft/ft	Hydraulic Radius (R)	0.53 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	2.12 ft/ft
		R/D84 (use D84 in ft)	2.23 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	4.8 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.048
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	3.88 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.79 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	3.81 ft/s

Mannings n by StreamType		
Stream type		B4
Mannings n	(Red Book: p187; Blue :p237)	0.037
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	5.04 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	22 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.79 ft/s

Velocity Comparison Form

Project:	R-977A (Proposed)	**Location:**	Cherokee County
Stream:	UT to Hiwassee River	**Reach:**	
Date:	5/6/2004	**Observers:**	GLS, HB

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	5.7 sq ft	Bankfull Mean Depth (Dbkf)	0.6 ft
Bankfull Width (Wbkf)	9.2 ft	Wetted Parameter (WP)	10.4 ft
D84 (Riffle or pavement)	72 mm	D84 (mm/304.8)	0.24 ft
Bankfull Slope (S)	0.0421 ft/ft	Hydraulic Radius (R)	0.55 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	2.54 ft/ft
		R/D84 (use D84 in ft)	2.32 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	5.2 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.045
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.54 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.86 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	4.24 ft/s

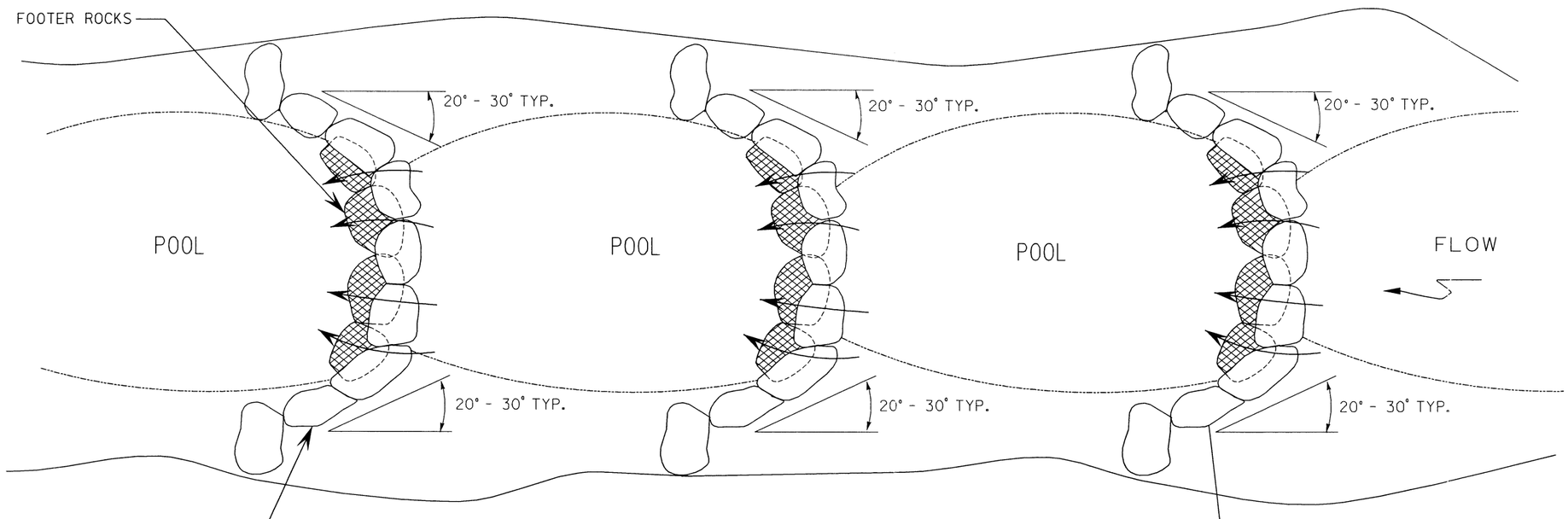
Mannings n by StreamType		
Stream type		B4
Mannings n	(Red Book: p187; Blue :p237)	0.037
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	5.52 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	25.65 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	4.50 ft/s

REVISIONS

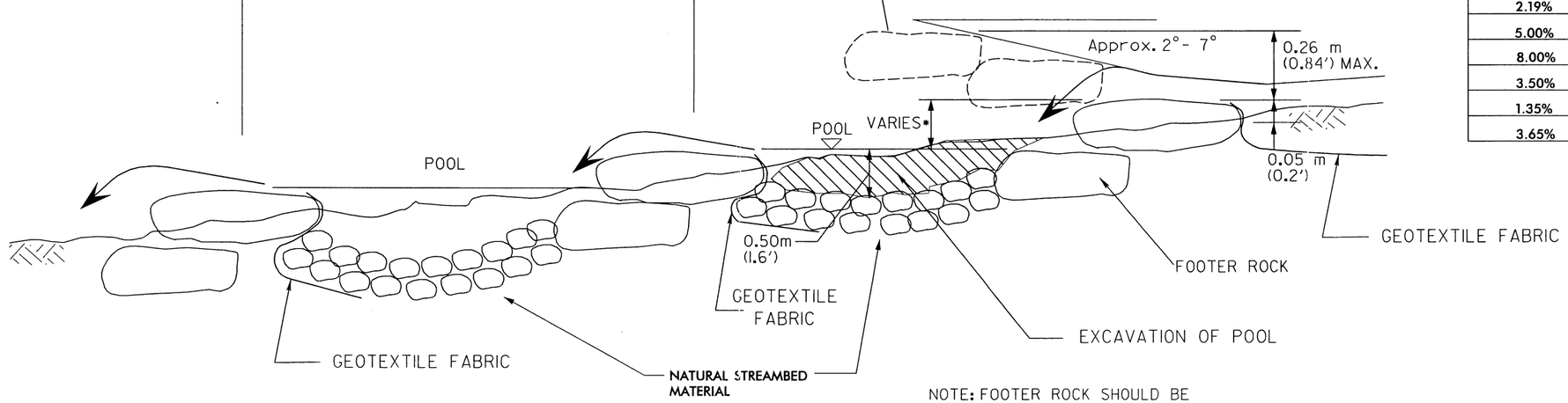
R-977A	SHEET NO.
	HYDRAULICS ENGINEER

STEP POOL DETAIL FOR CHANNEL RELOCATION STA. 12+20 TO 15+50 –Y3–



PLAN VIEW

NOT TO SCALE



PROFILE

NOT TO SCALE

*

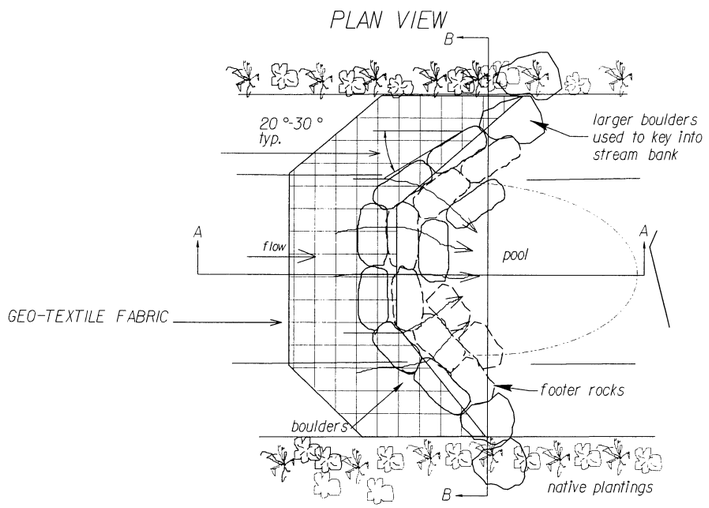
CHANNEL SLOPE	DROP PER STRUCTURE
4.21%	0.325m (1.07')
2.19%	0.228m (0.75')
5.00%	0.393m (1.29')
8.00%	0.400m (1.31')
3.50%	0.233m (0.76')
1.35%	0.135m (0.44')
3.65%	0.365m (1.20')

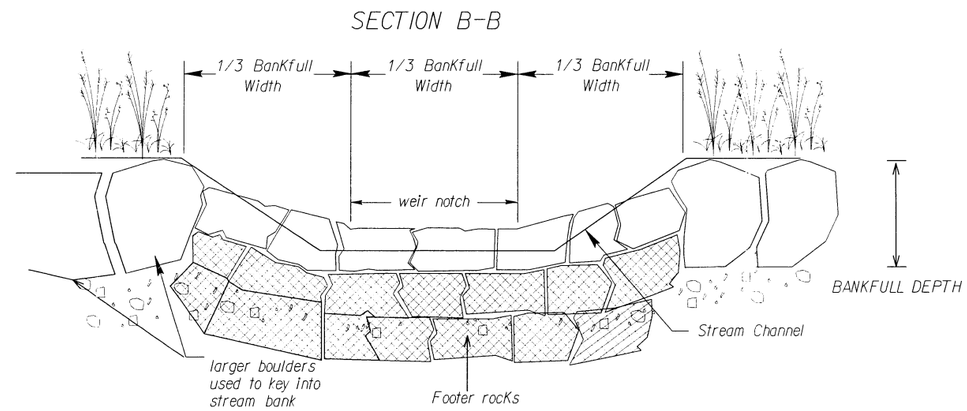
NOTE: FOOTER ROCK SHOULD BE ANGULAR AND OBLONG WITH WIDE AXIS APPROXIMATELY 0.75m IN LENGTH. ROCK SHOULD FIT TIGHTLY TOGETHER WITH MINIMAL VOIDS. SEE CROSSVANE DETAIL

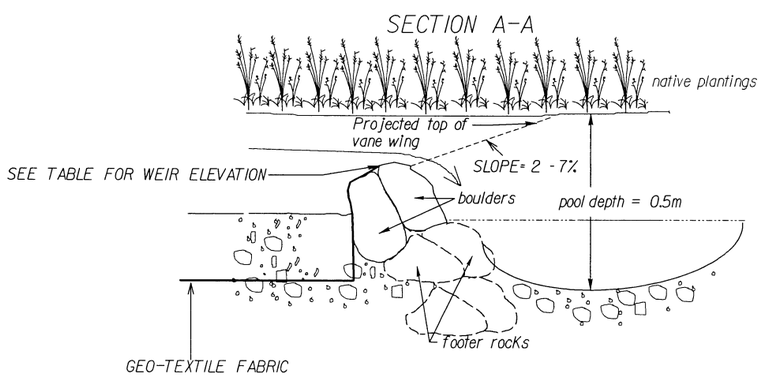
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977		
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION

CROSS VANE ROCK WEIR DETAIL







NOTE: Boulders should be native quarried rock or locally shot rock, angular and oblong with approximate minimum dimensions of 1.2m x 0.9m x 0.6m and weighing approximately (1600 kg)

Rocks should fit tightly with minimal spaces

Geotextile fabric should be placed on upstream side of boulders. Fabric should be overlain on exposed boulders and buried to a minmum depth as directed by on site engineer. Fabric should extend upstream a minimum length of of 2 m or as directed by on site engineer. Fabric should be backfilled with existing bed material.

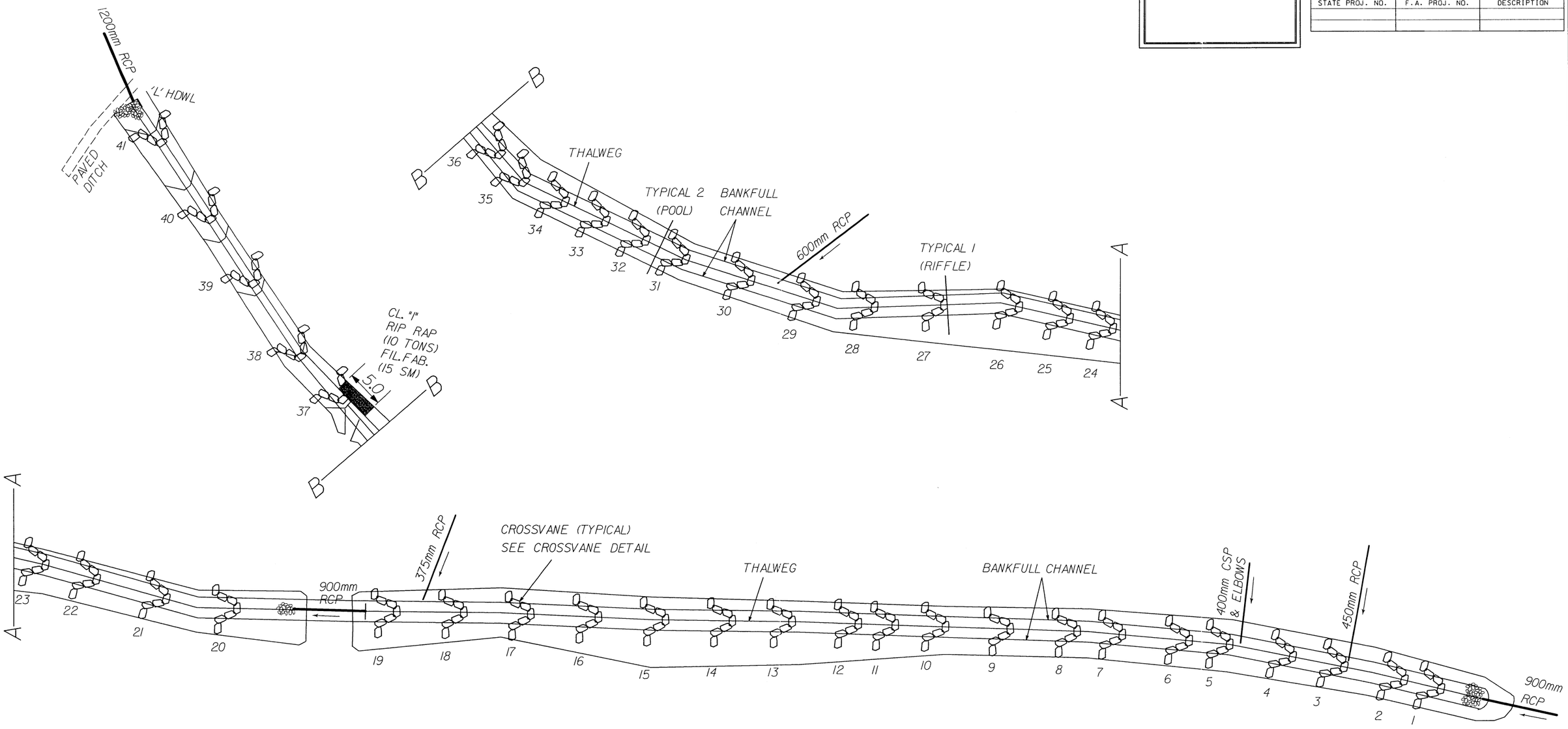
PROJECT R-977
CHEROKEE **COUNTY**
STATION

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

CROSS VANE DETAIL

DRAWN BY JSF DATE 4/04
CHECKED BY GLS DATE 4/04

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977		
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION



CHANNEL PLAN VIEW

SITE # 11

STATIONS 12+20 TO 15+50 -Y3-

PROJECT R-977

CHEROKEE **COUNTY**

STATION

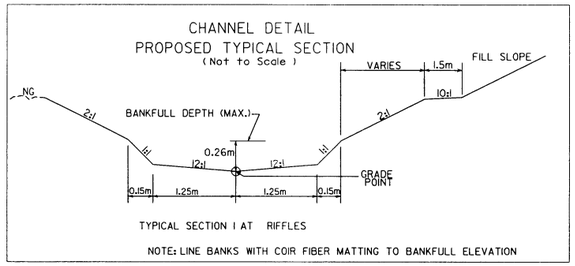
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

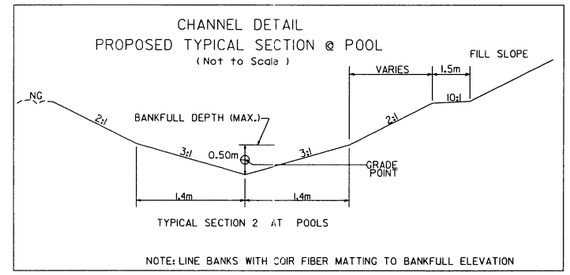
STREAM RELOCATION DETAIL

DRAWN BY JTL DATE 4/04
CHECKED BY JSF DATE 4/04

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977		
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION

NATURAL CHANNEL DESIGN TYPICALS





QUANTITES

DDE = 350m^3

BOULDERS = 575 EACH (910 MTONS)

COIR MAT = 2200m^2

GEOTEXTILE FABRIC = 1200m^2

STRUCTURE #	STATION	INV. ELEV.	BANKFULL ELEV.
1	15+50	499.18m	499.44m
2	15+45	498.86m	499.12m
3	15+36	498.53m	498.79m
4	15+29	498.21m	498.47m
5	15+20	497.88m	498.14m
6	15+14	497.56m	497.82m
7	15+05	497.23m	497.49m
8	14+98	496.91m	497.17m
9	14+89	496.58m	496.84m
10	14+80	496.26m	496.52m
11	14+73	495.93m	496.19m
12	14+68	495.61m	495.87m
13	14+59	495.28m	495.54m
14	14+51	494.96m	495.22m
15	14+42	494.63m	494.89m
16	14+33	494.40m	494.66m
17	14+24	494.17m	494.43m
18	14+15	493.94m	494.20m
19	14+06	493.72m	493.98m
20	13+85	493.49m	493.75m

STRUCTURE #	STATION	INV. ELEV.	BANKFULL ELEV.
21	13+76	493.26m	493.52m
22	13+67	493.03m	493.29m
23	13+60	492.80m	493.06m
24	13+55	492.55m	492.81m
25	13+49	492.16m	492.42m
26	13+42	491.77m	492.03m
27	13+33	491.37m	491.63m
28	13+24	490.98m	491.24m
29	13+17	490.59m	490.85m
30	13+08	490.20m	490.46m
31	13+00	489.80m	490.06m
32	12+95	489.40m	489.66m
33	12+90	489.00m	489.26m
34	12+85	488.60m	488.86m
35	12+80	488.20m	488.46m
36	12+74	487.99m	488.25m
37	12+67	487.75m	488.01m
38	12+60	487.50m	487.76m
39	12+50	487.37m	487.63m
40	12+40	487.23m	487.49m
41	12+28	486.86m	487.12m

CHANNEL PLAN VIEW

SITE # 11

STATIONS 12+20 TO 15+50 -Y3-

DRAWN BY JTL DATE 5/04
CHECKED BY JSF DATE 5/04

PROJECT R-977
CHEROKEE COUNTY
STATION

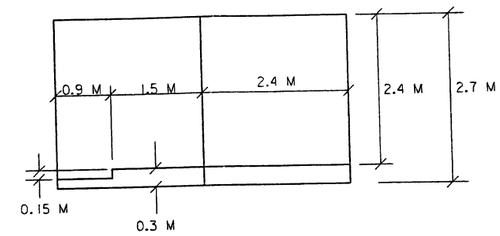
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

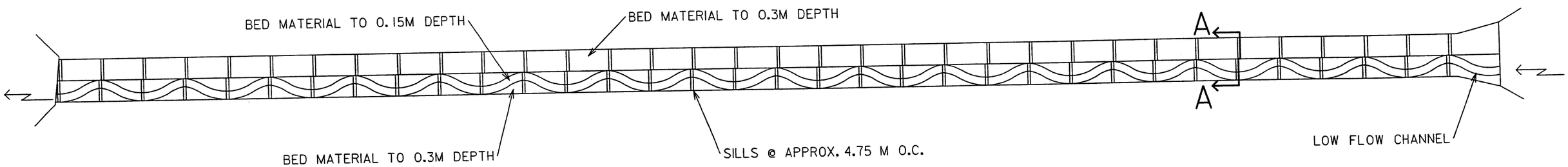
STREAM RELOCATION DETAIL

R-977A
-L- REV. 35+18.0
HAMPTON CREEK
CHEROKEE COUNTY
MARCH 23, 2004

(NOT TO SCALE)

SECTION A-A





NOTES:

1. CULVERT INVERTS TO BE SET 0.3 M BELOW EXISTING BED ELEVATION.

2. SPACE SILLS APPROX. 4.75 M ON CENTERS:

   A. TO BE CAST AND ATTACHED BY DOWELS TO FLOOR SLAB;

   B. THE 0.3 M AND 0.15 M HIGH SILLS ARE TO BE SEPERATE UNITS.

3. BED MATERIAL EXCAVATED FROM THE SITE FOR BOX CULVERT CONSTRUCTION IS TO BE STOCKPILED AND LATER PLACED ON THE FLOOR OF THE COMPLETED CULVERT.

4. MATERIAL TO BE PLACED IN CULVERT TO TOP OF SILLS; PROVIDE CONTINUOUS LOW FLOW CHANNEL BETWEEN SILLS. (SEE SECTION A-A).

APPENDIX C
Bridge / Culvert Reports

SITE DATA

Drainage Area 1086 Sq. Km Source "DA @ SELECTED SITES" & USGS QUAD MAP Character RURAL MOUNTAINS

Stream Classification (Such as Trout, High Quality Water, etc.) WS-IV

Data on Existing Structure NEW LOCATION

Waterway Opening N/A

Data on Structures Up and Down Stream DOWNSTREAM UNDER EXIST. US-64 -- 5@28M SPAN STEEL GIRDERS, 0.8M WIDE SQUARE PIERS; APPROXIMATE WATERWAY OPENING = 1854 M² / UPSTREAM UNDER SR-1548 --- 5@14.4M SPAN, CONC. GIRDER, VERT. ABUTMENTS, EARWALLS, ROUNDED PIERS - WATERWAY OPENING = 418 M²

Design Control Elev. @ SECTION 97.28 -- 100YR NAT + 0.3 = 466.95 + 0.3 = 467.25

Gage Station No. 03548500 (3.1± KM UPSTREAM) Period of Records PRE-REGULATION = 1897-1941 POST-REGULATION = 1942-PRESENT

Max. Discharge 654 (PRE-REGULATION) m³/s Date 3-19-1899 Frequency 100 YR +

Historical Flood Information: (@ SECT. 97.28)

Date 3-19-1899	Elev. 462.3 m	Est. Freq. 100+	Source 1959 TVA FLOOD STUDY	Period of Knowledge	N/A
Date 9-3-1898	Elev. 462.1 m	Est. Freq. 100	Source "	Period of Knowledge	N/A
Date 2-19-1936	Elev. 466.8 m	Est. Freq. 50	Source "	Period of Knowledge	N/A

Historical Scour Info. : General 0 Contraction 0 Local 0

Channel Slope .0021 Source 1996 TVA X SECTION DATA Normal Water Surface Elev. 462.16 (9-24-96) m

Manning's n : Left O.B. .013 TO .180 Channel .045 - .050 Right O.B. .013 TO .180 Source FIELD OBSERVATION

Flood Study / Status YES. APPROXIMATE Floodway Established? NO

Flood Study 100 yr. Discharge N/A m³/s; W.S. Elev. : With Floodway N/A m Without Floodway N/A m

DESIGN DATA

Hydrological Method PRORATION BY "USGS FREQUENCY AND MAGNITUDE" METHODS, OF GUAGE 03548500

Hydraulic Design Method HEC-2

Floods Evaluated:

	Freq.	Q	Elev.	Backwater	Bridge Opening Velocity (SECTION 97.15)
(SECTION 97.28)	10	440 M³/S	466.06	+0.00	1.35 m/s
	25	520	466.49	+0.00	1.44
	50	590	466.84	+0.02	1.49
	100	670	467.17	+0.02	1.54
	500	780	467.73	+0.04	1.58

Waterway Opening Provided 447 M² below 100YR WS El.

Average Channel Velocity (Design) (SECTION 97.15) 1.55 m/s Average Overbank Velocity (Design) LT 0.72 m/s RT 0.91 m/s

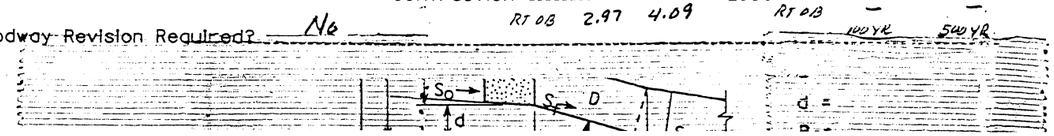
Computed Scour : General 0 Contraction

	100 YR	500 YR
CHANNEL	.19	.30
LT OB	.68	1.21
RT OB	2.97	4.09

Local

	100 YR	500 YR
LT OB	1.38-1.45	1.57-1.63
CH	2.33	2.39
RT OB	—	—

Is a Floodway Revision Required? NO



BRIDGE SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULICS UNIT
RALEIGH, N. C.

APPROXIMATE STUDY

I.D. No. R-977A Project No. 8.1910203 Proj. Station -L- REV. 16+97.5 P.O.T.

County CHEROKEE Bridge Over HIWASSEE RIVER Bridge Inv. No. N/A

On Highway Prop. US-64 Between US-19 and SR-1558

Recommended Structure Prop. 1D @ 27.5M SPANS ; 1.37M PRESTRESSED GIRDERS

Recommended Location is ON NEW LOCATION ~~Up, At, Down Stream from Existing Crossing~~. Skew 151°

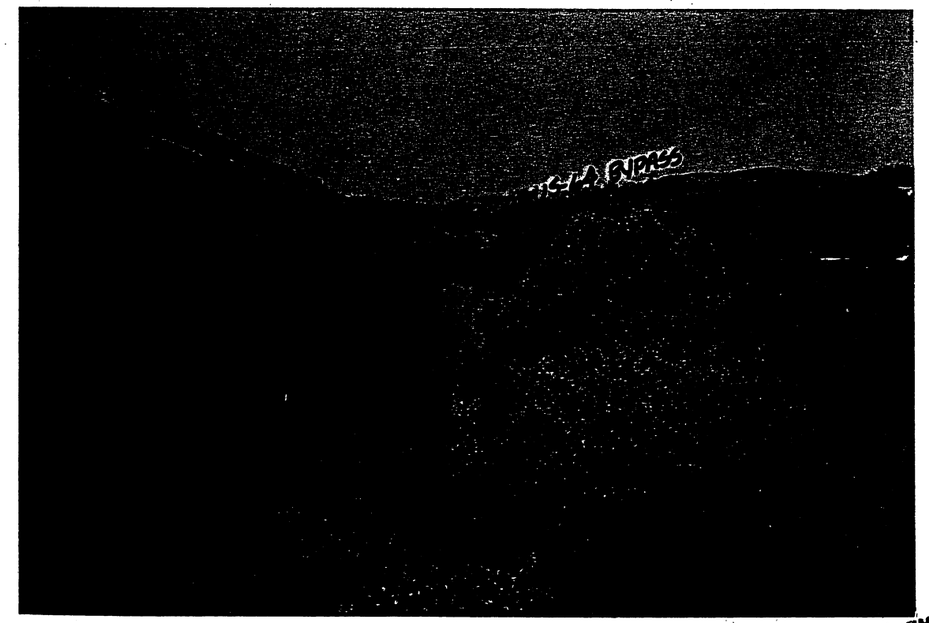
Recommended Width of Roadway 22.8M CLEAR ROADWAY m

Nearest Shipping Point MURPHY On SOUTHERN R.R., 1.6 km From Bridge

Bench Mark is BM #4, CHISLED SQUARE AT WATER FILTER PLANT, 3.7m RIGHT OF -L- STA. 13+60.000. Elev. 469.063 m Datum: NGVD 1929

Temporary Crossing NOT REQ'D.

Stream HIWASSEE R. Bridge Inv. No. N/A I.D. No. R-977A Project No. 8.1910203



Designed by: RICHARD SCARCE & ASSOCIATES

Assisted by: JK SCARCE, PE ; PJ CHROMY

Project Engineer: RN SCARCE, PE, RLS

Reviewed & Approved by: _____ Date _____

NORTH CAROLINA PROFESSIONAL SEAL 20737 ENGINEER JONATHAN KENNING SCARCE

REVISED 5-15-97 Jonathan K. Scarce 2-20-97

INFORMATION TO BE SHOWN ON PLANS

Design:	Discharge	590 m³/s	Frequency	50 YR.	Elev.	466.84 m
Base Flood:	Discharge	670 m³/s	Frequency	100 yr.	Elev.	467.17 m
RDWY Overtopping:	Discharge	780 + m³/s	Frequency	500 YR +	Elev.	473.15 m

ADDITIONAL INFORMATION AND COMPUTATIONS

Channel and Bank Stability CHANNEL IS A STABLE REACH. FAIRLY REGULAR SECTION. BANKS ARE FAIRLY STABLE W/ SOME SLOUGHING IN LOWER PART OF BANK DUE TO DAILY FLUCTUATIONS IN W.S. ELEVATIONS CREATED BY CHATUGE DAM RELEASE.

Reservoirs, Water Resource Projects, Other Flood Control Projects REGULATED BY THE CHATUGE DAM

DA = 1086 SQ KM USGS RURAL REGRESSION EQUATIONS (BUBRIDGE-REDMONT)

Q_n:

$RQ_2 = 2.11 A^{.691} = 264.27$ say 260 m³/s

$RQ_5 = 3.71 A^{.670} = 401.22$ 400

$RQ_{10} = 5.02 A^{.665} = 524.24$ 520

$RQ_{25} = 7.09 A^{.655} = 690.42$ 690

$RQ_{50} = 8.86 A^{.650} = 833.15$ 830 ✓

$RQ_{100} = 11.03 A^{.643} = 987.68$ 990

$RQ_{200} = 13.27 A^{.631} = 1092.65$ 1100

$RQ_{500} = 18.01 A^{.622} = 1392.51$ 1400

$$\log Q_{g(w)} = \frac{N \log Q_g + EY \log Q_n}{N + EY}$$

	Q_g	N	EY	Q_n	$Q_{g(w)}$
10	413.25	50	4	524.24	420.60
25	486.02		5	690.42	501.78
50	536.20		7	833.15	566.02
100	583.26		9	987.68	632.06

USGS DISCHARGES @ Gauge No. 03548500 — Gauge @ RM 99.1

ADJUSTED ESTIMATE AT UNGAGED SITE $Q_u = \left(\frac{A_u}{A_g}\right)^b Q_{g(w)}$

$Q_{10} = \left(\frac{1086}{1052}\right)^{.665} (420.60) = 429.59$ m³/s Gauge No. 03548500

$Q_{25} = (1.032)^{.655} (501.78) = 512.24$

$Q_{50} = (1.032)^{.650} (566.02) = 577.73$ ✓

$Q_{100} = (1.032)^{.643} (632.06) = 644.99$

WEIGHTED ESTIMATE $\Delta A = 419.31 - 406.18 = 13.13$ ✓ $Q_{u(w)} = \left(\frac{2\Delta A}{A_g}\right) Q_n + \left(1 - \frac{2\Delta A}{A_g}\right) Q_u$

$Q_{10} = \left(\frac{2(13.13)}{406}\right) 524.24 + \left(1 - \frac{2(13.13)}{406}\right) 429.59 = 435.71$ say 440

$Q_{25} = (.0647) 690.42 + (.9353) 512.24 = 523.77$ " 520

$Q_{50} = (.0647) 833.15 + (.9353) 577.73 = 594.26$ " 590 ✓

$Q_{100} = (.0647) 987.68 + (.9353) 644.99 = 667.16$ " 670

$Q_{500} = Q_{100} \left(\frac{Q_{g\,500YR}}{Q_{g\,100YR}}\right) = (667.16)\left(\frac{683.29}{583.26}\right) = 781.58$ " 780

SITE DATA

Drainage Area 1086 Sq. Km Source "DA @ SELECTED SITES" & USGS QUAD MAP Character RURAL MOUNTAINS

Stream Classification (Such as Trout, High Quality Water, etc.) WS-IV

Data on Existing Structure NEW LOCATION

Waterway Opening N/A

Data on Structures Up and Down Stream DOWNSTREAM UNDER EXIST. US-64 -- 5@28M SPAN STEEL GIRDERS, 0.8M WIDE SQUARE PIERS; APPROXIMATE WATERWAY OPENING = 1254 M² / UPSTREAM UNDER SR-1548 --- 5@14.4M SPAN, CONC. GIRDER, VERT. ABUTMENTS, EARWALLS, ROUNDED PIERS: WATERWAY OPENING = 418 M²

Design Control Elev. @ SECTION 97.28 -- 100YR NAT + 0.3 = 466.95 + 0.3 = 467.25

Gage Station No. 03548500 (3.1± KM UPSTREAM) Period of Records PRE-REGULATION = 1897-1941; POST-REGULATION = 1942-PRESENT

Max. Discharge 654 (PRE-REGULATION) m³/s Date 3-19-1899 Frequency 100 YR +

Historical Flood Information: (@ SECT. 97.28)

Date	Elev.	Est. Freq.	Source	Period of Knowledge
3-19-1899	467.3 m	100 +	1959 TVA FLOOD STUDY	N/A
9-3-1898	467.1 ± m	100	"	N/A
2-19-1936	466.8 ± m	50	"	N/A

Historical Scour Info. : General 0 Contraction 0 Local 0

Channel Slope .0021 Source 1996 TVA X SECTION DATA Normal Water Surface Elev. 462.16 m (9-24-96)

Manning's n : Left O.B. .013 TO .180 Channel .045 - .050 Right O.B. .013 TO .180 Source FIELD OBSERVATION

Flood Study / Status YES. APPROXIMATE Floodway Established? NO

Flood Study 100 yr. Discharge N/A m³/s; W.S. Elev. : With Floodway N/A m Without Floodway N/A m

DESIGN DATA

Hydrological Method PRORATION BY "USGS FREQUENCY AND MAGNITUDE" METHODS, OF GUAGE 03548500

Hydraulic Design Method HEC-2

Floods Evaluated:

	Freq.	Q	Elev.	Backwater	Bridge Opening (SECTION 97.15) Velocity
(SECTION 97.28)	10	440 m³/s	466.06	+0.00	1.35 m/s
	25	520	466.49	+0.00	1.44
	50	590	466.84	+0.02	1.49
	100	670	467.17	+0.02	1.54
	500	780	467.73	+0.04	1.58

Waterway Opening Provided 447 ±1 m² below 100YR WS El.

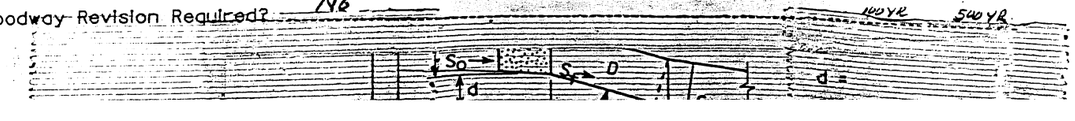
Average Channel Velocity (Design) (SECTION 97.15) 1.55 m/s

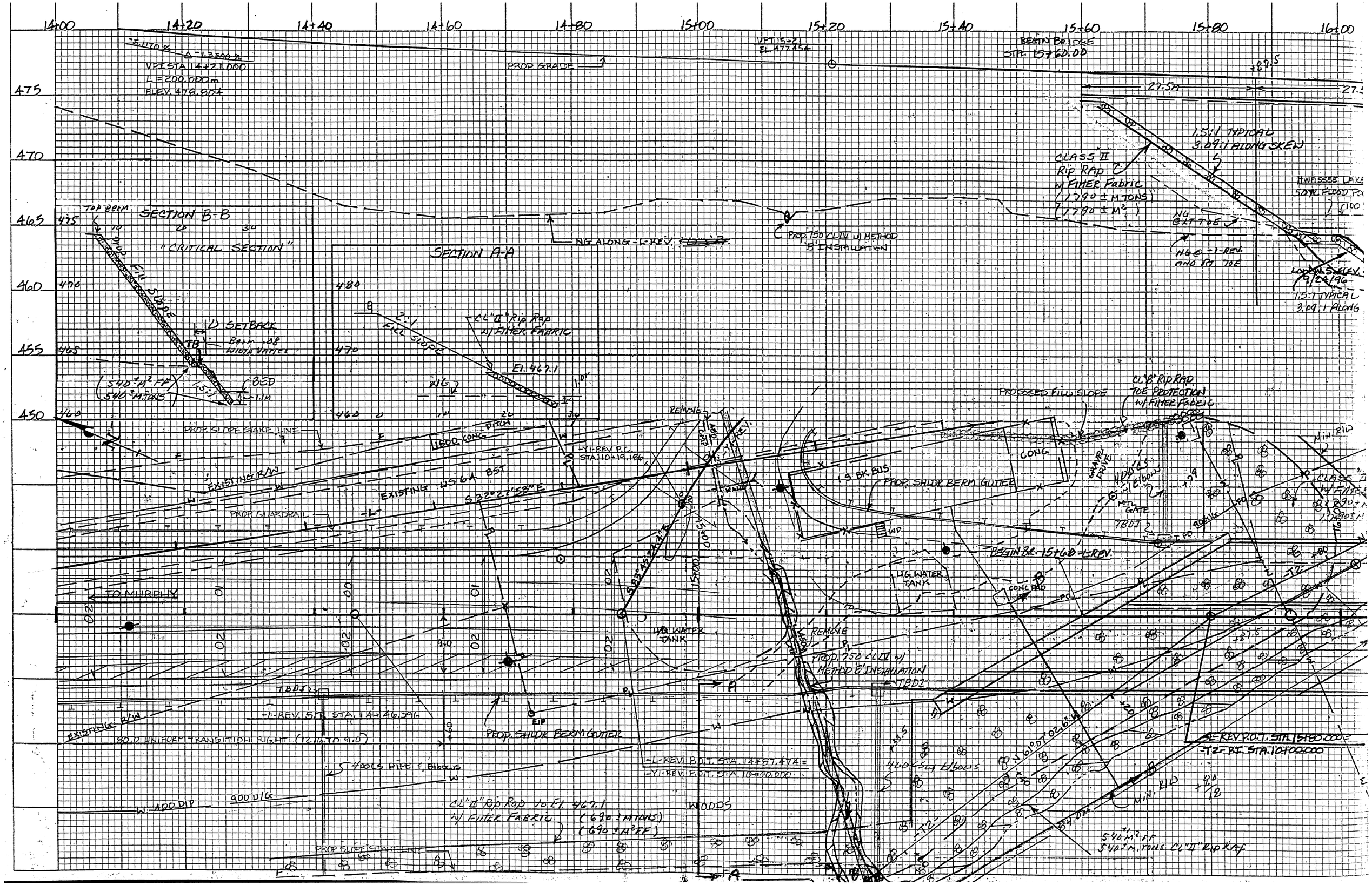
Average Overbank Velocity (Design) LT 0.72 m/s RT 0.91 m/s

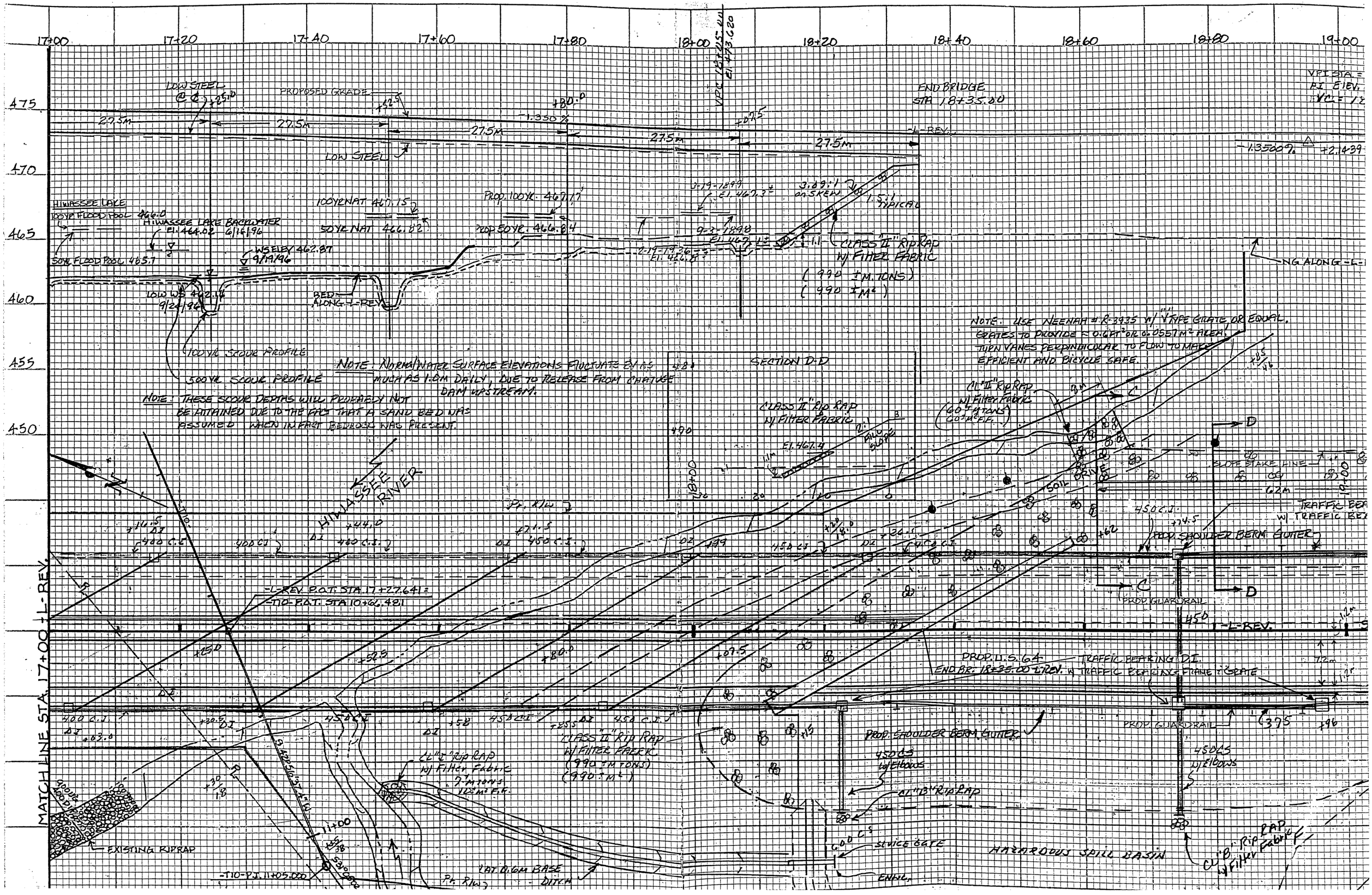
Computed Scour : General 0 Contraction 0 Local 0

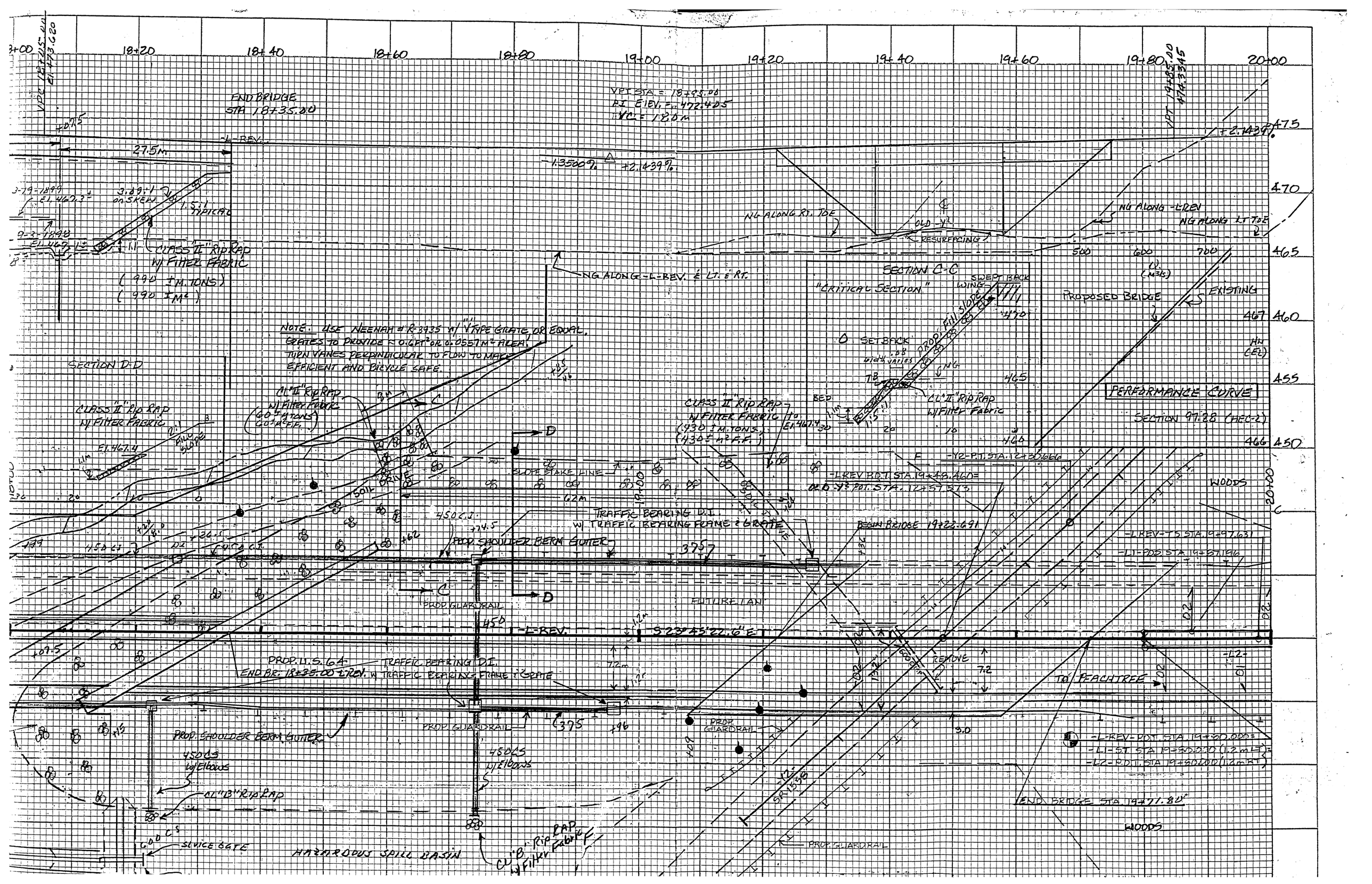
		100 YR	500 YR
CHANNEL		.19	.30
LT OB		.68	1.21
RT OB		2.97	4.09
LT OB		1.38-1.45	1.57-1.63
CH		2.33	2.39
RT OB		—	—

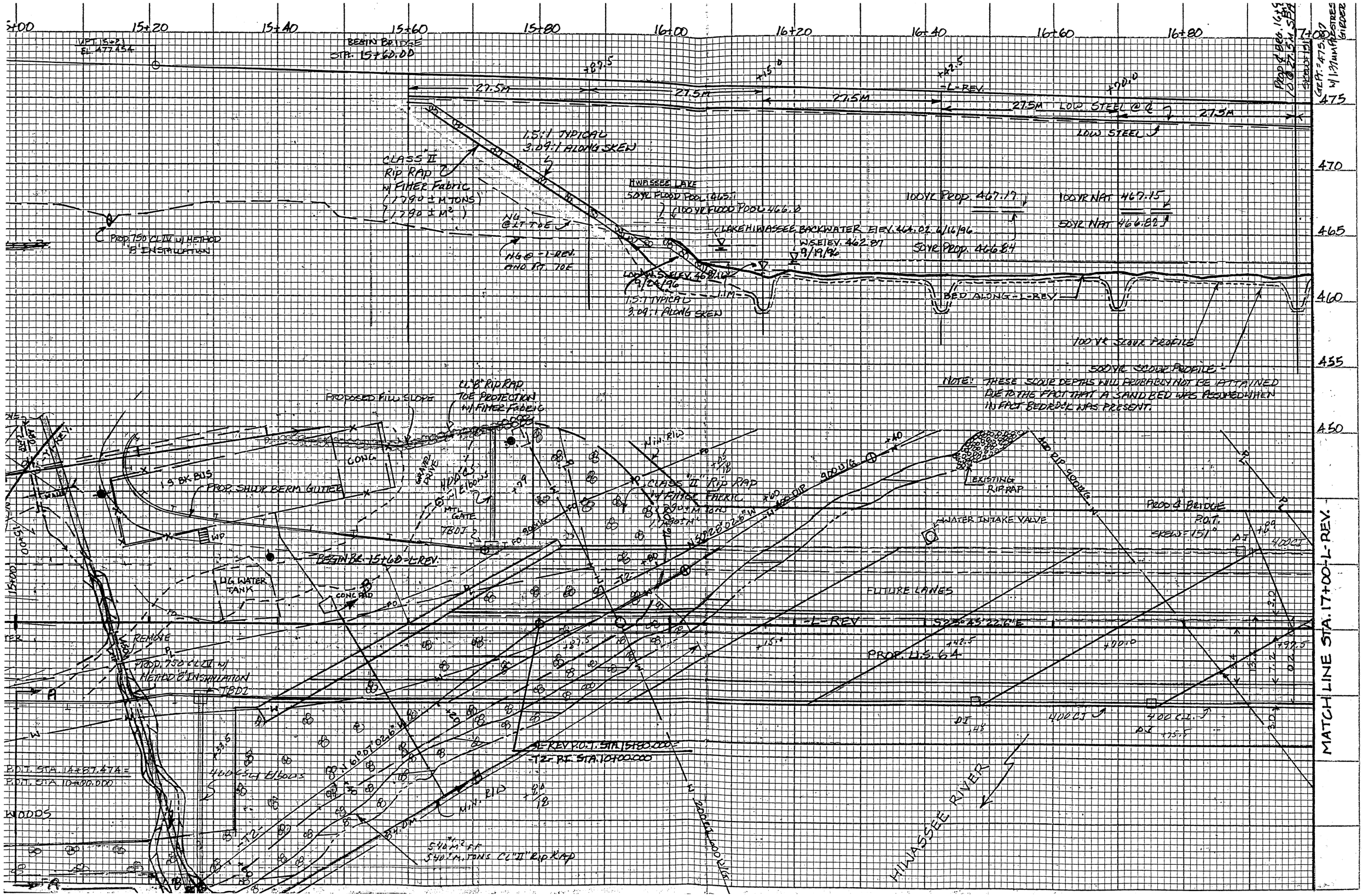
Is a Floodway Revision Required? NO




14+00
14+20
14+40
14+60
14+80
15+00
15+20
15+40
15+60
15+80
16+00
475
470
465
460
455
450
VPI STA 14+21.000
L=200.000m
ELEV. 479.904
PROD GRADE
VPI 15+21
EL 477.454
BEGIN BRIDGE
STA. 15+60.00
27.5M
1.5:1 TYPICAL
3.09:1 ALONG SKEW
CLASS II
RIP RAP
W/ FILTER FABRIC
(1790 ± M TONS)
(1790 ± M²)
NG @ LT TOE
NG @ -1-REV.
AND RT. TOE
SECTION B-B
"CRITICAL SECTION"
TOP BERM
FILL SLOPE
SETBACK
BERM DB
WIDTH VARIES
540 ± M² FF
540 ± M TONS
BED
SECTION A-A
CL "II" RIP RAP
W/ FILTER FABRIC
EL. 467.1
NG
PROP. SLOPE STAKE LINE
EXISTING R/W
EXISTING 456A BST
PROP GUARDRAIL
TO MURPHY
PROP. 750 CL II W/
METHOD "B" INSTALLATION
PROP. SHLDR BERM GUTTER
BEGIN BL 15+60 -L-REV.
UG WATER TANK
REMOVE
CONC BLD
GARAGE
MTL GATE
TBDL
-L-REV. 5.1 STA. 14+46.996
180.0' UNIFORM TRANSITION RIGHT (12.0 TO 9.0)
400 LS PIPE & ELBOWS
900 DIP
CL "II" RIP RAP TO EL 467.1
W/ FILTER FABRIC
(690 ± M TONS)
(690 ± M² FF)
WOODS
-L-REV. P.O.T. STA. 14+67.474
-Y1-REV. P.O.T. STA. 10+70.000
-Y1-REV. P.C. STA. 110+19.166
-L-REV. P.O.T. STA. 15+80.000
-Y2-P.T. STA. 10+00.000
440 LS ELBOWS
540 ± M² FF
540 ± M TONS CL "II" RIP RAP
CL "B" RIP RAP
TOE PROTECTION
W/ FILTER FABRIC
PROPOSED FILL SLOPE
CLASS II
W/ FILTER
HIWASSEE LAKE
50YR FLOOD PO
LOCAL SKEW
1.5:1 TYPICAL
3.09:1 ALONG


17+00
17+20
17+40
17+60
17+80
18+00
18+20
18+40
18+60
18+80
19+00
475
470
465
460
455
450
LOW STEEL @ ℄
PROPOSED GRADE
27.5M
1.350%
LOW STEEL
END BRIDGE STA 18+35.00
-L- REV.
HIWASSEE LAKE
100YR FLOOD POOL 466.0
HIWASSEE LAKE BACKWATER El. 464.02 6/16/96
50YR FLOOD POOL 465.7
100YR NAT 467.15
50YR NAT 466.82
PROP. 100YR. 467.17
PROP. 50YR. 466.84
W.S. ELEV. 462.87 9/19/96
LOW W.S. 462.16 9/24/96
BED ALONG -L- REV.
100YR. SCOUR PROFILE
500YR. SCOUR PROFILE
NOTE: NORMAL WATER SURFACE ELEVATIONS FLUCTUATE EVERY MUCH AS 1.0M DAILY, DUE TO RELEASE FROM CHATUGE DAM UPSTREAM.
NOTE: THESE SCOUR DEPTHS WILL PROBABLY NOT BE ATTAINED DUE TO THE FACT THAT A SAND BED WAS ASSUMED WHEN IN FACT BEDROCK WAS PRESENT.
3.89:1 ON SKEW
1.5:1 TYPICAL
CLASS "II" RIP RAP W/ FILTER FABRIC (990 ±M. TONS) (990 ±M²)
SECTION D-D
CLASS "II" RIP RAP W/ FILTER FABRIC
El. 467.4
NOTE: USE NEENAH #R-3935 W/ "V" TYPE GRATE OR EQUAL. GRATES TO PROVIDE ≥ 0.6M² OR 0.0557M² AREA. TURN VANES PERPENDICULAR TO FLOW TO MAKE EFFICIENT AND BICYCLE SAFE.
CLASS "II" RIP RAP W/ FILTER FABRIC (60 ±TONS) (60 ±M² EA.)
SLOPE STAKE LINE
TRAFFIC BEARING W/ TRAFFIC BEARING
PROP. SHOULDER BERM GUTTER
PROP. GUARDRAIL
-L- REV.
PROP. U.S. 64
END BR. 18+35.00 -L- REV.
TRAFFIC BEARING D.I. W/ TRAFFIC BEARING FRAME & GRATE
HIWASSEE RIVER
-L- REV. P.O.T. STA. 17+27.641 = -TIO- P.O.T. STA. 10+66.481
MATCH LINE STA. 17+00 -L- REV.
CLASS "II" RIP RAP W/ FILTER FABRIC 7 ±TONS 10 ±M² EA.
CLASS "II" RIP RAP W/ FILTER FABRIC (990 ±M TONS) (990 ±M²)
450 LS W/ ELBOWS
CL "B" RIP RAP
SLUICE GATE
HAZARDOUS SPILL BASIN
EXISTING RIPRAP
-TIO- P.I. 11+05.000
FLAT 0.6M BASE DITCH
CL "B" RIP RAP W/ FILTER FABRIC


18+20
18+40
18+60
18+80
19+00
19+20
19+40
19+60
19+80
20+00
END BRIDGE
STA 18+35.00
VPI STA = 18+95.00
EL. = 472.425
VC = 18.0m
27.5m
-L-REV.
-1.3500%
+2.439%
3.89:1 on SKEW
1.5:1 TYPICAL
"CLASS II" RIP RAP W/ FILTER FABRIC
(990 ± M. TONS)
(990 ± M²)
NG ALONG RT. TOE
OLD -Y-
RESURFACING
NG ALONG -L-REV
NG ALONG LT. TOE
NG ALONG -L-REV. & LT. & RT.
SECTION C-C
"CRITICAL SECTION"
SWEPT BACK WING
FILL SLOPE
SETBACK
PROPOSED BRIDGE
EXISTING
PERFORMANCE CURVE
SECTION 97.28 (HEC-2)
NOTE: USE NEENAH # R-3435 W/ "V" TYPE GRATE OR EQUAL. GRATES TO PROVIDE ≈ 0.6FT² OR 0.0557M² AREA. TURN VANES PERPENDICULAR TO FLOW TO MAKE EFFICIENT AND BICYCLE SAFE.
SECTION D-D
CLASS "II" RIP RAP W/ FILTER FABRIC
CLASS II RIP RAP W/ FILTER FABRIC
(930 ± M. TONS)
(430 ± M² F.F.)
SLOPE STAKE LINE
TRAFFIC BEARING D.I. W/ TRAFFIC BEARING FRAME & GRATE
PROP. SHOULDER BERM GUTTER
PROP. GUARDRAIL
FUTURE LAN
-L-REV.
S 23°43'22.6" E
PROP. U.S. 64
END BR. 18+35.00 -L-REV.
TRAFFIC BEARING D.I. W/ TRAFFIC BEARING FRAME & GRATE
REMOVE
TO PEACHTREE
WOODS
BEGIN BRIDGE 19+22.691
-L-REV-T.S. STA. 19+97.631
-L1-P.O.T. STA. 19+87.196
-L2-P.O.T. STA. 19+50.000
END BRIDGE STA. 19+71.80
45D L.S.
W/ ELBOWS
"B" RIP RAP
SERVICE GATE
HAZARDOUS SPILL BASIN
"B" RIP RAP W/ FILTER FABRIC


15+00
15+20
15+40
15+60
15+80
16+00
16+20
16+40
16+60
16+80
17+00
BEGIN BRIDGE
STA. 15+60.00
27.5M
L-REV.
LOW STEEL @ ℄
LOW STEEL
1.5:1 TYPICAL
3.09:1 ALONG SKEW
CLASS II
Rip Rap
w/ Filter Fabric
HIWASSEE LAKE
50YR FLOOD POOL 465.1
100YR FLOOD POOL 466.0
100YR PROP. 467.17
100YR NAT 467.15
50YR NAT 466.88
50YR PROP. 466.84
LAKE HIWASSEE BACKWATER ELEV. 464.02 6/16/96
W.S. ELEV. 462.87 9/19/96
BED ALONG -L-REV
100 YR SCOUR PROFILE
500 YR SCOUR PROFILE
NOTE: THESE SCOUR DEPTHS WILL PROBABLY NOT BE ATTAINED DUE TO THE FACT THAT A SAND BED WAS PROVIDED WHEN IN FACT BEDROCK WAS PRESENT.
PROP. 750 CL IV w/ METHOD "B" INSTALLATION
PROPOSED FILL SLOPE
CL "B" Rip Rap
TOE PROTECTION
w/ FILTER FABRIC
PROP. SHOULDER BERM GUTTER
BEGIN BL 15+60 -L-REV.
DG WATER TANK
CONC. POND
REMOVE
PROP. 750 CL III w/ METHOD "B" INSTALLATION
EXISTING RIP RAP
WATER INTAKE VALVE
PROP. BRIDGE
P.O.T.
SKEW: 151°
FUTURE LANES
-L-REV
PROP. U.S. 64
-L-REV. P.O.T. STA. 15+80.000 =
-Y2- BL STA. 10+00.000
HIWASSEE RIVER
WOODS
MATCH LINE STA. 17+00 -L-REV.

Drainage Area 23 ~~km~~/Sq. Km Source USGS QUAD MAP Character RURAL MOUNTAINS

Stream Classification (Such as Trout, High Quality Water, etc.) WS-IV

Data on Existing Structure NEW LOCATION

Data on Structures Up and Down Stream UPSTREAM UNDER SR-1556 -- 1@ 6.0M, CONC. VERTICAL WALLS & DECK WATERWAY OPENING = 13± M²
(1 ½ KM D.S.)
DOWNSTREAM UNDER SR-1558 -- 1@ 8.6M STEEL I BEAM, VERTICAL CONC ABUT., 60° SKEW, NET WATERWAY OPENING = 21.2 M²

Gage Station No. NONE Period of Records N/a

Max. Discharge N/a m³/s Date N/a Frequency

Historical Flood Information: NONE

Date Elev. m Est. Freq. Source Period of Knowledge

Date Elev. m Est. Freq. Source Period of Knowledge

Allowable HW Elev. 473.33 m (100 yr Nat. + 0.3 m) Normal Water Surface Elev. 469.73 m 6-15-96

Manning's n : Left O.B. 0.20 Channel .08 Right O.B. 0.20 Obtained From FIELD OBSERVATION

Flood Study / Status YES / APPROXIMATE Floodway Established? No

Flood Study 100 yr. Discharge N/a m³/s W.S. Elev.: With Floodway N/a m Without Floodway N/a m

DESIGN DATA

Hydrological Method USGS RURAL REGRESSION EQUATIONS

Hydraulic Design Method HDS #5

Design Tailwater : Q_{10} 2.68 m; Q_{25} 3.11 m; Q_{50} 3.46 m; Q_{100} 3.81 m; Q_{500} 4.77 m
AT TOP OF BED MATERIAL INV. IN 469.20 AT TOP OF BED MATERIAL INV. OUT 468.25

3@ 2.7x3.7 RCBC

Size & Type	Q, m³/s	Inlet Control Ke	HW/D	H.W., m	Outlet Control, m dc	(dc+D)/2	h_o	H	LS_o	H.W.	Remarks
ANALYZED AS → 3@ 2.7x3.4 RCBC	40	0.2	0.63	2.14	1.36	2.38	** 2.68	.29	0.95	2.02	10 YR
	55		0.78	2.65	1.68	2.54	3.11	.55		2.71	25 YR
~~3@ 3.4x3.7 RCBC~~ ANALYZED AS →	68		0.90	3.06	1.93	2.67	3.46	.84		3.35*	50 YR
	83		1.01	3.43	2.20	2.80	3.81	1.25		4.11*	100 YR
OVERSIZED 35% 3@ 3.4x3.4 RCBC	68		0.78	2.65	1.66	2.53	3.46	.52		3.03	50 YR
	83		0.88	2.99	1.89	2.65	3.81	.77		3.63	100 YR
3@ 2.7x3.4 RCBC	130		1.41	4.79	2.97	3.19	4.77	3.08	0.95	6.90	500 YR

Is a Floodway Revision Required? NO

Outlet Velocity, (V_{10}) ** 1.8 m/s Natural Channel Velocity, (V_{10}) 1.3 m/s

Required Outlet Protection CL "I" Rip Rap

INFORMATION TO BE SHOWN ON PLANS

Design: Discharge 68 m³/s Frequency 50 YR. Elev. 472.55 * m

Base Flood: Discharge 83 m³/s Frequency 100 yr. Elev. 473.31 * m

Overtopping: Discharge 130+ m³/s Frequency 500 YR + Elev. 478.3 + m

OVERTOPPING OCCURS AT RDWY NEAR STA. -L-REV. 23+25

* SHOWN ON INSIDE OF REPORT

CULVERT SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULIC DESIGN UNIT
RALEIGH, N. C.

APPROXIMATE STUDY

I.D. No. R-977A Project No. 8.1910203 Proj. Station -L-REV. 23+97.0

County CHEROKEE Stream MARTIN CREEK Stru. No. N/A

On Highway PROP. US-64 Between SR-1556 and SR-1561

Recommended Structure PROPOSED 3 @ 3.4 x 3.7 RCBC w/ HDWL w/ DEBRIS DEFLECTORS

Recommended Location is NEW LOCATION ~~Up, At, Down Stream from Existing Crossing.~~ Skew 58° @ ℄

Recommended Width of Roadway 37.6M Shldr. to Shldr. m

Bench Mark is STA. 23+20 - L - (USED AS BM)

Elev. 470.713 m Datum: NGVD 1929

Temporary Crossing NOT REQ'D.

Project No. 8.1910203 I.D. No. R-977A Stru. No. N/A Stream MARTIN

Designed by: RICHARD SCARCE & ASSOCIATES

Assisted by: JK SCARCE, PE ; PJ CHROMY

Project Engineer: RN SCARCE PE, RLS

Reviewed & Approved by: [signature] Date 4/3/97

REVISED 5-15-97

NORTH CAROLINA PROFESSIONAL SEAL 20737 ENGINEER JONATHAN KENNING SCARCE

Jonathan K. Scarce 3-7-97

SITE DATA

Drainage Area 23 ~~mi~~/Sq. Km Source USGS QUAD MAP Character RURAL MOUNTAINS

Stream Classification (Such as Trout, High Quality Water, etc.) WS-IV

Data on Existing Structure NEW LOCATION

Data on Structures Up and Down Stream UPSTREAM UNDER SR-1556 -- 1@6.0M, CONC. VERTICAL WALLS & DECK WATERWAY OPENING = 13± M²
(1± KM D.S.)
DOWNSTREAM UNDER SR-1558 -- 1@8.6M STEEL I BEAM, VERTICAL CONC ABUT., 60±° SKEW; NET WATERWAY OPENING = 21.2 M²

Gage Station No. NONE Period of Records N/A

Max. Discharge N/A m³/s Date N/A Frequency

Historical Flood Information: NONE

Date Elev. m Est. Freq. Source Period of Knowledge

Date Elev. m Est. Freq. Source Period of Knowledge

Allowable HW Elev. 473.33 m (100 YR Nat. + 0.3 m) Normal Water Surface Elev. 469.73 m 6-15-96

Manning's n : Left O.B. 0.26 Channel .08 Right O.B. 0.26 Obtained From FIELD OBSERVATION

Flood Study / Status YES / APPROXIMATE Floodway Established? NO

Flood Study 100 yr. Discharge N/A m³/s; W.S. Elev.: With Floodway N/A m Without Floodway N/A m

DESIGN DATA

Hydrological Method USGS RURAL REGRESSION EQUATIONS

Hydraulic Design Method HDS #5

Design Tailwater : Q_{10} 2.68 m; Q_{25} 3.11 m; Q_{50} 3.46 m; Q_{100} 3.81 m; Q_{500} 4.77 m
AT TOP OF BED MATERIAL AT TOP OF BED MATERIAL

3@ 2.7x3.7 RCBC INV. IN. 469.20 INV. OUT 468.25

	Size & Type	Q, m³/s	Inlet Control Ke	HW/D	H.W., m	Outlet Control, m dc	$\frac{dc+D}{2}$	h_o	H	LS_o	H.W.	Remarks
ANALYZED AS →	3@ 2.7x3.4 RCBC	40	0.2	0.63	2.14	1.36	2.38	** 2.68	.29	0.95	2.02	10 YR
		55		0.78	2.65	1.68	2.54	3.11	.55		2.71	25 YR
PROP. 3@ 3.4x3.7 RCBC ANALYZED AS OVERSIZED 25%		68		0.90	3.06	1.93	2.67	3.46	.84		3.35*	50 YR
		83		1.01	3.43	2.20	2.80	3.81	1.25		4.11*	100 YR
	3@ 3.4x3.4 RCBC	68		0.78	2.65	1.66	2.53	3.46	.52		3.03	50 YR
		83		0.88	2.99	1.89	2.65	3.81	.77		3.63	100 YR
	3@ 2.7x3.4 RCBC	130		1.41	4.79	2.97	3.19	4.77	3.08	0.95	6.90	500 YR

Is a Floodway Revision Required? NO

Outlet Velocity, (V_{10}) ** 1.8 m/s Natural Channel Velocity, (V_{10}) 1.3 m/s

Required Outlet Protection CL "I" Rip Rap

INFORMATION TO BE SHOWN ON PLANS

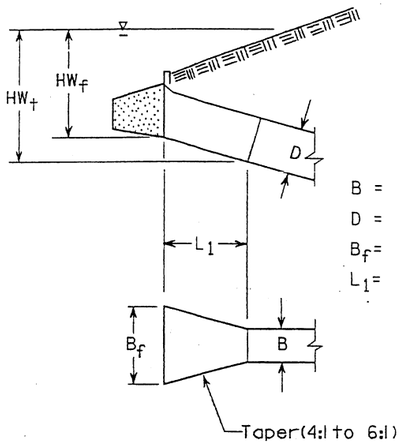
Design: Discharge 68 m³/s Frequency 50 YR. Elev. 472.55 * m

Base Flood: Discharge 83 m³/s Frequency 100 yr. Elev. 473.31 * m

Overtopping: Discharge 130+ m³/s Frequency 500 YR+ Elev. 478.3 * m

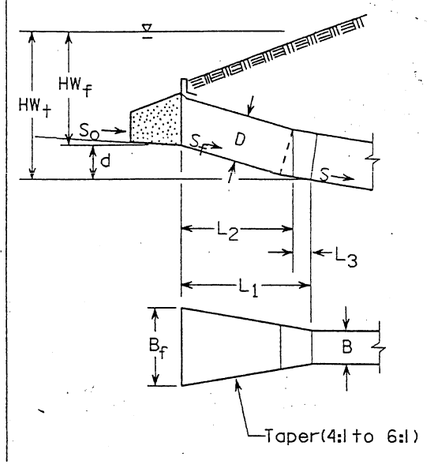
OVERTOPPING OCCURS AT RDWY NEAR STA. -L-REV. 23+25 * SHOWN ON INSIDE OF REPORT

SIDE-TAPERED INLET



B =
D =
B_f =
L_1 =

SLOPE-TAPERED INLET



B =
D =
d =
B_f =
L_1 =
L_2 =
L_3 =
So =
Sf =
S =

ADDITIONAL INFORMATION AND COMPUTATIONS

DA = 23 SQ. KM. USGS RURAL REGRESSION EQUATIONS (BLUERIDGE-PIEDMONT)

$RQ_2 = 2.11A^{0.691} =$ 18.42 say 18 M^3/s FEMA DISCHARGES

$RQ_5 = 3.71A^{0.670} =$ 30.32 30

$RQ_{10} = 5.02A^{0.665} =$ 40.39 40 40 m^3/s

$RQ_{25} = 7.04A^{0.655} =$ 55.28 55

$RQ_{50} = 8.86A^{0.650} =$ 68.01 68 ← USE FOR DESIGN 65 m^3/s

$RQ_{100} = 11.03A^{0.643} =$ 82.83 83 79 m^3/s

$RQ_{200} = 13.27A^{0.637} =$ 95.97 96

$RQ_{500} = 18.01A^{0.622} =$ 126.62 130 117 m^3/s

ANALYZED AS 3@ 2.7x3.4 RCBC

ANALYSIS OF BENDS

4 BENDS @ 20° EACH A = 27.54 P = 36.60

$H_b = K_b \frac{V^2}{2g}$ $\Sigma K_b = 4(.16) = .64$ R = .7525

$\bar{n} = \left[\frac{(28.5)(.012)^{1.5} + (8.1)(.035)^{1.5}}{36.6}\right]^{.67}$

$\bar{n} = .0179$

$H = \left[1 + 0.2 + \underbrace{.64}_{\Sigma K_b} + \frac{19.6\, n^2 L}{R^{4/3}}\right] \frac{V^2}{2A^2 g}$

$H = \left[1 + 0.2 + 0.64 + \frac{19.6(.0179)^2(94)}{(.7525)^{4/3}}\right] \frac{Q^2}{2(27.54)^2(9.8)}$

$H = .000182 Q^2$

ANALYZED AS PROP. 3@ 3.4x3.4 RCBC (25% INCREASE IN CULVERT WIDTH)

$H = \left[1 + 0.2 + .64 + \frac{19.6(.0186)^2(94)}{(.85)^{4/3}}\right] \frac{Q^2}{2(9.8)(34.68)^2}$

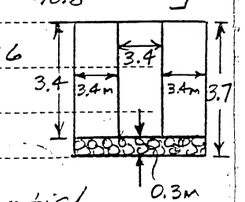
$A = 34.68 M^2$

$P = 40.8 M$ $\bar{n} = \left[\frac{30.6(.012)^{1.5} + 10.2(.035)^{1.5}}{40.8}\right]^{.67}$

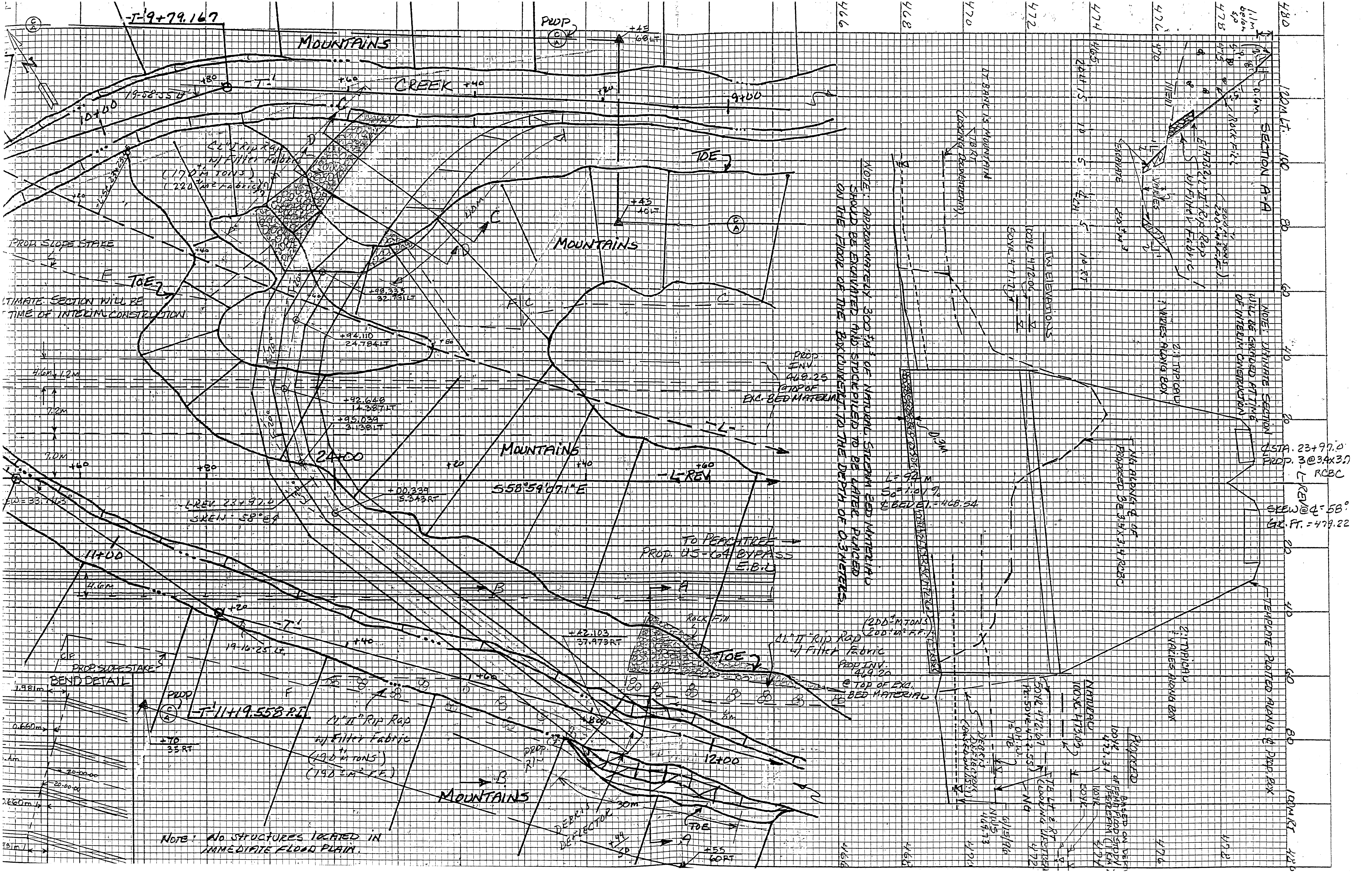
$R = 0.8500$

$\bar{n} = .0186$

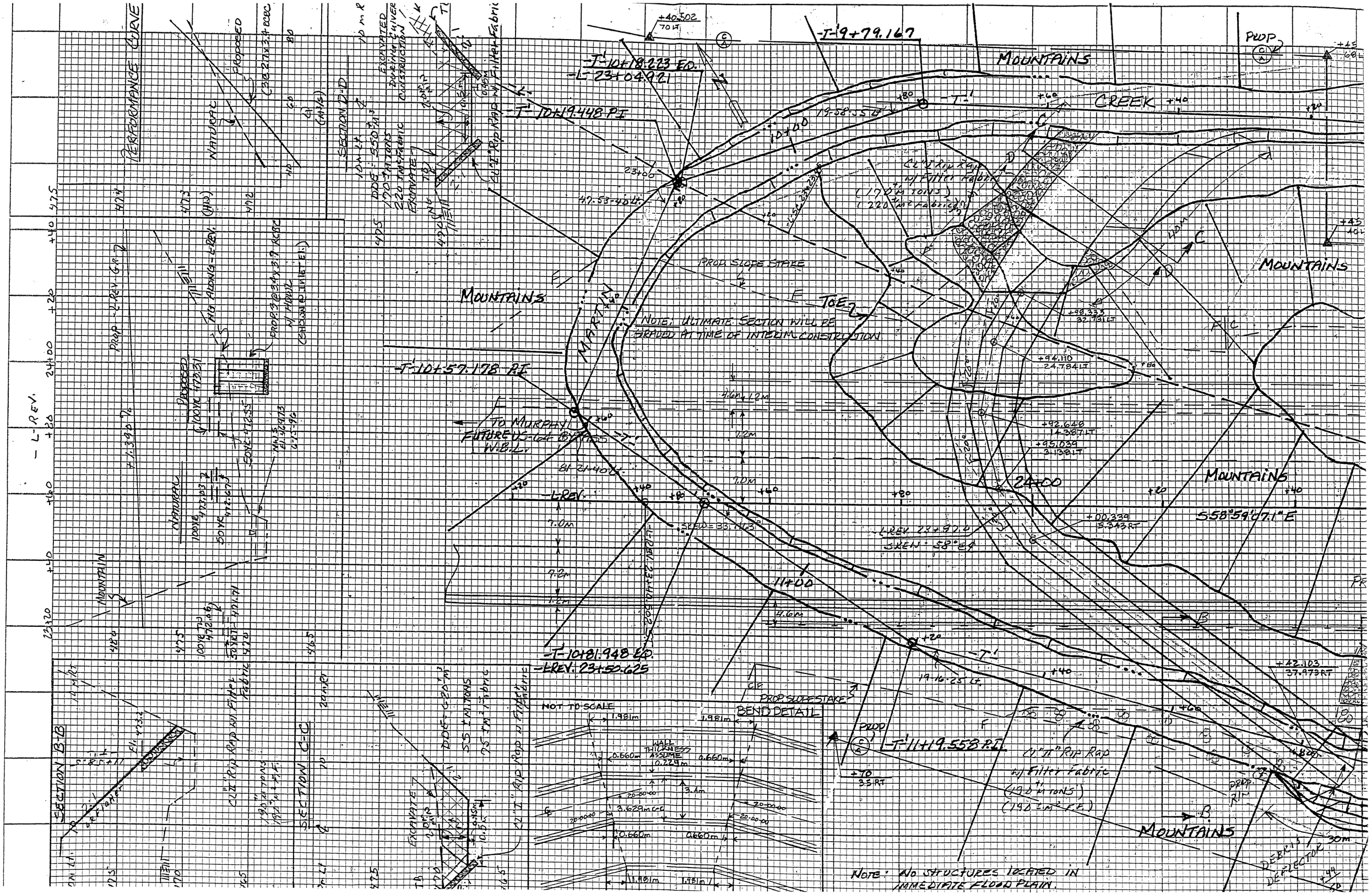
$H = .000112 Q^2$



NOTE: CULVERT IS OVERSIZED BY 25% DUE to high debris potential



-T-9+79.167
MOUNTAINS
CREEK
PROP
+45
68LT
9+00
10+00
19-58-35 LT
CL"I" Rip Rap
w/ Filter Fabric
(170± M TONS)
(220±M² Fabric)
TOE
+45
40LT
MOUNTAINS
PROP. SLOPE STAKE
ULTIMATE SECTION WILL BE
TIME OF INTERIM CONSTRUCTION
+98.333
32.731LT
+94.110
24.784LT
+92.648
14.387LT
+95.039
3.138LT
24+00
4.6M 1.2M
7.2M
7.0M
PROP. INV. 468.25 @ TOP OF EXC. BED MATERIAL
-L-
MOUNTAINS
-L-REV
S58°59'07.1"E
+00.339
3.343RT
-L-REV 23+97.0
SKEW 58°
11+00
4.6M
TO PEACHTREE
PROP. US-64 BYPASS
E.B.L.
-T-
19-16-25 LT.
+42.103
37.973RT
ROCK FILL
(200± M TONS)
(200± m² F.F.)
CL"II" Rip Rap
w/ Filter Fabric
TOE
PROP INV. 469.20
@ TOP OF EXC. BED MATERIAL
PROP. SLOPE STAKE
BEND DETAIL
1.981m
0.660m
20-00-00
0.660m
PROP
-T- 11+19.558 P.I.
+70
35 RT
CL"II" Rip Rap
w/ Filter Fabric
(190± M TONS)
(190±M² F.F.)
12+00
MOUNTAINS
DEBRIS DEFLECTOR
30m
TOE
+44
30
+55
60RT
NOTE: NO STRUCTURES LOCATED IN IMMEDIATE FLOOD PLAIN.
NOTE: APPROXIMATELY 300± M³ OF NATURAL STREAM BED MATERIAL SHOULD BE EXCAVATED AND STOCKPILED TO BE LATER PLACED ON THE FLOOR OF THE BOX CULVERT TO THE DEPTH OF 0.3 METERS.
L=94 M
S0=1.01%
℄ BED EL.=468.54
0.3M
LT BANK IS MOUNTAIN
TW ELEVATIONS
SECTION A-A
120M LT.
ROCK FILL
EL. 473.2
CL "II" RIP RAP W/ FILTER FABRIC
EXCAVATE
NOTE: ULTIMATE SECTION WILL BE GRADED AT TIME OF INTERIM CONSTRUCTION
2:1 TYPICAL VARIES ALONG BOX
℄ STA. 23+97.0
PROP. 3@3.4X3.0 RCBC
-L-REV
SKEW @ ℄ = 58°
GR. PT. = 479.22
TEMPLATE PLOTTED ALONG ℄ PROP. BOX
NATURAL
100YR 473.03
50YR 472.67
TE 50YR 472.55
O.H.W. IS TIE
PROPOSED
100YR 473.31
50YR
BASED ON DEPT. OF FEMA FLOOD STUDY
DEBRIS DEFLECTORS
NWS 469.73
6/15/96
100M RT
466
468
470
472
474
476
478
480


PERFORMANCE CURVE
NATURAL
PROPOSED
SECTION D-D
EXCAVATED DURING RIVER CONSTRUCTION
CULVERT RIP RAP W/ FILTER FABRIC
-T-10+18.223 E.P.
-L-23+04.921
-T-10+19.448 P.I.
-T-9+79.167
MOUNTAINS
CREEK
PROP SLOPE STAKE
TOE
NOTE: ULTIMATE SECTION WILL BE GRADED AT TIME OF INTERIM CONSTRUCTION
-T-10+57.178 P.I.
TO MURPHY
FUTURE US-64 BYPASS W.B.L.
-L-REV.
-T-10+81.948 E.P.
-L-REV. 23+50.625
SECTION B-B
SECTION C-C
NOT TO SCALE
BEND DETAIL
WALL THICKNESS ASSUME 0.229m
-T-11+19.558 P.I.
11" "II" Rip Rap w/ Filter Fabric
(190 m TONS)
(190 m² F.F.)
S58°59'07.1"E
24+00
11+00
10+00
23+00
NOTE: NO STRUCTURES LOCATED IN IMMEDIATE FLOOD PLAIN.

SITE DATA

Drainage Area 384 Sq. Km Source "DA OF SELECTED SITES" & USGS QUAD MAPS Character RURAL MOUNTAINS

Stream Classification (Such as Trout, High Quality Water, etc.) NS-IV

Data on Existing Structure NONE

Waterway Opening N/A

Data on Structures Up and Down Stream DOWNSTREAM UNDER EXIST. US-64 -- 5@28M SPAN STEEL GIRDERS, 0.8M WIDE SQUARE PIERS; APPROX. WATERWAY OPENING = 1854 M^2 / UPSTREAM UNDER SR-1548 -- 5@14.4M SPAN CONC. GIRDER, VERTICAL ABUTMENTS, EARWALLS, ROUNDED PIERS; WATERWAY OPENING = 418 M^2

Design Control Elev. @ SECTION 101.40 -- 100 YR BASE FLOOD ELEVATION = El. 477.88 (½ KM DOWNSTREAM)

Gage Station No. 03548500 (Pre-Regulation) Period of Records Pre-Regulation - 1897-1921; Post Regulation - 1942 to PRESENT

Max. Discharge 654 m^3/s Date 3-19-1899 Frequency 100 YR +

Historical Flood Information:

Date 3-19-1899	Elev. 477.9 +/- m	Est. Freq. 100 +/-	Source 1959 TVA STUDY	Period of Knowledge	N/A
Date 9-3-1888	Elev. 477.9 +/- m	Est. Freq. 100 +/-	Source	Period of Knowledge	
Date 2-19-1936	Elev. 477.5 +/- m	Est. Freq. 25 +	Source	Period of Knowledge	

Historical Scour Info. : General 0 (SECTION 99.13 to 102.22) Contraction 0 Local 0

Channel Slope .0013 Source HEC-2 DATA Normal Water Surface Elev. 473.22 m (9/24/91)

Manning's n : Left O.B. .06 TO .012 Channel .038 TO .045 Right O.B. .03 TO .12 Source HEC-2 DATA

Flood Study / Status YES. DETAILED Floodway Established? YES

Flood Study 100 yr. Discharge 566.36 m^3/s; W.S. Elev.: With Floodway 477.31 m Without Floodway 477.01 m @ SECTION D-D (101.45)

DESIGN DATA

Hydrological Method FEMA DISCHARGES USED

Hydraulic Design Method HEC-2

Floods Evaluated:

Freq.	Q	SECTION 101.40 Elev.	Backwater	SB OUTPUT Bridge Opening Velocity
10	404.64	477.39	+0.0	1.52 M/s
50	524.71	477.76	+0.0	1.65
100	573.98	477.88	+0.00	1.71
500	677.06	478.12	+0.02	1.84

Waterway Opening Provided 3000 +/- M^2 below LOW STEEL @ SECTION 101.38

Average Channel Velocity (Design) 1.94 m/s

Average Overbank Velocity (Design) LT. OB 0.93 m/s RT OB 0.56 m/s

	CH.	LT. O.B.	RT. O.B.
100YR	0	.51	.48
500YR	0	.84	1.22

	100YR	500YR
Pier #1-#4	1.3 TO 1.9	1.4 TO 1.9
#5 & 6	2.6	2.7
#7	1.1	1.3

Computed Scour : General 0 Contraction Local

Is a Floodway Revision Required? NO - NO NEW FILL IN FLOODWAY

BRIDGE SURVEY & HYDRAULIC DESIGN REPORT 2a OF 2

N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULICS UNIT
RALEIGH, N. C.

PLAN VIEW

DETAILED FLOOD STUDY w/ FLOOD ZONE

I.D. No. R-977A Project No. 8.1910203 Proj. Station -LREW 68+58.00 POC

County CHEROKEE Bridge Over HIWASSEE RIVER Bridge Inv. No. N/A

On Highway PROP. US-64 Between SR-1558 and NC-141

Recommended Structure PROP. 8 @ 26.25M SPANS 1370MM PRESTRESSED GIRDERS when projected onto ℄ Median

Recommended Location is ON NEW LOCATION ~~Up-Ast. Down Stream from Existing Crossing~~. Skew 67°

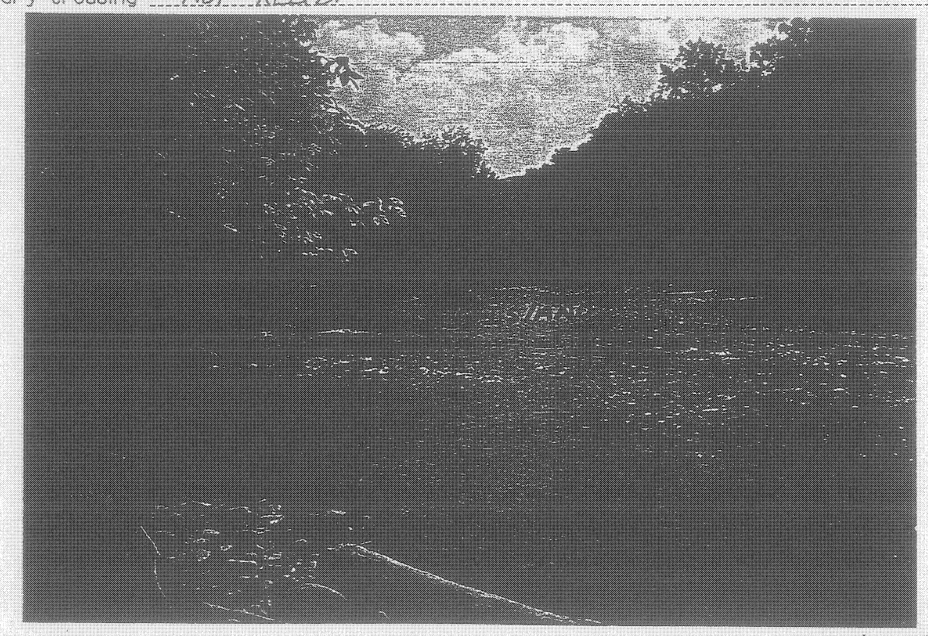
Recommended Width of Roadway 11.4 M Clear ROADWAY m

Nearest Shipping Point MURPHY On SOUTHERN R.R., 1.6 km From Bridge

Bench Mark is BM#24, 200 NAIL SET IN BASE OF 200 CHERRY TREE, 46.5 m RT. OF -L- STA. 69+00. Elev. 478.221 m Datum: NGVD 1929

Temporary Crossing NOT REQ'D.

Stream HIWASSEE Bridge Inv. No. N/A I.D. No. R-977A Project No. 8.1910203



Designed by: RICHARD SCARCE & ASSOCIATES

Assisted by: JK SCARCE, PE; RJ CHROMY; CA RUTH

Project Engineer: RN SCARCE, PE, RLS

Reviewed & Approved by: _____ Date _____

NORTH CAROLINA PROFESSIONAL SEAL 20737 ENGINEER JONATHAN KENNING SCARCE

Jonathan Scarce

INFORMATION TO BE SHOWN ON PLANS

Design: Discharge 524.71 m^3/s Frequency 50YR Elev. 477.76 m

Base Flood: Discharge 573.98 m^3/s Frequency 100 yr. Elev. 477.88 m

Overtopping: Discharge 677.06 + m^3/s Frequency 500 YR + Elev. 493.83 m

OVERTOPPING OCCURS AT TOP RDWY AT SAG LOCATED AT -L- REV. 70+50.2

ADDITIONAL INFORMATION AND COMPUTATIONS

Channel and Bank Stability CHANNEL: SMALL ISLAND LOCATED 60+M UPSTREAM; SAND, COBBLES, + FEW LARGE ROCKS; FAIRLY REGULAR & STABLE REACH. BANKS - FAIRLY STABLE, ALMOST VERTICAL IN SOME AREAS, LINED W/ VEGETATION AND TREES.

Reservoirs, Water Resource Projects, Other Flood Control Projects REGULATED BY THE CHATUGE DAM

DA = 384.50 KM USGS RURAL REGRESSION EQUATIONS (BLUERIDGE - PIEDMONT)

$RQ_2 = 2.11 A^{.691} = 128.84$ say 130 m^3/s

$RQ_5 = 3.71 A^{.670} = 199.93$ | 200

$RQ_{10} = 5.02 A^{.665} = 262.54$ | 260

$RQ_{25} = 7.09 A^{.655} = 349.45$ | 350

$RQ_{50} = 8.86 A^{.650} = 423.89$ | 420

$RQ_{100} = 11.03 A^{.643} = 506.17$ | 510

$RQ_{200} = 13.27 A^{.631} = 567.00$ | 570

$RQ_{500} = 18.01 A^{.622} = 729.40$ | 730

FEMA DISCHARGES

$Q_{10} = 404.64$ M^3/s

Q_{50} 524.71 ← USED THESE

$Q_{100} = 573.98$ (QT CARD AT SECTION 100.95)

$Q_{500} = 677.06$

SITE DATA

Drainage Area 384 Sq. Km Source "DA OF SELECTED SITES" & USGS QUAD MAPS Character RURAL MOUNTAINS

Stream Classification (Such as Trout, High Quality Water, etc.) WS-IV

Data on Existing Structure NONE

Waterway Opening N/A

Data on Structures Up and Down Stream DOWNSTREAM UNDER EXIST. US-64 -- 5@ 28M SPAN STEEL GIRDERS, 0.8M WIDE SQUARE PIERS; APPROX. WATERWAY OPENING = 1854 M^2 / UPSTREAM UNDER SR-1548 -- 5@14.4M SPAN CONC. GIRDER, VERTICAL ABUTMENTS, EARWALLS, ROUNDED PIERS; WATERWAY OPENING = 418 M^2

Design Control Elev. @ SECTION 101.40 -- 100 YR BASE FLOOD ELEVATION = El. 477.88 (1 KM DOWNSTREAM)

Gage Station No. 03548500 (Pre-Regulation) Period of Records Pre-Regulation - 1897-1941; Post Regulation - 1942 to PRESENT

Max. Discharge 654 m^3/s Date 3-19-1899 Frequency 100 YR +

Historical Flood Information:

Date 3-19-1899 Elev. 477.9 +/- m Est. Freq. 100 +/- Source 1954 TVA STUDY Period of Knowledge N/A

Date 9-3-1898 Elev. 477.9 +/- m Est. Freq. 100 +/- Source Period of Knowledge

Date 2-19-1936 Elev. 477.5 +/- m Est. Freq. 25 + Source Period of Knowledge

Historical Scour Info.: General 0 (SECTION 99.13 TO 102.22) Contraction 0 Local 0

Channel Slope .0013 Source HEC-2 DATA Normal Water Surface Elev. 473.22 m (9/24/96)

Manning's n: Left O.B. .06 TO .012 Channel .038 TO .045 Right O.B. .03 TO .12 Source HEC-2 DATA

Flood Study / Status YES. DETAILED Floodway Established? YES

Flood Study 100 yr. Discharge 566.36 m^3/s; W.S. Elev.: With Floodway 477.31 m Without Floodway 477.01 m @ SECTION D-D (101.45)

DESIGN DATA

Hydrological Method FEMA DISCHARGES USED

Hydraulic Design Method HEC-2

Floods Evaluated:

Freq.	Q	SECTION 101.40 Elev.	Backwater	SB OUTPUT Bridge Opening Velocity
10	404.64	477.39	+0.0	1.52 M/s
50	524.71	477.76	+0.0	1.65
100	573.98	477.88	+0.00	1.71
500	677.06	478.12	+0.02	1.84

Waterway Opening Provided 3000 +/- M^2 below low steel @ SECTION 101.38

Average Channel Velocity (Design) 1.94 m/s

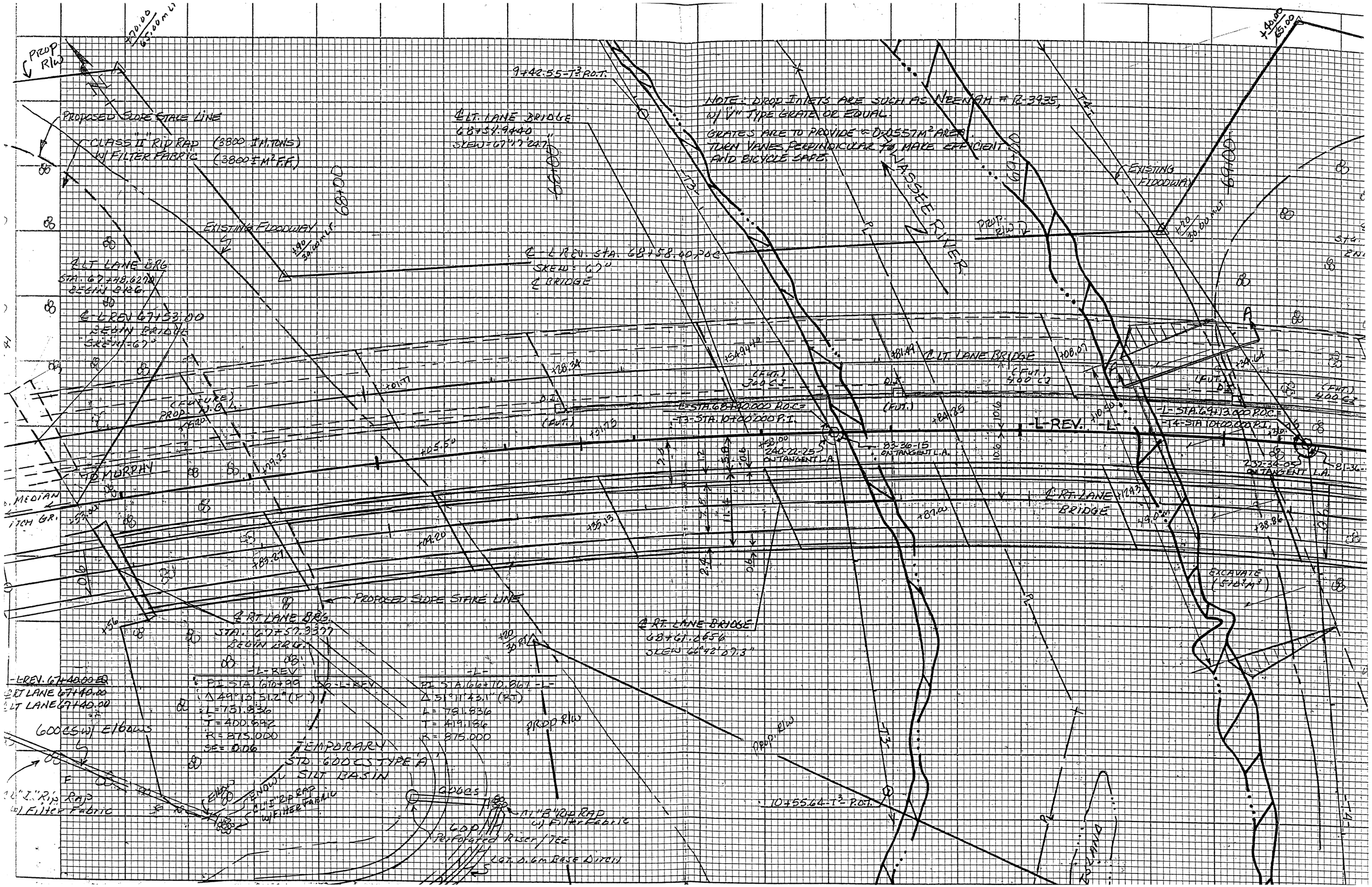
Average Overbank Velocity (Design) LT. OB 0.93 m/s RT OB 0.56 m/s

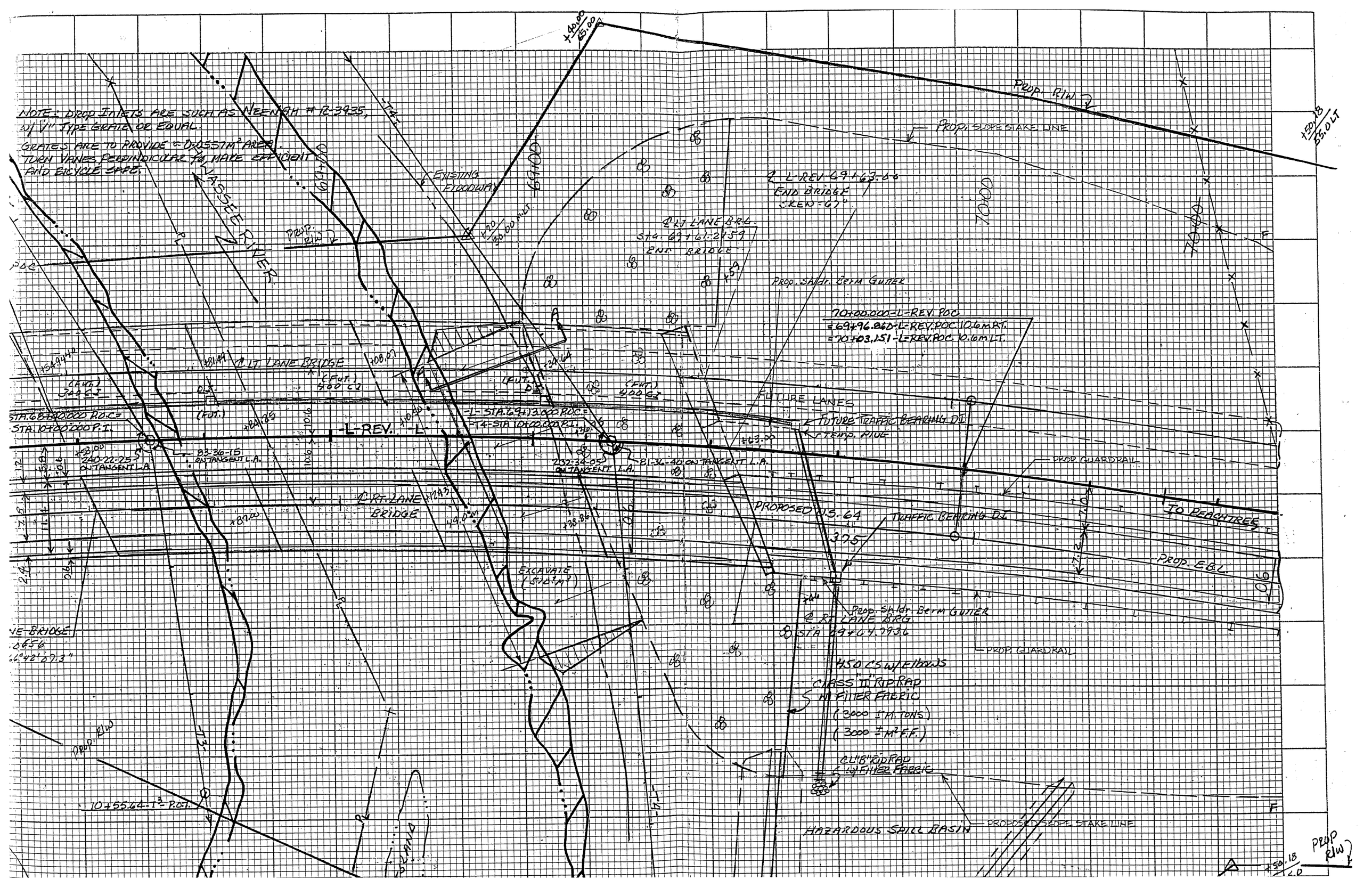
	CH.	LT. O.B.	RT. O.B.
100YR.	0	.51	.98
500YR.	0	.89	1.22

Computed Scour: General 0 Contraction Local

	100YR	500YR
PIER #1-#4	1.3 TO 1.7	1.4 TO 1.9
#5, #6	2.0	2.7
#7	1.1	1.3

Is a Floodway Revision Required? NO - NO NEW FILL IN FLOODWAY


PROP R/W
PROPOSED SLOPE STAKE LINE
CLASS "II" RIP RAP (3800 TONS)
W/ FILTER FABRIC (3800 ± M² F.F.)
EXISTING FLOODWAY
℄ LT. LANE BRG
STA. 67+48.6270
BEGIN BRG.
℄ L REV 67+53.00
BEGIN PROJ.
SKEW = 67°
9+42.55-T³ P.O.T.
℄ LT. LANE BRIDGE
68+54.9440
SKEW = 67°17'04.7"
℄ L REV. STA. 68+58.00 POC
SKEW = 67°
℄ BRIDGE
NOTE: DROP INLETS ARE SUCH AS NEENAH # R-3925, W/ "V" TYPE GRATE OR EQUAL.
GRATES ARE TO PROVIDE ≈ 0.255 M² AREA.
THEN VANES PERPENDICULAR TO MAKE EFFICIENT AND BICYCLE SAFE.
NASSEE RIVER
EXISTING FLOODWAY
PROP. R/W
℄ LT. LANE BRIDGE
-L- STA. 68+90.000 P.O.C.
-T3- STA. 10+00.000 P.I.
-L- STA. 69+13.000 P.O.C.
-T4- STA. 10+00.000 P.I.
-L- REV.
03-30-15 ON TANGENT L.A.
240-22-25 ON TANGENT L.A.
232-32-05 ON TANGENT L.A.
(FUT.) 400.62
(EXT.)
(FUTURE) PROP. J.G.L.
MURPHY
MEDIAN
DITCH GR.
℄ RT. LANE BRIDGE
PROPOSED SLOPE STAKE LINE
℄ RT. LANE BRG.
STA. 67+57.3377
BEGIN BRG.
-L- REV
PI STA 67+99
Δ 49°15'51.2" (RT)
L = 751.836
T = 400.692
R = 875.000
SE = 0.06
-L-
PI STA 66+70.867
Δ 51°11'43.1" (RT)
L = 781.836
T = 419.186
R = 875.000
℄ RT. LANE BRIDGE
68+61.2656
SKEW 66°42'07.3"
EXCAVATE (5.2 M³)
-L REV. 67+40.00 EQ
℄ RT LANE 67+40.00
℄ LT LANE 67+40.00
600 CS W/ ELBOWS
TEMPORARY STD. 600 CS TYPE A SILT BASIN
4" "I" RIP RAP W/ FILTER FABRIC
4" "E" RIP RAP W/ FILTER FABRIC
4" "B" RIP RAP W/ FILTER FABRIC
600 CS
Perforated Riser / TEE
Lot. 0.6m BASE DITCH
10+55.66-T³ P.O.T.
PROP R/W


NOTE: DROP INLETS ARE SUCH AS NEENAH # R-3435, W/ "V" TYPE GRATE OR EQUAL.
GRATES ARE TO PROVIDE ≈ 0.2551M² AREA.
TOP VANES PERPINDICULAR TO MAKE EFFICIENT AND BICYCLE SAFE.
PROP. R/W
PROP. SLOPE STAKE LINE
EXISTING FLOODWAY
ASSEE RIVER
2-L-REV-69+63.66
END BRIDGE
SKEW=67°
℄ LT. LANE BRG.
STA. 69+61.2159
END BRIDGE
PROP. SHLDR. BERM GUTTER
70+00.000-L-REV. POC
=69+96.060-L-REV. POC 10.6m RT.
=70+03.151-L-REV. POC 10.6m LT.
℄ LT. LANE BRIDGE
FUTURE LANES
FUTURE TRAFFIC BEARING DI
TEMP. PIPE
STA. 68+40.000 P.O.C.
STA. 10+00.000 P.I.
-L-REV. -L-
-L- STA. 69+13.000 P.O.C.
-T4- STA. 10+00.000 P.I.
23-36-15 ON TANGENT L.A.
240-22-25 ON TANGENT L.A.
232-24-05 ON TANGENT L.A.
81-36-40 ON TANGENT L.A.
DROP GUARDRAIL
℄ RT. LANE BRIDGE
PROPOSED U.S. 64
TRAFFIC BEARING DI
TO PEACHTREE
PROP. E.B.L.
EXCAVATE (610 M³)
PROP. SHLDR. BERM GUTTER
℄ RT. LANE BRG.
STA. 69+64.7936
PROP. GUARDRAIL
450 CS W/ ELBOWS
CLASS "II" RIP RAP
W/ FILTER FABRIC
(3000 ± M. TONS)
(3000 ± M² F.F.)
CL "B" RIP RAP
W/ FILTER FABRIC
HAZARDOUS SPILL BASIN
PROPOSED SLOPE STAKE LINE
10+55.64-T3-P.O.T.
PROP. R/W

APPENDIX D

EEP Acceptance Letter

Ecosystem Enhancement PROGRAM

September 23, 2004
DOT TIP#: R-0977 A
DWQ#: N/A
COE#: N/A

Greg Thorpe
Department of Transportation
1548 Mail Service Center
Raleigh, NC 27699-1548

Subject: Project: Murphy Bypass, US 64 Relocation
County: Cherokee

The purpose of this letter is to notify you that the North Carolina Ecosystem Enhancement Program (NCEEP) is willing to accept payment for stream and wetlands impacts associated with the subject project. Please note that the decision by the NCEEP to accept the mitigation requirements of this project does not assure that this payment will be approved by the U.S. Army Corps of Engineers and the N.C. Division of Water Quality Wetlands/401 Unit. It is the responsibility of the applicant to contact these agencies to determine if payment to the NCEEP for impacts associated with this project is appropriate.

Based on the information supplied by you in a letter dated September 8, 2004 the stream and wetlands restoration that is necessary to satisfy the compensatory mitigation requirements for this project is summarized in the following table. The maximum amount of mitigation that the NCEEP will accept for this project is also indicated in this table.

	Stream (linear feet)	Wetlands Riparian (acres)	Riparian Buffer (ft^2)
Impacts	6,011	0.82	
Mitigation Maximum	6,011	0.82	

The riparian wetlands and stream mitigation will be provided as specified in the 401 Water Quality Certification and/or Section 404 Permit for impacts associated with the subject project in Cataloging Unit 06020002 of the Hiwassee River Basin. The mitigation will be performed in accordance with the Memorandum of Agreement between the N.C. Department of Environment and Natural Resources, the U.S. Army Corps of Engineers and the N.C. Department of Transportation signed July 22, 2003.

If you have any questions or need additional information, please contact Carol Shaw at (919) 733-5208.

Sincerely,

Deborah D. Anderson

Deborah D. Anderson
In-Lieu Fee Administrator

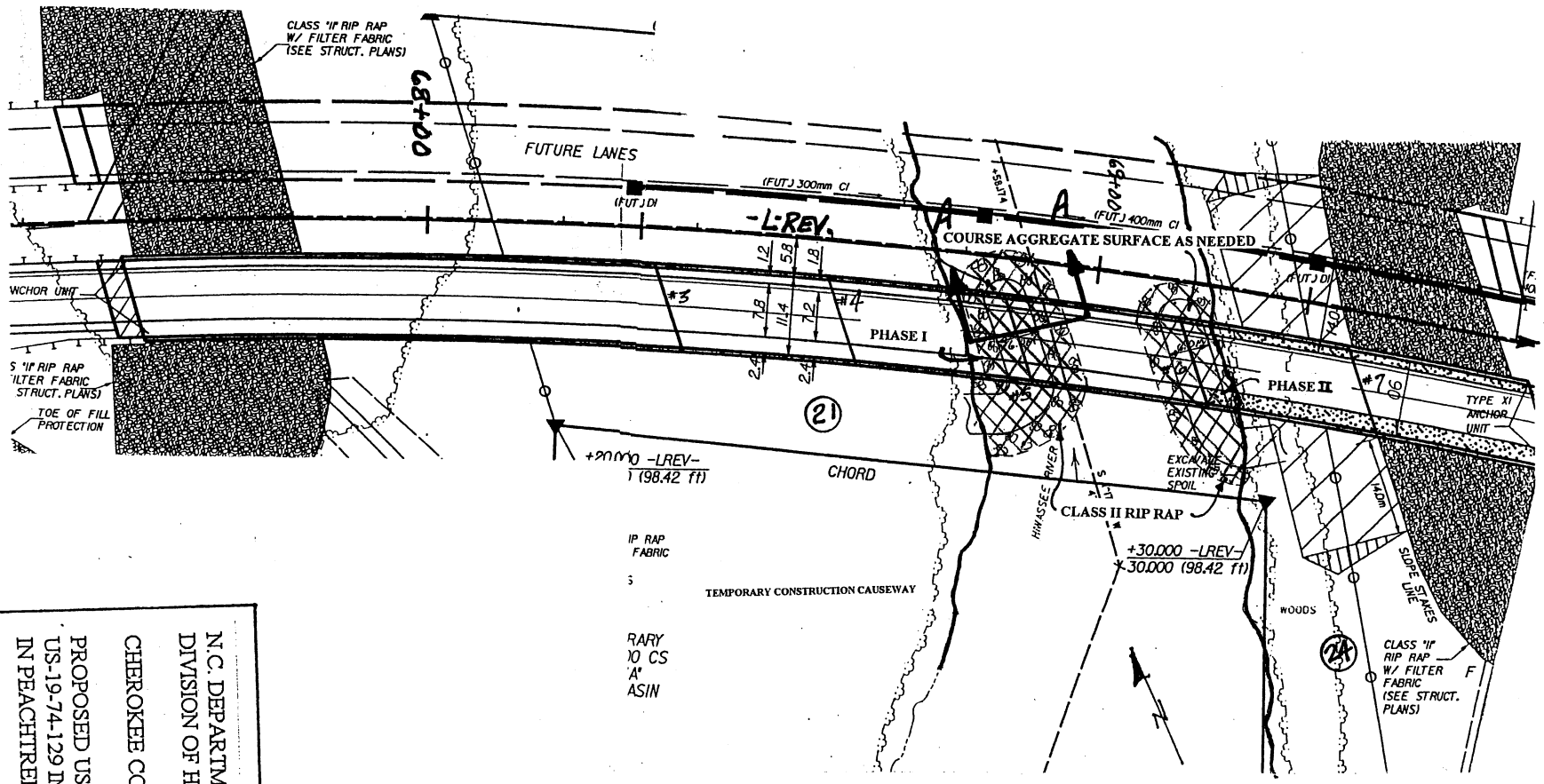
cc: Cyndi Karoly, Wetlands/401 Unit
Steve Lund, USACOE-Asheville
Mike Parker, DWQ Regional Office-Asheville
File

Restoring... Enhancing... Protecting Our State

NCDENR

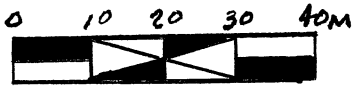
APPENDIX E

Original Design Drawings



TEMPORARY CONSTRUCTION CAUSEWAY II

DENOTES FILL IN SURFACE WATERS



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

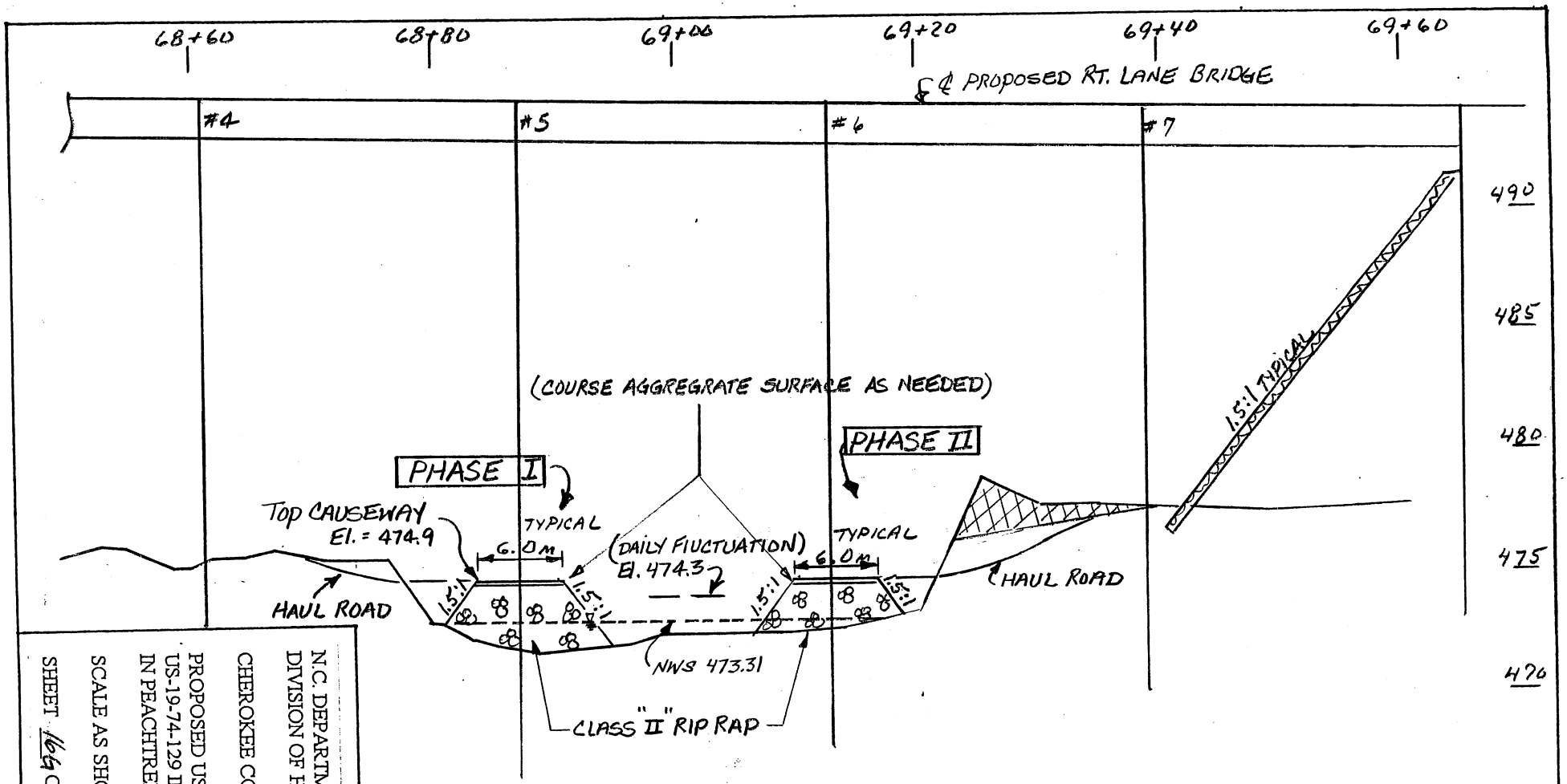
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

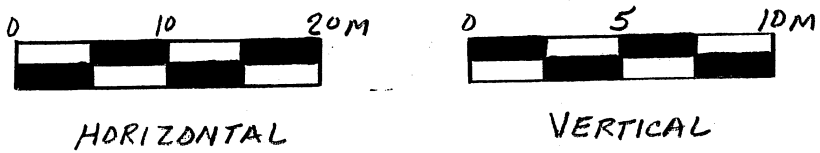
SCALE AS SHOWN

SHEET 16F OF 18

JUNE 1997



TEMPORARY CONSTRUCTION CAUSEWAY



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

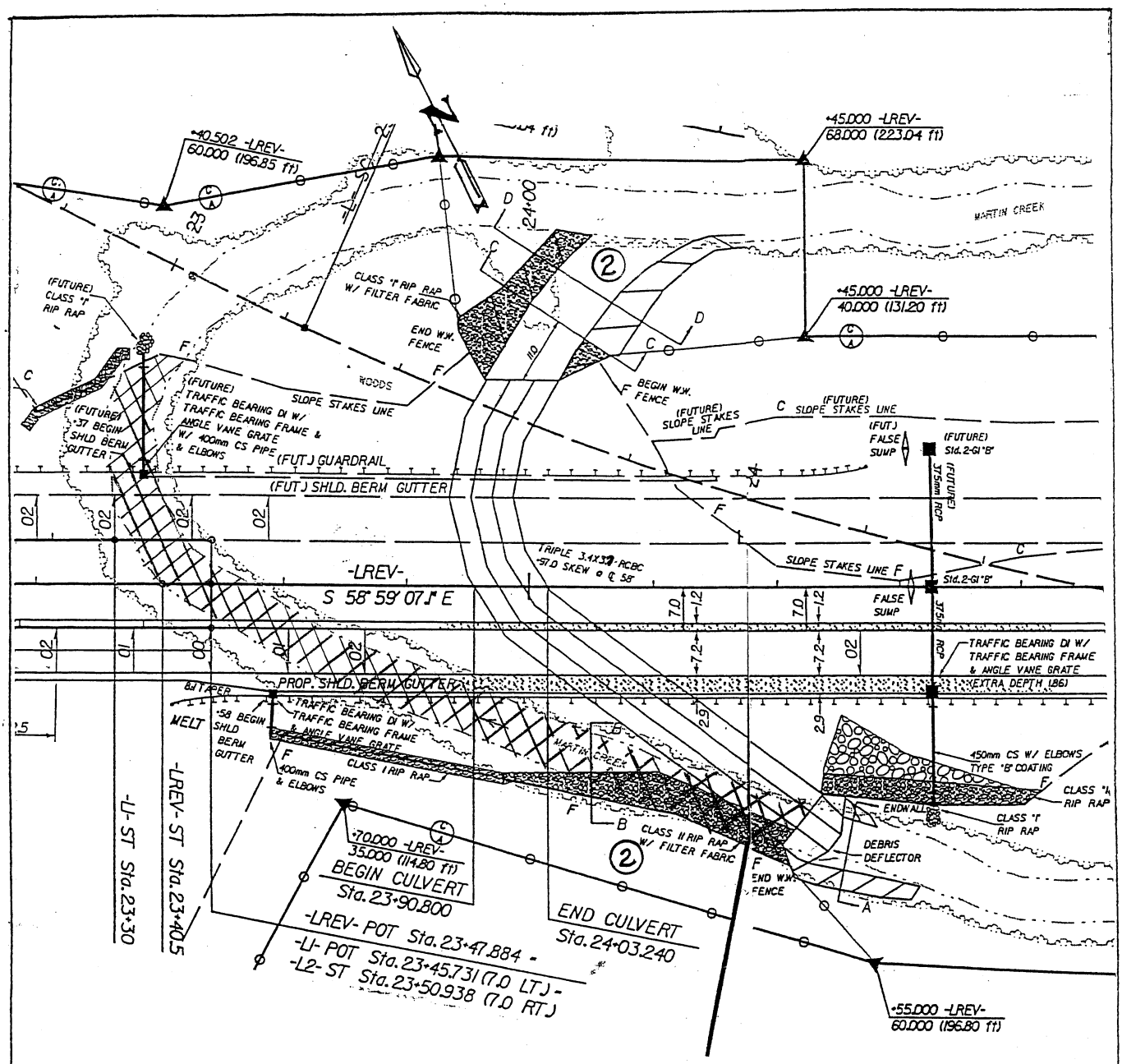
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16G OF 18

JUNE 1997



SITE No. 6

FILL IN SURFACE WATERS

SCALE

0 10 20m 40

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

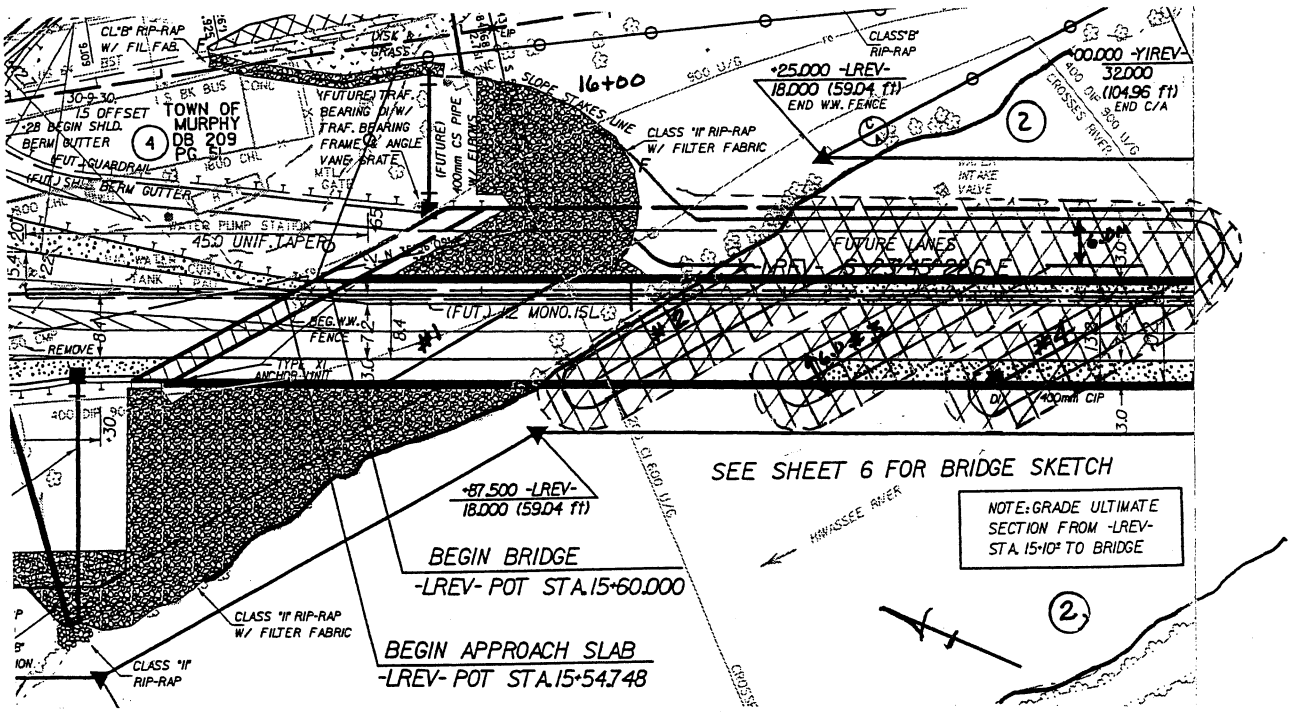
PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 8 OF 12

JUNE 1997

PHASE I

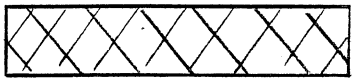


Construction Sequence

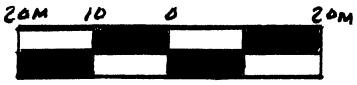
Phase I

1. Place Class II Rip Rap for construction of causeway.
2. Use course aggregrate surface as needed.
3. Build 6.0 meter wide causeway with 1.5:1 fill slopes.
4. Construct End Bent 1 and Bents 1,2, 3, and 4 during Phase I.
5. Install girders and bridge decks supported by the Bents.
6. Upon completion, remove construction causeway.

TEMPORARY CONSTRUCTION CAUSEWAY



DENOTES FILL IN SURFACE WATERS



Temporary Fill in Surface Waters = .20 ha.

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

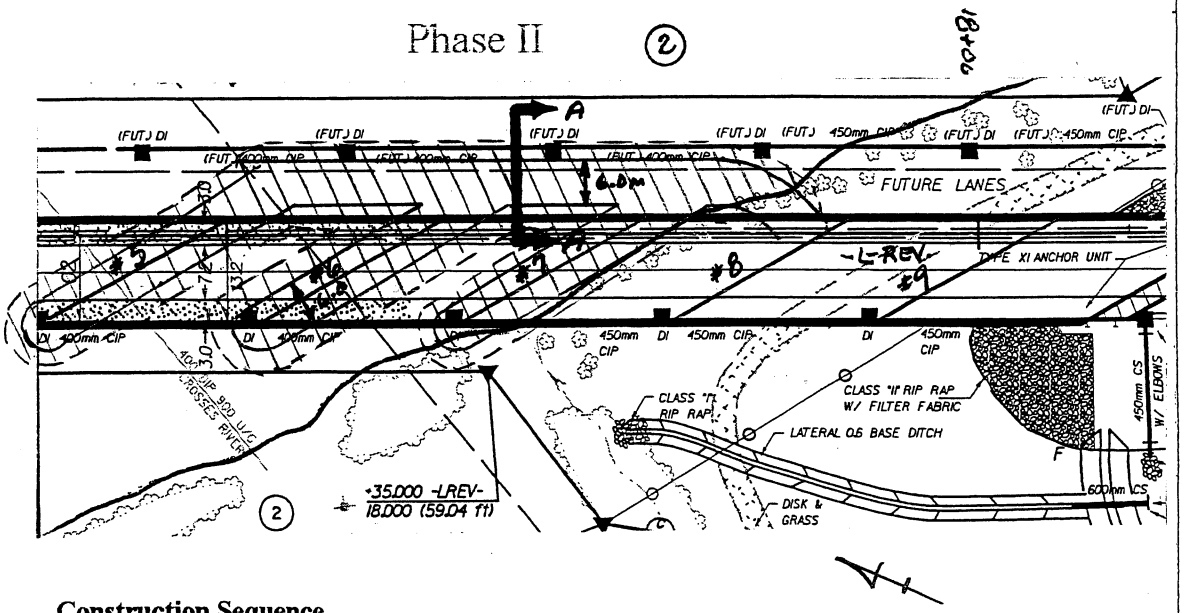
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16b OF 18 JUNE 1997

Phase II



Construction Sequence

Phase II

1. Place Class II Rip Rap for construction of causeway.
2. Use course aggregate surface as needed.
3. Build 6.0 meter wide causeway with 1.5:1 fill slopes.
4. Construct End Bent 2 and Bents 5,6,7,8, and 9 during Phase II.
5. Install girders and bridge decks supported by the Bents.
6. Upon completion, remove construction causeway.

TEMPORARY CONSTRUCTION CAUSEWAY I

DENOTES FILL IN SURFACE WATERS

20M 10 0 20M

Temporary Fill in Surface Waters = .19 ha.

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

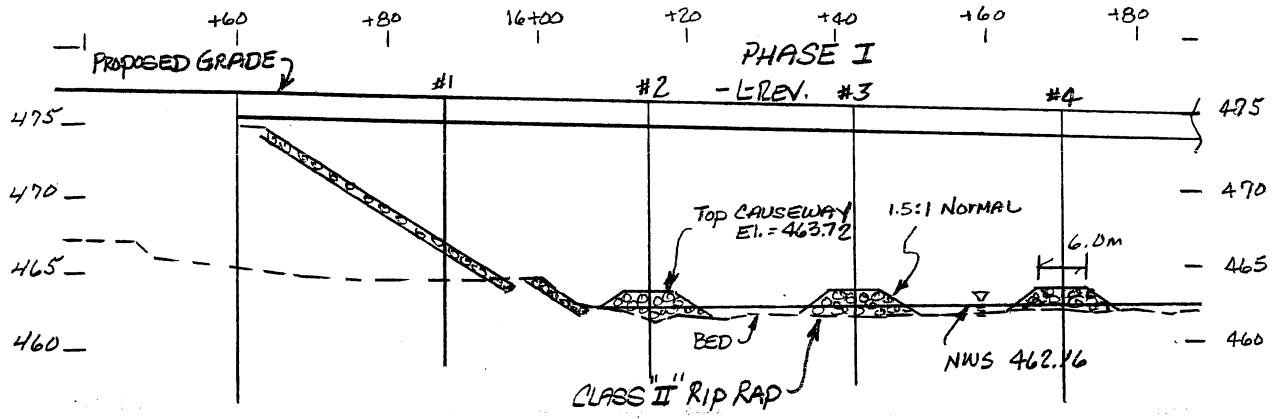
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

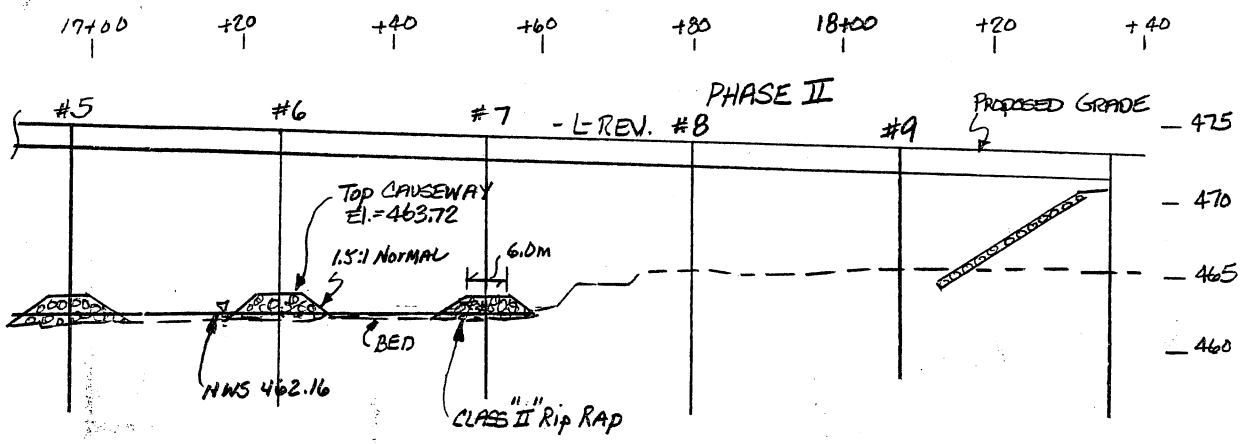
SCALE AS SHOWN

SHEET 16C OF 18 JUNE 1997

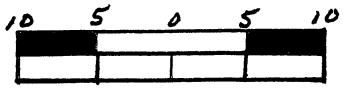
PHASE I



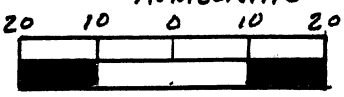
PHASE II



VERTICAL



HORIZONTAL



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

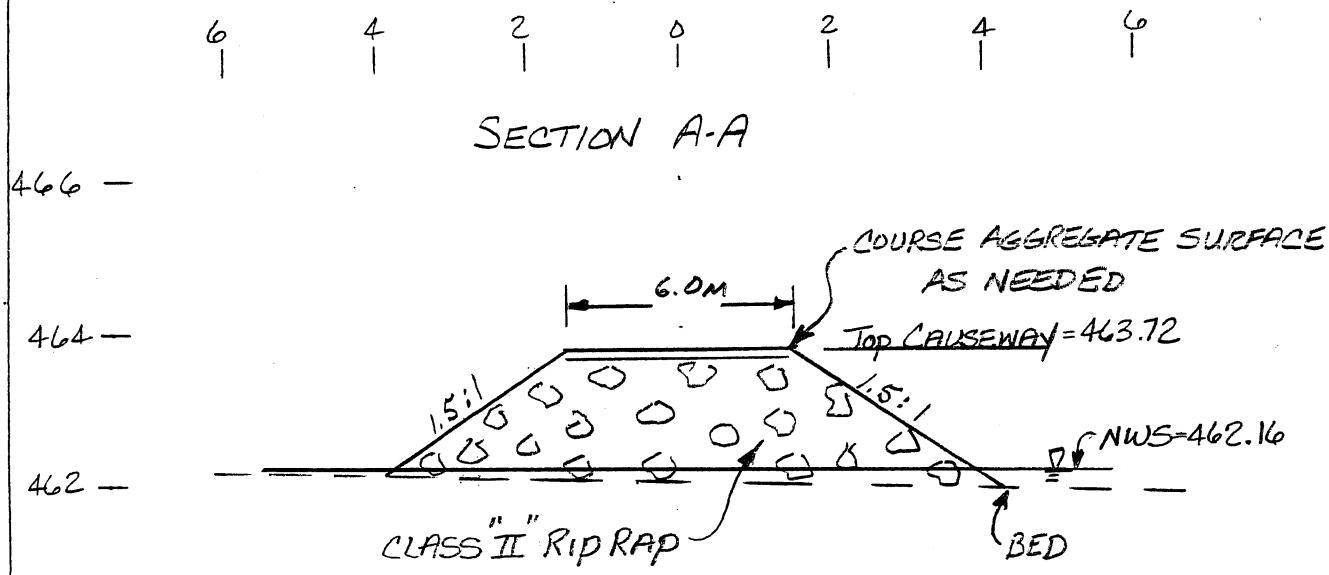
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

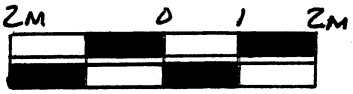
SCALE AS SHOWN

SHEET 16d OF 18

JUNE 1997



[Top CAUSEWAY = NWS + 1.0M (DAILY FLUCTUATION) + .06 (BACKWATER) + 0.5M (FREEBOARD) = 463.72]



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16e OF 18

JUNE 1997

APPENDIX F

Sulfidic Rock Data and Special Provisions

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Michael F. Easley
GOVERNOR

P.O. BOX 25201, RALEIGH, N.C. 27611-5201

Lyndo Tippett
SECRETARY

7 September, 2004

MEMO TO: Terry Hackett, The Catena Group

FROM: Jody C. Kuhne, PG, PE, Geotechnical Engineering

PROJECT: 34357.1.1, R-977A
COUNTY: Cherokee

DESC.: US 64 Bypass in Murphy

SUBJECT: NNP Sample locations

Sample #	Station	Offset
1	24+64	6.5 rt
2	24+70	16.5 rt
3	25+45	2.5 rt
4	24+70	16.5 rt
5	24+64	6.5 rt
6	16+53	1 lt
7	17+07	10 rt
8	16+47	10 rt
9	14+92	1 lt
10	15+52	1 lt
11	16+47	10 rt
12	14+86	10 rt
13	18+54	2 rt
14	16+47	10 rt
15	18+02	8 rt
16	18+54	2 rt
17	18+02	9 rt
18	18+47	9 rt
19	15+52	1 rt
20	18+47	9 rt

21	14+92	1 lt
22	15+46	10 rt
23	16+53	16 rt
24	17+47	10 rt
25	22+80	CL
26	20+00	150 rt

All offsets are in meters. Duplicate sample locations and offsets denote different sample depths in a core boring.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
MATERIALS & TESTS UNIT
P.O. BOX 25201 - RALEIGH, NORTH CAROLINA
August 18, 2004

TEST REPORT FOR: ROCK

TYPE OF MATERIAL: HARD ROCK
SAMPLE #: 1 – 26
PROJECT #: 34357.1.1
SAMPLED BY: J. Kuhne

DATE SAMPLED: 08/06 – 08/11 2004
RECEIVED: 08/11/04
COUNTY: CHEROKEE

TEST RESULTS

SAMPLE #	*SULFUR %*	*NEUTRAL POTENTIAL*	*ACID POTENTIAL*	*NET NEUTRAL POTENTIAL*
1	2.850	66.460	89.073	-22.613
2	0.487	52.743	15.221	37.521
3	0.361	49.950	11.275	38.675
4	0.289	24.564	9.020	15.544
5	0.704	2.370	21.986	-19.616
6	0.216	50.998	6.765	44.233
7	0.126	50.250	3.946	46.304
8	0.018	52.245	0.564	51.681
9	0.018	46.010	0.564	45.446
10	0.235	26.558	7.329	19.229
11	0.126	25.560	3.946	21.614
12	0.018	38.778	0.564	38.214
13	0.018	40.025	0.564	39.461
14	0.018	42.020	0.564	41.456
15	0.415	39.278	12.966	26.311
16	0.018	30.548	0.564	29.984
17	0.595	43.018	18.604	24.414
18	0.018	47.755	0.564	47.191
19	0.126	29.800	3.946	25.854
20	0.018	44.265	0.564	43.701
21	0.018	41.023	0.564	40.459
22	0.108	28.803	3.383	25.420
23	0.072	27.555	2.255	25.300
24	0.018	43.018	0.564	42.454
25	0.072	47.258	2.255	45.003
26	0.036	48.753	1.128	47.625

NET NEUTRALIZATION POTENTIAL (NNP) REPORTED IN TONS $CaCO_3$ PER 1000 TONS OF MATERIAL. **NNP VALUES LESS THAN NEGATIVE FIVE ARE CONSIDERED HARMFUL (HOT).*

SIGNED: _____

CHRISTOPHER A. PEOPLES
CHEMICAL TESTING ENGINEER

cc: W.D. FRYE/FILE

POTENTIAL ACID PRODUCING ROCK MATERIALS

Description

Work under this section consists of testing for and disposing of potential acid producing rock materials as directed by the Engineer. Acid producing rock contains sufficient amounts of certain minerals that may produce damaging acid levels in leachate when exposed to the atmosphere and weathering processes.

All fresh rock on this project has low potential for producing acid drainage. Acid potential in rock is measured as Net Neutralization Potential (NNP). Acidity levels in runoff is reflected in pH and sulfate content.

Testing and Monitoring Procedure

Testing and monitoring consists of weekly water sampling by Contractor's independent agent, to be approved by the Engineer. Monitoring consists of testing runoff from approved temporary and permanent erosion control basins as shown in the Plans. Testing must be conducted by an accredited lab facility and must consist of reported values of pH, acidity, alkalinity and sulfate content. Measure values for pH at the sampling sites and record immediately. Report pH results to the Engineer within 24 hours of measuring. Report lab results to the Engineer within 7 days of sampling.

NCDOT Geotechnical Engineering Unit will concurrently test existing streams for the same values on a monthly basis with results available through the Engineer.

Testing Values and Results

If reported pH values are below 6.0, the Engineer will select a Mitigation Plan within 72 hours from receiving results. Mitigation Plans will consist of any of the courses of action listed under "Mitigation Plans" with payment according to the line item under "Basis of Payment".

Mitigation Plan

Possible mitigation methods for acid producing rock consists of:

1) Select placement and treatment of excavated material in a location to be approved by the Engineer.
2) Treatment of excavated material in embankment or waste area.
3) Cover treated material with soil backfill meeting AASHTO requirements A-2-4, A-4, A-6 or A-7.

At the direction of the Engineer, temporarily mitigate by treatment with lime and covering with high-density polyethylene (HDPE) sheeting at the excavation site while awaiting transport to the disposal site.

Treatment consists of layering excavated material lifts with crushed limestone aggregate and/or agricultural grade ground limestone at a spread rate recommended by the Geotechnical Engineering Unit based on NNP values of the rock material. The Geotechnical Engineering Unit and Materials and Tests Unit of NCDOT will conduct sampling and testing for NNP.

Basis of Payment

Payment will be made under:

Crushed Limestone Aggregate	Metric Ton
Agricultural Grade Ground Limestone	Metric Ton
High Density Polyethylene Sheeting	Square Meter
Soil backfill	Cubic Meter

Excavation and placement of rock is considered incidental to work performed for the treatment process and is considered "Unclassified Excavation."

APPENDIX G

Indirect and Cumulative Effects Report

INDIRECT AND CUMULATIVE EFFECTS REPORT

US 64 Relocation from US 19 to East of SR 1548

TIP R-0977

Cherokee County, North Carolina

Prepared for

North Carolina Department of Transportation

Office of Human Environment

Prepared by:

HNTB North Carolina, PC

2108 South Boulevard

Suite 108

Charlotte, North Carolina 28203

April 8, 2003

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EXISTING PLANS AND REGULATIONS 1
ENVIRONMENTAL REPORTS CONCLUSIONS 2
POTENTIAL FOR INDUCED DEVELOPMENT 2

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IDENTIFICATION OF DEMOGRAPHIC AREA 3
IDENTIFICATION OF POTENTIAL GROWTH IMPACT AREA 3
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IV. COMMUNITY AND DEMOGRAPHICS **4**

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MAGNITUDE OF LAND USE CHANGE 11

North Carolina Department of Transportation
Office of Human Environment

Indirect and Cumulative Effects (ICE) Report
TIP R-0977
US 64 Relocation form US 10 to just east of SR 1548
Cherokee County, North Carolina

I. EXECUTIVE SUMMARY

Community and Demographics

- TIP R-0977 is located in a predominantly rural, mountain environment in extreme western North Carolina, popular with tourists and vacationers who enjoy the outdoors.
- Although the population is minimal compared to more urban areas, the population *growth rate* within the demographic area (32.1%) between 1990 and 2000 exceeded both Cherokee County (20.7%) and North Carolina (21.4%).
- The Town of Murphy, the largest municipality and county seat of Cherokee County, anchors the west end of TIP R-0977. Murphy lost population slightly during the last decade, going from 1,575 persons in 1990 to 1,568 persons in 2000.

Employment and Economic Development

- Responding to the needs of vacationers and retired persons, the services sector dominates employment within both the demographic area and Cherokee County as a whole.
- The Tri-County Community College and Murphy Medical Center, both located near the intersection of existing US 64 and NC 141, serve as economic development catalysts for the demographic area.

Existing Plans and Regulations

- There is no zoning ordinance or land use plan for Cherokee County. Murphy is the only jurisdiction with zoning in the entire county. Land along the tiny portion of R-0977 within Murphy's town limits is zoned for Residential and Highway Business.
- A portion of the demographic area is located within the WS-IV Hiwassee River Watershed, which allows up to two dwelling units per acre or 24% built-upon area (70% built-upon area if the 1" storm is controlled for).
- According to the Department of Environment and Natural Resources, Brasstown Creek and Valley River are considered impaired bodies of water within the demographic area.

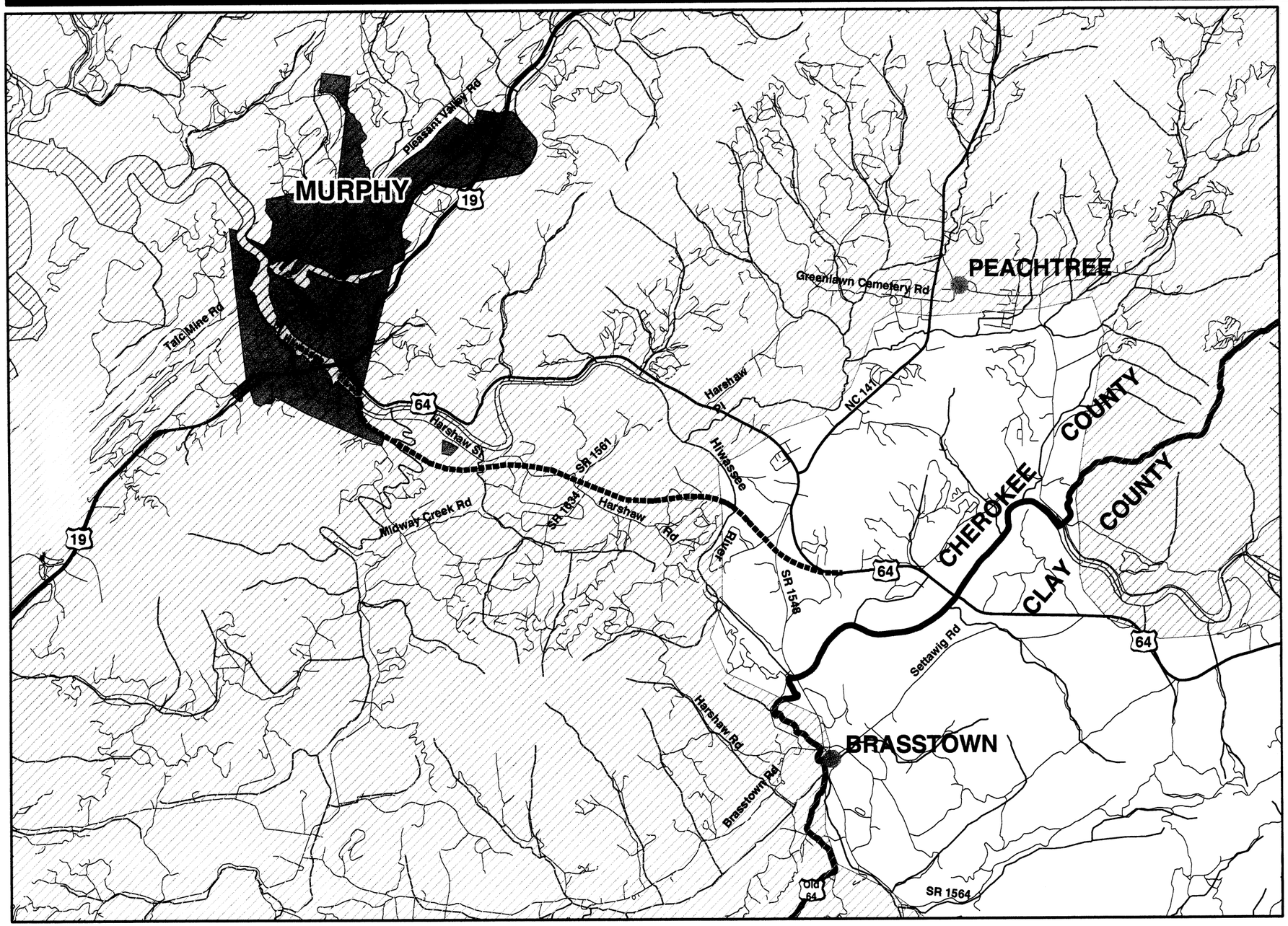


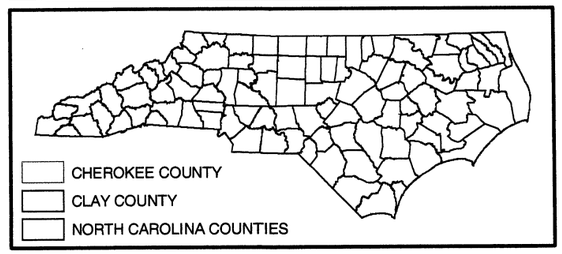
FIGURE 1: ALIGNMENT

- TIP R-0977
- MAJOR ROADS
- MINOR ROADS
- RIVERS/CREEKS
- WATER BODIES
- CHEROKEE COUNTY
- CLAY COUNTY
- TOWN OF MURPHY
- NANTAHALA NATIONAL FOREST
- UNINCORPORATED TOWNS

1 0.5 0 1 Miles

N

MAP SOURCES:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)
HNTB



Environmental Reports Conclusions

- The 1994 Environmental Assessment indicated that a total of 2.2 acres of wetlands would be impacted by TIP R-0977 and that 9 relocations would be required.
- No federally-listed threatened or endangered plant or animal species are known to occur in Cherokee County. It was also determined that no unique farmlands are presently defined along the US 64 relocation corridor.
- As part of the Finding of No Significant Impact report, the Federal Highway Administration (FHWA) determined that R-0977 would not have a significant impact on the natural or human environment.

Potential for Induced Development

- TIP R-0977 is likely to stimulate land development having complementary (to highway-related travel) functions, such as gas stations, convenience stores, restaurants, etc. The project could influence intraregional land development decisions as well because of US 64 being the major east-west route in the region, connecting I-26 in western North Carolina to I-75 in southeastern Tennessee.
- A moderate amount of induced growth, including new and in-fill residential as well as commercial nodes at major intersections, is expected to occur as a result of the completion of TIP R-0977. Some of the reasons for this growth are access to previously inaccessible land, the presence of existing water and sewer services, and a pro-growth environment.

II. PROJECT DESCRIPTION

The North Carolina Department of Transportation (NCDOT) plans to construct a 4.9-mile relocation of US 64 in Cherokee County from US 19/US 64 in the Town of Murphy proceeding eastward to existing US 64 just east of SR 1548 north of Brasstown, NC (see Figure 1). A widening of existing US 64 was originally proposed, but withdrawn because of geo-technical concerns and costs. The proposed roadway would be a new two-lane facility constructed on a four-lane right-of-way, predominantly south of the Hiwassee River. A 46-foot median is also proposed for the cross section, as well as two new bridges across the Hiwassee River. The proposed right-of-way width would vary from 170 feet to 500 feet due to the mountainous terrain. The main purpose of R-0977 is to improve traffic capacity and safety for motorists along US 64 in this area.

As a result of the 1994 Environmental Assessment findings, one of eight alternative alignments on new location was chosen as the preferred alternative (C1). Based on input from numerous agencies, including the Federal Highway Administration, United States Fish and Wildlife Service, DENR-Division of Water Quality, North Carolina Wildlife Resources Commission, US Army Corps of Engineers, and the Environmental Protection Agency, the preferred alternative was further evaluated and amended to minimize impacts to several species of mussels in the Hiwassee River. C1B, the final chosen alternative, crosses the Hiwassee River slightly further downstream as it exits the town

limits of Murphy, with piers approximately ten to twenty feet from the edge of the water. This slight modification substantially minimizes the impact to the mussel species and the need for causeways.

III. DEMOGRAPHIC AREA, POTENTIAL GROWTH IMPACT AREA, & IMPACT AREA DESCRIPTION

Identification of Demographic Area

The project is located in the south central portion of Cherokee County in extreme western North Carolina. It is located within the Nantahala National Forest, with elevations varying from 1,520 feet to 1,750 feet. The area north of the proposed relocation alignment is sparsely populated, particularly between the Hiwassee River and Harshaw Road (SR 1558). South of the R-0977, particularly along the south side of Harshaw Road, are a number of suburban homes. Beaver Ridge subdivision, located north of Harshaw Road and east of SR 1561 (Harshaw Place), is the largest of these residential communities. Murphy, the county seat, includes most of the commercial activity within Cherokee County, including neighborhood retail, industrial, and institutional uses. In addition, the Town of Peachtree, located along SR 141 just north of existing US 64, includes a community college, a hospital, and a new regional water/wastewater treatment plant.

R-0977 is predominantly located in unincorporated Cherokee County, with a small portion located within the Town of Murphy. For demographic analysis purposes, a demographic area was established for the project, bounded by four census tract block groups (see Figure 2):

- Census Tract 9904, Block Groups 4,5
- Census Tract 9905, Block Groups 1,2

This demographic area is generally bounded by the Cherokee-Clay County border to the east, US 19/US 74 to the west, near the North Carolina-Georgia state line to the south, and Vengeance Creek to the north.

Identification of Potential Growth Impact Area

The Potential Growth Impact Area is the area within which the project has the potential to induce land use changes. This area is generally defined by a three- to five-mile radius from each of the proposed intersections or interchanges. For smaller projects, particularly those involving the widening of a roadway on existing alignment, the Potential Growth Impact Area is more typically a three-mile or less radius from the proposed intersections or interchanges[1]. Because R-0977 predominantly runs parallel to an existing thoroughfare (Harshaw Road), it does not provide much new access to previously inaccessible parcels of land in certain areas. Therefore, it was more appropriate for the

[1] Cervero, Robert 2002 (forthcoming). Road Expansion, Urban Growth, and Induced Travel: A Path Analysis. Journal of the American Planning Association.

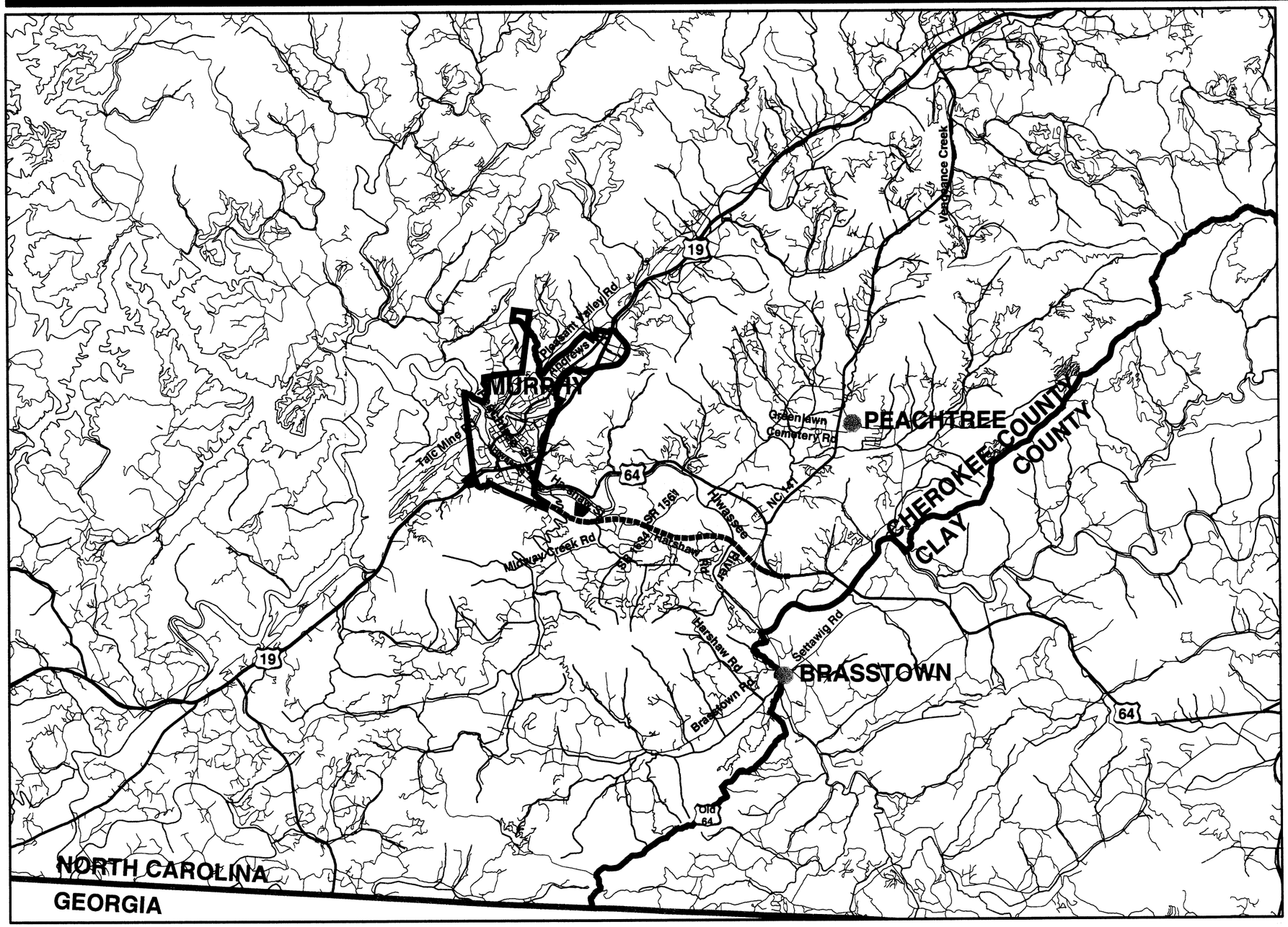


FIGURE 2: DEMOGRAPHIC AREA

- TIP R-0977
- MAJOR ROADS
- MINOR ROADS
- RIVERS/CREEKS
- WATER BODIES
- BOUNDARY LINE
- TOWN OF MURPHY
- UNINCORPORATED TOWNS

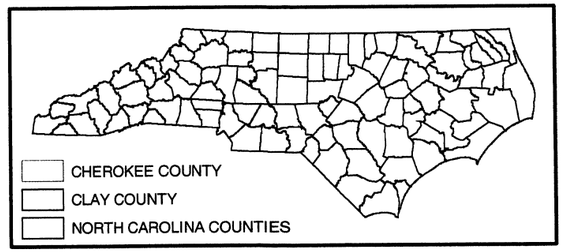
CENSUS TRACTS & BLOCK GROUPS

- CT 9904 BG 4
- CT 9904 BG 5
- CT 9905 BG 1
- CT 9905 BG 2

2 1 0 2 Miles

N

MAP SOURCES:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)
US CENSUS
HNTB



Potential Growth Impact Area to encompass a three-mile buffer from the proposed alignment (see Figure 3). Intersecting roadways that will from new intersections with R-0977 include:

- US-19
- Existing US-64
- Harshaw Street
- Harshaw Place
- SR 1548

Identification of Impact Area

The Impact Area for R-0977 is defined as that area which is most likely to develop as a result of the construction of the project. It was created by eliminating undevelopable lands, such as already built-up areas (Murphy) and steep topography from the Potential Growth Impact Area and identifying the area that would benefit most in terms of time-savings (see Figure 3). In-fill development is likely to occur within the residential communities along the south side of Harshaw Road, and therefore this area was included as part of the impact area. Because of access already provided by the existing US 64 corridor, the impact area does not extend as far north as it does south, where travel time savings is more abundant. Floodplain areas along the Hiwassee River and its tributaries are also included within this impact area, but are assumed to be non-developable.

IV. COMMUNITY AND DEMOGRAPHICS

The community surrounding R-0977 is predominantly rural residential, except for the extreme western segment of the project, which includes a mix of urban uses. The picturesque area is popular with both vacationers and retirees. With limited employment growth, much of the community's economy relies on the travel and tourism industry in order to remain healthy and viable. Indicative of the area's ability to attract retirees, the population within the demographic area aged 55 years or older was 34.1% in 2000, compared to 15.9% in Charlotte, North Carolina and 21.0% in North Carolina as a whole.

Table 1 below indicates population growth trends for the demographic area, the Town of Murphy, Cherokee County, and North Carolina. Noticeable is the fact that the demographic area grew the fastest (32.1%) between 1990 and 2000 among all four geographies, while the Town of Murphy actually lost population. Also noteworthy is the increasing demographic area share of overall county population growth. The demographic area represented 24.8% of the Cherokee County population in 1990 and 27.3% in 2000.
Cherokee County as a whole only grew by 6.5% between 1980 and 1990, but that growth rate increased to 20.5% between 1990 and 2000. These statistics indicate that the unincorporated portions of Cherokee County seem to be growing fairly rapidly, particularly along the US 64 and US 19/US 74 corridors. However, according to the North Carolina Office of State Planning, the Cherokee County population growth rate,

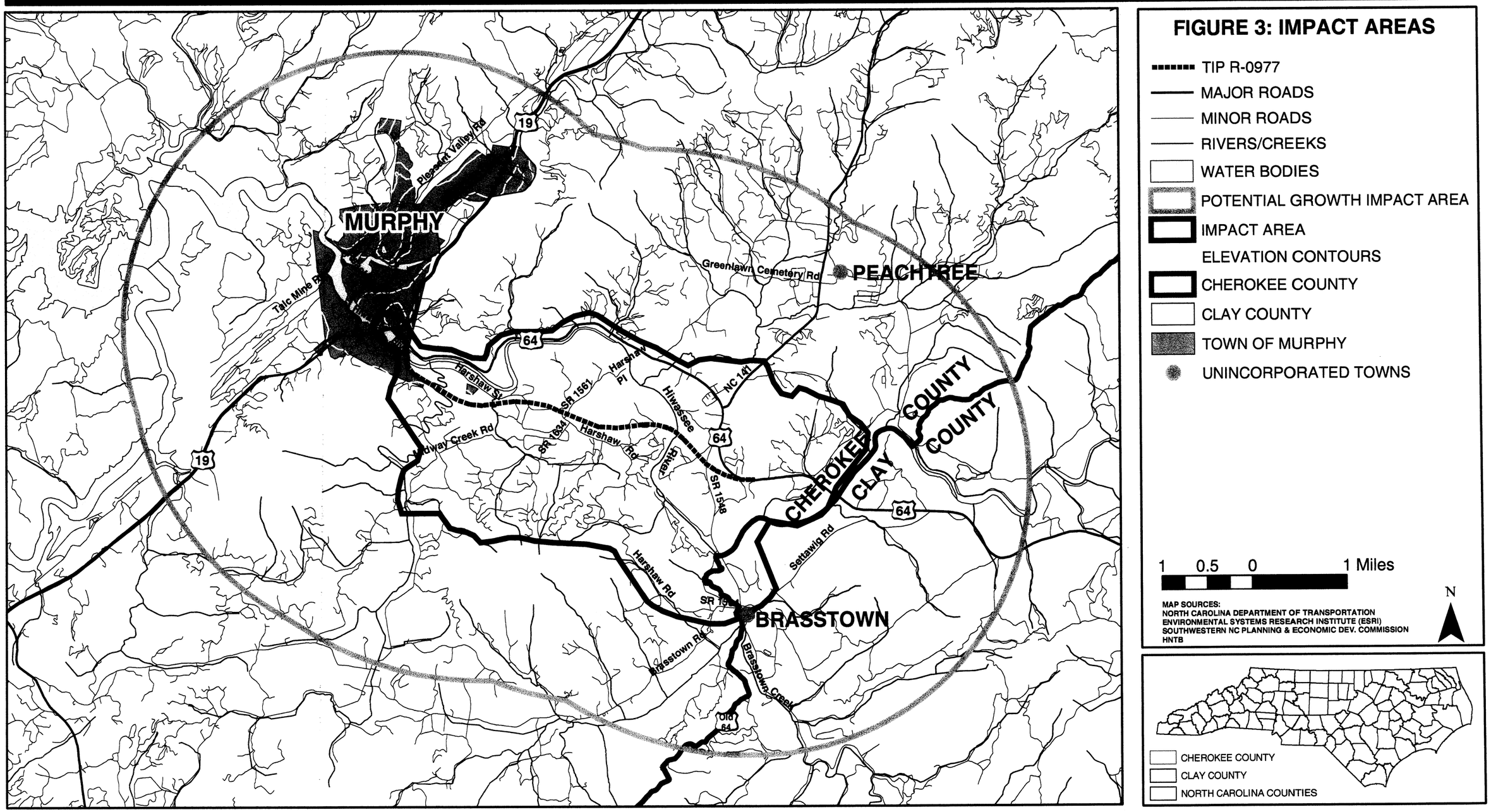


FIGURE 3: IMPACT AREAS
TIP R-0977
MAJOR ROADS
MINOR ROADS
RIVERS/CREEKS
WATER BODIES
POTENTIAL GROWTH IMPACT AREA
IMPACT AREA
ELEVATION CONTOURS
CHEROKEE COUNTY
CLAY COUNTY
TOWN OF MURPHY
UNINCORPORATED TOWNS
1 0.5 0 1 Miles
N
MAP SOURCES:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)
SOUTHWESTERN NC PLANNING & ECONOMIC DEV. COMMISSION
HNTB
MURPHY
PEACHTREE
BRASSTOWN
CHEROKEE COUNTY
CLAY COUNTY
Pleasant Valley Rd
Talc Mine Rd
Greenlawn Cemetery Rd
Harshaw St
Harshaw Pl
Hiwassee
Harshaw Rd
Midway Creek Rd
Settawig Rd
Brasstown Rd
Brasstown Creek
Old 64
19
64
NC 141
SR 1561
SR 1834
SR 1548
CHEROKEE COUNTY
CLAY COUNTY
NORTH CAROLINA COUNTIES

along with the growth rate for the State of North Carolina overall, is projected to decrease.

Table 1. Population Growth Trends and Projections, 1980 - 2020

	Demographic Area	Murphy	Cherokee County	North Carolina
Population:				
1980	N/A	N/A	18,933	5,880,095
1990	5,020	1,575	20,170	6,632,448
Percentage Growth 1980-1990	N/A	N/A	6.5%	12.8%
2000	6,632	1,568	24,298	8,049,313
Percentage Growth 1990-2000	32.1%	-0.4%	20.5%	21.4%
Population Projections:				
2010	N/A	N/A	28,012	9,491,374
Percentage Growth 2000-2010	N/A	N/A	15.3%	17.9%
2020	N/A	N/A	31,106	10,966,138
Percentage Growth 2010-2020	N/A	N/A	11.0%	15.5%

Source: US Census Bureau, North Carolina Office of State Planning

Note: Demographic Area includes Census Tract 9904, Block Groups 4, 5 and Census Tract 9905, Block Groups 1, 2

V. EMPLOYMENT AND ECONOMIC DEVELOPMENT

According to data within Table 2 below, Cherokee County public and private industries employed a total of 10,162 persons in 2000, an increase of 23.0% from the 8,317 employees in 1990. Most of the employees in 2000 were in the services sector (35.2%), which grew by 104.7% between 1990 and 2000. In addition, the person per job ratio of 2.39 in Cherokee County is higher than North Carolina's ratio of 2.08. These statistics reinforce the presence of a population-driven economy in this area, which is predominantly reliant on both household growth and tourism activity. The manufacturing sector, similar to most communities in North Carolina, lost employment (23.7%) between 1990 and 2000.

Table 2. Employment By Sector
Cherokee County, 1990-2000

Sector	Employment		Change	
	1990	2000	#	%
Construction	745	1,367	622	83.5%
Agriculture	260	290	30	11.5%
Mining	72	N/A	N/A	N/A
Manufacturing	2,851	2,174	-677	-23.7%
Transportation/ Public Utilities	435	535	100	23.0%
Wholesale Trade	224	251	27	12.1%
Retail Trade	1,524	1,289	-235	-15.4%
FIRE	203	376	173	85.2%
Services	1,748	3,578	1,830	104.7%
Government	255	302	47	18.4%
Total:	**8,317**	**10,162**	**1,917**	**23.0%**

Source: US Census Bureau

Within the demographic area, employment trends are similar to those of Cherokee County as a whole. Total employment grew by 40.1% between 1990 and 2000, with the services sector leading the way, representing 77.3% of the 807 employees added to the demographic area. Along with services, the construction and FIRE (finance, insurance, and real estate) sectors grew by 112.2% and 93.4% during the same time frame, respectively.

Table 3. Employment By Sector
Demographic Area, 1990-2000

Sector	Employment		Change	
	1990	2000	#	%
Construction	131	278	147	112.2%
Agriculture	63	68	5	7.9%
Mining	12	0	-12	-100.0%
Manufacturing	575	535	-40	-7.0%
Transportation/ Public Utilities	107	97	-10	-9.3%
Wholesale Trade	62	94	32	51.6%
Retail Trade	403	377	-26	-6.5%
FIRE	61	118	57	93.4%
Services	513	1,137	624	121.6%
Government	83	113	30	36.1%
Total:	**2,010**	**2,817**	**807**	**40.1%**

Source: US Census Bureau

Major community facilities and cultural resources within the demographic area include:

- Tri-County Community College at SR 1548 and US 64 south of NC 141
- Murphy Medical Center at SR 1548 and US 64 north of NC 141
- Harshaw House on Harshaw Place
- Public Golf Course on Harshaw Road just east of SR 1634

These destinations generate a fair amount of the local traffic in the area. Much of the overall traffic, however, is through traffic, as people commute back and forth to employment centers in Murphy and along US 19/129. A portion of the through traffic is also related to vacationers travelling through the region.

VI. EXISTING PLANS AND REGULATIONS

Current Land Use/Zoning and Transportation Plans

Cherokee County does not have an adopted zoning or land use plan in place at this time. Currently, zoning is only applied within the town limits of Murphy, within which R-0977 is only slightly included. South of US 19/129 within Murphy, the west side of US 64 is zoned for residential at a density of two units per acre, while the east side is zoned for highway business.

Other than the 2002-2008 Statewide Transportation Improvement Program (TIP), Cherokee County does not have an adopted transportation plan in place at this time. Projects related to R-0977 that are included in the Statewide TIP include:

- **R-2703** – US 64 widening from two lanes to five lanes with curb and gutter from SR 1100 to NC 69 in Clay County
- **A-11** – US 64 widening from two lanes to five lanes with curb and gutter from NC 69 to Hiwassee River, and upgrade US 64 from Hiwassee River to NC 175 in Clay County
- **B-4072** – Replace bridge over Brasstown Creek at SR 1564 with culvert

Environmental Regulations

One of the main intersections which will be created (SR 1548 and R-0977), and some of the land to which new access will be granted, lie within the boundaries of the WS-IV Hiwassee River Watershed (see Figure 4). Development within the protected area of this watershed is restricted to two dwelling units per acre, or 24% built-upon area. If the requirements to control for the 1" storm are incorporated into the construction process, the amount of maximum built-upon area increases to 70%. The 10/70 Provision is also allowed within the WS-IV Hiwassee River Watershed, which permits 70% built-upon area within 10% of the protected area of the watershed. Northwest of Murphy, the WS-I Marble Creek Watershed and the WS-I Brittian Creek Watershed are more stringent in terms of their development regulations, yet are not within the impact area of R-0977.

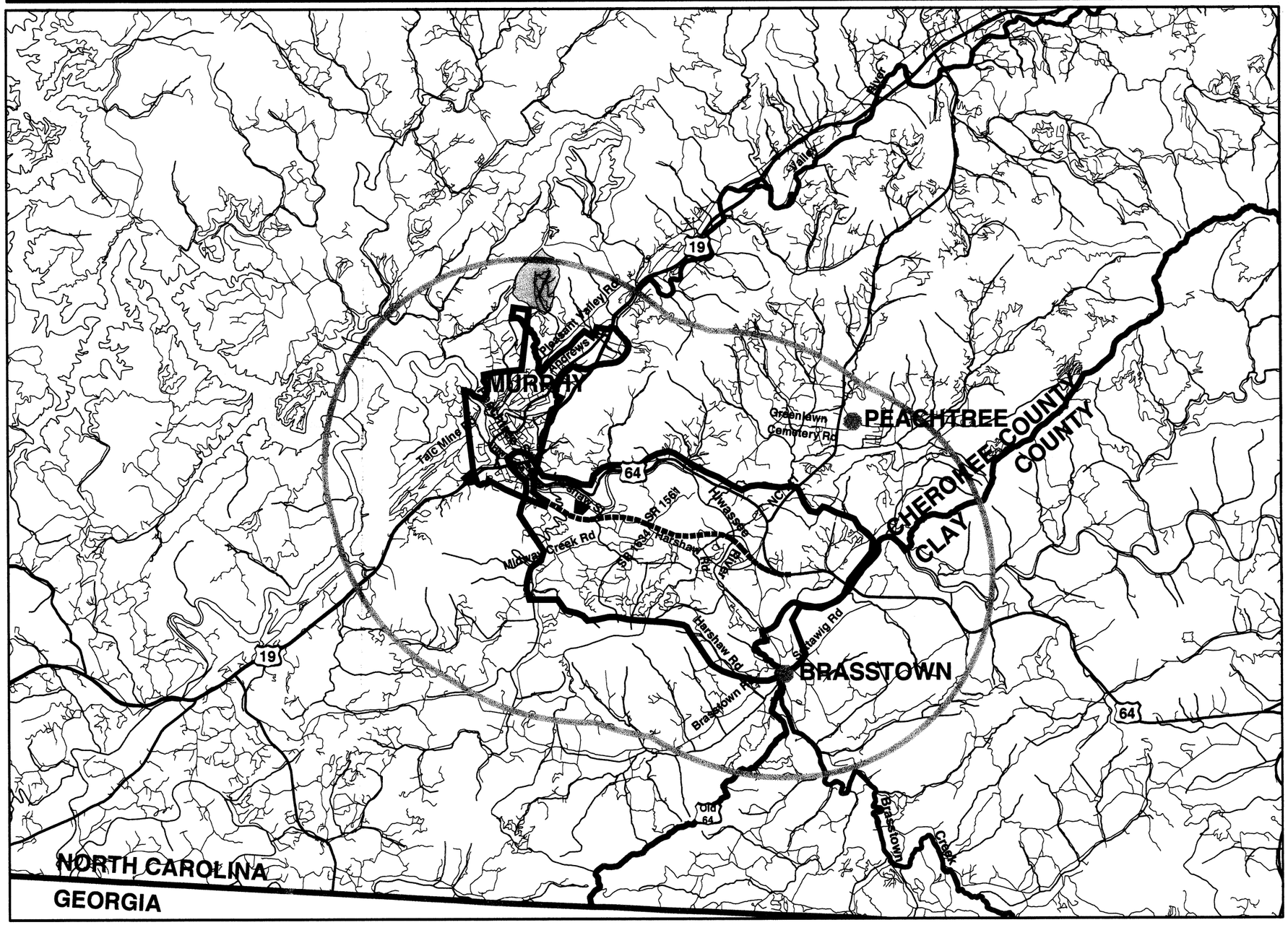


FIGURE 4: WATER SUPPLY WATERSHEDS

- TIP R-0977
- MAJOR ROADS
- MINOR ROADS
- RIVERS/CREEKS
- 303D IMPAIRED RIVER/CREEK
- WATER BODIES
- POTENTIAL GROWTH IMPACT AREA
- IMPACT AREA
- BOUNDARY LINE
- TOWN OF MURPHY
- UNINCORPORATED TOWNS

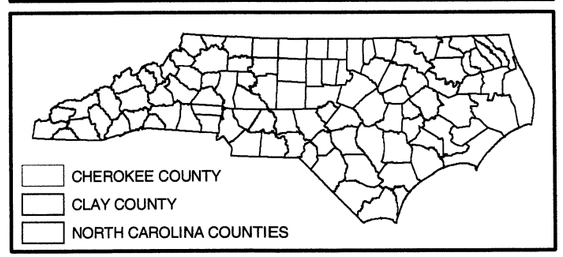
WATERSHEDS

- WS-I BRITTIAN BRANCH
- WS-IV HIWASSEE RIVER
- WS-I MARBLE CREEK

2 1 0 2 Miles

N

MAP SOURCES:
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES (DENR)
HNTB



According to the North Carolina Department of Natural Resources – Division of Water Quality, there are also two impaired water bodies within or adjacent to the Potential Growth Impact Area: Valley River and Brasstown Creek (see Figure 4). Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed. Brasstown Creek is considered a high priority with the cause of impairment related to sediment loading. Potential sources include agricultural uses as well as highway/road/bridge runoff. Approximately $2.1 million of mitigation funds have been approved through the Clean Water Management Trust Fund Project (Hiwassee River Watershed Coalition). Mitigation strategies include:

- Restore streambank on over 10,000 feet of mainstem and 10,000 feet of tributaries
- Reestablish over 10,000 feet of riparian buffers along mainstem and tributaries
- Restore 100 acres of land within 300 feet of streams
- Restore 1,000 acres of pasture land
- Identify future sites for wetlands restoration or construction of retention ponds

Valley River is considered low priority with an unknown cause of impairment or source.

VII. ENVIRONMENTAL REPORTS CONCLUSIONS

Previous Conclusions

Environmental Assessment (EA)
At the time the Environmental Assessment for R-0977 was completed in 1994, neither Murphy nor Cherokee County had an adopted land development plan. The assessment concluded that the proposed project would "open new areas to development, especially near the center of the project". A total of nine relocations (7 families, 1 business, 1 non-profit organization) are expected as a result of the preferred alignment. The project is not expected to disproportionately benefit, harm, or impact any social group, including, but not limited to, minority or low-income persons.

The Environmental Assessment also determined that there were no federally-listed threatened or endangered plant or animal species known to occur in Cherokee County. It was also determined that no unique farmlands are presently defined along the US 64 relocation corridor.

Finding of No Significant Impact (FONSI)
The Federal Highway Administration (FHWA) determined that R-0977 would not have a significant impact on the natural or human environment. According to this document, the following impacts would occur as a result of the completion of the US 64 relocation project:

- Improved accessibility for potential development
- Reduced travel time and vehicle operating costs
- Improved traffic safety; a faster and safer route between Murphy and the Murphy Medical Center

- 2.2 acres of wetlands will be lost
- No adverse effect on the air quality of the attainment area
- No violations of the FHWA Noise Abatement Criteria
- Minor floodplain encroachment at three locations
- Minimal water quality impacts because of the application of strict erosion and sedimentation control measures in accordance with the NCDOT's "Best Management Practices for Protection of Surface Waters"
- No underground storage tanks or potential hazardous waste sites will be impacted
- No historic architectural properties eligible for the National Register of Historic Places (NRHP) within the area of potential effect
- Eight archaeological sites could be impacted by construction

VIII. POTENTIAL AND MAGNITUDE OF LAND USE CHANGE

The Louis Berger Group Inc., in their April 2001 handbook titled "Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina", outline a set of factors that need to be evaluated to determine whether or not a detailed indirect and cumulative impact analysis (ICI) is required for specific projects.

Assessment Factors

The following is an assessment of those factors as they relate to R-0977:

Conflict with local plan: NO
It has already been determined from a previous section that there is no land use or zoning plan for Cherokee County. The Town of Murphy, however, does have an existing zoning plan, and R-0977 should not cause any inconsistencies with this plan, which recommends highway business on one side of the new roadway and residential at two dwelling units per acre.

Explicit economic development purpose: NO
The purpose and need of R-0977 is to provide a safer traveling environment along US 64 east of Murphy, as well as to serve projected traffic volumes by relocating existing US 64 to an alignment that is conducive to a future four-lane highway. R-0977 is not intended to promote the economic development of the surrounding area, particularly since there is not much business or industry along the proposed alignment that would directly benefit from the project.

Planned to serve specific development: NO
Other than within the Town of Murphy, there is very little development to speak of along the proposed alignment, which is limited to predominantly low-density residential and agricultural uses. Therefore, the construction of the relocated US 64 is not planned to serve any specific development.

Likely to stimulate land development having complementary (to highway-related travel) functions: YES
The assessment of this factor partially involves an evaluation of a subset of factors commonly used to determine the potential for induced growth surrounding rural interchanges including:

- Distance to a major urban center
- Traffic volumes on intersecting roadways
- Presence of frontage roads
- Availability of water/sewer

The US 64 relocation project is predominantly located within a rural environment, except for the small portion located within the Town of Murphy, which is comparatively speaking not considered a "major urban center". Traffic volumes along intersecting roadways are generally low, except for US 19/129, which carries a moderate amount of traffic. No frontage roads are planned for R-0977. According to the Environmental Assessment, water and sewer lines are located along Harshaw Road, which is parallel to the proposed R-0977 alignment.

This overall assessment would indicate a moderate likelihood of R-0977 stimulating land development having complementary functions. In addition, since this is a project on new location that provides access to previously inaccessible land, the level of induced land development increases.

Likely to influence intraregional land development location decisions: MAYBE
Typically, if the conditions are favorable for development and/or a region is currently undergoing urbanization, an improvement in the transportation infrastructure is likely to influence where development will occur. In this circumstance, conditions within the majority of the demographic area as well as the potential growth impact area are not overwhelmingly favorable for development and it is not undergoing any type of urbanization process.

However, with US 64 being a federal highway and the only major east-west route through the southern portion of western North Carolina and southeasternTennessee (connecting I-26 to I-75), it is not completely improbable that a major employer could locate a facility somewhere along the newly proposed alignment in the near future.

Notable feature present in Potential Growth Impact Area: YES
Notable features relate to the natural environment, historic and cultural properties, wildlife habitat, etc. Based on the 1994 Environmental Assessment, as well as field observations, the only notable features present along the project corridor are the Hiwassee River and the federal candidate rare and protected species located within its waters, including:

- Hellbender
- Olive Darter
- Knotty Elimia

Notable feature significantly impacted: NO
Because of design and construction issues that have been addressed, as well as the relatively low likelihood of substantial induced growth as a result of R-0977, the Hiwassee River and its contents do not appear as if they will be impaired, either temporarily or permanently.

Magnitude of Land Use Change

To further justify the determination that indirect and cumulative impacts would be relatively moderate as a result of R-0977, an analysis of a set of quantitative factors was completed. This analysis helps to determine that, if indeed there is some level of indirect and cumulative impacts related to the project, what *magnitude* they would have. Table 4 below indicates the results of this rating analysis:

Table 4. Magnitude of Land Use Change, 2000-2020

Rating	Change in Accessibility	Change in Property Values	Forecasted Growth	Land Supply vs. Land Demand	Water/Sewer Availability	Market For Development	Public Policy
Strong	> 10 min. travel time savings	> 50% increase in property values	> 3% annual pop. growth	< 10-year supply of land	Existing service available	Development activity abundant	Less stringent; no growth management
^							
"					X		X
"	X	X	X				
"				X		X	
"							
Weak	< 2 min. travel time savings	No property value increase	0-1% annual pop. Growth	> 20-year supply of land	No service available now or in future	Development activity lacking	More stringent; growth management

Source: HNTB

In terms of positive indications of growth potential, Cherokee County, within which R-0977 is entirely located, does not have a land use or zoning plan in place. Therefore, local government is not in a position to regulate any growth induced by the project, creating a pro growth environment. Thus, the public policy factor rates strongly with respect to the magnitude of potential land use change. Also, water and sewer service is provided along the proposed route, providing for a conducive environment to future development.

Finally, the forecasted annual population growth rate for Cherokee County as a whole between 2000 and 2020 is 1.2%. Between 1990 and 2000, the annual population and employment growth rate for the demographic area was 2.8% and 3.4%, respectively. No population or employment growth forecast was available for the demographic area, yet it grew fairly respectably between 1990 and 2000. Based on these statistics, this factor was rated moderately strong with respect to the magnitude of land use change as a result of R-0977.

Travel time savings will be noticeable, although it should not be greater than 10 minutes. In addition, since R-0977 is a project on new location, it will provide access to land that currently does not have transportation access. Because of this, there is a potential for property values along the project length, particularly at proposed intersections, to increase. This increase should be moderate, considering that the new access for these land parcels will be to the major east-west route across western North Carolina and southeastern Tennessee. Parcels that do not front the newly relocated US 64 should not experience the same level of property value increases.

Developable land is abundant within the Impact Area, but the market for development within the demographic area is somewhat lacking, with only one major residential subdivision and very few existing commercial establishments along the newly proposed US 64 corridor.

IX. FUTURE LAND USE WITH AND WITHOUT THE PROJECT

Since R-0977 is on new location, it will provide access to land that previously did not have access. It will also be more conveniently located to serve the suburban and rural residential growth areas along Harshaw Road to the south of the Hiwassee River. There is a potential for in-fill residential development in these areas. This potential increases with the completion of R-0977.

Commercial development (predominantly convenience stores, gas stations, restaurants) is likely at major intersections along the R-0977 alignment that can serve the surrounding population. Because of the residential attractiveness along the corridor and the amount of local traffic that would use the newly relocated roadway, there is also a potential for a neighborhood or community retail center at one of the major intersections. In addition, existing US 64 may lose highway-oriented uses such as gas stations and restaurants to the future US 64 alignment.

Most of the future traffic along the new US 64 alignment will be from traffic that previously used existing US 64, and from new growth that has occurred within the demographic area for reasons other than the road being built. Induced traffic, which comes from households and jobs that were created solely because of R-0977's existence, should be a minor component of overall future traffic generated along the new alignment. However, if a major employment facility(s) decides to locate at any point along the new alignment, any induced development within the Impact Area could be larger in magnitude.

If R-0977 is not built, future land use development that would have been induced by the relocated alignment would be focused along existing US 64, eventually causing a potential strain on vehicular movement and a possible increase in traffic accidents. Existing US 64 has sporadic development located along its route, but the Hiwassee River floodplain and the topography (steep slopes) limit the amount and intensity of expansion and/or future development opportunities, particularly near Murphy and SR 1548.

BIOLOGICAL ASSESSMENT

for the

MURPHY BYPASS (R-977A)

Prepared for:

Federal Highway Administration
Raleigh, North Carolina

Prepared by:

North Carolina Department of Transportation
Raleigh, North Carolina

September 20, 2004

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INTRODUCTION

The North Carolina Department of Transportation (NCDOT) proposes to improve highway US 64 by relocating a segment of the road south of the existing alignment between US 19-74-129 in Murphy and SR 1547 east of NC 141 in Peachtree, Cherokee County, North Carolina, Transportation Improvement Program (TIP) number R-0977A (Murphy Bypass). As proposed, the Murphy Bypass is 4.9 miles long and crosses several surface waters, including two crossings of the Hiwassee River. A map showing the proposed alignment of the Murphy Bypass is provided in Figure 1.

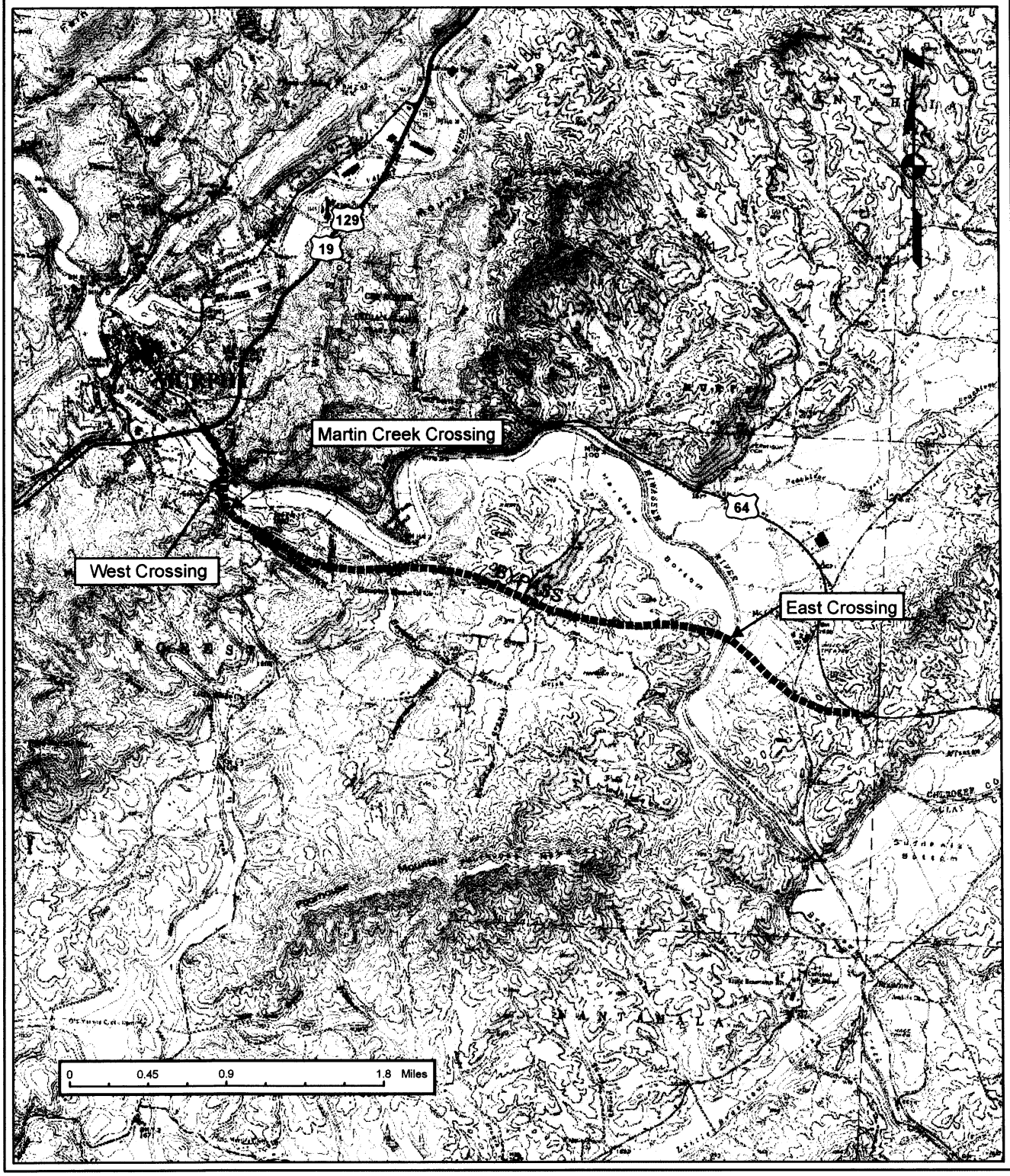
Portions of the Hiwassee River within North Carolina contain a diverse aquatic fauna. Two Federal Species of Concern (FSC), the Tennessee clubshell (*Pleurobema oviforme*) and the sicklefin redhorse (*Moxostoma sp.*), have been located in the Hiwassee River within the project area, and will likely be provided federal protection by the time construction of this project is complete. Therefore, NCDOT in agreement with the US Fish and Wildlife Service (USFWS), has opted to address this project as if these two species were currently protected under the Endangered Species Act (ESA). This Biological Assessment (BA) addresses project-related concerns and probable direct, secondary, and cumulative impacts regarding these species. Additionally, this BA addresses federally protected species that are not currently known in the project area but for which appropriate habitat exists.

PURPOSE AND NEED

The purpose of this project is to provide a safe, efficient, and direct route for traffic traveling east-west through Cherokee County with provisions for additional capacity as traffic volumes grow. The project will serve as an alternative to the substandard route east of the Town of Murphy and will ease traffic congestion to the downtown area.

The predominant east-west route through the southern portion of Cherokee County and western North Carolina is along US 64. Currently, traffic traveling along the segment between US 19-74-129 and SR 1547 east of NC 141 must navigate dangerous curves that well exceed the recommended maximum design for horizontal curves in the area, as well as steep grades, all within very limited sight distance on a road way with little to no shoulders. This geometry severely restricts operating speeds, thereby reducing the capacity of the roadway. These factors, combined with the lack of shoulders in many areas, result in a hazardous stretch of highway with few areas to pass or pull over.

US 64 carried 5,500 vehicles per day (vpd) in 1993. The 1994 Environmental Assessment (EA) predicted the "No-Build" traffic volumes would increase to 5,700 vpd by 1996 and between 10,700 and 11,400 vpd by 2016. This amounts to an overall increase of 100 percent in traffic volumes over the 20-year period. This doubling of traffic would substantially reduce the level of service (LOS) of the roadway and seriously increase the accident potential. As of 2001, LOS is a D and will degrade to a level of E by 2016 (on an A to F scale, where A is be the best operating condition).



	Site Location Map TIP R-0977 (Murphy Bypass) Cherokee County, North Carolina	Date: July 2004 Scale: As Shown Job No.: 3012	Figure 1

Currently, accident rates on existing US 64 are higher than the statewide averages for similar two-lane rural roadways. During the four-year period from July 1, 1988 to July 31, 1992, this section of US 64 experienced an accident rate of 198 accidents per 100 million vehicle miles of travel. The 1990-1992 statewide average accident rate for rural, two-lane undivided roadways was 167 accidents per 100 million vehicle miles of travel. The accident rate on US 64 was 12 percent higher than the statewide average. The majority of these accidents involved rear-end collisions and vehicles running off the road, which is indicative of a substandard design that results in reduced sight and stopping distance (NCDOT, 2002).

East of the project area, US 64 provides access through the waterfalls area of the state, a popular tourist attraction, and continues east to the interchange with I-26/US 74 in Hendersonville, providing Cherokee County access to Shelby, Gastonia, Charlotte and the rest of eastern North Carolina. West of Murphy, US 64 continues to Cleveland, Tennessee and merges with I-75, providing access to major metropolitan areas north, south and west, including Chattanooga, Nashville, Knoxville, Birmingham, and Atlanta. The major north-south traffic in Cherokee County is served by US 19-74-129 which meets US 64 near the western terminus of the project in downtown Murphy. The proposed improvements would provide safer, more efficient vehicle operation, reduce travel times, and result in road user cost savings for motorists traveling through western North Carolina.

US 64 IMROVEMENTS

Project Description

The proposed roadway will be a two-lane facility constructed on a four-lane right-of-way. The preferred alignment crosses the Hiwassee River at River Mile 102 (East Crossing) and again at River Mile 97 (West Crossing). Concern has been raised regarding the impacts of these crossings (as well as the crossing of Martin Creek) on the aquatic resources of the Hiwassee River. These three crossings are noted in Figure 1.

East Crossing: The Hiwassee River at this location is approximately 76 meters (249 ft) wide. An expansive gravel and small cobble dominated riffle/run sequence occurs at the crossing and continues a short distance downstream. This section of river provides some of the best sicklefin redhorse breeding habitat within the entire river (Tim Savidge, personal observation). The proposed structure at this crossing has been redesigned to span the river entirely.

West Crossing: The river is approximately 150 meters (492 feet) wide at this crossing which is near the western end of the project near Murphy. The original alignment would have placed the upstream bridge of the dual bridges within a high quality mussel bed containing the Tennessee clubshell. NCDOT redesigned the bridge at this location to avoid/minimize impacts to the river. However, due to the length of the bridge, impacts to the river cannot be completely avoided.

Martin Creek: The proposed alignment will cross Martin Creek approximately 0.5 river miles from its confluence with the mainstem of the Hiwassee River. The creek at this location is approximately 5 meters (16 feet) wide. While relatively small in size, it contains appropriate mussel habitat for some of the species known from the mainstem of the Hiwassee. Additionally, it is likely that the sicklefin redhorse occurs sporadically in

Martin Creek, especially near the confluence with the Hiwassee River. The proposed structure at this crossing has been redesigned from a triple barrel box culvert to a bridge that will span the stream entirely, although the placement of a temporary work bridge to facilitate this work may result in some minor temporary impacts.

Project History

U.S. Highway 64 in Cherokee County was constructed on its present alignment in 1933 on an existing roadbed. Other than resurfacing and widening short segments, no major improvements have been made. This section of US 64 was determined to be substandard and unable to handle existing levels of service based on current traffic volumes and NCDOT future projections. Subsequently, NCDOT proposed improvements to the existing alignment of US 64 as part of the Transportation Improvement Program (TIP). In 1986 the U.S. Department of Transportation, Federal Highway Administration (FHWA), and NCDOT prepared an Environmental Assessment (EA) for the proposed improvements. In September of that year, a Finding of No Significant Impact (FONSI) was issued.

However, preliminary design studies indicated that improvements to US 64 were not feasible due to geometric restrictions, environmental concerns, and construction costs. One of the environmental concerns was acidification potential of exposed rock or "hot rock". The underlying geologic formation was known to contain hot rock that when exposed to the elements could produce acidic runoff that would reach waterways crossed by the project. Since widening the existing alignment would require exposing rock, adverse impacts were expected. Coupled with concerns raised by the Town of Murphy, this caused NCDOT to abandon plans for improving US 64 on its existing alignment. Instead, NCDOT proposed to relocate the portion of US 64 between Murphy and the town of Peachtree. In 1990, design and environmental studies were initiated for the proposed relocation.

In July 1994, a new EA was prepared for the proposed relocation. In addition to the "No Build" Alternative, NCDOT evaluated eight build alternatives (A, B, C1, C2, D1, D2, D3 and E) in the EA. Based on information detailed in the EA, the B, D1, D2, D3 and E alternatives were eliminated from further consideration. Alternatives A, C1, and C2 were determined to be the only feasible alternatives. Alternative C1 was subsequently selected as the preferred alternative, and a FONSI was issued in February of 1995. Preliminary design was approved and hydraulic design of the project initiated. After the design phase was completed, NCDOT submitted an Individual Section 404 Permit application for the proposed project with a cover letter dated August 4, 1998. The application was put on public notice in March of 1999.

In response to the public notice, the U.S. Fish and Wildlife Service (USFWS) indicated that two Federal Species of Concern (FSC), the Tennessee clubshell (*Pleurobema oviforme*) and the sicklefin redhorse (*Moxostoma* sp.), may be impacted by the project. The USFWS has recognized these two species since issuance of the FONSI. Therefore, additional surveys were completed in the fall of 2000. Based on these surveys and concerns over other natural resource impacts raised during the interagency meetings held in May of 2000, further design studies were conducted on the preferred alternative identified in the FONSI. Additionally, State and Federal review agencies requested that

three of the alternative alignments that were first detailed in the July 1994 EA, (D1, D2 and D3) be re-evaluated in greater detail.

In October of 2001, an interagency meeting was held to present findings of the additional alternative studies. During this meeting, the USFWS raised concerns regarding potential impacts to mussels and to the sicklefin redhorse. They further stated that the FSCs could become listed prior to completion of this project. This required additional survey work and review of alternative designs to avoid and/or minimize potential impacts. Subsequent interagency meetings have been held to review updated designs and project status. Since potential impacts to species that may become listed prior to project completion may not be avoided, a Biological Assessment (BA) was completed by NCDOT and submitted to the USFWS concurrently with this permit application.

HIWASSEE RIVER SUBBASIN 04-05-02 OF THE HIWASSEE RIVER BASIN

OVERALL BASIN SUMMARY

The Hiwassee River (HR) Basin originates in the mountains of southwestern North Carolina and northern Georgia and flows west into Tennessee to join the Tennessee River. The North Carolina portion of the HR Basin is composed of two Subbasins: 1) the Upper Hiwasee River (Subbasin 040501) and its tributaries upstream of the confluence of Brasstown creek with the mainstem of the Hiwassee, and 2) the Lower Hiwassee River (Subbasin 040502) and its tributaries, extending to the western most corner of North Carolina. Within North Carolina, the flow of the HR is captured to form three impoundments: Chatuge Lake, Hiwassee Lake, and Apalachia Lake. The Tennessee Valley Authority (TVA) manages the release of water from these lakes for hydroelectric power production, navigation, and flood control; therefore the flow of the mainstem of the HR is highly regulated (NCDENR-DWQ, 2000).

The HR Basin watershed encompasses approximately 2,700 square miles, much of which is in National Forests. In North Carolina, the watershed drains approximately 644 square miles of land in four counties and includes the municipalities of Andrews, Hayesville, and Murphy. Based on 2000 census data, the NC population in the basin is 31,271. Cherokee County, containing the towns of Murphy and Andrews, is the most populated area in the HR basin in North Carolina. In 1990, the overall population density of the HR basin in North Carolina was 43 persons per square mile versus a statewide average of 123 persons per square mile (NCDENR-DWQ, 2000). Approximately 70 percent of the HR basin is forested, with only three percent categorized as urban. However over a 15-year period between 1982 and 1997, cultivated crop and forested land have significantly decreased while the amount of developed land has more than doubled (NCDENR-DWQ, 2002).

The proposed project falls entirely within HR subbasin 040502. The North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) section, formerly known as the Division of Environmental Management (DEM), assigns these subbasin classifications (DEM, 1986).

HIWASSEE RIVER PHYSICAL CHARACTERISTICS

The Hiwassee River basin is located in the Blue Ridge province of the Appalachian mountains of western North Carolina. The headwater reaches of the HR arise in Towns and Union Counties, Georgia. Much of the land in the HR Basin is federally owned and includes sections of the Chattahoochee (GA), Nantahala (NC), and Cherokee (TN) National Forests (NCDENR-DWQ 2002).

The majority (70%) of the federal and non-federal lands in the HR Basin are forested (NCDENR-DWQ, 2002). While the majority of the streams in the HR Basin are generally of high quality, there are some significant sedimentation and erosion problems occurring in the basin in North Carolina. Sedimentation sources include agricultural and pasture lands, mining operations, development, highway construction, and forest clearing. Areas of concern include residential and commercial development in the Andrews and Brasstown areas, among others.

Rock formations along the Hiwassee River in the project area are primarilly metamorphic in origin. Underlying rocks include slates, metasiltstones, phyllites, shists, dolomitic and calacareous marbles, and quartzites (NC Geological Survey, 2000).

Best Usage Classification and Water Quality Assessment

The DENR assigns a best usage classification to all waters of North Carolina. These classifications provide for a level of water quality protection to ensure that the designated usage of that water body is maintained. Within the project area, the mainstem of the HR has three best usage classifications. From a point 1.2 miles upstream of the rivers confluence with McComb Branch (DWQ Index No. 1-43-(1-2) 07/01/95) to approximately 0.1 miles downstream of McComb Branch (at the Murphy water supply intake), it is classified as WS-IV; CA (DWQ Index No. 1-(42.3) 08/01/02). From the Murphy water supply intake to a point 0.3 miles downstream of Martin Creek, the HR is classified as WS-V (DWQ No. 1-(43.7) 07/01/95). From this point to Laurel Creek (also the classification for Hiwassee Lake) the HR has a classification of "C" (07/01/61).

Class C refers to waters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture and other uses. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development activities. The supplemental "CA" dictates that it is a Critical Area, in this case due to the water intake downstream of this area of the HR. WS-IV waters are protected as water supplies which are generally in moderately to highly developed watersheds. WS-V waters are protected as water supplies which are generally upstream and draining to Class WS-IV waters. WS-V and WS-IV have no categorical restrictions on watershed development or wastewater discharges like other WS classifications and local governments are not required to adopt watershed protection ordinances (NCDENR-DWQ, 2004).

The Benthic Macroinvertebrate Ambient Network (BMAN), a water biomonitoring program of DWQ, assesses water quality by sampling for selected benthic macroinvertebrate organisms. The species richness and overall biomass, as well as the presence of various groups intolerant of water quality degradation, are reflections of water quality. A biodiversity rating is given to a water body sampled, based on the taxa

richness of the stream, and a qualitative sampling for intolerant species such as mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Tricoptera), collectively referred to as EPT. Biodiversity ratings include: Excellent, Good, Good-Fair, Fair, and Poor. Excellent and Good ratings indicate that the best usage classification for that stream is being supported (S). A rating of Good-Fair indicates that the usage is supported, but is threatened (ST). A Fair rating relates to a partial support (PS) of the best usage, and a Poor rating indicates that the best usage classification for that stream is not being supported (NS). Of the 653.8 stream miles in this subbasin, 497.9 are considered Fully Supporting (FS) and 0.0 are considered NS. The remaining 155.9 miles have no report for their rating (NCDENR-DWQ, 2002).

One BMAN station occurs on the mainstem of the Hiwassee River within the project area at the USGS gauging station approximately 1.5 river miles downstream of the confluence of Brasstown Creek with the river. This site received a "Good" Bioclassification rating. Additionally, there is a BMAN station in Peachtree Creek near the current US 64 crossing of the creek. This station received an "Excellent" Bioclassification rating (NCDENR-DWQ, 2000).

Another method of assessing water quality is a fish community assessment which assigns an Index of Biotic Integrity (IBI). The IBI evaluates species richness and composition, trophic composition, and fish abundance and condition. Nine sites were evaluated within the subbasin between March-August 1999 by Tennessee Valley Authority (TVA) biologists. These studies assigned an IBI and EPT rating for each of these sites (Table 1).

Table 1. Index of Biological Integrity Ratings Hiwassee River Subbasin 03-02-01

Site	County	TVA IBI	EPT Rating	Collector
Valley River off SR 1515 & US 19/74/129	Cherokee	52	Good	TVA
Valley River near SR 1370 & US 19/129	Cherokee	58	Good	TVA
South Shoal Creek	Cherokee	28	Excellent	TVA
Rapier Mill Creek	Cherokee	40	Excellent	TVA
Nottely River	Cherokee	34	Good	TVA
L. Brasstown Creek	Cherokee	50	Good	TVA
Hanging Dog Creek	Cherokee	42	Good	TVA
Brasstown Creek	Cherokee	52	Excellent	TVA
Beaverdam Creek	Cherokee	42	Excellent	TVA

The North Carolina Lake Assessment Program seeks to protect the water quality of lakes in NC through monitoring and pollution prevention. The trophic state, or relative measure of nutrient enrichment and productivity, is one of the paramaters measured to determine if the designated uses of the lake are being supported. The North Carolina Trophic State Index (NCTSI) is based upon total phosphourus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll a (CHL in ug/l). Two lakes in this subbasin, Hiwassee Lake and Appalachia Lake, are currently monitored.

Hiwassee Lake received a NCTSI score of -4.0 in 1999 thus indicating oligotrophic status and is considered to be fully supporting all of its designated uses as a class "C" water body. Apalachia Lake is also of oligotrophic status, receiving a -4.9 NCTSI score in 1999, and is also considered to be fully supporting of all its designated

uses as a class "C" waterbody. In 1990, the TVA began a program to monitor the biological conditions and "health" of its reservoirs. The TVA rating system differs from DWQ rating systems and is based on the assignment of a numerical score then used to define the reservoir as Poor, Fair, or Good. The ecological health of both Hiwassee and Apalachia Lakes were given a rating of "Fair" according to the program (DWQ, 2000).

POINT SOURCE POLLUTION

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

Under Section 301 of the Clean Water Act of 1977 (CWA), discharge of pollutants into surface waters is regulated by the Environmental Protection Agency (EPA). Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permitting program, which delegates permitting authority to qualifying states. In North Carolina, DWQ, which is a division of DENR, is responsible for permitting and enforcement of the NPDES program. There are 7 NPDES permitted dischargers in subbasin 04-05-02 (Table 2), some of which are small wastewater treatment plants serving schools or subdivisions. The largest discharge is from the Town of Andrew's WWTP to the Valley River which discharges at a maximum permitted rate of 1.5 million gallon per day (MGD). Two dischargers within the subbasin are required to monitor their effluent's toxicity: the Town of Andrews WWTP and the Town of Murphy WWTP. In 1999, the Town of Andrews WWTP suffered from one failing to meet a permit or target value. However, substantial improvements in effluent toxicity were observed relative to earlier data for both the monitored plants.

Table 2. NPDES Permit Hiwassee River Subbasin 04-05-02

Permit #	Facility	Type	Flow (MGD)	Receiving Stream
NC0020800	Town of Andrews	Major	1.5	Valley River
NC0035386	Cherokee County Schools	Minor	0.0088	Thompson Creek
NC0069892	Town of Andrews	Minor	not limited	Dan Holland Creek
NC0020940	Town of Murphy	Major	1.4	Hiwassee River
NC0023001	Carolina Water Service of Murphy	Minor	0.08	Hiwassee River
NC0079031	Industrial Opportunities Inc.	Minor	0.003	Hyatt Creek
NC0027359	TVA-Hiwassee Hydro Plant	Minor	not limited	Hiwassee River

NONPOINT SOURCE POLLUTION

Nonpoint source pollution (NPS) refers to runoff that enters surface waters through storm water or snowmelt. There are many types of land use activities that contribute to nonpoint source pollution including land development, construction activity, animal waste disposal, mining, agriculture, and forestry operations as well as impervious surfaces such as roadways and parking lots. Various nonpoint source management programs have been developed by a number of agencies to control specific types of nonpoint source pollution (e.g., forestry, pesticide, urban and construction related pollution). Each of these management plans develops Best Management Practices (BMP) to control the specific type of nonpoint source pollution.

North Carolina does not have a numeric water quality standard at the State level for suspended solids; however, all discharges must meet federal effluent guideline values (e.g. maximum of 30 mg/l for domestic discharges). However, the state has adopted a numerical instream turbidity standard for point and nonpoint source pollution. Nonpoint sources are considered to be in compliance with the standard if approved BMPs have been implemented.

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

ECOLOGICAL SIGNIFICANCE

The diversity and uniqueness of the aquatic fauna of the Hiwassee River has only been discovered and documented in recent years. Several aquatic Federal Species of Concern have recently been found in the Hiwassee River (Table 3).

Table 3. Federal Species of Concern Aquatic Species Recently Reported From the Hiwassee River

Scientific Name	Common Name	Federal Status	NC Status
Cambarus hiwasseensis	Hiwassee crayfish	FSC	W2
Cambarus parrishi	Parrish crayfish	FSC	SC
Cryptobranchus alleganiensis	Hellbender	FSC	SC
Lithasia christyi	Knotty rocksnail	FSC	none
Moxostoma sp.	"Sicklefin" redhorse	FSC	SR (PT)
Pleurobema oviforme	Tennessee clubshell	FSC	E

E Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy.
SC Any species of wild animal native to NC which requires monitoring (NCWRC) but which may be taken under regulations adopted under regulation.
SR Species which are very rare in NC, generally with 1-20 populations in the state, generally substantially reduced in numbers and determined by NCNHP to need monitoring.
W Any other species believed to be rare and of conservation concern in the state but not warranting active monitoring at this time.
PT Species proposed as a taxon which is likely to become an endangered within the foreseeable future throughout all or a significant portion of its range

In addition to this project, other projects, such as TIP A-11BA, impacted, or will impact the Hiwassee River. In order to assess the potential impacts of these projects on the river, it was necessary to survey the river to better understand its aquatic fauna and characteristics. A cooperative effort was made by biologists from NCDOT, USFWS and NC Wildlife Resources Commission (NCWRC) to survey the Hiwassee River in the summer of 1998 and 1999. Subsequent surveys followed in March 2000. Biologists from the TVA and the US Geological Survey (USGS) were involved in the March 2000 survey effort. Survey methodology included mask and snorkel, SCUBA and view buckets. Canoeing was used to access a majority of the survey sites. The majority of Hiwassee River between Hayesville and Murphy was surveyed at some point during this effort.

A total of six freshwater mussel species were found during the surveys. These include the spike (*Elliptio dilitata*), Long-solid (*Fusconaia subrotunda*), wavy-rayed lampmussel (*Lampsilis fasciola*), Tennessee clubshell (*Pleurobema oviforme*), rainbow (*Villosa iris*), and mountain creekshell (*Villosa vanuxemensis*). The rainbow and longsoild are the two most common mussels in the river, while the mountain creekshell and the Tennessee clubshell appear to be the rarest. Mitochondrial DNA (mtDNA) sequences were obtained for an amplified segment of the COI gene (c. 650 bp) and used to aid in the identification of the Fusconaia and Pleurobema specimens from the Hiwassee River. Charles Lydeard, Associate Professor at the University of Alabama, Department of Biological Sciences, conducted this study for NCDOT. The COI-based molecular phylogeny revealed that both the longsoild and Tennessee clubshell occur in the Hiwassee River. Based on the samples collected for this analysis, the Long-solid mussel appears to be the more common of the two species in the river (Lydeard and Campbell, 2003).

Prior to these surveys, the Long-solid was considered to have been extirpated from North Carolina. This species has subsequently been found in the Little River of the French Broad River Basin by NCDOT and USFWS biologists. The Long-solid population found in the Hiwassee River appears to be genetically distinct from other Long-solid populations that were examined in the genetic study.

Distribution of freshwater mussels is variable in the Hiwassee River. Mussels were discovered to be sparsely distributed in areas, fairly common in others, and totally absent from other areas. The occupied range of mussels in the river was found to be from the backwaters of Hiwassee Lake in Murphy (just upstream of the US 19/74/64 crossing) upstream to approximately the confluence of Fires Creek and the Hiwassee River (River Mile 111) in Clay County. In general, mussel concentrations increase downstream, and are fairly uncommon above Mission Dam (RM 106). Poor habitat conditions (for mussels) occur from the US 64 crossing in Hayesville downstream to approximately RM 115. These conditions are likely the result of excessive sedimentation coming from Hayesville as well as the fluctuations in flow regimes that create streambank instability. Although "good" habitat for mussels occurs in stretches below RM 115, water temperatures are very low (9-12° C in June of 1999). Mussel densities in the river are highest in the lower stretch of the river near Murphy. Water temperatures in these lower reaches ranged from 11°C to 26°C in the June 1999 surveys. The coldwater release of Chatuge Lake is believed to be the limiting factor in the upriver distribution of mussels.

In addition to the mussel species observed, all of the FSC species listed in Table 3, excluding the knotty rocksnail, were observed at various locations during this survey. Although the knotty rocksnail is common in the Hiwassee River below Apalachia Lake in Tennessee, only a few specimens have ever been collected in Hiwassee River above Hiwassee Lake in North Carolina (John Fridell, USFWS pers. comm. 2004).

The sicklefin redhorse was observed at a number of locations in the river as well as Martin Creek, a tributary at RM 98, during the mussel surveys. Robert E. Jenkins of Roanoke College conducted a range wide assessment of this species, and found it to occur in the Hiwassee River from Hiwassee Lake upstream to Mission Dam (RM 106). The furthest upstream record of the sicklefin redhorse was just below Mission Dam. This hydroelectric dam is located approximately 3.5 river miles upstream of the first of the two project crossings.

SPECIES DESCRIPTION

The USFWS list five species as either federally threatened or endangered in Cherokee County, NC. Table 4 includes these species and their current status. One of the species, the bog turtle (*Clemmys muhlenbergii*) is listed due to its similarity in appearance to the northern bog turtle. However, species listed due to their similarity in appearance are not subject to Section 7 Consultation, therefore a detailed discussion of the bog turtle is not presented. Brief descriptions of characteristics and habitat requirements for the other four species listed in Table 4 are provided below.

Table 4. Federally Protected Species in Cherokee County

Scientific Name	Common Name	Federal Status
Myotis sodalis	Indiana Bat	E
Isotria medeoloides	Small-whorled pogonia	T
Pegias fabula	Little-wing pearly mussel	E
Villosa trabalis	Cumberland bean	E
Clemmys muhlenbergii	Bog turtle	T(S/A)

E= a species that is in danger of extinction throughout all or a significant portion of its range.
T= a species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
T(S/A) = Threatened due to similarity of appearance with other rare species and is listed for its protection.

INDIANA BAT (Myotis sodalis) (Miller and Allen)

Status: Endangered
Family: Vespertilionidae

Characteristics

The Indiana bat is a medium-sized, monotypic species of the genus Myotis that is distinguished by its dental formula of 2/3, 1/1, 3/3, 3/3; no other bat species found in North Carolina has this arrangement (Adams 1987). The head and body length ranges from 1 5/8- 1 7/8 in., and forearm length ranges from 1 3/8- 1 5/8 in. (USFWS 1999). This bat weighs between 6 and 9 grams (0.2-0.3 ounce) and has a wingspan of 9-11 inches (Harvey et al. 1999). The calcar (cartilaginous spur from the heel which helps support tail or interfemoral membrane is keeled. The fur lacks luster (Hall 1981), with the dorsal fur being brown in color and the ventral fur lighter with a slight cinnamon cast. The Indiana bat is most frequently confused with the little brown bat (Myotis lucifugus). Several characteristics can be used to distinguish these two species. These are summarized in Adams (1987) as well as in the recovery plan for this species (USFWS 1983).

Indiana bats feed strictly on flying insects with moths (Lepidoptera) the most common prey item (Brack and LaVal 1985). Caddisflies (Trichoptera) and flies (Diptera) (Kurta and Whitaker 1998) as well as mosquitoes and midges (Belwood 1979)

Indiana bats have been referred to as "cluster" bats because of the large aggregations they form during hibernation (Adams 1987). This behavior would explain the name "social myotis", which is also used for this species (Webster et al. 1985). Hibernation takes place from October to April, depending on climatic conditions.

Mating usually takes place shortly before hibernation as large numbers of bats congregate around the entrances to the hibernacula. This "swarming" behavior is believed to be important in facilitating mate-finding, familiarizing young with the hibernacula and to prevent inbreeding (Cope and Humphrey 1977). Adult females are believed to store sperm through the winter and with delayed fertilization occurring soon after leaving the hibernacula in the spring (Thompson 1982). Single young are usually born in June or early July (Cole and Humphrey 1977) and the young are capable of flight in mid-July to August.

Hibernaculas occur in caves or mines that attain stable low (37-43° F, 3-6° C) temperatures throughout the hibernation period. The stability of the low temperatures is important for maintaining a low rate of metabolism and conserving fat reserves, and only a small percentage of available caves provide these conditions (USFWS 1999).

Distribution and Habitat Requirements

The range of the Indian bat centers around cavernous limestone regions in the eastern United States. The Indiana bat has different summer and winter habitat requirements. Winter habitat is in caves and abandoned mines with standing water. The bat migrates to the winter habitat between September and November. They stay there with occasional periods of activity until they emerge in mid-March to early May. Hibernation only occurs in regions where winter temperatures are stable and are around four degrees Celsius. More than 85% of the range wide population occupies nine "Priority One" hibernacula (sites with > 30,000 bats). There are no "Priority One" or Priority Two" (500< 30,000 bats) hibernaculas that have been recorded in North Carolina. Three "Priority Three" hibernaculas have been recorded in North Carolina, one in each Henderson, Jackson and Rutherford Counties respectively (USFWS 1999).

The summer needs of this species are still not fully understood (USFWS 1999). Indiana bats forage in and around the canopy and subcanopy of a number of different types of forests. Early researchers considered floodplain and riparian forests as the primary foraging and roosting areas, however recent studies have shown that upland forests may also be important roosting and foraging areas (Gardner et al. 1991).

Males typically leave the hibernacula later than the females and disperse throughout their range foraging alone (Adams 1987). Females leave the hibernacula to form maternity colonies. These maternities generally have multiple roost sites. The most important factor of a suitable roost site seems to be structural (exfoliating bark with space for bats to roost between the bark and the bole of the tree), rather than related to tree species composition (USFWS 1999). Romme et al. (1995) developed a habitat suitability index model that identified (1) the amount of overstory canopy, (2) the diameter of overstory trees, (3) the density of potential live roost trees, (4) snag density, and (5) the amount of understory as the five variables considered most important for roosting habitat.

In July 1995 a maternity colony of at least 28 Indiana bats was discovered in Graham County North Carolina. This is the first documented maternity colony in North Carolina and the first evidence of summer breeding found south of Kentucky (USFWS 2000). It is likely that this maternity colony came from a Priority II hibernacula (White Oak Blowhole Cave) is located 5 miles from the border of Graham County and Tennessee.

Threats to Species

An estimated 85% of the total population of this species winters in one of seven hibenaculas, with almost half wintering in just two (USFWS 1983). With such a high reliance to a few hibernaculas the Indiana bat is vulnerable to disturbances to these wintering sites. Numerous factors have been contributed to the decline of this species, however all of the causes have not been explained. Modification of caves, human disturbances during the hibernation period and vandalism are some of the human-related factors affecting hibernacula sites, while flooding, temperature changes and ceiling

collapses (in mines) are some natural hazards that have been identified to affect hibernacula site (USFWS 2000). Land use patterns have changed dramatically within the Indiana bat's maternity range. This fragmentation of forests, fire suppression and agricultural conversion of land may also have contributed to the decline.

Summary of Findings

Initial screening and preliminary investigation by the USFWS suggested that potential Indiana bat summer roosting and maternity habitat existed with the Murphy Bypass project area. In July 2002, surveys for Indiana bat were conducted in areas within the project corridor that contained potential habitat using mist-netting techniques. No individuals were captured. Additional mist-netting surveys were conducted during July 30-31 and August 3, 2004. Again, no individuals were captured. Based on the survey results, the Indiana Bat does not appear to utilize the project area for maternity roosting and no individual Indiana bats were observed.

Biological Conclusion: May Affect, Not Likely to Adversely Affect

Potentially suitable spring/summer roosting habitat for the Indiana Bat exists within the Murphy Bypass project corridor. Construction of the project may potentially impact or destroy this habitat. However, this impact is considered insignificant because the US Forest Service currently protects greater than 500,000 acres of suitable spring/summer roosting habitat that could be utilized by Indian bats. Therefore, while potentially suitable spring/summer roosting habitat may be impacted by the construction of the Murphy Bypass, impacts from the project construction "May Affect, Not Likely to Adversely Affect" the Indiana Bat.

SMALL-WHORLED POGONIA (Isotria medeoloides)

Status: Threatened
Family: Orchidaceae

Characteristics

Small whorled pogonia is a perennial herb with long, pubescent roots and a smooth, hollow stem 9.5 to 25 centimeters (cm) tall terminating in a whorl of 5 or 6 light green, elliptical leaves that are somewhat pointed and measure up to 8 by 4 cm. A flower, or occasionally two flowers, is produced at the top of the stem. Small whorled pogonia's nearest relative is the purple five leaf orchid (*Isotria verticillata*), which is similar looking but can be distinguished by its purplish stem and by differences in the flower structure. *I. verticillata* is much more common and widespread than the small-whorled pogonia. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of Isotria will separate it from the genus Medeola, which has a solid, more slender stem (USFWS, 2004).

Distribution and Habitat Requirements

The 23 populations in the Southeast Region occur in North Carolina (5 populations); South Carolina (4 populations); Georgia (13 populations); and Tennessee (1 population). Most Southeastern populations number less than 25 plants. South Carolina has one population of over 25 plants, and Georgia has two populations numbering about

100 plants. In the Southeast, North Carolina has two protected sites, both of which are viable; South Carolina has four protected sites, two of which are viable; and Georgia has seven protected sites, four of which are viable (USFWS, 2004).

Habitat Requirements and Life History

This orchid typically grows in open, dry deciduous woods and in areas along streams with acidic soil. The plant can also be found in rich, mesic woods in association with white pine (*Pinus strobus*) and rhododendron (*Rhododendron sp.*). Small-whorled pogonia prefers leaf litter and decaying material but can also be found on dry, rocky wooded slopes, moist slopes or slope bases near vernal streams (NCNHP, 2004).

Small-whorled pogonia may remain underground in a dormant state for several years. It is often found in colonies. Flowering typically occurs in May through June. The plant may be found in four different phases: vegetative, with an abortive flower, flowering, or dormant. An individual plant may retain a flower for 4-14 days. Dormancy can last from 1-10 years and even up to 20. Successful seed germination is dependent upon substrate containing suitable mychorrhizal fungus, since this plant requires a symbiotic foot/fungus association (NCNHP, 2004).

Threats to Species

The current status of small whorled pogonia is attributed to loss of habitat and overutilization for scientific and private collections. Loss of habitat is attributed to recreational use, residential development, road construction and even herbivory from deer.

Summary of Findings

Preliminary investigations indicated that the project corridor may contain suitable habitat for small-whorled pogonia. Specific surveys were conducted by NCDOT within areas of the project corridor containing potentially suitable habitat. No individuals were noted found and it was determined that the project was not likely to adversely impact this species. However, since initial surveys were conducted prior to 2002, additional surveys for small-whorled pogonia were conducted June 9-11 and July 8-9, 2004. Areas of appropriate habitat were searched, but no individuals were found.

Biological Conclusion: Not Likely to Adversely Affect

Small-whorled pogonia is known to occur in Cherokee County and potentially suitable habitat occurs within the project area. However, initial and subsequent surveys of the potential habitat indicate that the plant is not present within the project corridor. Therefore construction of the Murphy Bypass is Not Likely to Adversely Affect this species.

LITTLEWING PEARLYMUSSEL (Pegias fabula) (I.Lea 1838)

Status: Federal Species of Concern
Family: Unionidae

Characteristics

The little wing pearly mussel (LWP) was described as (*Margaritana fabula*) by Lea (1838), and was later placed in a new genus Pegias by Simpson (1900). The LWP is

a small mussel having the anterior portion of its shell evenly rounded and semi- circular. The periostrium is usually eroded, giving the shell a chalky or ashy white appearance. If the periostracum is present it is light green or yellowish-brown with dark rays on the anterior surface that vary in width. It has well developed but incomplete hinge teeth and the lateral teeth are either vestigial or completely lacking (USFWS 1989).

Little is known about the reproductive biology of the LWP; however nearly all freshwater mussel species have similar reproductive strategies, which involves a larval stage (glochidium), that becomes a temporary obligatory parasite on a fish. Many mussel species have specific fish hosts that must be present to complete their life cycle. Based upon laboratory infestation experiments, Layzer and Anderson (1992) identified the greenside darter (*Etheostoma blennioides*) and the emerald darter (*E. baileyi*) as the potential fish hosts for the lwp. Ahlstedt (in Neves, 1991:271) suggests the banded sculpin (*Cottus carolinae*) and redline darter (*Etheostoma rufilineatum*) as potential hosts based on field observations of habitat preferences of these species. Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

Distribution and Habitat Requirements

The little wing pearly mussel was historically widespread but uncommon in tributaries of the Tennessee and Cumberland River basins in Alabama, Kentucky, North Carolina, Tennessee and Virginia. At the time of listing, the LWP was believed to have been extirpated from all but 6 of the 24 historically known stream reaches. Prior to its discovery in the Little Tennessee River in 1990, the LWP was known from only one site in North Carolina, the Valley River in Cherokee County. This population is believed to have been extirpated (USFWS 1989). The LWP inhabits small to medium sized streams with low turbidity, cool water, and a high to moderate gradient (Parmalee and Bogan 1998, USFWS 1989). This mussel can be found buried in gravel or beneath boulders and slabrock, lying on top of the substratum in riffles, and partly buried or on the surface of the substratum in the transition zone between long pools and riffles. It has been suggested that the best times to find this mussel are in late spring and in the late fall, when they are on top or partly buried in the substratum during spawning (Ahlstedt 1986).

Threats to Species

Coal mining and gas and oil development have been recognized as the main reasons for decline of the LWP in the upper Cumberland and Powell river basins (USFWS 1989). Additional impacts include reservoir construction, water pollution from sedimentation, and point and non-point source discharge, as well as invasion of exotic species. The consequences of these impacts on freshwater mussels are described further in later sections.

Summary of Findings

The population of the LWP in Cherokee County is based on one nearly one-hundred year old record from "Valley Creek," which has been interpreted as the Valley River, a major tributary to the HR. Habitat conditions have been heavily altered since this record and surveys conducted in the Valley River as recently as 2002 have failed to locate the LWP. While it is very likely that a population of LWP existed in the HR, and appropriate habitat currently exists within the project area, no individuals have ever been reported from the HR.

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

Since the LWP is historically known from Cherokee County in the HR Basin, and appropriate habitat exists within the project area, its presence cannot be discounted. However, the mussel surveys conducted for this project targeted the potential habitat of this species within the project corridor and no individuals were located. Therefore, the construction of the Murphy Bypass is Not Likely to Adversely Affect this species. NCDOT has committed to perform a pre-construction survey in areas of appropriate habitat for this species in order to update survey information on which this biological conclusion is currently based. If the LWP is found, the appropriate agencies will be immediately informed and Section 7 consultation will be initiated.

CUMBERLAND BEAN (Villosa trabalis) (Conrad 1834)

Status: Endangered
Family: Unionidae

Characteristics

The Cumberland bean was described by Conrad in 1834 with records indicating this species is restricted to tributary streams of the Tennessee and Cumberland Rivers. It inhabits small rivers and streams in fast riffles with gravel or sand and gravel stubstrate (USFWS 2004). Abundance is considered highest in the Cumberland system and extremely rare in the Tennessee River basin (USFWS, 1984; Ortman 1918, 1925).

This species is a small to medium sized freshwater mussel. It has a relatively thick, elongated, oval shell. Females have somewhat more rounded and slightly larger (maximum about 55 millimeters or 2.2 inches long) shells. According to Biggins (USFWS 2004), the outer shell surface (periostracum) is smooth (no ridges or bumps) and somewhat shinny; it is olive green, yellowish brown, or blackish with fine wavy dark green or blackish rays. However, the rays are typically difficult to see unless the shell surface is cleaned. The inside shell surface (nacre) is bluish white or white with a bluish iridescence towards posterior end of the shell (the description adapted from Parmalee and Bogan 1998, USFWS 1984, and USFWS 2004; Ortmann (1915) described the species' internal anatomy).

Reproduction of the Cumberland bean is similar to other freshwater mussel species. After males release sperm into the water column, females take the sperm in through their siphons during feeding and respiration. Once fertilized, eggs are retained in a specialized portion of the gills (marsupium) until the larvae (glochidia) fully develop. Once they are fully developed, the glochidia are released into the water. They attach and encyst on the gills and/or fins of a host fish. When metamorphosis (change to a young mussel) is complete, they drop to the streambed as juvenile mussels. Spawning likely occurs in late summer through early fall. The glochidia are likely released in late spring and early summer (Schultz 1996). As reported by Biggins (USFWS 2004), two fish have been identified as host species, fantail darter (*Etheostoma flabellare*) and striped darter (*Etheostoma virgatum*) (Layzer and Madison 1995).

Distribution and Habitat Requirements

According to the recovery plan (USFWS 1984), the Cumberland bean historically occurred in ten river systems within the Cumberland and Tennessee river basins in

Alabama, Georgia, Kentucky, Tennessee, and Virginia. Currently, the species is known to occur in only a few streams in the upper Cumberland River system, Kentucky and Tennessee and in the upper Tennessee River system, Tennessee. In the Hiwasse River, a relatively strong population still exists in a short reach downstream of the North Carolina/Tennessee State line in Polk County, Tennessee (Parmalee and Bogan 1998). Biggins reports that while no specimens have been collected in North Carolina, suitable habitat is present and the USFWS believes that the species likely occurs in small numbers in the North Carolina portion of the Hiwassee River below Appalachia Dam, Cherokee County (USFWS, 2004).

Threats to Species

Like most freshwater mussels, the Cumberland bean has been directly impacted by siltation, channelization, water quality degradation and impoundments. In fact, within the Tennessee and Cumberland river basins, reservoir construction is one of the most obvious causes of habitat loss and lowered mussel species diversity. More than 2,300 river miles or about 20 percent of the Tenneesee River and its tributaries with drainage areas of 25 square miles or more are impounded (USFWS 2004, Tennessee Valley Autority 1971). Reservoirs not only cause loss of riverine habitat within the impoundments but alter downstream flows which in turn adversely impact downstream aquatic habitat. Additionally, impoundments typically cause changes in fish fauna. This change can severely impact fish species essential to a mussel's reproductive cycle.

Impacts to water quality, such as coal mining related siltation and associated toxic runoff have adversely impacted many stream reaches. Within these two river basins, many streams experienced mussel and fish kills due to toxic chemical spills. Likewise, poor land use practices have increased siltation within these waters. Urban runoff has also degraded water and substrate quality. Because of the extent of habitat destruction, the overall aquatic faunal diversity in many of the basins' rivers has declined significantly (USFWS 1984). The consequences of these impacts on freshwater mussels are described further in later sections.

Summary of Findings

The record of the Cumberland bean from Cherokee County is based on a known population of this species established in the HR below Apalachia Lake. This species has been recorded as recently as 2003 by a USFWS/ The Catena Group survey crew in the areas immediately below Apalachia Lake. While the habitat within the project area is similar to the occupied habitat for the Cumberland bean below Apalachia Lake, no individuals have been found of this species in the HR above Apalachia Lake.

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

Since the Cumberland bean is known from the HR downstream of the project area, and appropriate habitat exists within the project area, its presence cannot be discounted. However, the mussel surveys conducted for this project targeted the potential habitat of this species within the project corridor and no individuals were located. Therefore, the construction of the Murphy Bypass is Not Likely to Adversely Affect this species. NCDOT has committed to perform a pre-construction survey in areas of appropriate habitat for this species in order to update survey information on which this biological conclusion is currently based. If the Cumberland bean is found, the

appropriate agencies will be immediately informed and Section 7 consultation will be initiated.

TENNESSEE CLUBSHELL (Pleurobema oviforme) (Conrad 1834)

Status: Federal Species of Concern
Family: Unionidae

Characteristics

Described by Conrad (1834) as *Unio oviformis* from the Holston River in Tennessee, this species is characterized as having a solid, obovate, elliptical to nearly rhomboid, somewhat inflated shell (Ortmann 1925). This species has been described as being highly variable with distinct "big river" and headwater forms. More taxonomic study is needed to determine if this widely distributed, highly variable species is actually more than one species assigned to this complex. In general, the shell of the Tennessee clubshell has a broadly rounded anterior margin, a slightly curved ventral and a bluntly pointed posterior end (Parmalee and Bogan 1998).

As with most freshwater mussel species the reproductive strategy of the Tennesse clubshell requires a juvenile stage that is parasitic of the gills of a "host" fish species. McMahon and Bogan (2001) and Pennak (1989) can be consulted for a general overview of freshwater mussel reproductive biology. The breeding season is unknown; however, July has been reported as the peak period of gravidity (Kitchel 1985). Weaver et al. (1991) has shown that under both natural and laboratory conditions, a number of darter and minnow species serve as host fish.

Distribution and Habitat Requirements

The Tennessee clubshell was historically found throughout the Tennessee River and Cumberland River drainage (Parmalee and Bogan 1998). Further study is needed to determine the current distribution of this species, however Williams et al. (1993) considered it to be a species of Special Concern. Currently in North Carolina, it is known from short stretches of the main channels of the Hiwassee River and the Little Tennessee River. Also, it was recently believed to have been observed (Personal observation) in the Little River (French Broad River Basin) in Transylvania County. Further survey work is needed to confirm its presence in this river.

Because it was so widespread, there is no specific habitat description for this species. In the Hiwassee and Little Tennessee in North Carolina it has been observed in gravel/coarse sand and cobble substrates in areas with moderate flow and shallow (< 1 m) depths (Tim Savidge, personal observation). Like many other mussel species, it appears to be absent from areas with a high composition of silt.

Threats to Species (particularly the Hiwassee River Population)

There have not been any specific threats and reasons for imperilment stated for this species, however like other mussel species it is likely susceptible to a wide variety of factors (impoundments, siltation, pollution, etc). With the exception of the Little Tennessee River population, all of the other populations are generally small in numbers and restricted to short reaches of isolated streams. The low numbers of individuals and the restricted range of most of the surviving populations make them extremely vulnerable

to extirpation from a single catastrophic event or activity. Catastrophic events may consist of natural events such as flooding or drought, as well as human influenced events such as toxic spills associated with highways or railroads. In 1998 a tanker truck carrying Octocure 554 (a chemical liquid used in the rubber making process) wrecked, resulting in a toxic spill killing several miles of mussel populations in the Clinch River near Cedar Bluff, Virginia. The spill killed thousands of fish and mussels, including three federally protected species. The Clinch River contains one of the most diverse mussel faunas in the United States. The stretch of the river affected by the spill was one of the few remaining areas that contained a reproducing population of the Endangered tan riffleshell (*Epioblasma florentina walkeri*). The toxic spill is believed to have eliminated this population (Richmond Times Dispatch, September 2, 1998). Biologists in Virginia feel that it could take more than 20 years before mussel populations in this area recover, if they recover at all (Bristol Herald Courier, September 4, 1998). The mussel fauna of the Little Tennessee in North Carolina occurs in a small reach of the river (@ 23 miles), and is thus susceptible to extinction from a catastrophic toxic spill like that which occurred in the Clinch.

Siltation resulting from improper erosion control of various types of land usage, including agricultural, forestry, and development activities, has been recognized as a major contributing factor to degradation of mussel populations (USFWS 1996). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and by direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulation of less than 1 inch has been shown to cause high mortality in most mussel species (Ellis 1936). In Massachusetts, a bridge construction project decimated a population of the endangered dwarf wedgemussel (*Alasmidonta heterodon*) because of accelerated sedimentation and erosion (Smith 1981). The abrasive action of sediment on mussel shells has been shown to cause erosion of the outer shell, which allows acids to reach and corrode underlying layers (Harman 1974).

The soils in the Hiwassee River Basin are considered to be some of the most erodable soils in the state. The generally steep topography in the watershed increases the erosion potential. Past agricultural practices and increasing development pressures throughout the watershed has led to, and could continue to lead to significant sedimentation problems within the Hiwasse River. In 1997 the Mission Reservoir was drained, flushing sediment down the river, the effects of which were observed throughout the mainstem to Hiwassee Lake, approximately 9 river miles (Jenkins 1999). This type of operating procedure has also been documented in a similar reservoir, Lake Emory, on the Little Tennessee River, operated by the same power company with similar effects (Jenkins and Burkhead 1984).

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992a, Neves 1993). Construction of dams transforms lotic habitats into lentic habitats, which results in changes with aquatic community composition. The changes associated with inundation adversely affect both adult and juvenile mussels as well as fish community structure, which could eliminate possible fish hosts for glochidia (Fuller 1974). In addition, the construction of dams often results in fragmentation of mussel populations, by effectively blocking upstream expansion and recruitment of mussel and fish species. Muscle Shoals on the Tennessee River in northern Alabama, once the

richest site for naiads (mussels) in the world, is now at the bottom of Wilson Reservoir and covered with 19 feet of muck (USFWS 1992b). More specifically, the population of the Tennessee clubshell appears to be limited upstream by the cold nutrient poor release from Chatuge Lake, and downstream by the lentic habitat created by Hiwassee Lake (Personal observation). The construction of these two impoundments likely resulted in a decrease of the population in the river.

Sewage treatment effluent has also been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations might not occur for up to two miles below points of chlorinated sewage effluent. There are no wastewater treatment plant (WWTP) facilities within or directly (within two miles) upstream of the project area. The Town of Murphy WWTP occurs downstream of the project area, therefore the closest major point-source wastewater discharge is the Town of Andrews WWTP which is approximately 12 miles upstream.

Additionally, the introduction of exotic species such as the Asiatic clam (*Corbicula flumine*a) and zebra mussel (*Dreissena polymorpha*) has been shown to pose significant threats to native freshwater mussels. The Asiatic clam is now established in most of the major river systems in the United States (Fuller and Powell 1973) and has been observed in the Hiwassee River (personal observation). Concern has been raised over competitive interactions for space, food and oxygen with this species and native mussels, possibly at the juvenile stages (Neves and Widlak 1987, Alderman 1995).

The zebra mussel, native to the drainage basins of the Black, Caspian and Aral Seas, is an exotic freshwater mussel that was introduced into the Great Lakes in the 1980s. Since its introduction, this species has rapidly expanded its range into the surrounding river basins, including those of the South Atlantic slope (O'Neill and MacNeill 1991). This species competes for food resources and space with native mussels, and is expected to contribute to the extinction of at least 20 freshwater mussel species if it becomes established throughout most of the eastern United States (USFWS 1996).

Summary of Findings

During the 1998-2000 mussel surveys conducted in the project area, the Tennessee clubshell was the rarest of the six mussel species found in this stretch of the HR. The population in the HR in North Carolina is mostly represented by old (>30 yr.) individuals with little evidence of age class variations. It has been suggested that this is due to the coldwater release of Lake Chatuge. Because of the small population sizes and ranges in North Carolina, this species is very susceptible to extirpation from the state. Further examination of the project's potential effects and the Biological Conclusion for this species are discussed in conjunction with the sicklefin redhorse as presented in following sections.

SICKLEFIN REDHORSE (Moxostoma sp.)

Status: Federal Species of Concern
Family: Catostomidae

Characteristics

The sicklefin redhorse is an undescribed species of sucker that has historically been misidentified as other redhorse species until 1992 when Robert Jenkins of Roanoke College recognized specimens from the Little Tennessee as being distinctive (Jenkins 1999). After intensive sampling and examination of museum specimens, Jenkins (1999) concludes that the sicklefin is clearly a true species morphologically, phylogenetically, and reproductively. The sicklefin redhorse is a colorful, sleek-bodied, medium-sized sucker that is characterized by its very high, deeply falcate (sickle-shaped) dorsal fin. The body has an olive tone with a brassy, or coppery sheen; scale bases are olive to black; lower fins are yellow or orange, the caudal fin is red, and dorsal fin olive or red (Jenkins and Freeman 1997). Maximum body length has been recorded as 550 mm TL (total length), however field observations (Jenkins 1999) of some individuals were estimated to be much larger (650-675 mm TL). Jenkins (1999) should be referred to for a complete species description.

Distribution and Habitat Requirements

Much has yet to be learned of the habitat requirements of this species. Although it is adapted to lotic (stream) conditions, it inhabits both the Hiwassee and Fontana Reservoirs. More study is needed to determine the extent of use of lacustrine habitats by this species. The sicklefin redhorse is restricted to less than 20% of each of the Hiwassee and Little Tennessee River basins in the upper Tennessee River drainage in the Blue Ridge physiographic province in southwestern North Carolina and barely into Georgia (Jenkins 1999). There is no evidence that the sicklefin ever inhabited any of the other tributaries (French Broad, Little, Pigeon, Nolichucky, Watauga and South Fork Holston) of the Tennessee in the Blue Ridge province (Jenkins 1999). Based on estimated historical ranges, the sicklefin is believed to presently occur in only 42% of its original range.

The sicklefin occupies cool to warm, moderate gradient, medium-size creeks to medium rivers and large, mostly steep banked reservoirs. Typical substrate associations are with gravel, cobble and boulder that are relatively silt free.

Threats to Species (particularly the Hiwassee Population)

Like many other aquatic species, the sicklefin redhorse appears to be very sensitive to activities effecting water quality. Jenkins (1999) identified dams, impoundments and tailwaters as the major factor that delimits the range of this species. Mission dam is believed to be the limiting factor in the upstream migration of this species in the Hiwassee River (Bob Jenkins, pers. comm. 2004). Etnier (1997) identified altered flow regimes as the reason for the imperiled status of the sicklefin redhorse. Sedimentation and pollution are also recognized as factors contributing to the decline of this species. The effects of these factors on aquatic organisms have been discussed earlier.

In addition to the inundation of habitat, dams also result in modifying the downstream habitat by changing water temperatures (cold-water releases), causing irregular flow regimes that lead to bed scour, as well as causing a reduction or prevention of gravel renewal. Low dissolved oxygen from hypolimnetic releases is often a consequence of hydro-electric operations.

Summary of Findings

The sicklefin redhorse was observed at a number of locations in the river as well as Martin Creek, a tributary at RM 98, during the mussel surveys conducted in 1998, 1999, and 2000. Robert E. Jenkins of Roanoke College conducted a range wide assessment of this species, and found it to occur in the HR from Hiwassee Lake upstream to Mission Dam (RM 106). The furthest upstream record of the sicklefin redhorse was just below Mission Dam, approximately 3.5 river miles upstream of the east crossing of the HR. Based on the currently known range for this species, the HR in the project area may be some of the best habitat for sicklefin redhorse in NC. Further examination of the project's potential effects and the Biological Conclusion for this species are discussed in conjunction with the Tennessee clubshell as presented in following sections.

AVOIDANCE AND MINIMIZATION MEASURES

A number of measures have been incorporated into the design and planned construction of this project. The species addressed in this BA were not discovered in the Hiwassee River until the later stages of project planning, thus many changes were made to the design of the roadway and structures.

STANDARD MEASURES

The following measures are incorporated into NCDOT projects that occur within or upstream of water bodies that contain federally protected aquatic species.

Erosion Control Measures: The areas adjacent to the Hiwassee River will be identified as "Environmentally Sensitive Areas" on the Erosion Control plans for this project.

Within the Environmentally Sensitive Areas the following shall apply:

1. Provide 50-Foot Buffer Zone (both sides of stream) that allow for clearing but not grubbing until immediately before grading operations.
2. Limit grubbing operations to within 10 days of grading.
3. Erosion and Sediment Control Measures to be installed immediately after clearing.
4. Require "Seeding and Mulching" to be performed immediately following grade establishment.
5. Require "Staged Seeding" – 20 foot fill sections or 2 acres, whichever is less.
6. Erosion and Sediment Control Measures must be cleaned out when ½ full.

7. Increase sediment storage capacity by 50% above standard BMP guidelines.

Agency Coordination: NCDOT will invite representatives from the USFWS and the NCWRC to the pre-construction meetings for these projects, along with all subsequent field inspections prior to construction, to insure compliance with all special project commitments.

Bridge Drainage: Deck drains will be placed at the ends of each planned bridge and run into grassed swales so no direct stormwater discharge will occur over the Hiwassee River or Martin Creek. This commitment has been incorporated in the Structure Design Plans.

Preconstruction Survey: NCDOT conducts final surveys (just prior to construction) in the project footprint of projects impacting waters known to contain protected mussel species. NCDOT is anticipating that few individuals will be found in surveys of the project footprint and is proposing to relocate these mussels to appropriate upstream habitat. The preconstruction survey will be incorporated into the relocation plan that will be developed (See Reasonable and Prudent Measures).

PROJECT SPECIFIC MEASURES

In response to concerns raised over impacts to water resources and aquatic communities, particularly freshwater mussels and the sicklefin redhorse, various design changes have been implemented by NCDOT at three particular locations; East Crossing of Hiwassee River, West Crossing of Hiwassee River, and Martin Creek.

East Crossing: The original bridge design for the east crossing HR consisted of a span that would require two bents directly in the HR channel. Additionally, the design required two temporary causeways in the channel to assist construction. The design would have resulted in significant temporary and permanent impacts to the mainstem of the HR channel. NCDOT proposes a new design that completely spans the HR. There will be no permanent fill impacts to the HR as a result of the new design (see Appendices A & B, respectively, for old and new designs).

West Crossing: The original bridge design consisted of 10 spans with 9 piers. This design was crossing the HR on a greater skew than the currently proposed design, resulting in a longer bridge that required bents directly in the HR. NCDOT proposes a new span arrangement for the western most crossing that is further downstream of the original design and on a lesser skew, resulting in a more perpendicular crossing of the HR. The new arrangement will span the HR at the western crossing completely, although it will require two temporary work pads in the river to assist in construction. The proposed span of the HR in this location will substantially reduce the permanent impacts. As mentioned, the structure will require two temporary work pads that will have to stay in place through much of the construction. These work pads are needed to set the steel girders, pour the concrete deck, and generally assist in the spanning of the HR. These work pads are to consist of an A-frame foundation or precast footings, therefore only the footings will directly impact substrate (potential mussel habitat) of the HR. The A-frame foundation will allow for flow underneath the pad, thereby minimizing impacts to fish passage. However, it is likely that the footings of the work pads will require shallow drilled shafts for attachment due to the close proximity of bedrock the river bottom.

Drilling these shafts would likely result in increased sedimentation in this area, the best known mussel habitat in the project area, therefore increasing impact potential to the HR mussel fauna (see Appendices A & B, respectively, for old and new designs).

Martin Creek: The proposed structure at this crossing has been redesigned from a triple barrel box culvert to a bridge that will span the stream entirely, significantly reducing impacts. Martin Creek flows through a deep ravine at the crossing location and would have required a massive volume of fill and a culvert of over 234 meters in length. The new design will bridge this ravine and Martin Creek completely, resulting in no permanent impacts. A temporary work bridge will be required to assist construction of the bridge that will result in some temporary impacts to Martin Creek and its fauna. The old and new designs are detailed in Appendices A & B.

IMPACT ANALYSIS

Potential impacts to the Hiwassee River have been greatly reduced by the avoidance and minimization measures previously described. However, construction of this project has will invariably impact the aquatic fauna in the Hiwassee River, including the Tennesse clubshell and the sicklefin redhorse. Potential and anticipated project-related impacts to these species are considered below. Direct, secondary and cumulative impacts are included in the analysis.

DIRECT IMPACTS

Direct impacts refer to consequences that are directly attributed to the project. Direct impacts associated with road construction include, but are not limited to, loss of and modification of habitat, stream rechannelization, hydrologic modification, and erosion. Potential direct impacts to aquatic species associated with transportation projects include; substrate disturbance, siltation, alteration of hydrologic regime, and introduction of toxic compounds.

Substrate disturbance (habitat loss)

It is estimated that a total of 301.4 ft^2 of streambed habitat will be temporarily impacted by the construction of these bridges. Individual mussels occurring in this impact area will be adversely impacted by construction of this bridge. If the placement of the temporary work pads requires shallow drilled shafts, as anticipated, further impacts to individuals downstream of the bridge will occur. NCDOT is proposing to remove individuals from the impact site and relocate to other locations (see Reasonable and Prudent Measures section of this BA).

Sedimentation/siltation impacts

The detrimental effects of siltation on aquatic species have been discussed earlier. Suspended solids, sedimentation, and turbidity result in reduced biodiversity as well as a decline in productivity at all trophic levels (Gilbert 1989). Because of the topography and the erodable nature of the soils in the project area, project construction has the potential to result in sedimentation into the Hiwassee River. To eliminate/minimize the potential for sedimentation, the NCDOT has developed specific erosion control measures designed to protect environmentally sensitive areas (discussed above). If the Erosion

Control Plans are properly incorporated into project construction and strictly adhered to, the aquatic habitat of the Hiwassee River should not be adversely impacted by erosion and sedimentation.

Roadway runoff impacts

Numerous pollutants have been identified in highway runoff, including various metals (e.g., lead, zinc, iron), sediment, pesticides, deicing salts, nutrients (e.g., nitrogen, phosphorus), and petroleum hydrocarbons (Yousef et al. 1985, Gupta et al. 1981). The sources of these runoff constituents range from construction and maintenance activities, to daily vehicular use. Hoffman et al. (1984) concluded that highway runoff can contribute up to 80% of the total pollutant loadings to receiving water bodies. Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, lead and zinc were some of the pollutants identified in this study.

The toxicity of highway runoff to aquatic ecosystems is poorly understood. A major reason for this poor understanding is the lack of studies on highway runoff alone. Potential impacts of highway runoff have often been inferred from studies conducted on urban runoff; however, the relative loadings of pollutants are often much greater in urban runoff, because of a larger drainage area and lower receiving water dilution ratios (Dupuis et al. 1985). The negative effects of urban runoff inputs on benthic macroinvertebrate communities have been well documented (Garie and McIntosh 1986, Jones and Clark 1987, Field and Pitt 1990, and others). Lieb (1999) found the macroinvertebrate community of a headwater stream in Pennsylvania to be highly degraded by urban runoff via a detention pond. Improvements were observed at continual distances downstream from the discharge point; however, all sites examined were still impaired compared to a reference community that received no urban runoff.

The few studies that examined actual highway runoff show that some species demonstrate little sensitivity to highway runoff exposure, while others are much more sensitive (Dupuis et al. 1985). Maltby et al. (1995) found elevated levels of hydrocarbons and metals in both stream sediments and water column below a heavily traveled British motorway. They demonstrated that the benthic amphipod (*Gammarus pulex*) experienced a decrease in survival when exposed to sediments contaminated with roadway runoff. However, this species showed no increase in mortality when exposed to water contaminated with roadway runoff. Unfortunately, most of these studies only measured acute toxicity to runoff and did not examine long-term impacts.

The effects of highway runoff on freshwater bivalves have not been studied extensively. Benkert and Augspurger (1992) compared sediment samples and soft tissues of the eastern elliptio (*Elliptio complanata*) upstream and downstream of the I-95 crossing of Swift Creek in Nash County, North Carolina. The sediment samples as well as the mussels (n=3) exhibited higher levels of aliphatic hydrocarbons, arsenic, lead, zinc and other heavy metal contaminants in the downstream samples. Because of the small sample size, the effect on the health of these mussels was not studied. The North Carolina Mussel Research Program, which consists of representatives from various federal and state conservation and regulatory agencies, academia and NCDOT, identified this issue, as a major research need. NCDOT recently funded a 2-year study that evaluated the impacts of highway runoff on the health of freshwater mussels. It is anticipated that these contaminants are detrimental to the health of freshwater mussels.

Upon the completion of this project there will be an increase in the amount of roadway runoff entering the river due to the increased impervious area and associated steep terrain. However, stormwater coming off of the roadway in these locations will not be directly discharged into any water body; rather it will be directed over grass swales where possible. Finley and Young (1993) found grassy swales to be an effective means of pollutant removal from stormwater. However, their study was conducted in an area of less dramatic change in topography than occurs in this project area. Due to these dramatic natural slopes, grassy swales are often unstable and therefore insufficient in treating stormwater directed into them. This is illustrated in the need to completely rip-rap the channel of an Unnamed tributary up to the HR at the western crossing (Site 4A) of the project due to the steep slopes along the banks of the river. Stormwater directed into channels flowing down steep slopes will not effectively remove pollutants and may result in additionally impacts to the aquatic resources of the Hiwassee River.

Sulfidic Rocks (Hot Rocks) Impacts

Two rock formations, the Mineral Bluff Formation and particularly the Natahala Formation, that underlie or are in close proximity to the project area, are known to contain sulfur-rich minerals (NC Geological Survey 2000). When disturbed and exposed to the atmosphere and weathering process, this acid producing "hot rock" may produce damaging acid levels in leachate that can acidify the receiving water bodies (NCDOT, 2004). Sensitivity to pH varies with taxon and life stage, but acid-sensitive species are well documented among most groups of aquatic organisms, including mollusks and fishes (Baker, 1991a).

In order to determine the potential for acid producing rock within the project corridor, the NCDOT Geotechnical unit has conducted investigations of the hard rock underlying the project by taking cores at intervals along the project corridor. These cores were analyzed by NCDOT Materials and Test Unit in order to determine the acid potential of the rock, which is measured as Net Neutralization Potential (NNP). NNP values less than negative five are considered as having a high potential for producing acid drainage. The test results for the rock samples taken along the Murphy bypass project corridor are listed in Appendix C. The results indicate that two of the samples have significantly low NNP values (Sample 1: -22.6 NNP and Sample 5: -19.6 NNP). The NNP values for the rock underlying the remainder of the project corridor are all positive and therefore indicate a low potential for producing acid drainage. The area that containing the potential "hot rock" is in the vicinity of the Martin Creek crossing at station 24 + 64 in the attached drawings in Appendix A. Due to that fact that Martin Creek contains potential spawning habitat for the sicklefin redhorse and drains into some of the best mussel habitat in the HR, there is the potential for some detrimental impacts to these and other aquatic species in the HR as a result of disturbing these acid producing rocks.

Special provisions developed by the Geotechnical Unit of the NCDOT for dealing with the Potential Acid Producing Rock Materials that occur within the R-0977A project corridor are included in Appendix C. These provisions outline plans for weekly testing and monitoring of runoff from erosion control basins in the active construction areas in order to evaluate pH and sulfate values. If pH values are below 6.0, a pre-approved

mitigation plan will be chosen within 72 hours. The methods of these possible mitigation plans are detailed in the attached special provisions.

If NCDOT strictly follows special provisions of testing and monitoring areas of known and potential "hot rock" within the Murphy bypass corridor and, in accordance, develops an approved mitigation plan to properly counteract these potentially damaging effects, then potential "hot rock" effects to the aquatic species of Martin Creek and the HR should be minimized.

SECONDARY AND CUMULATIVE IMPACTS

Secondary or indirect impacts are defined as those "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable" (40CFR 1508.8). Cumulative impacts are defined as effects of future State or private activities, not involving Federal actions that are reasonably certain to occur within the impact area of the proposed Federal action. The National Environmental Policy Act (NEPA) defines cumulative impacts as those that result from "the incremental impacts of an action when added to other past and reasonable foreseeable future actions" (40CFR 1058.7).

For roadway projects, secondary and cumulative impacts often result from increased accessibility to parcels of land and from modifications in travel time between various areas (Mulligan and Horowitz 1986). This allows increased residential, commercial, and industrial development. In fact, economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990).

One unintended consequence of roadway improvements can be, depending upon local land development regulations, development demand, water/sewer availability, and other factors, which encourage additional development and sprawl[1]. Improvements to LOS, better accommodation of merging and exiting traffic, and reductions in travel times can have land development impacts outside of the project area. New growth and development within mountain and piedmont areas always has the potential to degrade water quality, scenic values, and recreational opportunities unless proper planning and development regulations are utilized. This potential increases when it occurs in an area with minimal or new planning programs and virtually non-existent development controls. Local development controls along the Hiwassee River corridor should be encouraged.

Because the mussel populations were discovered only recently, it is difficult to assess the impacts of previous actions on them. However, based on recent field reconnaissance, it appears likely that the conditions caused by the Chatuge, Hiwasee, and Mission Dams has effected mussel distribution in the Hiwassee. For instance, all three dams have resulted in the loss of free flowing habitat. Furthermore, the habitat below the Chatuge is adversely effected by the nutrient poor, cold water discharge.

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[1] Some common traits of sprawl are 1. Unlimited outward expansion and leapfrog development; 2. low-density residential and commercial settlements; 3. Widespread strip commercial development; 4. Large areas of homogenous land uses and 5. Poor accessibility of related land uses such as housing, jobs, and services like schools and health care.

Jenkins (1999) stated "The sickelfin redhorse is locked into its current range in the Hiwassee system by at least two dams" (Hiwassee and Mission Dam). He further estimates that the sicklefin redhorse now only occupies 41.6% of its likely historic range.

The combined impacts to the habitat and individual mussels at the two sites is fairly small, however, given the irregular distribution of mussel populations (a reflection of limited habitat), these locations (particularly the West Bridge location) may be very significant for the continued survival of these species in the Hiwassee River. The NCDOT has taken measures to minimize impacts to these sites, however unavoidable impacts will occur.

Biological Conclusion: **Will Adversely Affect**

The construction of the proposed US 64 improvements will result in impacts to the aquatic community in the Hiwassee River, including the Tennesse clubshell and the sicklefin redhorse and their habitats. As mentioned above, the combined total estimated impacts resulting from the temporary work bridge construction at the west crossing of the HR to river bottom are approximately 28 square meters (301 square feet). It is additionally anticipated that the footings of these temporary work bridges will require shallow drilled shafts to secure them. The instream work that these drilled shafts may require could also be detrimental to the existing mussel and fish populations in this area as a result of increased substrate disturbance and sedimentation, as well as the potential for the disturbance of sulfidic minerals. A number of measures have been made to reduce these impacts, however, further measures can be incorporated to help offset these impacts to the Hiwassee River mussel populations.

PROPOSED MEASURES TO OFFSET IMPACTS

There are a number of mitigative measures that can be taken to offset impacts to the aquatic community in the Hiwassee River as a result of project construction. Potential opportunities for mitigative measures have been discussed between the USFWS, NCWRC and the Project Development & Environmental Analysis Branch of NCDOT. The NCDOT proposes the following measures to help offset the impacts from this project.

Mussel Relocation

It is anticipated that a limited number of individuals of the Tennessee clubshell will occur in the area of the west crossing of the Hiwassee. While the realignment and decision to span the HR at this location will significantly avoid and minimize impacts to these individuals, NCDOT has committed to remove these individuals from the impact site and relocate them to suitable locations far enough removed from direct impacts of project construction. NCDOT will develop a relocation plan detailing collection methods, tagging and recapture, selection of relocation sites, handling and transportation of individuals, monitoring protocols, and the feasibility of returning the individuals to their original locations post construction. This relocation plan will be developed with input from the USFWS and NCWRC and will require the approval of all parties prior to implementation.

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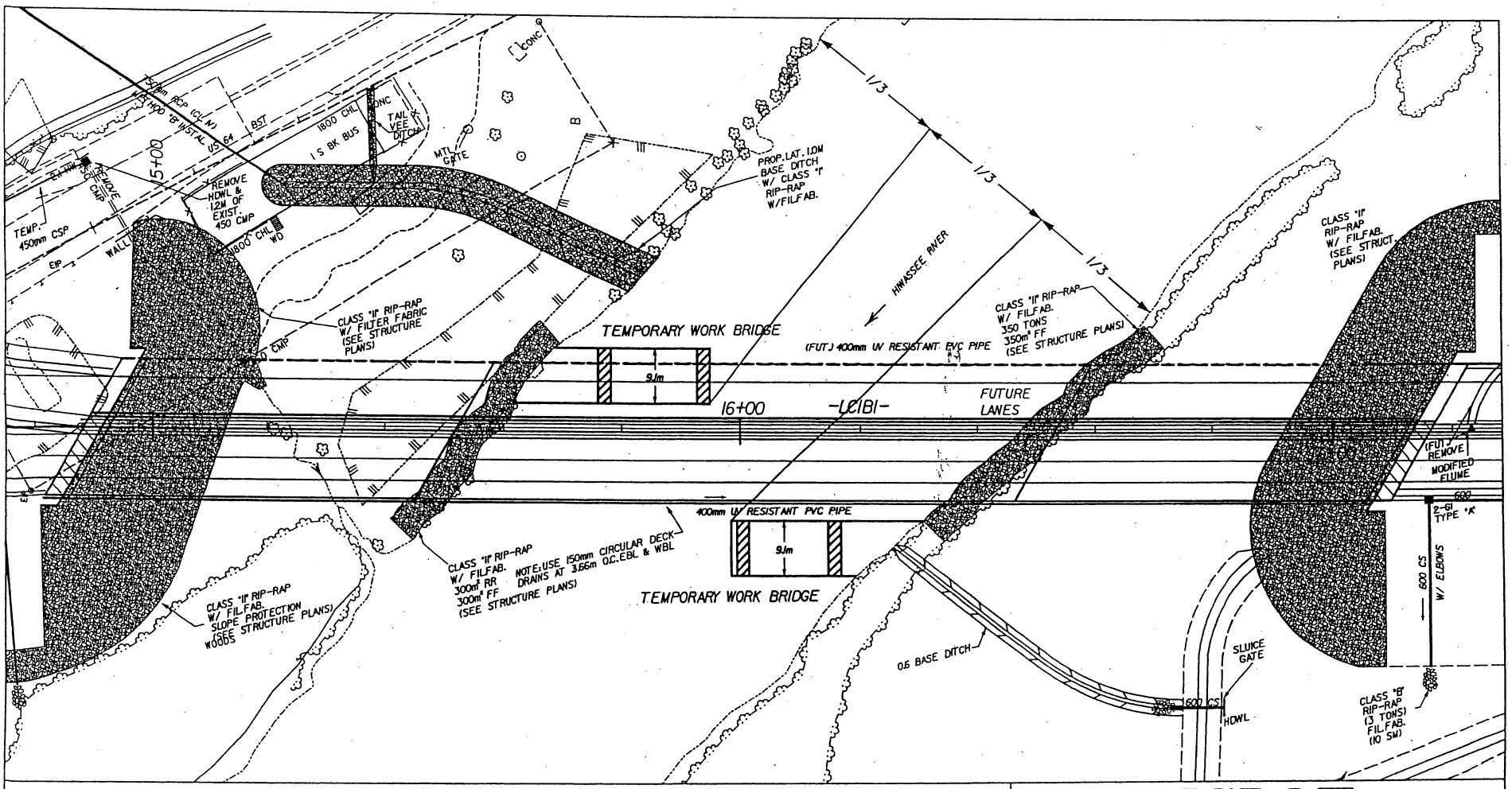
APPENDIX A
Proposed Design Drawings



PLAN VIEW
TEMPORARY WORK BRIDGE
SITE 4A
SCALE 1:1000

NCDOT

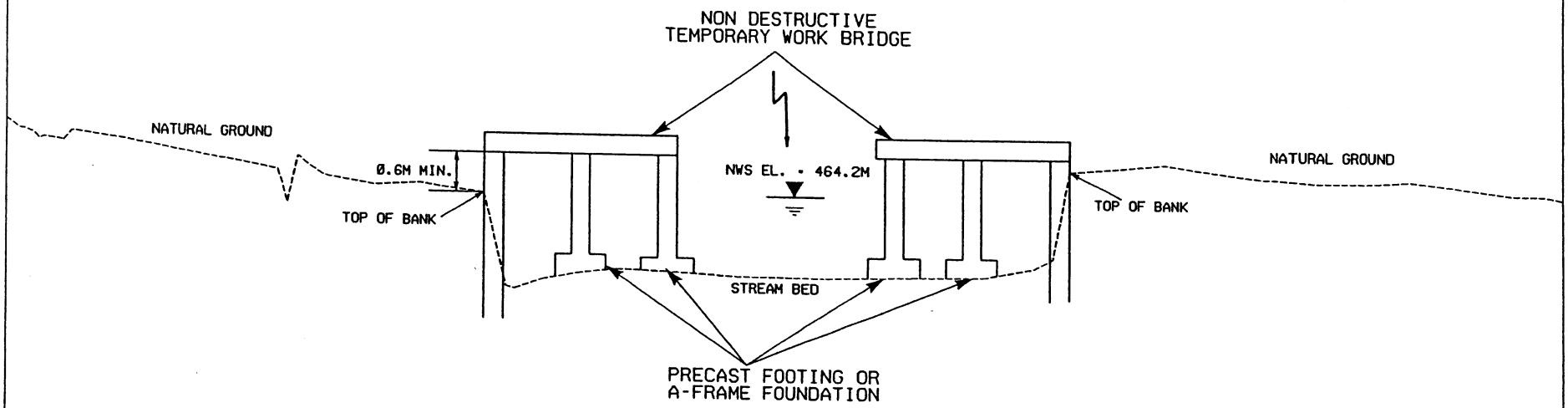
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET OF **8/17/04**



AREA OF TEMPORARY IMPACTS DUE TO TEMPORARY FOOTING/ FOUNDATIONS = $28M^2$

PROFILE VIEW
TEMPORARY WORK BRIDGE
SITE 4A
NOT TO SCALE

NCDOT

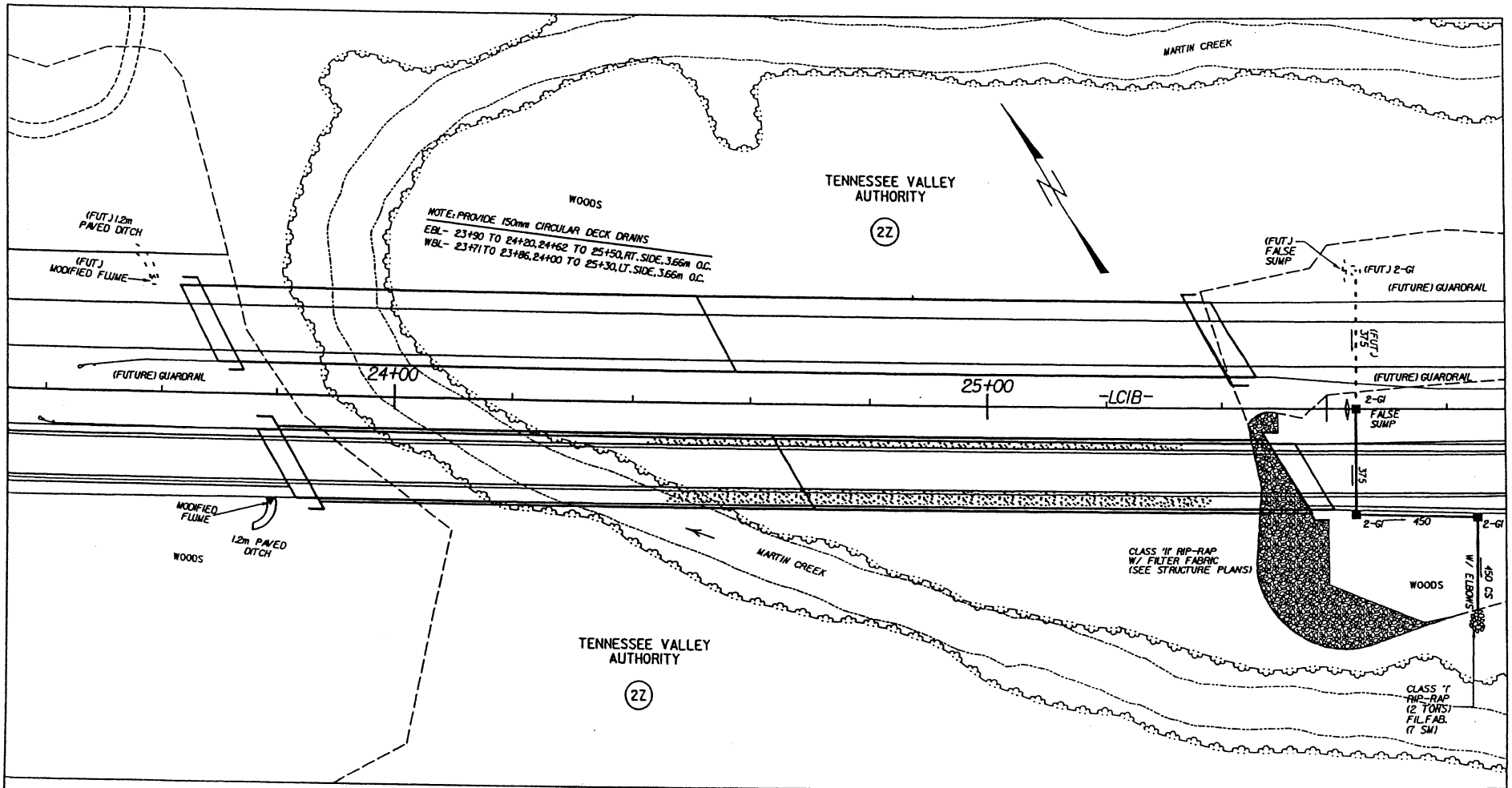
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 2 OF **5/20/04**



PLAN VIEW
NO
IMPACTS
SITE 6
SCALE 1:1000

NCDOT

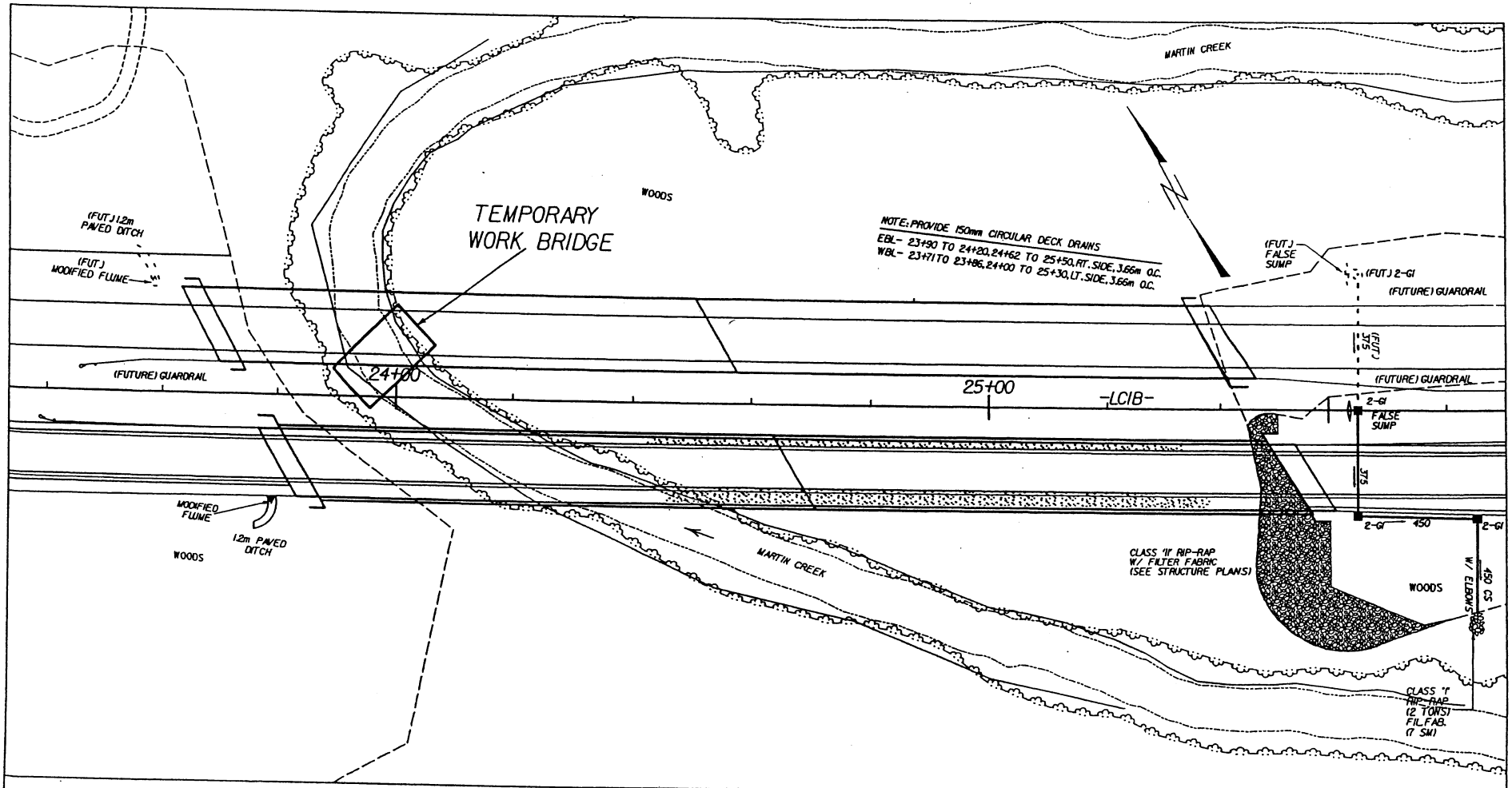
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 11 OF **2/25/04**



PLAN VIEW
TEMPORARY WORK BRIDGE
AT MARTINS CREEK
NO IMPACTS
SCALE 1:1000

NCDOT

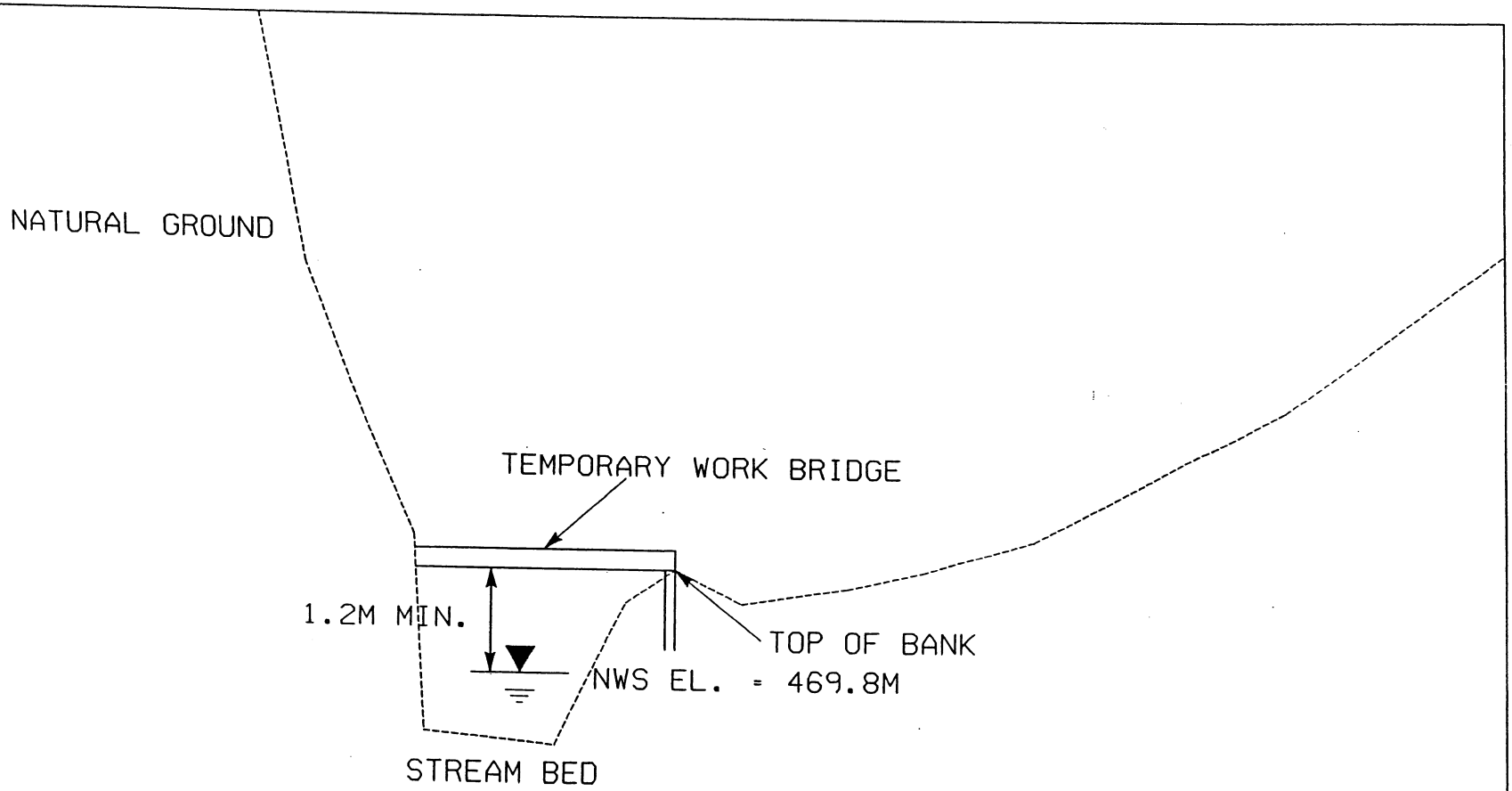
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 12 OF **2/25/04**



PROFILE VIEW
TEMPORARY WORK BRIDGE
AT MARTINS CREEK
NO IMPACTS
NOT TO SCALE

NCDOT

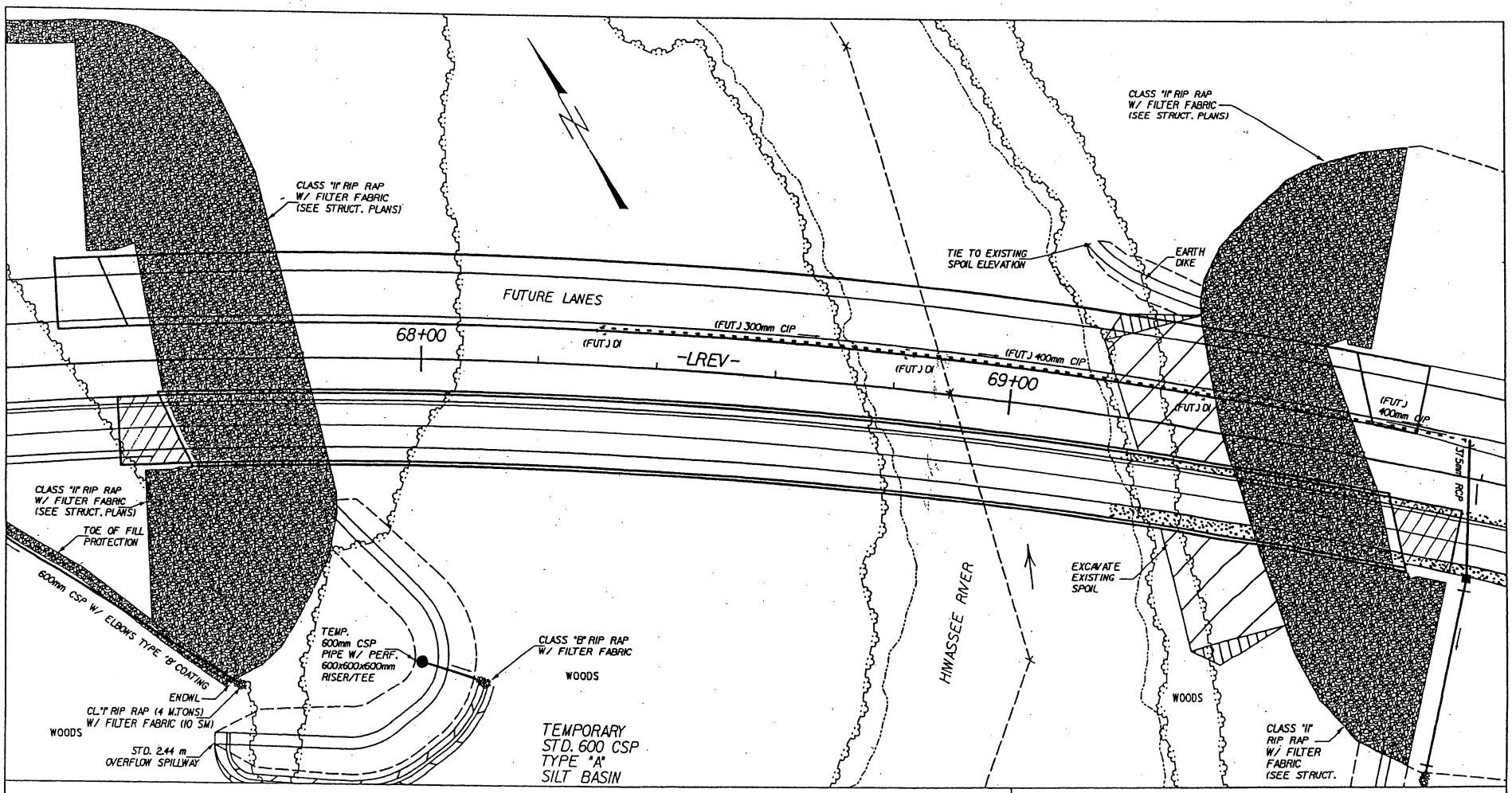
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET 13 OF **2/25/04**



PLAN VIEW
NO
IMPACTS
SITE 16A
SCALE 1:1000

NCDOT

DIVISION OF HIGHWAYS

CHEROKEE COUNTY

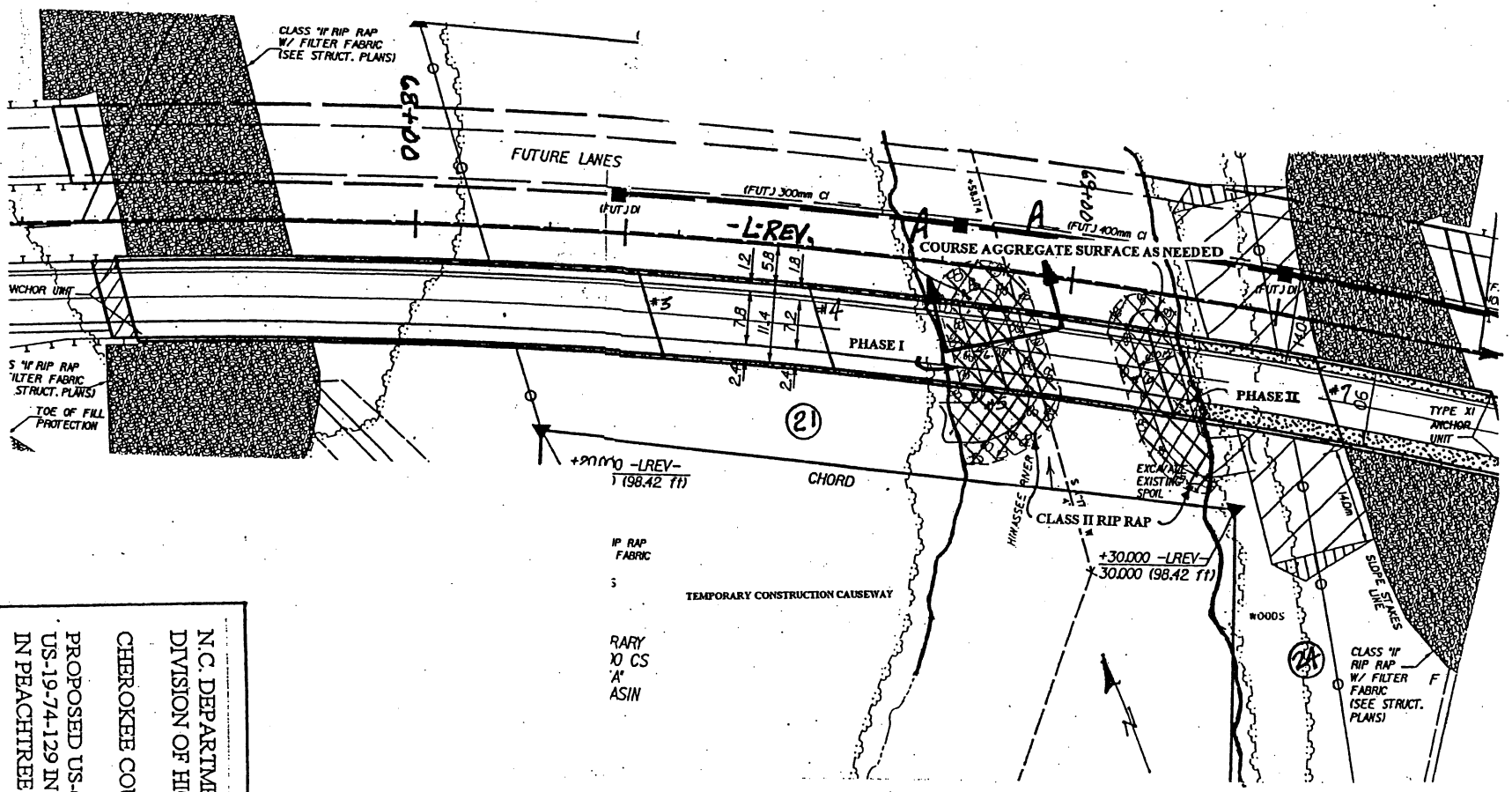
PROJECT: 8.1910203 (R-977A)

PROPOSED US 64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

SHEET OF 7/1/04

APPENDIX B

Original Design Drawings



TEMPORARY CONSTRUCTION CAUSEWAY II

0 10 20 30 40M

DENOTES FILL IN SURFACE WATERS

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

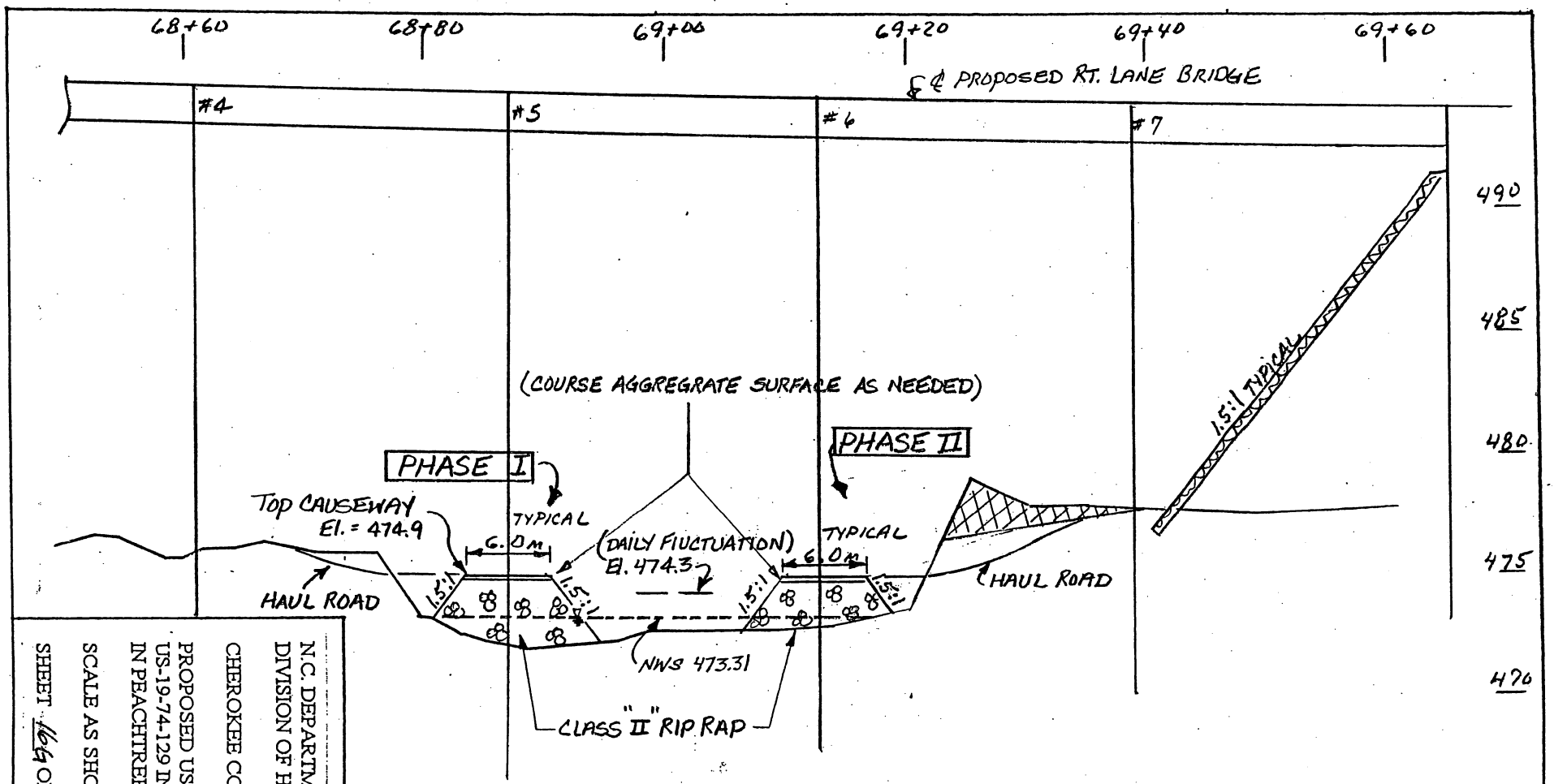
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

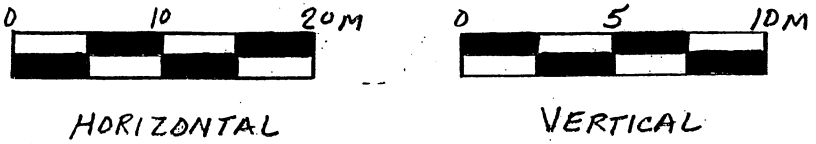
SCALE AS SHOWN

SHEET 16 OF 18

JUNE 1997



TEMPORARY CONSTRUCTION CAUSEWAY



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

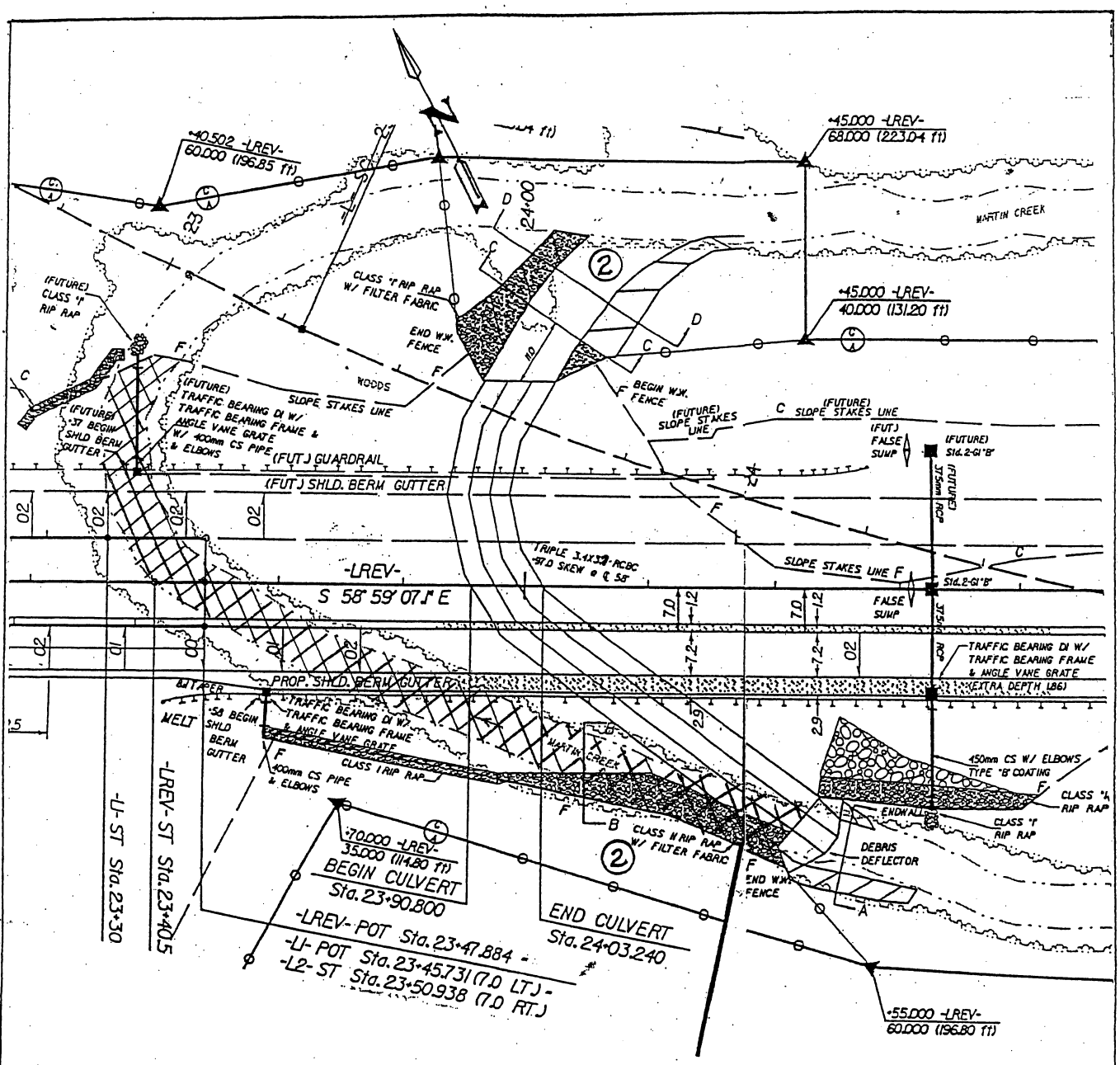
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16A OF 18

JUNE 1997



SITE No. 6

FILL IN SURFACE WATERS

SCALE

0 10 20m 40

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

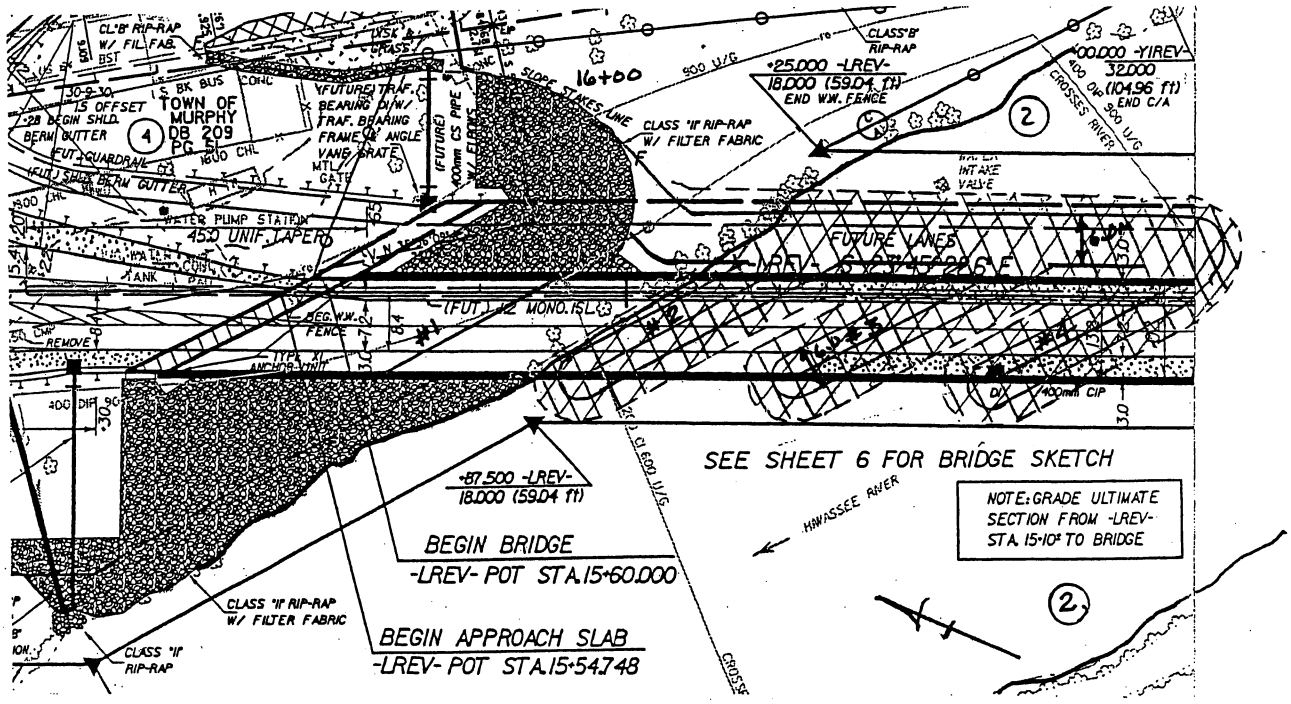
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 8 OF 18 JUNE 1997

PHASE I

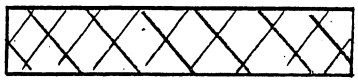


Construction Sequence

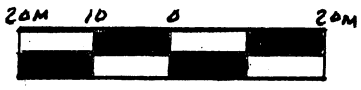
Phase I

1. Place Class II Rip Rap for construction of causeway.
2. Use course aggregrate surface as needed.
3. Build 6.0 meter wide causeway with 1.5:1 fill slopes.
4. Construct End Bent 1 and Bents 1,2, 3, and 4 during Phase I.
5. Install girders and bridge decks supported by the Bents.
6. Upon completion, remove construction causeway.

TEMPORARY CONSTRUCTION CAUSEWAY



DENOTES FILL IN SURFACE WATERS



Temporary Fill in Surface Waters = .20 ha.

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

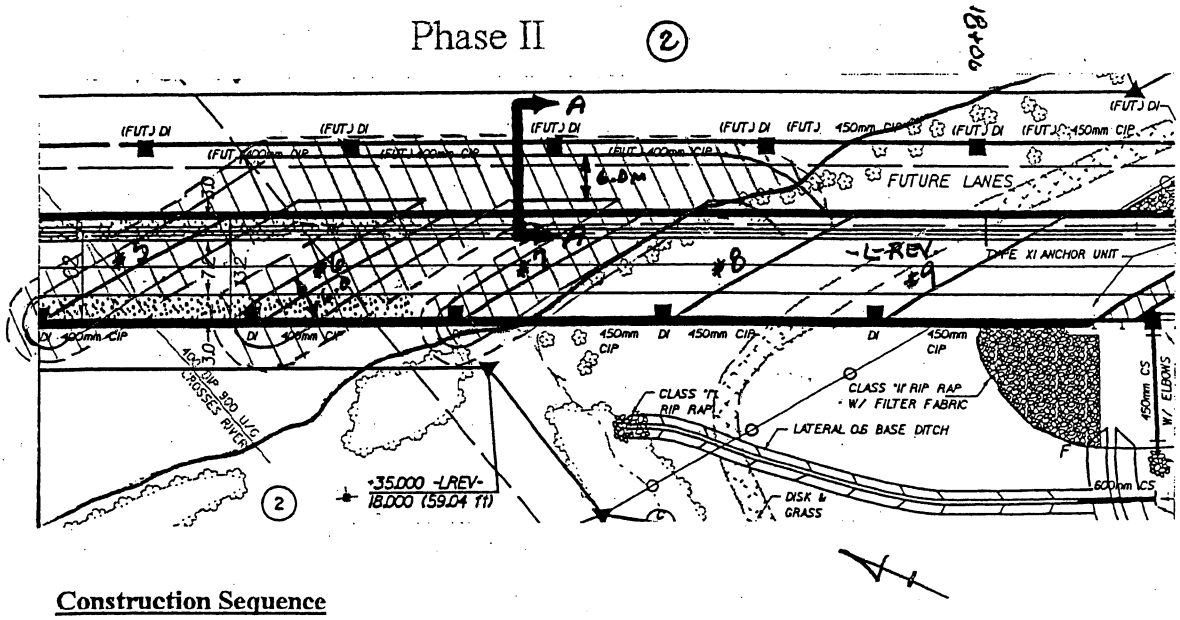
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16b OF 18 JUNE 1997

Phase II ②

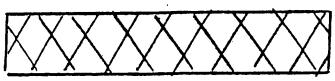


Construction Sequence

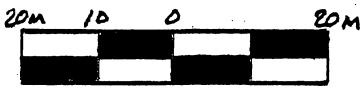
Phase II

1. Place Class II Rip Rap for construction of causeway.
2. Use course aggregate surface as needed.
3. Build 6.0 meter wide causeway with 1.5:1 fill slopes.
4. Construct End Bent 2 and Bents 5,6,7,8, and 9 during Phase II.
5. Install girders and bridge decks supported by the Bents.
6. Upon completion, remove construction causeway.

TEMPORARY CONSTRUCTION CAUSEWAY 1



DENOTES FILL IN SURFACE WATERS



Temporary Fill in Surface Waters = .19 ha.

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

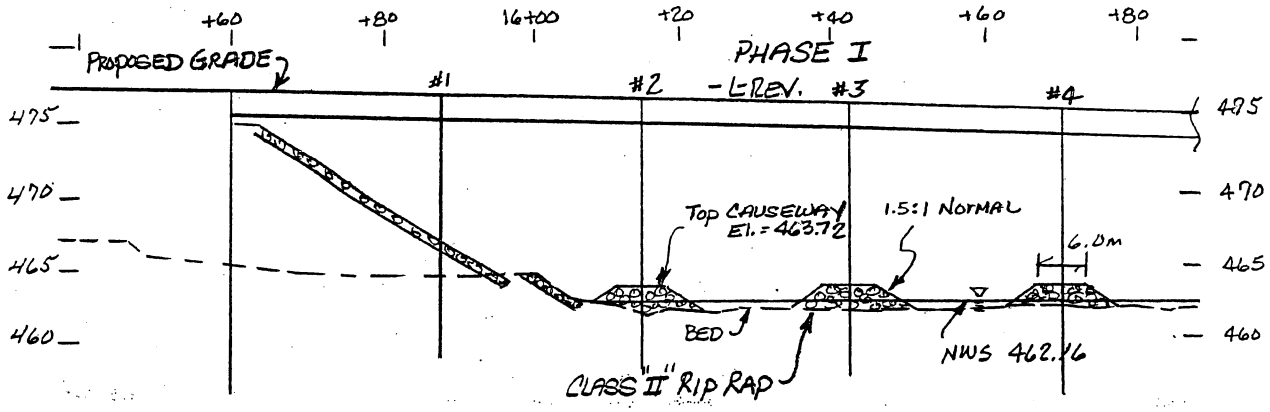
CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

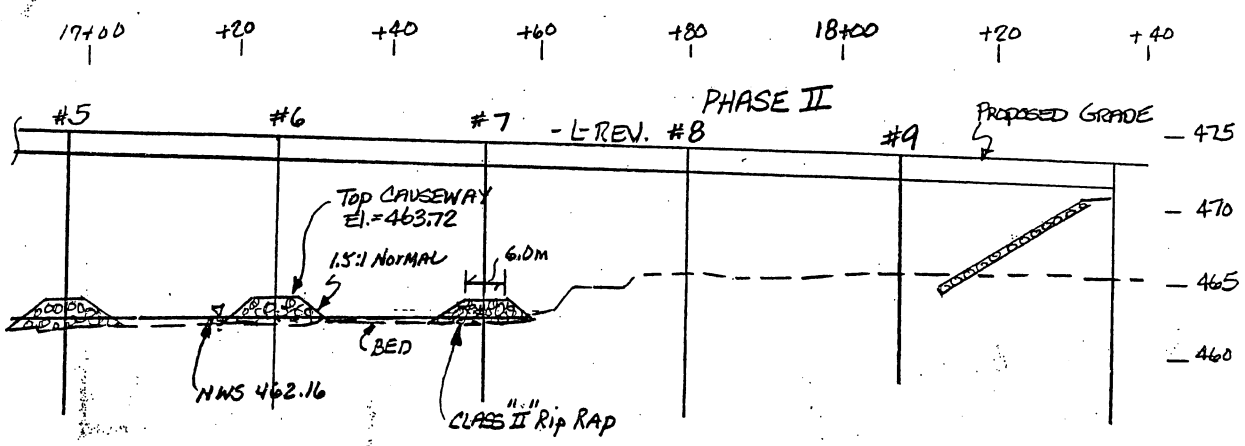
SCALE AS SHOWN

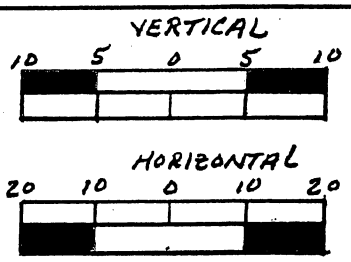
SHEET 16C OF 18 JUNE 1997

PHASE I



PHASE II





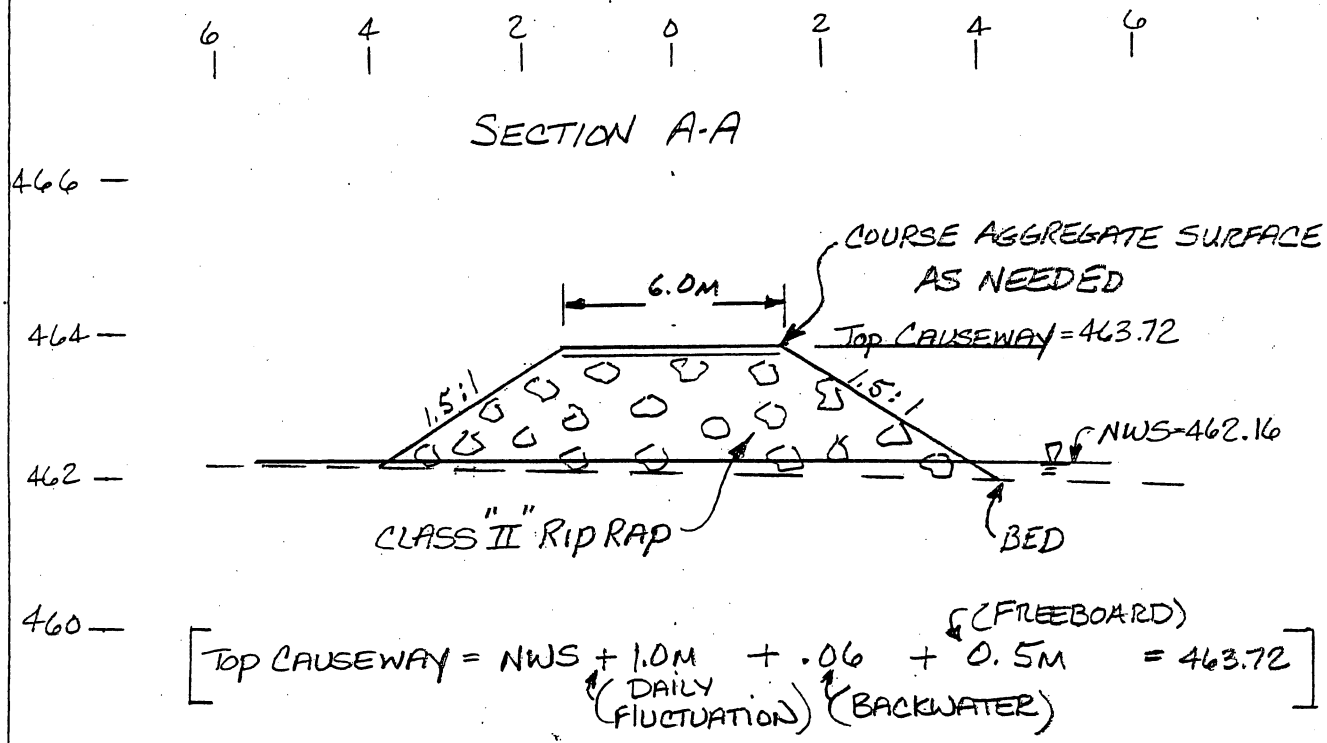
N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

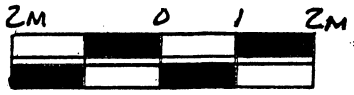
PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16d OF 18 JUNE 1997



[Top CAUSEWAY = NWS + 1.0M (DAILY FLUCTUATION) + .06 (BACKWATER) + 0.5M (FREEBOARD) = 463.72]



N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

PROPOSED US-64 RELOCATION FROM EXISTING US-19-74-129 IN MURPHY TO EAST OF NC-141 IN PEACHTREE

SCALE AS SHOWN

SHEET 16e OF 18 JUNE 1997

APPENDIX C

Sulfidic Rock Data and Special Provisions

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

Michael F. Easley
GOVERNOR

P.O. BOX 25201, RALEIGH, N.C. 27611-5201

Lyndo Tippett
SECRETARY

7 September, 2004

MEMO TO: Terry Hackett, The Catena Group

FROM: Jody C. Kuhne, PG, PE, Geotechnical Engineering

PROJECT: 34357.1.1, R-977A
COUNTY: Cherokee

DESC.: US 64 Bypass in Murphy

SUBJECT: NNP Sample locations

Sample #	Station	Offset
1	24+64	6.5 rt
2	24+70	16.5 rt
3	25+45	2.5 rt
4	24+70	16.5 rt
5	24+64	6.5 rt
6	16+53	1 lt
7	17+07	10 rt
8	16+47	10 rt
9	14+92	1 lt
10	15+52	1 lt
11	16+47	10 rt
12	14+86	10 rt
13	18+54	2 rt
14	16+47	10 rt
15	18+02	8 rt
16	18+54	2 rt
17	18+02	9 rt
18	18+47	9 rt
19	15+52	1 rt
20	18+47	9 rt

21	14+92	1 lt
22	15+46	10 rt
23	16+53	16 rt
24	17+47	10 rt
25	22+80	CL
26	20+00	150 rt

All offsets are in meters. Duplicate sample locations and offsets denote different sample depths in a core boring.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
MATERIALS & TESTS UNIT
P.O. BOX 25201 - RALEIGH, NORTH CAROLINA
August 18, 2004

TEST REPORT FOR: ROCK

TYPE OF MATERIAL: HARD ROCK
SAMPLE #: 1 – 26
PROJECT #: 34357.1.1
SAMPLED BY: J. Kuhne

DATE SAMPLED: 08/06 – 08/11 2004
RECEIVED: 08/11/04
COUNTY: CHEROKEE

TEST RESULTS

SAMPLE #	*SULFUR %*	*NEUTRAL POTENTIAL*	*ACID POTENTIAL*	*NET NEUTRAL POTENTIAL*
1	2.850	66.460	89.073	-22.613
2	0.487	52.743	15.221	37.521
3	0.361	49.950	11.275	38.675
4	0.289	24.564	9.020	15.544
5	0.704	2.370	21.986	-19.616
6	0.216	50.998	6.765	44.233
7	0.126	50.250	3.946	46.304
8	0.018	52.245	0.564	51.681
9	0.018	46.010	0.564	45.446
10	0.235	26.558	7.329	19.229
11	0.126	25.560	3.946	21.614
12	0.018	38.778	0.564	38.214
13	0.018	40.025	0.564	39.461
14	0.018	42.020	0.564	41.456
15	0.415	39.278	12.966	26.311
16	0.018	30.548	0.564	29.984
17	0.595	43.018	18.604	24.414
18	0.018	47.755	0.564	47.191
19	0.126	29.800	3.946	25.854
20	0.018	44.265	0.564	43.701
21	0.018	41.023	0.564	40.459
22	0.108	28.803	3.383	25.420
23	0.072	27.555	2.255	25.300
24	0.018	43.018	0.564	42.454
25	0.072	47.258	2.255	45.003
26	0.036	48.753	1.128	47.625

NET NEUTRALIZATION POTENTIAL (NNP) REPORTED IN TONS $CaCO_3$ PER 1000 TONS OF MATERIAL. **NNP VALUES LESS THAN NEGATIVE FIVE ARE CONSIDERED HARMFUL (HOT).*

SIGNED: _____

CHRISTOPHER A. PEOPLES
CHEMICAL TESTING ENGINEER

cc: W.D. FRYE/FILE

POTENTIAL ACID PRODUCING ROCK MATERIALS

Description

Work under this section consists of testing for and disposing of potential acid producing rock materials as directed by the Engineer. Acid producing rock contains sufficient amounts of certain minerals that may produce damaging acid levels in leachate when exposed to the atmosphere and weathering processes.

All fresh rock on this project has low potential for producing acid drainage. Acid potential in rock is measured as Net Neutralization Potential (NNP). Acidity levels in runoff is reflected in pH and sulfate content.

Testing and Monitoring Procedure

Testing and monitoring consists of weekly water sampling by Contractor's independent agent, to be approved by the Engineer. Monitoring consists of testing runoff from approved temporary and permanent erosion control basins as shown in the Plans. Testing must be conducted by an accredited lab facility and must consist of reported values of pH, acidity, alkalinity and sulfate content. Measure values for pH at the sampling sites and record immediately. Report pH results to the Engineer within 24 hours of measuring. Report lab results to the Engineer within 7 days of sampling.

NCDOT Geotechnical Engineering Unit will concurrently test existing streams for the same values on a monthly basis with results available through the Engineer.

Testing Values and Results

If reported pH values are below 6.0, the Engineer will select a Mitigation Plan within 72 hours from receiving results. Mitigation Plans will consist of any of the courses of action listed under "Mitigation Plans" with payment according to the line item under "Basis of Payment".

Mitigation Plan

Possible mitigation methods for acid producing rock consists of:

1) Select placement and treatment of excavated material in a location to be approved by the Engineer.
2) Treatment of excavated material in embankment or waste area.
3) Cover treated material with soil backfill meeting AASHTO requirements A-2-4, A-4, A-6 or A-7.

At the direction of the Engineer, temporarily mitigate by treatment with lime and covering with high-density polyethylene (HDPE) sheeting at the excavation site while awaiting transport to the disposal site.

Treatment consists of layering excavated material lifts with crushed limestone aggregate and/or agricultural grade ground limestone at a spread rate recommended by the Geotechnical Engineering Unit based on NNP values of the rock material. The Geotechnical Engineering Unit and Materials and Tests Unit of NCDOT will conduct sampling and testing for NNP.

Basis of Payment

Payment will be made under:

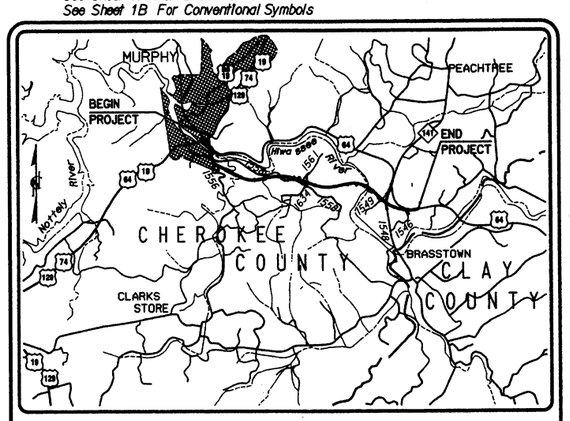
Crushed Limestone Aggregate	Metric Ton
Agricultural Grade Ground Limestone	Metric Ton
High Density Polyethylene Sheeting	Square Meter
Soil backfill	Cubic Meter

Excavation and placement of rock is considered incidental to work performed for the treatment process and is considered "Unclassified Excavation."

TIP PROJECT: R-977A

CONTRACT:

See Sheet 1A For Index of Sheets
See Sheet 1B For Conventional Symbols



VICINITY MAP

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CHEROKEE COUNTY

LOCATION: US 64, FROM US 19–74–129 IN MURPHY TO EAST OF NC 141 IN PEACHTREE

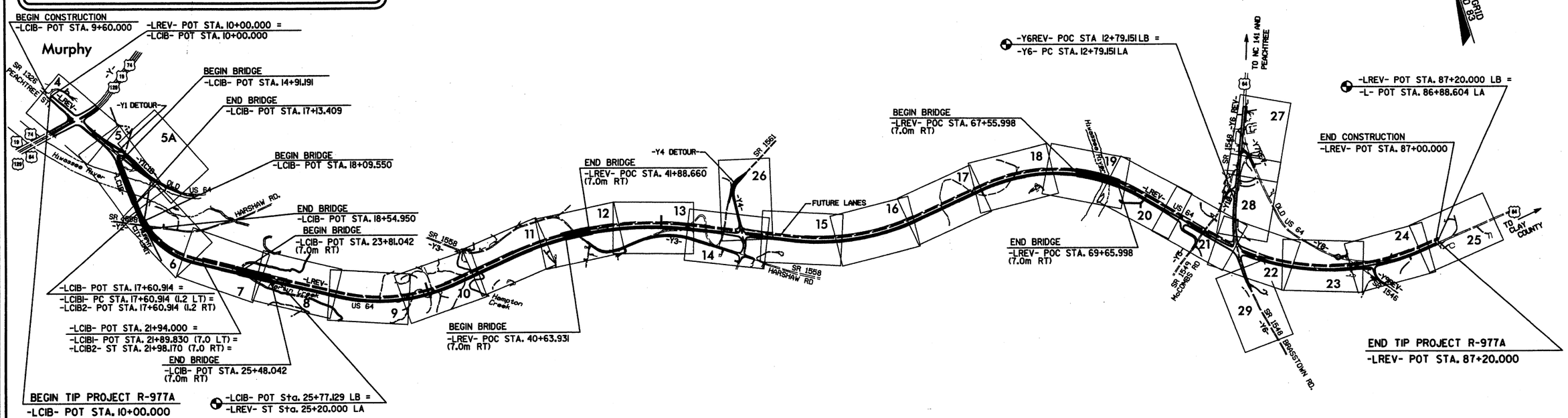
TYPE OF WORK: GRADING, DRAINAGE, PAVING, GUARDRAIL, LONGLIFE PAVEMENT MARKINGS & SNOWPLOWABLE MARKERS, SIGNALS, STRUCTURES AND CULVERTS

ALL DIMENSIONS IN THESE PLANS ARE IN METERS AND /OR MILLIMETERS UNLESS OTHERWISE NOTED

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-977A	1	

STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION
34357.1.1	FR-14-1(1)	P.E.
34357.2.1	STP-64(21)	P.E., R.W. & UTIL.

FINAL FIELD INSPECTION SUBMITTAL



NOTE: THIS IS A PARTIAL CONTROLLED–ACCESS PROJECT WITH ACCESS BEING LIMITED TO POINTS SHOWN ON PLANS.

NOTE: CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III.

GRAPHIC RATIO

5 m 0 10 m
PLANS

5 m 0 10 m
PROFILE (HORIZONTAL)

1 m 0 2 m
PROFILE (VERTICAL)

DESIGN DATA

ADT 2004 = 6900 – 9900
ADT 2024 = 11900 – 17200
DHV = 11%
D = 60%
T = 4% (1% TTST+3% DUALS)
V = 80 km/h (–LC1B–)
V = 100 km/h (–LREV–)

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT R-977A	=	6.951 km
LENGTH STRUCTURE TIP PROJECT R-977A	=	0.769 km
TOTAL LENGTH TIP PROJECT R-977A	=	7.720 km

Prepared In the Office of:
LOCHNER
H. W. LOCHNER, INC.
2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612
FOR THE NORTH CAROLINA DIVISION OF HIGHWAYS

2002 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:
September 23, 2003

LETTING DATE:
December 21, 2004

Stephen C. Browde, P.E.
PROJECT ENGINEER

Thomas A. McCloskey, P.E.
PROJECT DESIGN ENGINEER

N.C.D.O.T. CONTACT:
Cathy Houser, P.E.
PROJECT ENGINEER – DESIGN SERVICES

HYDRAULICS ENGINEER

SIGNATURE: *P.E.*

ROADWAY DESIGN

SIGNATURE: *P.E.*

DIVISION OF HIGHWAYS
STATE OF NORTH CAROLINA

P.E.
STATE HIGHWAY ENGINEER – DESIGN

DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED FOR
DIVISION ADMINISTRATOR *DATE*

...\1594\Design\R0977_RDY_TSH.dgn 8/12/2004 7:55:27 AM

PROJ. REFERENCE NO.	SHEET NO.
R-977A	1-A

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

...\Design\R977_RDY_PSHEET1A.dgn 8/14/2004 1:31:29 PM

PROJ. REFERENCE NO.	SHEET NO.
R-977A	1-B

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

ROADS & RELATED ITEMS

Edge of Pavement
Curb
Prop. Slope Stakes Cut — C
Prop. Slope Stakes Fill — F
Prop. Woven Wire Fence
Prop. Chain Link Fence
Prop. Barbed Wire Fence
Prop. Wheelchair Ramp — WCR
Prop. Curb Cut for Future Wheelchair Ramp — CCFR
Exist. Guardrail
Prop. Guardrail
Equality Symbol
Pavement Removal

RIGHT OF WAY

Baseline Control Point
Existing Right of Way Marker
Exist. Right of Way Line w/Marker
Prop. Right of Way Line with Proposed R/W marker (Iron Pin & Cap)
Prop. Right of Way Line with Proposed (Concrete or Granite) R/W Marker
Exist. Control of Access Line — C
Prop. Control of Access Line — C
Exist. Easement Line — E
Prop. Temp. Construction Easement Line — E
Prop. Temp. Drainage Easement Line — TDE
Prop. Perm. Drainage Easement Line — PDE

HYDROLOGY

Stream or Body of Water
Flow Arrow
Disappearing Stream
Spring
Swamp Marsh
Shoreline
Falls, Rapids
Prop Lateral, Tail, Head Ditches — FLOW

STRUCTURES

MAJOR
Bridge, Tunnel, or Box Culvert — CONC
Bridge Wing Wall, Head Wall and End Wall — CONC WW

MINOR
Head & End Wall — CONC HW
Pipe Culvert
Footbridge
Drainage Boxes — CB
Paved Ditch Gutter

UTILITIES

Exist. Pole
Exist. Power Pole
Prop. Power Pole
Exist. Telephone Pole
Prop. Telephone Pole
Exist. Joint Use Pole
Prop. Joint Use Pole
Telephone Pedestal — T
Cable TV Pedestal — C
Hydrant
Satellite Dish
Exist. Water Valve
Sewer Clean Out
Power Manhole — P
Telephone Booth
Water Manhole — W
Light Pole
H-Frame Pole
Power Line Tower
Pole with Base
Gas Valve
Gas Meter
Telephone Manhole — T
Power Transformer
Sanitary Sewer Manhole
Storm Sewer Manhole — S
Tank; Water, Gas, Oil
Water Tank With Legs
Traffic Signal Junction Box — S
Fiber Optic Splice Box — F
Television or Radio Tower

Utility Power Line Connects to Traffic Signal Lines Cut Into the Pavement — TS TS
Water Line — W W
Sanitary Sewer — SS SS
Sanitary Sewer Force Main — FSS FSS
Gas Line — G G
Storm Sewer — S S
Power Line — P P
Telephone Cable — T T
U/G Telephone Conduit — TC TC
Unknown Utility — ?UTL ?UTL
Television Cable — TV TV
Fiber Optics Cable — FO FO
Exist. Water Meter — 0
Drawn According to U/G Records — DATUR
Abandoned According to U/G Records — AATUR
End Of Information — E.O.I.

BOUNDARIES & PROPERTIES

State Line
County Line
Township Line
City Line
Reservation Line
Property Line
Property Line Symbol — PL
Exist. Iron Pin — EIP
Property Corner
Property Monument — ECM
Property Number — 123
Parcel Number — 6
Fence Line — WW & ISBW
Existing Wetland Boundaries — WLB
Proposed Wetland Boundaries — WLB
Existing Endangered Animal Boundaries — EAB
Existing Endangered Plant Boundaries — EPB

BUILDINGS & OTHER CULTURE

Buildings
Foundations
Area Outline
Gate
Gas Pump Vent or U/G Tank Cap
Church
School
Park
Cemetery
Dam
Sign
Well — W
Small Mine
Swimming Pool

TOPOGRAPHY

Loose Surface
Hard Surface
Change in Road Surface
Curb
Right of Way Symbol — R/W
Guard Post — GP
Paved Walk
Bridge
Box Culvert or Tunnel
Ferry
Culvert
Footbridge
Trail, Footpath
Light House

VEGETATION

Single Tree
Single Shrub
Hedge
Woods Line
Orchard
Vineyard — VINEYARD

RAILROADS

Standard Gauge — CSX TRANSPORTATION
RR Signal Milepost — MILEPOST 35
Switch — SWITCH

revised 03/26/97

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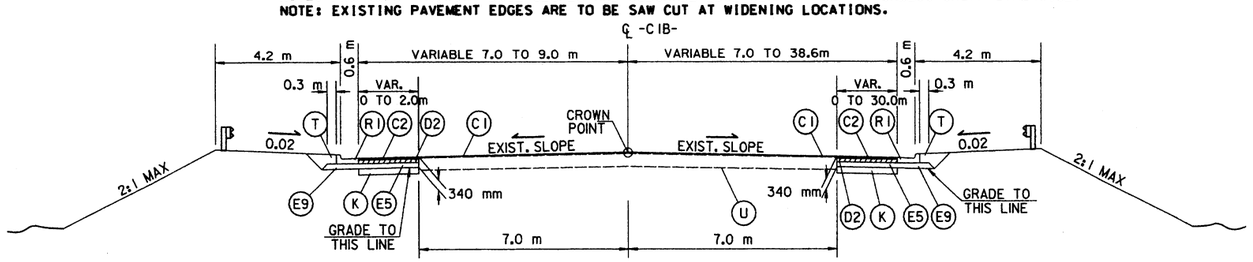
PROJECT REFERENCE NO.	SHEET NO.
R-977A	2
ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER
CONST.REV.	
R/W REV.	

PAVEMENT SCHEDULE

C1	PROP. APPROX. 30 MM ASPH. CONC. SURFACE COURSE. TYPE SP9.5B. AT AN AVERAGE RATE OF 72 KG. PER SQ. METER.
C2	PROP. APPROX. 60 MM ASPH. CONC. SURFACE COURSE. TYPE SP9.5B. AT AN AVERAGE RATE OF 72 KG PER SQ. METER IN EACH OF TWO LAYERS.
C3	PROP. VAR. DEPTH ASPH. CONC. SURFACE COURSE. TYPE SP9.5B. AT AN AVERAGE RATE OF 2.4 KG PER SQ. METER PER 1 MM DEPTH TO BE PLACED IN LAYERS NOT LESS THAN 30 MM OR GREATER THAN 50 MM IN DEPTH.
D1	PROP. APPROX. 60 MM ASPH. CONC. BINDER COURSE. TYPE I19.0B. AT AN AVERAGE RATE OF 144 KG PER SQ. METER.
D2	PROP. APPROX. 120 MM ASPH. CONC. BINDER COURSE. TYPE I19.0B. AT AN AVERAGE RATE OF 144 KG PER SQ. METER IN EACH OF TWO LAYERS.
D3	PROP. VAR. DEPTH ASPH. CONC. BINDER COURSE. TYPE I19.0B. AT AN AVERAGE RATE OF 2.45 KG PER SQ. METER PER 1 MM DEPTH TO BE PLACED IN LAYERS NOT LESS THAN 50 MM OR GREATER THAN 90 MM IN DEPTH.
D4	PROP. APPROX. 80 MM ASPH. CONC. BINDER COURSE. TYPE I19.0B. AT AN AVERAGE RATE OF 144 KG PER SQ. METER.
D5	PROP. APPROX. 90 MM ASPH. CONC. BINDER COURSE. TYPE I19.0B. AT AN AVERAGE RATE OF 144 KG PER SQ. METER.
E1	PROP. APPROX. 80 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 188 KG PER SQ. METER.
E2	PROP. APPROX. 100 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 235 KG PER SQ. METER.
E3	PROP. APPROX. 120 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 282 KG PER SQ. METER.
E4	PROP. APPROX. 150 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 176.25 KG PER SQ. METER IN EACH OF TWO LAYERS.
E5	PROP. APPROX. 160 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 188 KG PER SQ. METER IN EACH OF TWO LAYERS.
E6	PROP. APPROX. 200 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 235 KG PER SQ. METER IN EACH OF TWO LAYERS.
E7	PROP. APPROX. 220 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 258.5 KG PER SQ. METER IN EACH OF TWO LAYERS.
E8	PROP. APPROX. 260 MM ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 305.5 KG PER SQ. METER IN EACH OF TWO LAYERS.
E9	PROP. VAR. DEPTH ASPH. CONC. BASE COURSE. TYPE B25.0. AT AN AVERAGE RATE OF 2.45 KG PER SQ. METER PER 1 MM DEPTH. TO BE PLACED IN LAYERS NOT GREATER THAN 140 MM IN DEPTH OR LESS THAN 80 MM IN DEPTH.
J1	PROP. 150 MM AGGREGATE BASE COURSE.
J2	PROP. 200 MM AGGREGATE BASE COURSE.
J3	PROP. 250 MM AGGREGATE BASE COURSE.
J4	PROP. VARIABLE DEPTH AGGREGATE BASE COURSE.
K***	SUBBASE TO BE TREATED WITH LIME TO A DEPTH OF 200 MM. AT A RATE OF 11 KG PER SQ. METER AS DRECTED BY THE ENGINEER. OR SUBBASE TO BE TREATED WITH CEMENT TO A DEPTH OF 180 MM. AT A RATE OF 30 KG PER SQ. METER AS DIRECTED BY THE ENGINEER. OR SUBGRADE TO BE TREATED WITH AGGREGATE A RATE OF 135 KG PER SQ. METER AND CEMENT AT A RATE OF 30 KG PER SQ. METER TO A DEPTH OF 180 MM AS DIRECTED BY THE ENGINEER.
P1	PRIME COAT AT THE RATE OF 1.6 L PER SQ. METER.
R1	750 MM CONCRETE CURB AND GUTTER.
R2	SHOULDER BERM GUTTER.
R3	125 MM MONOLITHIC CONCRETE ISLAND (FUTURE).
T	EARTH MATERIAL.
U	EXISTING PAVEMENT.
W	VARIABLE DEPTH ASPHALT PAVEMENT. (SEE STANDARD WEDGING DETAILS ON SHEET 2-G).

*** THE FOLLOWING WIDTHS SHALL BE USED FOR STABILIZATION:
(1) WIDTH IN CURB & GUTTER SECTIONS - EDGE OF PAVEMENT TO EDGE OF PAVEMENT.
(2) WIDTH IN SHOULDER SECTIONS - 0.3 M OUTSIDE THE TOP EDGES OF THE MAIN PAVEMENT STRUCTURE.

NOTE: PROPOSED PAVEMENT EDGE SLOPES AND SUBGRADE EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.
NOTE: EXISTING PAVEMENT EDGES ARE TO BE SAW CUT AT WIDENING LOCATIONS.



TYPICAL SECTION NO. 1

USE TYPICAL SECTION NO. 1 AS FOLLOWS:
-LC IB- STA 10+00.000 TO 11+62.100

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

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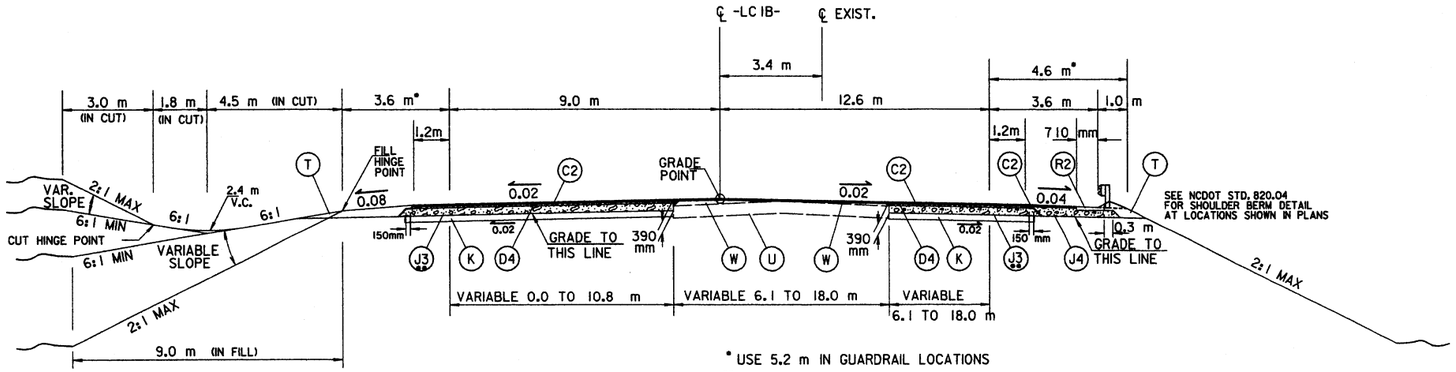
PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-A
ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER

CONST. REV.

R/W REV.



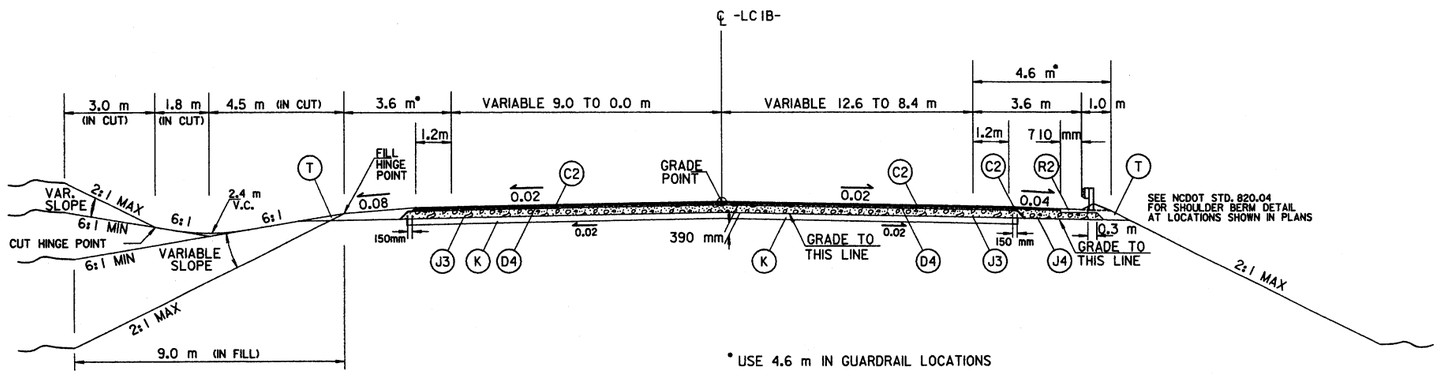
* USE 5.2 m IN GUARDRAIL LOCATIONS

** FOR WIDENING LESS THAN 1.8m, USE E7 IN LIEU OF J3.

USE TYPICAL SECTION NO. 2 AS FOLLOWS:

-LC IB- STA 12+00.000 TO 12+60.000

TYPICAL SECTION NO. 2

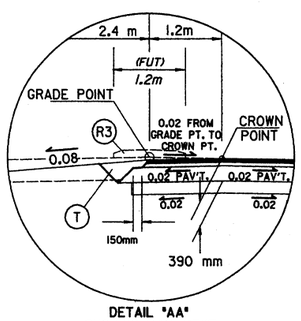


* USE 4.6 m IN GUARDRAIL LOCATIONS

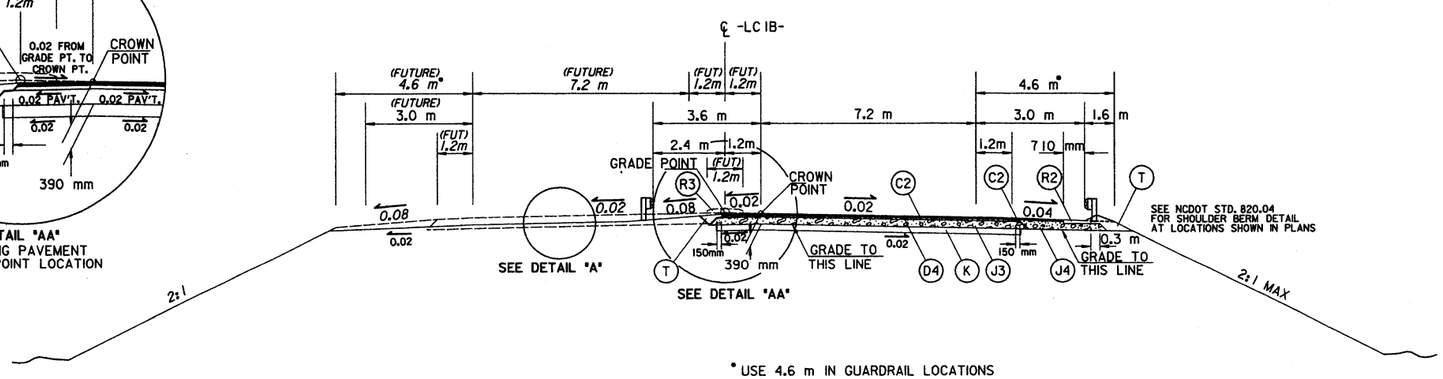
USE TYPICAL SECTION NO. 3 AS FOLLOWS:

-LC IB- STA 12+60.000 TO 14+92.478

TYPICAL SECTION NO. 3



DETAIL "AA"
SHOWING PAVEMENT CROWN POINT LOCATION

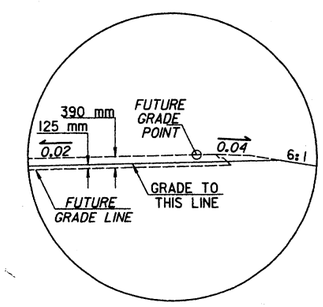


* USE 4.6 m IN GUARDRAIL LOCATIONS

USE TYPICAL SECTION NO. 4 AS FOLLOWS:

-LC IB- STA 17+12.082 TO 17+60.914

TYPICAL SECTION NO. 4



USE DETAIL "A" AS FOLLOWS:

-LC IB- AT LOCATIONS LABELED ON PLANS (WHEN GRADING FOR FUTURE LANES OF ULTIMATE SECTION)

C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING

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

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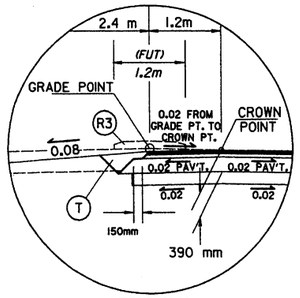
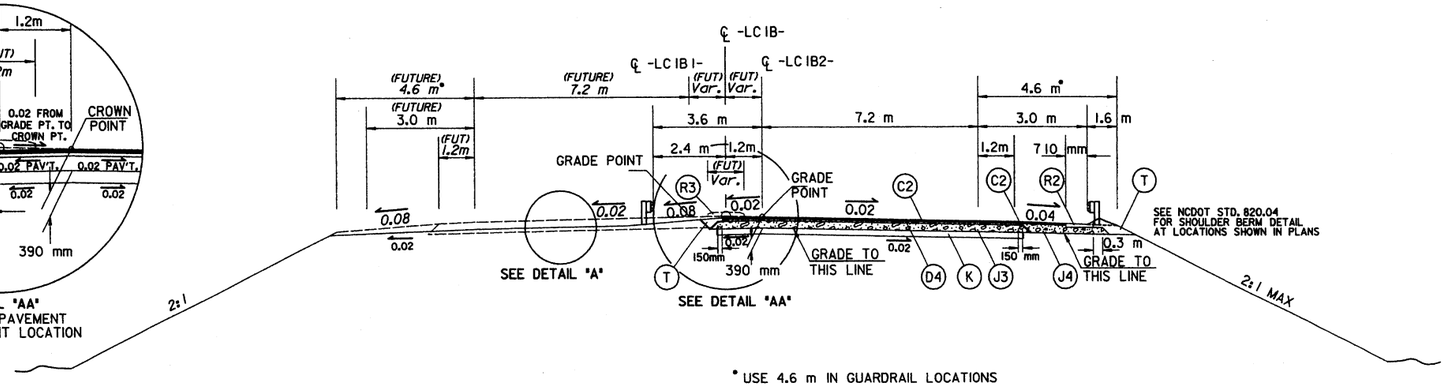
C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING

PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-B
ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER
CONST. REV.	
R/W REV.	



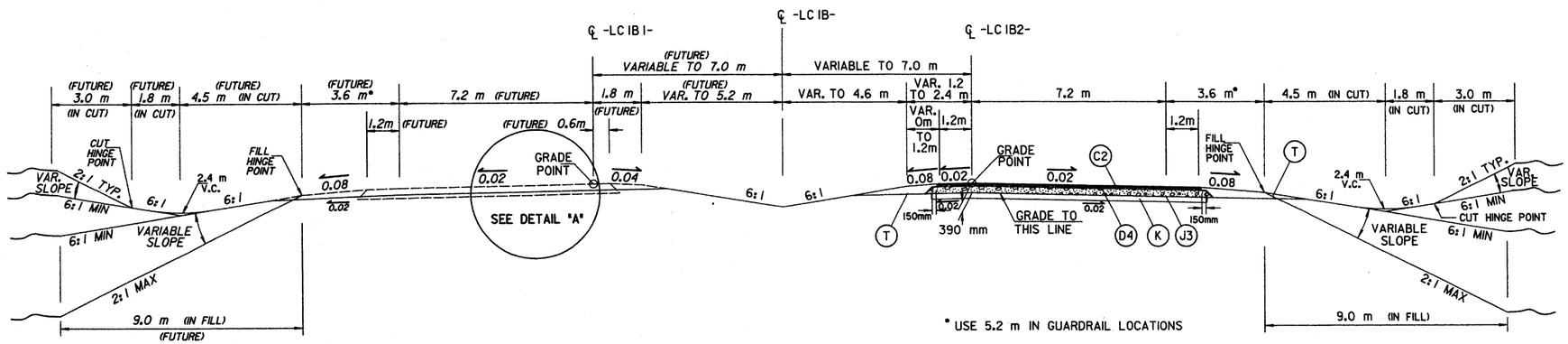
DETAIL "AA"
SHOWING PAVEMENT CROWN POINT LOCATION



* USE 4.6 m IN GUARDRAIL LOCATIONS

TYPICAL SECTION NO. 5

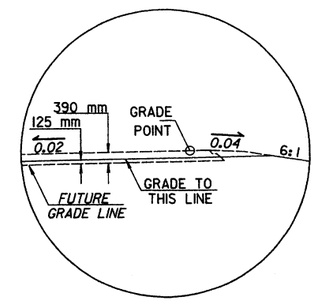
USE TYPICAL SECTION NO. 5 AS FOLLOWS:
-LC IB- STA 17+60.914 TO 18+12.763
-LC IB1- STA 17+01.488 TO 18+14.200
-LC IB2- STA 17+01.488 TO 18+11.483



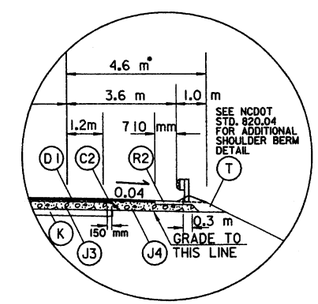
* USE 5.2 m IN GUARDRAIL LOCATIONS

TYPICAL SECTION NO. 6

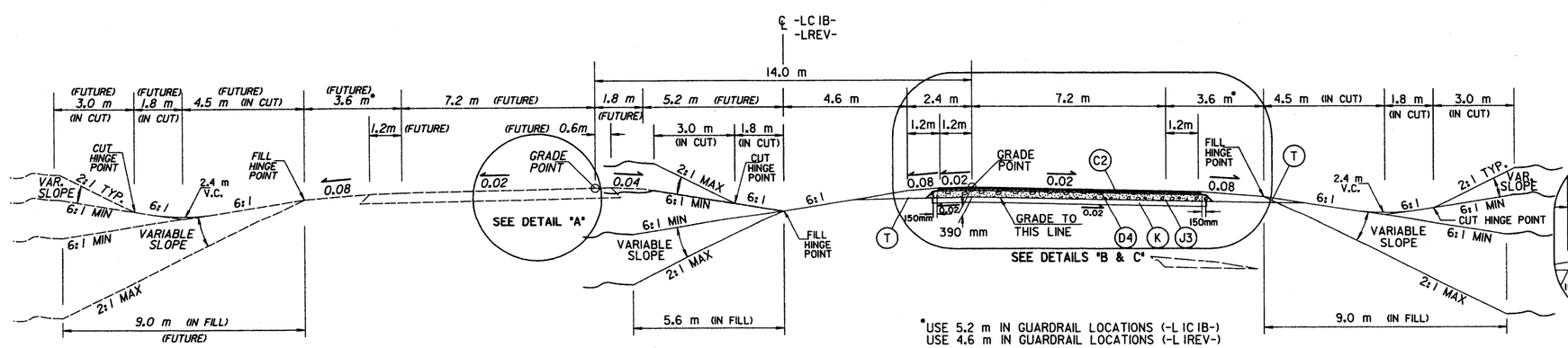
USE TYPICAL SECTION NO. 6 AS FOLLOWS:
-LC IB- STA 18+54.835 TO 22+23.716
-LC IB1- STA 18+52.778 TO 22+19.546
-LC IB2- STA 18+57.162 TO 22+27.886



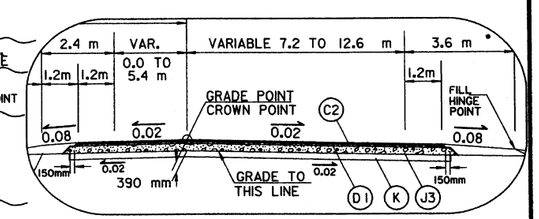
USE DETAIL "A" AS FOLLOWS:
-LC IB- AT LOCATIONS LABELED ON PLANS
(WHEN GRADING FOR FUTURE LANES OF ULTIMATE SECTION)



USE DETAIL "B" AS FOLLOWS:
-LREV- AT SHOULDER BERM LOCATIONS AS LABELED ON PLANS



* USE 5.2 m IN GUARDRAIL LOCATIONS (-L IC IB-)
USE 4.6 m IN GUARDRAIL LOCATIONS (-L IREV-)



USE DETAIL "C" AS FOLLOWS:
-LREV- AT LOCATIONS OF TURN-LANES
(WIDEN AS SHOWN IN PLANS)

TYPICAL SECTION NO. 7

USE TYPICAL SECTION NO. 7 AS FOLLOWS:
-LC IB- STA 22+23.716 TO 23+77.202
-LC IB- STA 25+44.079TO 25+77.129
-LREV- STA 25+00.000 TO 40+63.811
-LREV- STA 41+83.936 TO 67+55.998
-LREV- STA 69+65.998 TO 84+30.000

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

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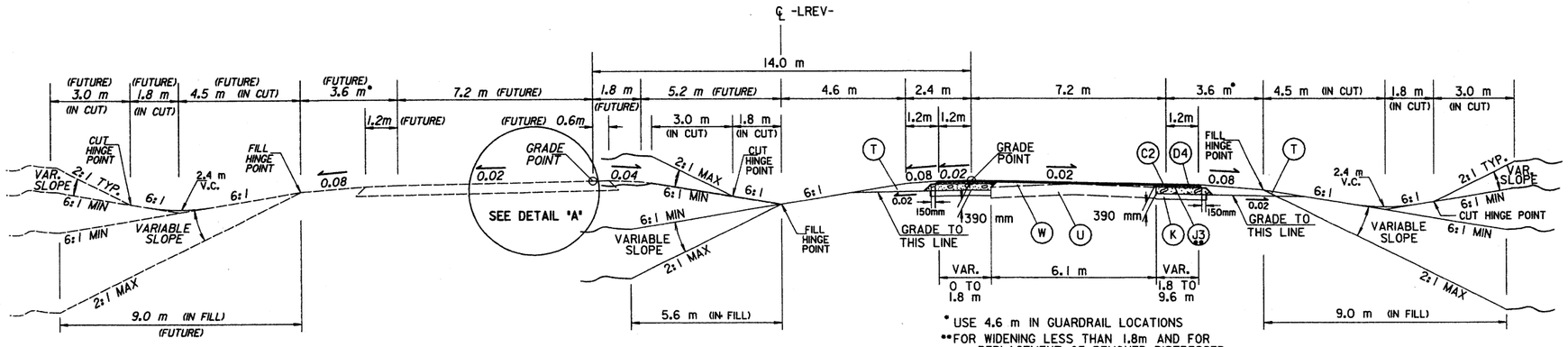
C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-C
ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER

CONST. REV.

R/W REV.



* USE 4.6 m IN GUARDRAIL LOCATIONS

**FOR WIDENING LESS THAN 1.8m AND FOR REPLACEMENT OF REMOVED DISTRESSED PAVEMENT, USE E7 IN LIEU OF J3.

TYPICAL SECTION NO. 8

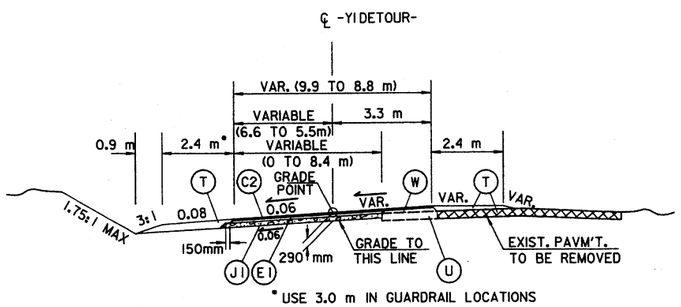
**LOCATIONS OF DISTRESSED PAVEMENT TO BE REPLACED

STATION	LANE	WIDTH
-LREV- 85+00± TO 86+30±	RIGHT	1± m
-LREV- 85+00± TO 85+30±	LEFT	1± m
-LREV- 85+70± TO 85+80±	LEFT	1± m
-LREV- 86+20± TO 86+30±	LEFT	1± m
-LREV- 86+30± TO 86+32±	LEFT	1± m
-LREV- 86+80± TO 86+82±	RIGHT	1± m
-LREV- 86+80± TO 87+00±	LEFT	1± m

USE TYPICAL SECTION NO. 8 AS FOLLOWS:

-LREV- STA 84+30.000 TO 86+62.000

TRANSITION TO EXISTING PAVEMENT:
-LREV- STA 86+62.000 TO 87+00.000



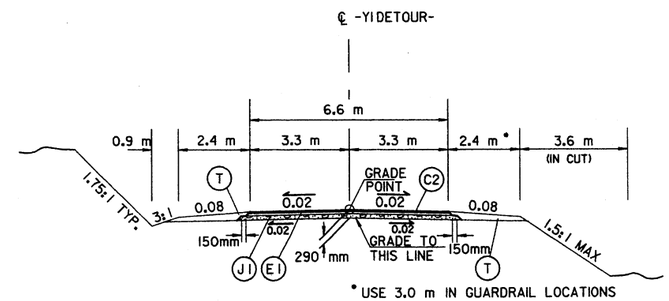
* USE 3.0 m IN GUARDRAIL LOCATIONS

TYPICAL SECTION NO. 9

USE TYPICAL SECTION NO. 9 AS FOLLOWS:

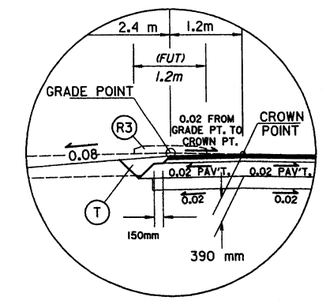
-Y1DETOUR- STA 12+34.000 TO 12+79.250
(WIDEN ON EXIST. PAVEMENT SLOPE ONLY)

-Y1DETOUR- STA 12+79.250 TO 13+00.000



* USE 3.0 m IN GUARDRAIL LOCATIONS

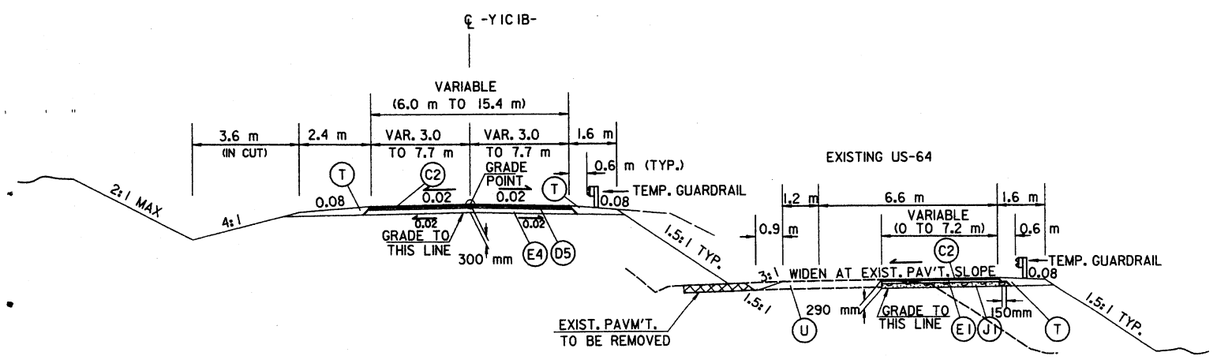
TYPICAL SECTION NO. 10



DETAIL "AA"
SHOWING PAVEMENT CROWN POINT LOCATION

USE TYPICAL SECTION NO. 10 AS FOLLOWS:

-Y1DETOUR- STA 13+00.000 TO 15+28.543

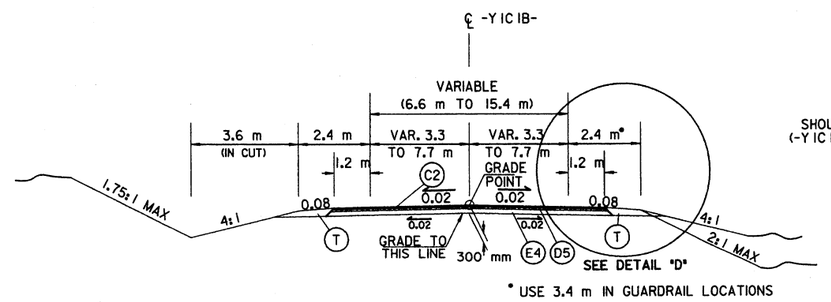


TYPICAL SECTION NO. 11

(SEE PLAN SHEET 30, CROSS-SECTIONS AND TRAFFIC CONTROL PLANS)

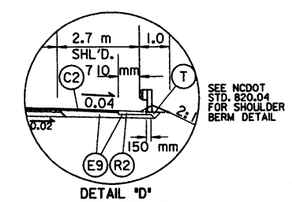
USE TYPICAL SECTION NO. 11 AS FOLLOWS:

TEMPORARY WIDENING OF EXISTING US-64
(RIGHT OF -Y1C1B- STA 10+92 TO 13+46.94)
(USE IN CONJUNCTION WITH TYPICAL SECTION NOS. 11 & 12)



* USE 3.4 m IN GUARDRAIL LOCATIONS

TYPICAL SECTION NO. 12



DETAIL "D"
TO BE USED AT SHOULDER BERM GUTTER LOCATIONS
(-Y1C1B- STA 9+79.181 TO 11+01 RT.)

USE TYPICAL SECTION NO. 12 AS FOLLOWS:

-Y1C1B- STA 9+90.670 TO 12+60.000

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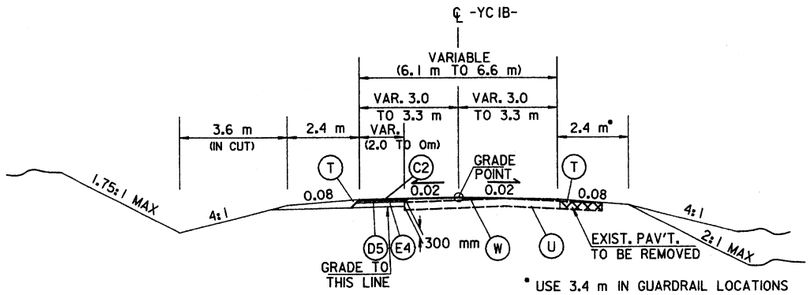
...\1594\Design\R977_RDY_TYP.dgn 8/12/2004 8:00:44 AM

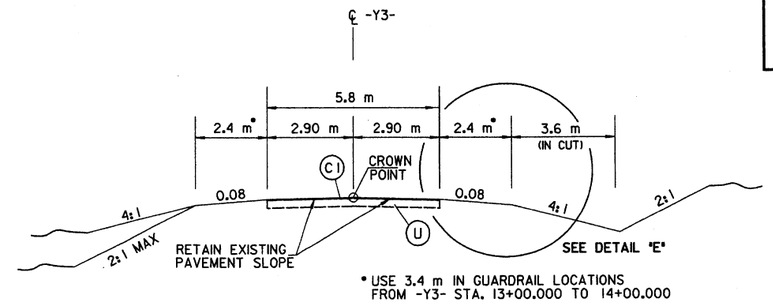
C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING

METRIC	PROJECT REFERENCE NO.	SHEET NO.
	R-977A	2-D
CONST. REV.	ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER
R/W REV.		



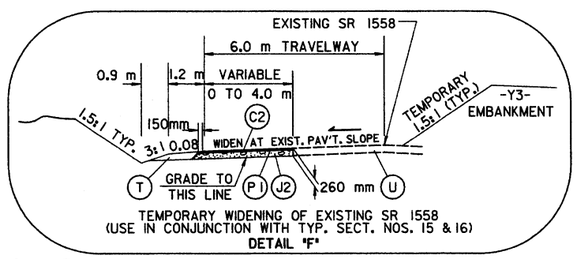
TYPICAL SECTION NO. 13

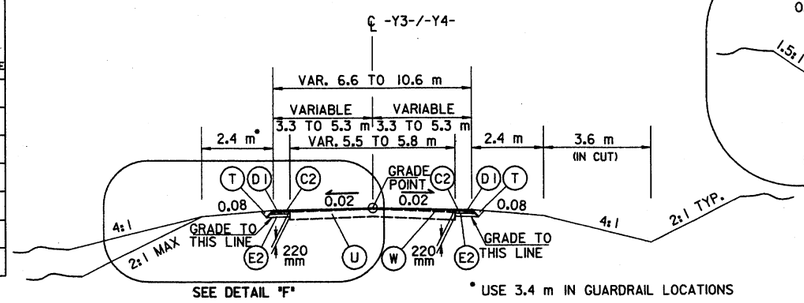
USE TYPICAL SECTION NO. 13 AS FOLLOWS:
-YIC IB- STA 12+60.000 TO 13+47.056



TYPICAL SECTION NO. 14

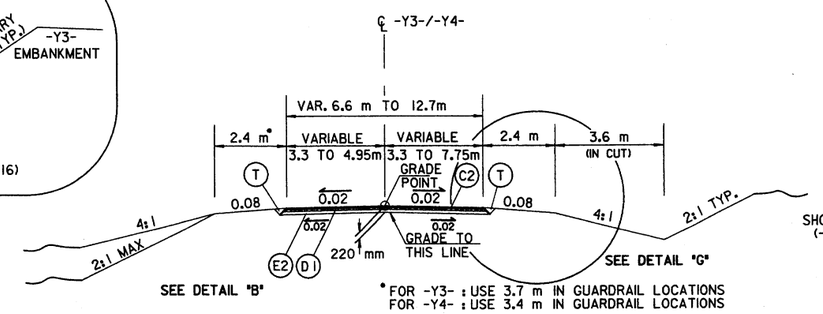
USE TYPICAL SECTION NO. 14 AS FOLLOWS:
-Y3- STA 11+90.000 TO 14+00.000

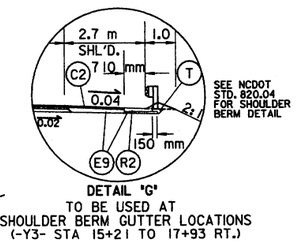




TYPICAL SECTION NO. 15

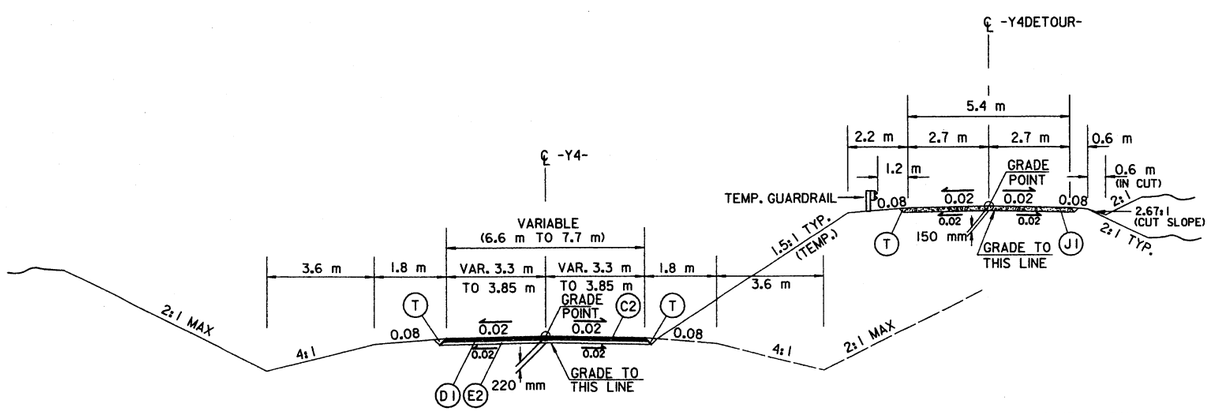
USE TYPICAL SECTION NO. 15 AS FOLLOWS:
-Y3- STA 14+00.000 TO 14+90.000
-Y3- STA 20+20.000 TO 20+83.000
-Y4- STA 14+06.000 TO 14+40.000





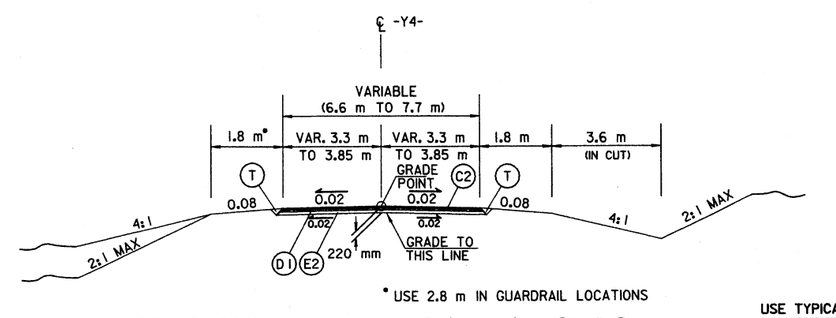
TYPICAL SECTION NO.16

USE TYPICAL SECTION NO. 16 AS FOLLOWS:
-Y3- STA 14+90.000 TO 20+20.000
-Y4- STA 13+38.900 TO 13+98.500



TYPICAL SECTION NO.17

USE TYPICAL SECTION NO. 17 AS FOLLOWS:
-Y4DETOUR- STA 9+55.000 TO 11+40.000



TYPICAL SECTION NO.18

USE TYPICAL SECTION NO. 18 AS FOLLOWS:
-Y4- STA 9+55.000 TO 12+40.000

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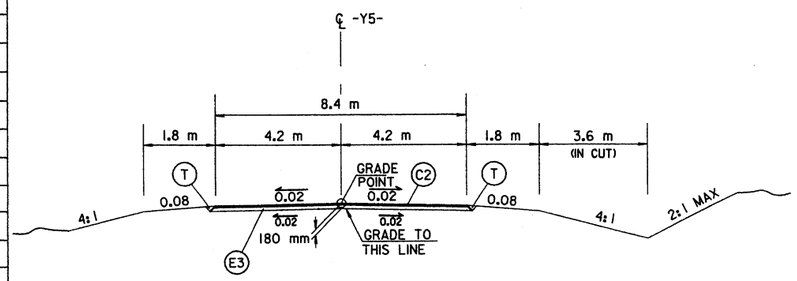
C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING

METRIC

CONST.REV.

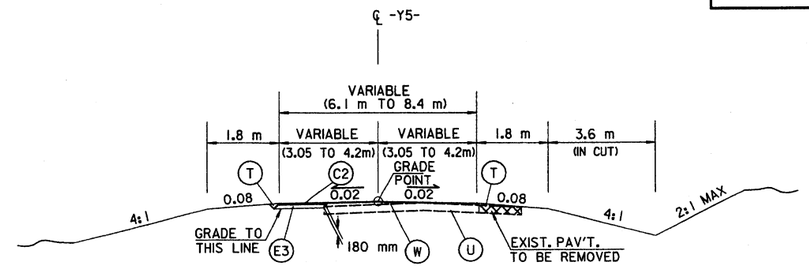
R/W REV.

PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-E
ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER



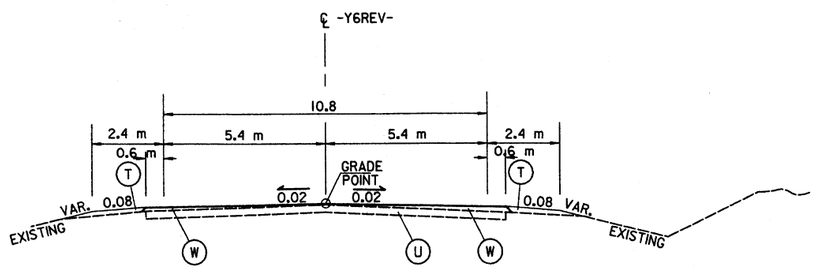
TYPICAL SECTION NO. 19

USE TYPICAL SECTION NO. 20 AS FOLLOWS:
-Y5- STA 12+69.700 TO 13+60.000



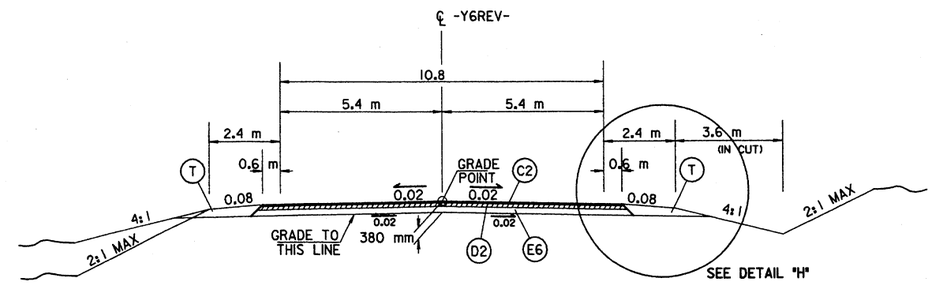
TYPICAL SECTION NO. 20

USE TYPICAL SECTION NO. 20 AS FOLLOWS:
-Y5- STA 13+60.000 TO 14+10.000



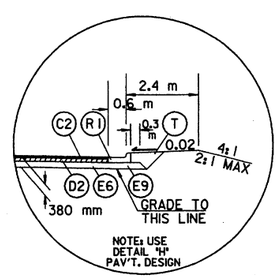
TYPICAL SECTION NO. 21

USE TYPICAL SECTION NO. 21 AS FOLLOWS:
-Y6REV- STA 7+97.444 TO 8+80.000

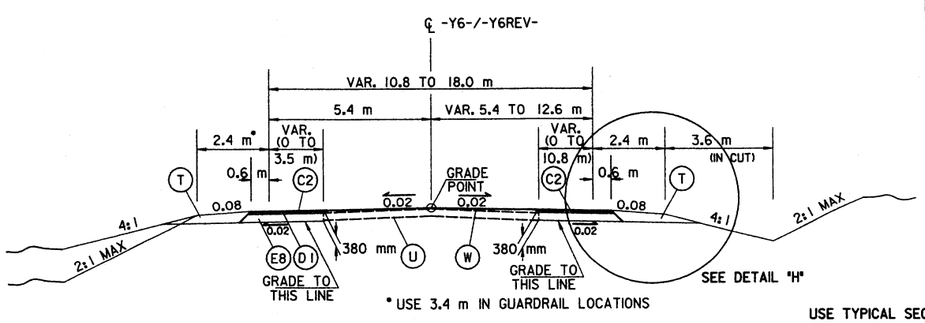


TYPICAL SECTION NO. 22

USE TYPICAL SECTION NO. 22 AS FOLLOWS:
-Y6REV- STA 9+63.000 TO 10+23.000

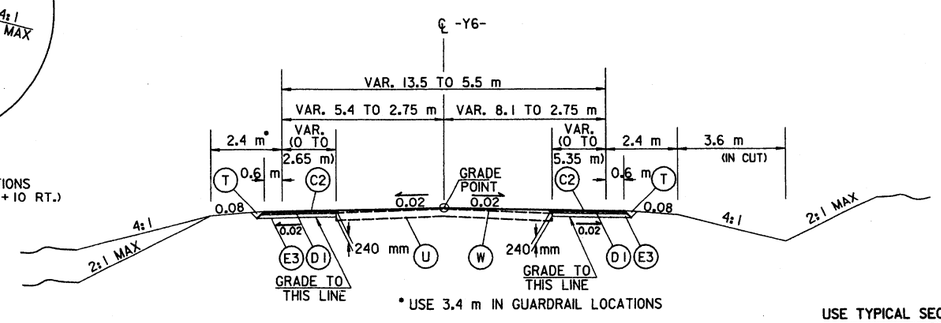


DETAIL "H"
TO BE USED AT
CURB & GUTTER LOCATIONS
(-Y6REV- STA 9+25 TO 11+10 RT.)



TYPICAL SECTION NO. 23

USE TYPICAL SECTION NO. 23 AS FOLLOWS:
-Y6REV- STA 8+80.000 TO 9+63.000
-Y6REV- STA 10+23.000 TO 12+79.151
-Y6- STA 12+79.151 TO 14+83.400



TYPICAL SECTION NO. 24

USE TYPICAL SECTION NO. 24 AS FOLLOWS:
-Y6- STA 15+90.800 TO 17+40.000

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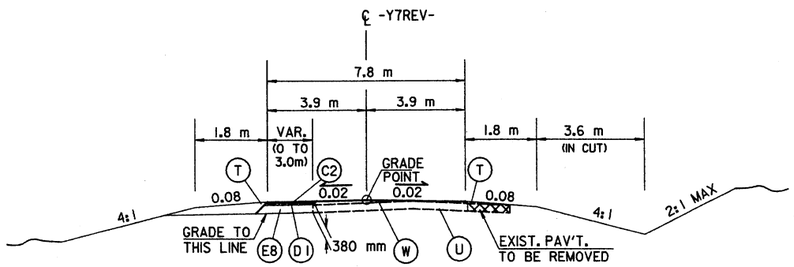
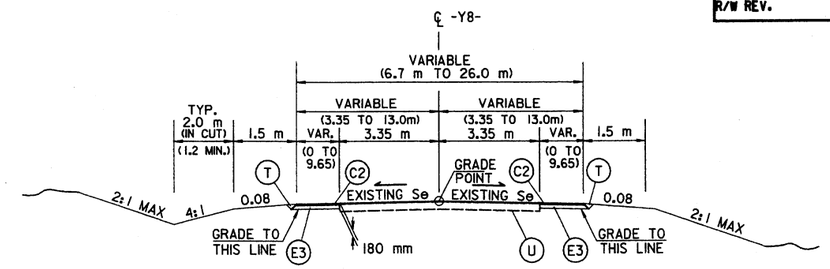
PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-F
ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER
CONST. REV.	
R/W REV.	



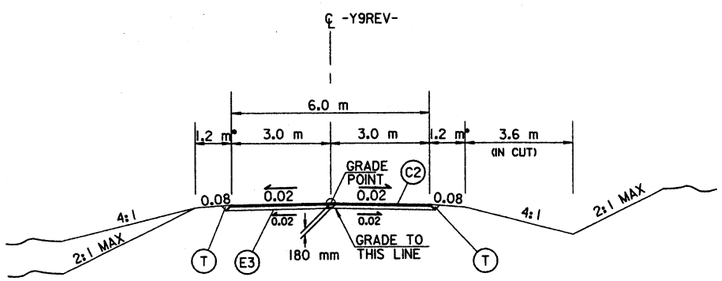
TYPICAL SECTION NO. 25

USE TYPICAL SECTION NO. 25 AS FOLLOWS:
-Y7REV- STA 75+76.600 TO 76+60.000



TYPICAL SECTION NO. 26

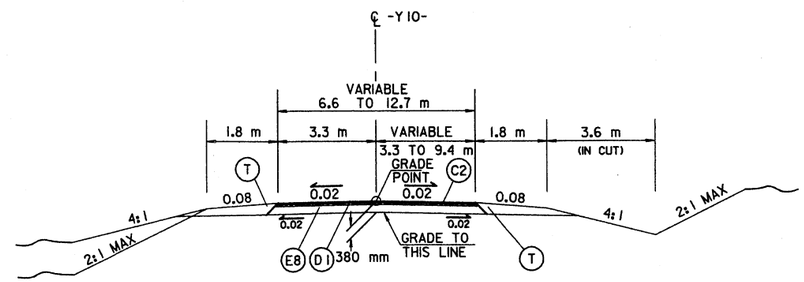
USE TYPICAL SECTION NO. 26 AS FOLLOWS:
-Y8- STA 10+19.000 TO 10+53.000



*USE 2.2 m IN GUARDRAIL LOCATIONS

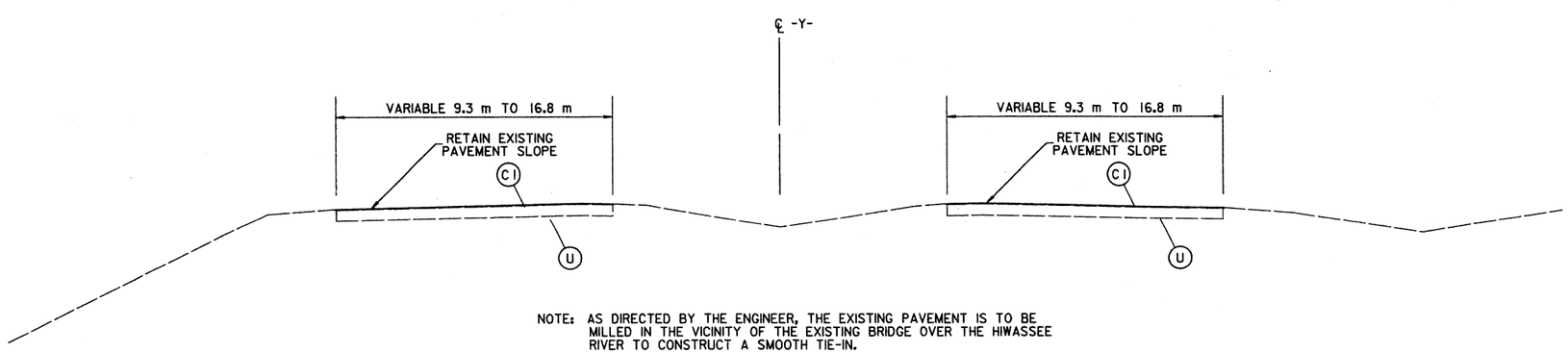
TYPICAL SECTION NO. 27

USE TYPICAL SECTION NO. 27 AS FOLLOWS:
-Y9REV- STA 10+42.100 TO 11+20.000
-Y9REV- STA 11+20.000 TO 11+35.000
(USE J1 FOR PAVEMENT DESIGN)



TYPICAL SECTION NO. 28

USE TYPICAL SECTION NO. 28 AS FOLLOWS:
-Y10- STA 9+90.000 TO 10+50.400



NOTE: AS DIRECTED BY THE ENGINEER, THE EXISTING PAVEMENT IS TO BE MILLED IN THE VICINITY OF THE EXISTING BRIDGE OVER THE HIWASSEE RIVER TO CONSTRUCT A SMOOTH TIE-IN.

TYPICAL SECTION NO. 29

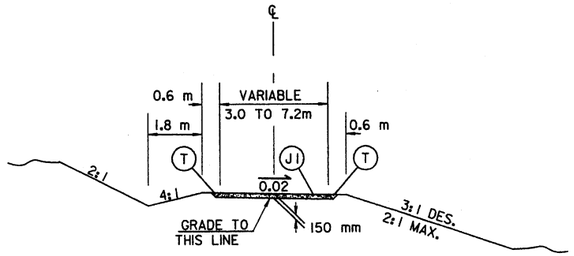
USE TYPICAL SECTION NO. 29 AS FOLLOWS:
-Y- STA 10+60.000 TO 13+30.000± (EXIST. BRIDGE)

C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING

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

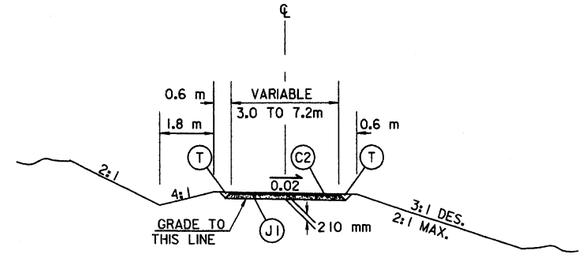
...\1564\Design\R977_RDY_TYP.dgn 8/12/2004 8:01:12 AM

METRIC	PROJECT REFERENCE NO.	SHEET NO.
	R-977A	2-G
CONST. REV.	ROADWAY DESIGN ENGINEER	STATE PAVEMENT DESIGN ENGINEER
R/W REV.		



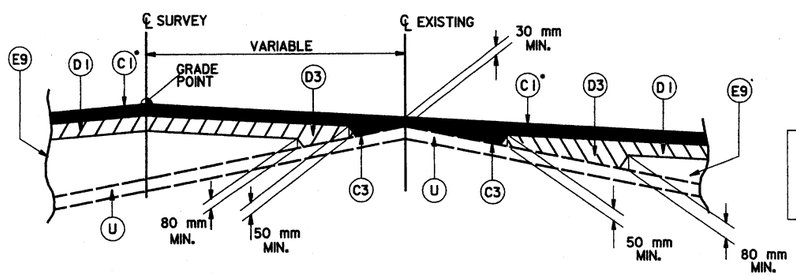
TYPICAL SECTION NO. 30

USE TYPICAL SECTION NO. 30 AS FOLLOWS:
STONE DRIVEWAYS



TYPICAL SECTION NO. 31

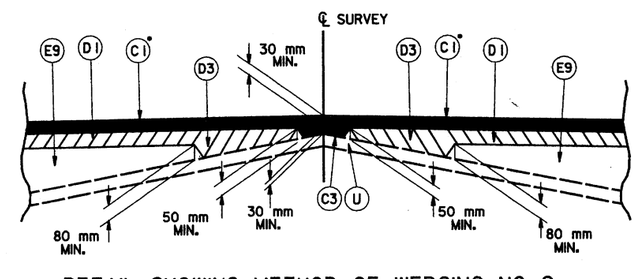
USE TYPICAL SECTION NO. 31 AS FOLLOWS:
PAVED DRIVEWAYS



DETAIL SHOWING METHOD OF WEDGING NO. 1

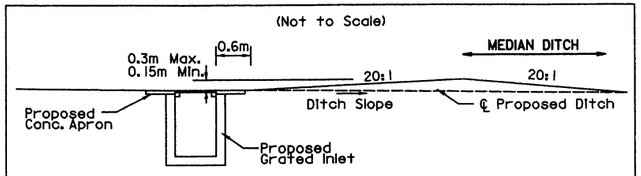
* FOR WEDGING DETAILS
USE C2 IN LIEU OF C1 AT THE FOLLOWING LOCATIONS:

-LC1B- STA. 12+00.000 TO 12+60.000
-LREV- STA. 84+30.000 TO 87+00.000

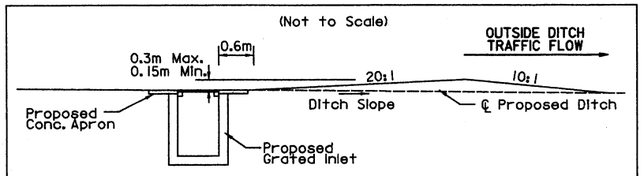


DETAIL SHOWING METHOD OF WEDGING NO. 2

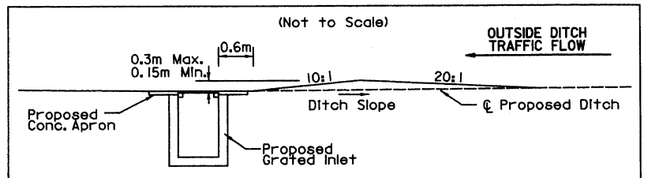
C1	30mm S9.5B
C2	60mm S9.5B
C3	VAR. S9.5B
D1	60mm I19.0B
D2	120mm I19.0B
D3	VAR. I19.0B
D4	80mm I19.0B
D5	90mm I19.0B
E1	80mm B25.0
E2	100mm B25.0
E3	120mm B25.0
E4	150mm B25.0
E5	160mm B25.0
E6	200mm B25.0
E7	220mm B25.0
E8	260mm B25.0
E9	VAR. B25.0
J1	150mm ABC
J2	200mm ABC
J3	250mm ABC
J4	VAR. ABC
K	200mm LIME SUBBASE (OR) 180mm CEMENT SUBBASE (OR) 180mm AGG/CEM SUBBASE
P1	PRIME COAT
R1	750mm CURB & GUTTER
R2	SHOULDER BERM GUTTER
R3	125mm MON. ISLAND
T	EARTH MATERIAL
U	EXIST. PAVEMENT
W	ASPH. WEDGING



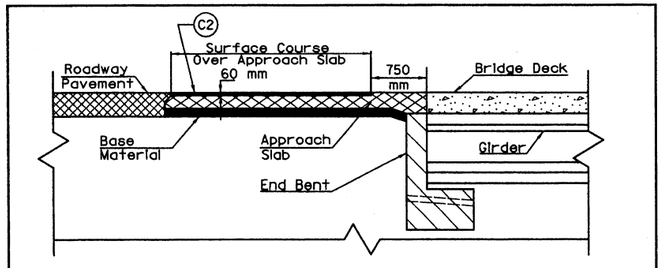
FALSE SUMP DETAIL
(TO BE USED AT LOCATIONS AS SHOWN ON PLANS)



FALSE SUMP DETAIL
(TO BE USED AT LOCATIONS AS SHOWN ON PLANS)



FALSE SUMP DETAIL
(TO BE USED AT LOCATIONS AS SHOWN ON PLANS)



Detail of Asphalt Wearing Surface On Approach Slab

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

...\1594\Design\R977_RDY_TYP.dgn 8/13/2004 2:54:23 PM

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-H
HIGHWAY DESIGN ENGINEER	

METRIC

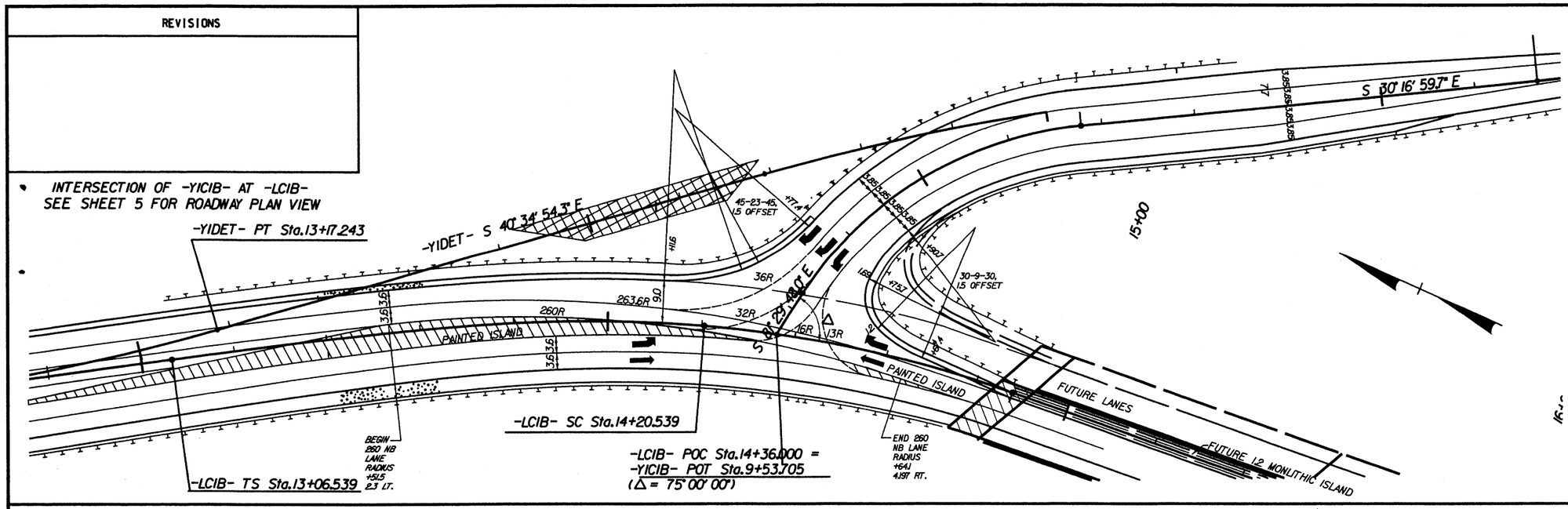
5 0 10

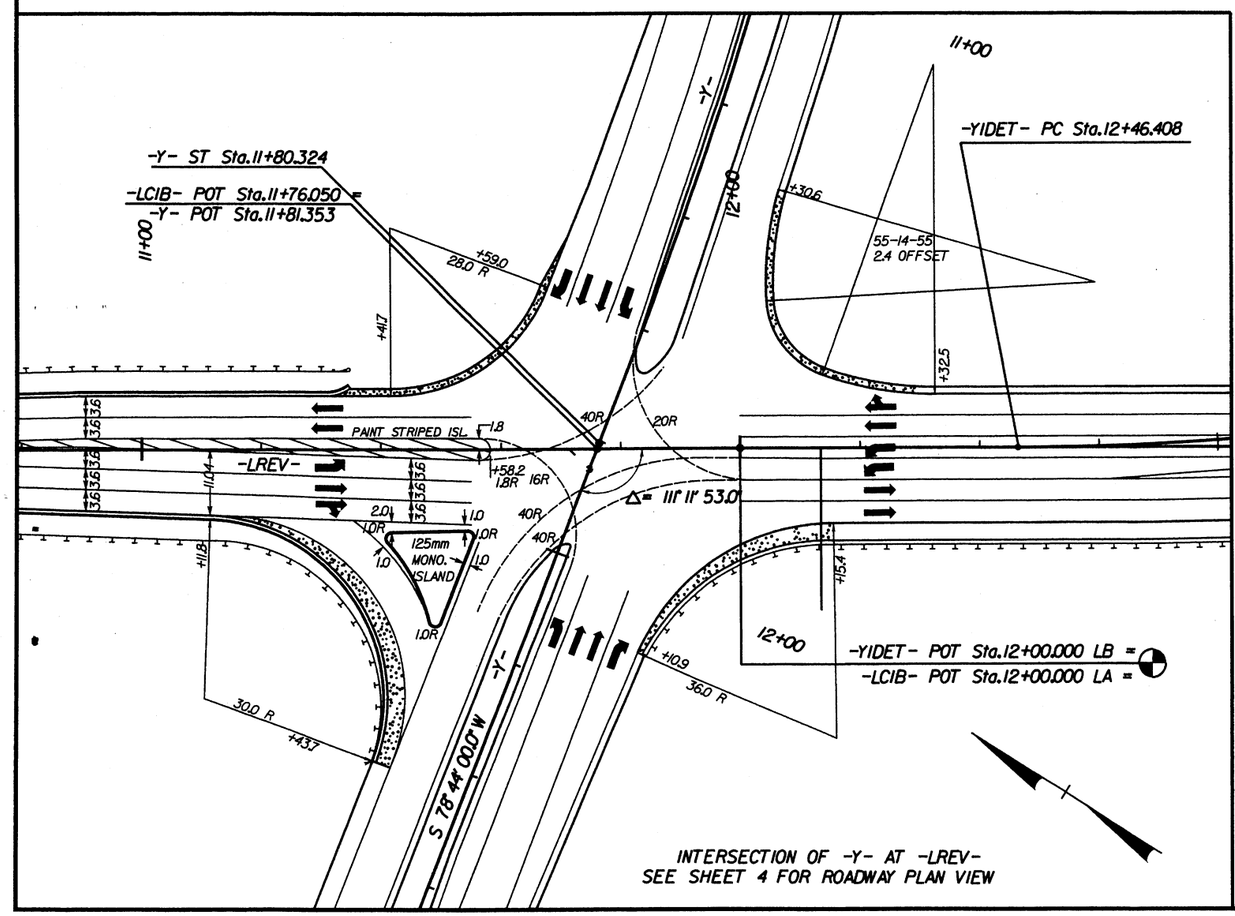
CONST. REV.

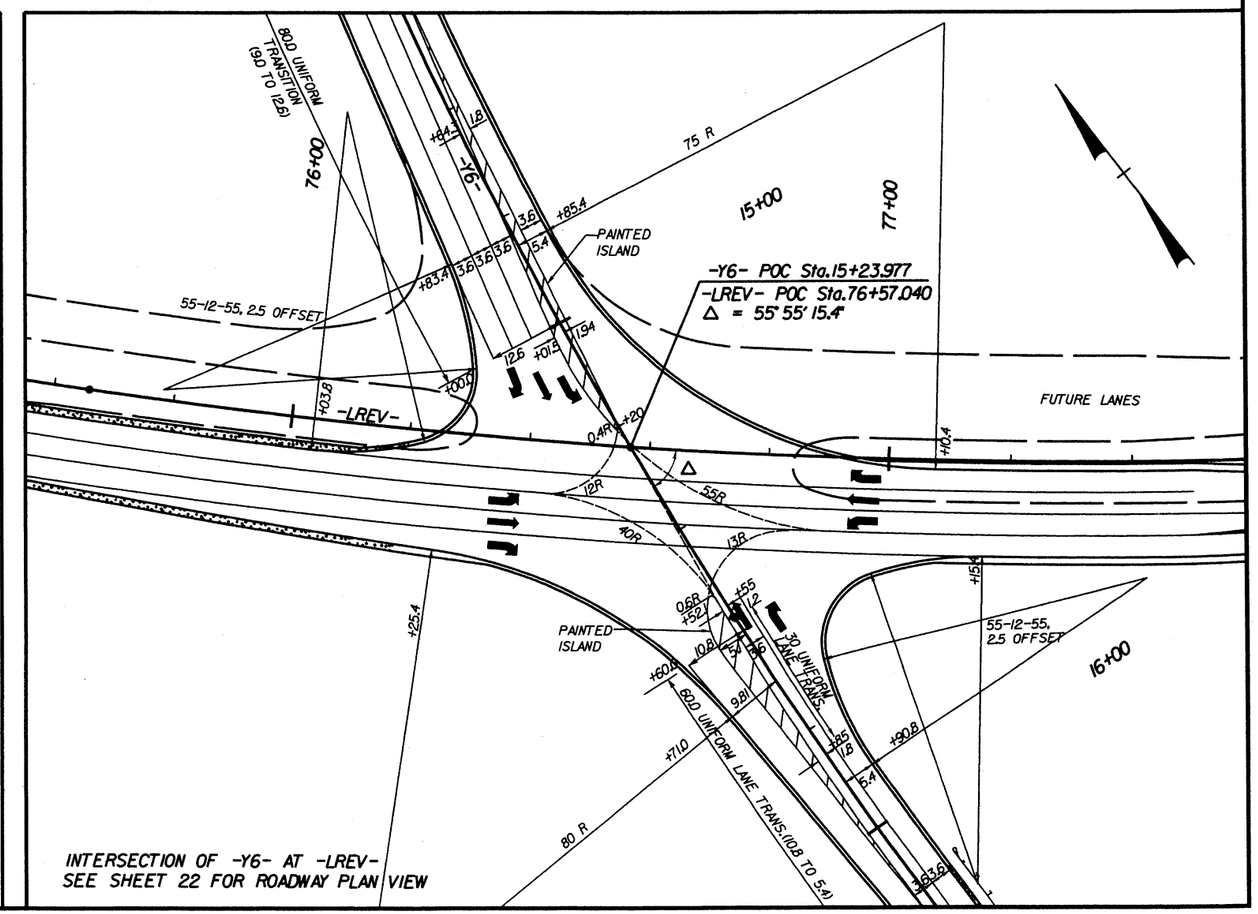
R/W REV.

LOCHNER

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







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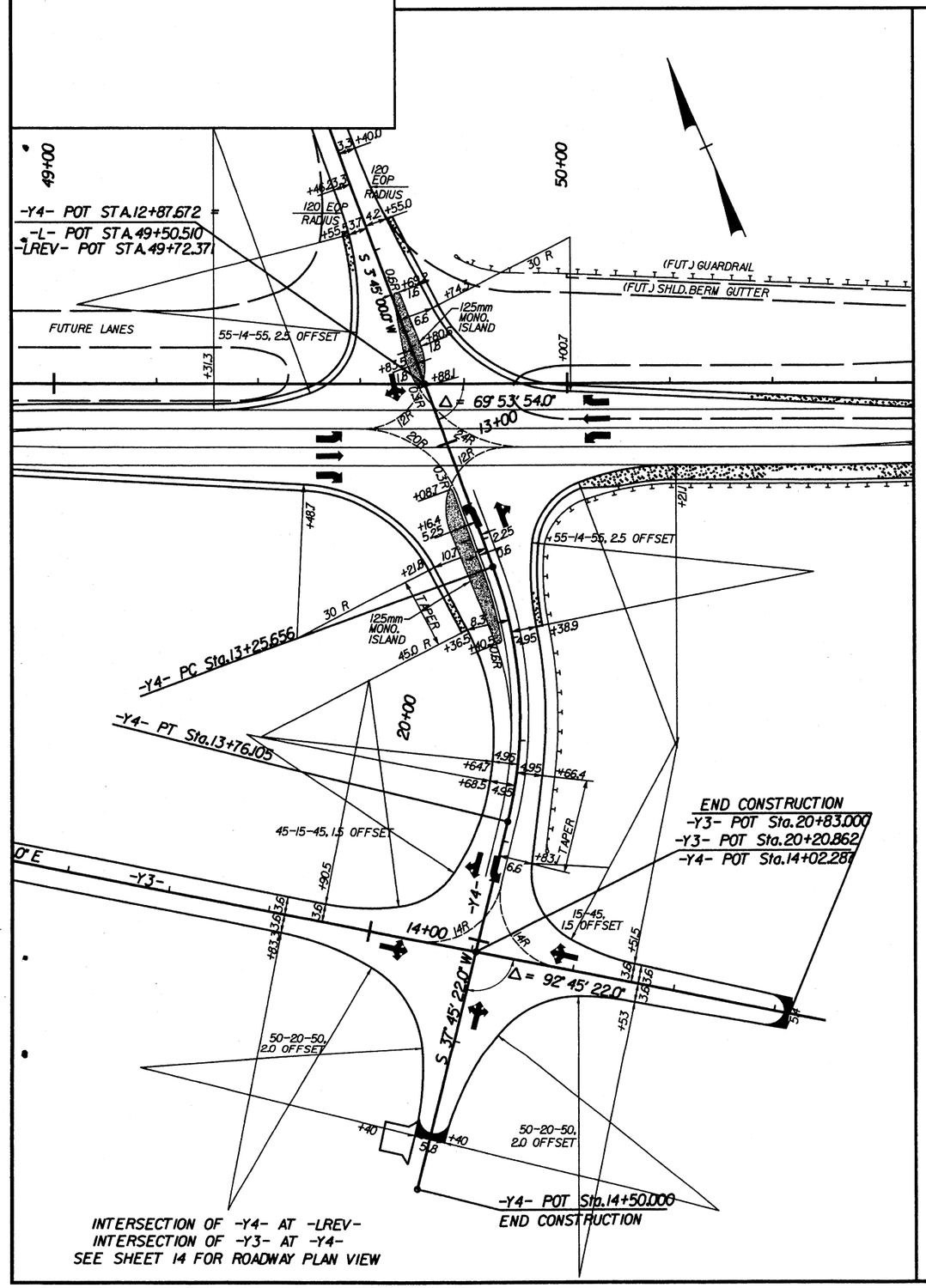
REVISIONS

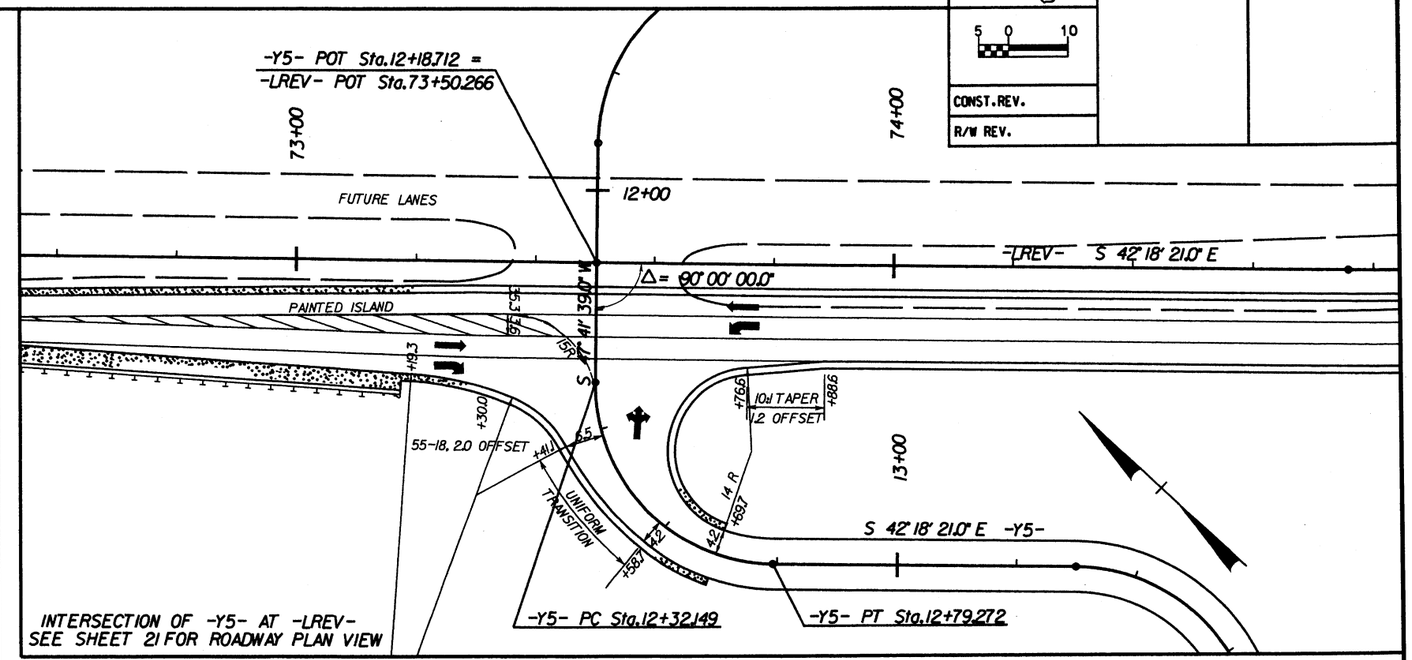
-LREV- INTERSECTION DETAILS

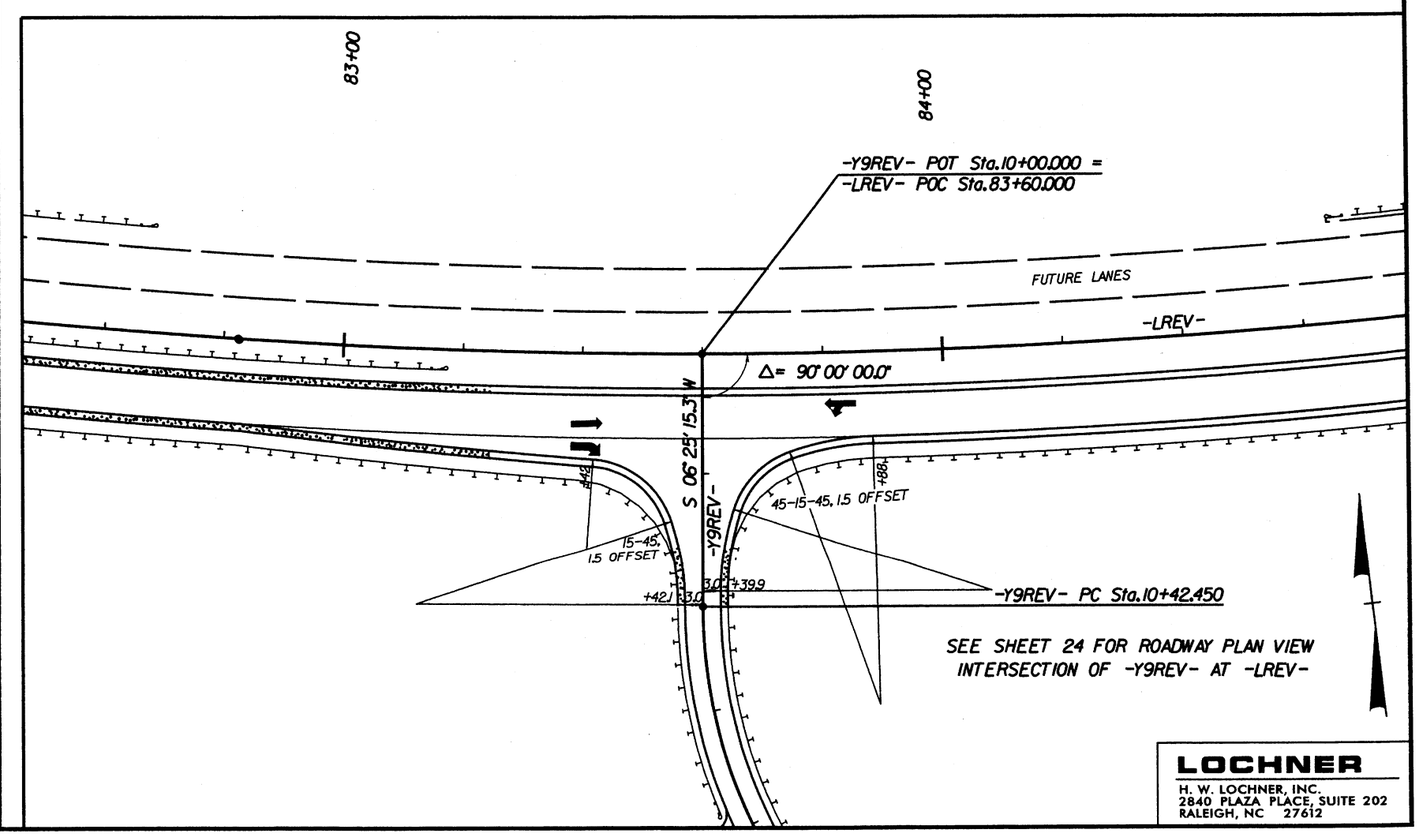
METRIC

5 0 10

PROJECT REFERENCE NO.	SHEET NO.
R-977A	2-1
HIGHWAY DESIGN ENGINEER	
CONST. REV.	
R/W REV.	







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2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

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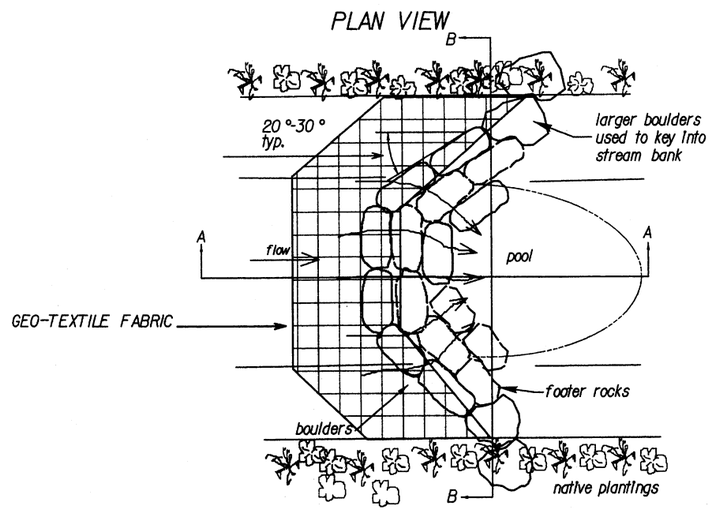
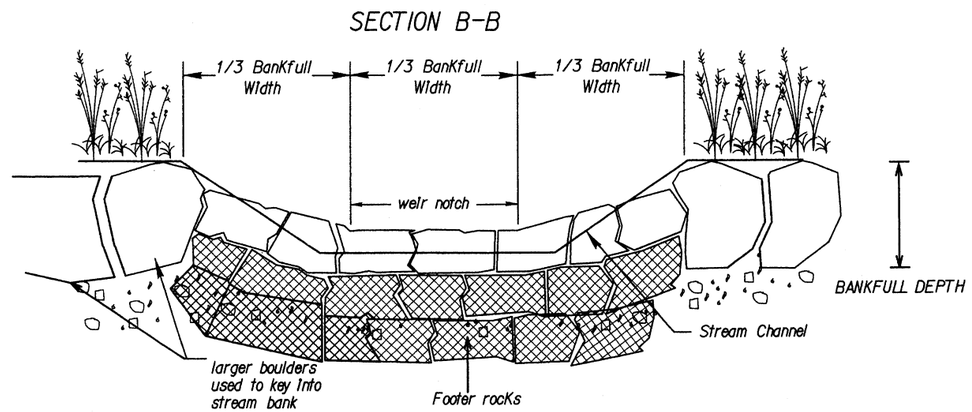
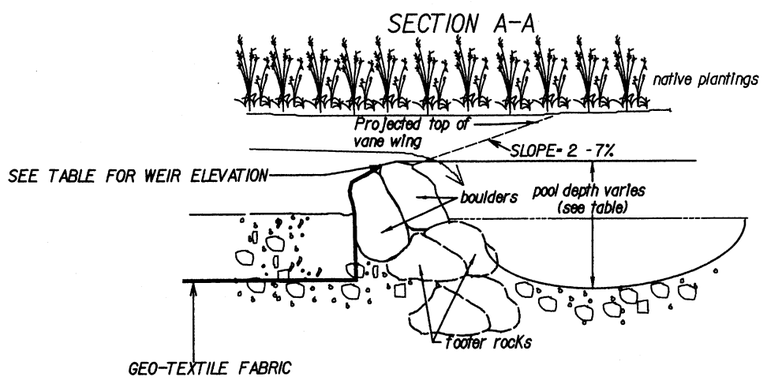
PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977A	2-J	
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION

CROSS VANE ROCK WEIR DETAIL







NOTE: Boulders should be native quarried rock or locally shot rock, angular and oblong with approximate minimum dimensions as listed in table.

Rocks should fit tightly with minimal spaces

Geotextile fabric should be placed on upstream side of boulders. Fabric should be overlain on exposed boulders and buried to a minmum depth as directed by on site engineer. Fabric should extend upstream a minimum length of of 2 m or as directed by on site engineer. Fabric should be backfilled with existing bed material.

PIPE DIAMETER	BOULDER DIMENSIONS	POOL DEPTH
450mm - 900mm (15" - 36")	1.2m x 1.0m x 0.6m (4' x 3' x 2')	Min. 0.3m (1.0')
1050mm - 1650mm (42" - 66")	1.5m x 1.2m x 0.6m (5' x 4' x 2')	Min. 0.6m (2.0')
1800mm & Larger (72" & Larger)	1.8m x 1.2m x 1.0m (6' x 4' x 3')	Min. 1.0m (3.0')

PROJECT R-977A
CHEROKEE COUNTY
STATION

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

CROSS VANE DETAIL

DRAWN BY JSF DATE 4/04
CHECKED BY GLS DATE 4/04

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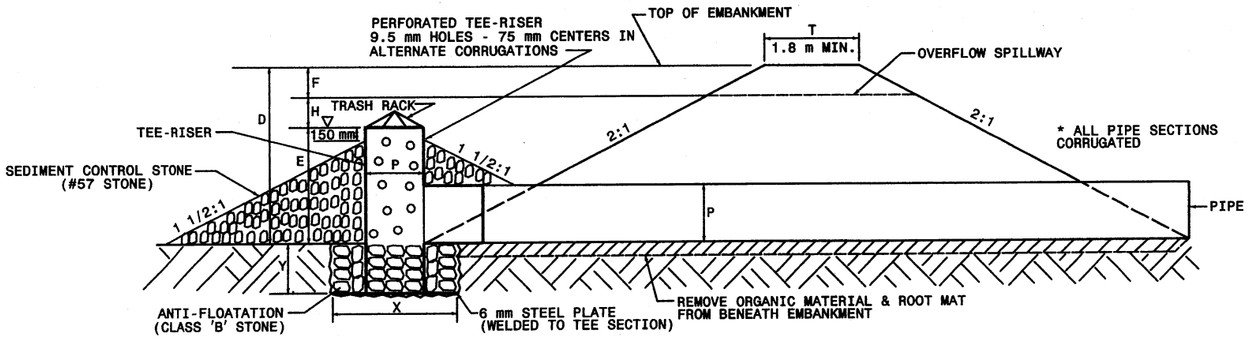
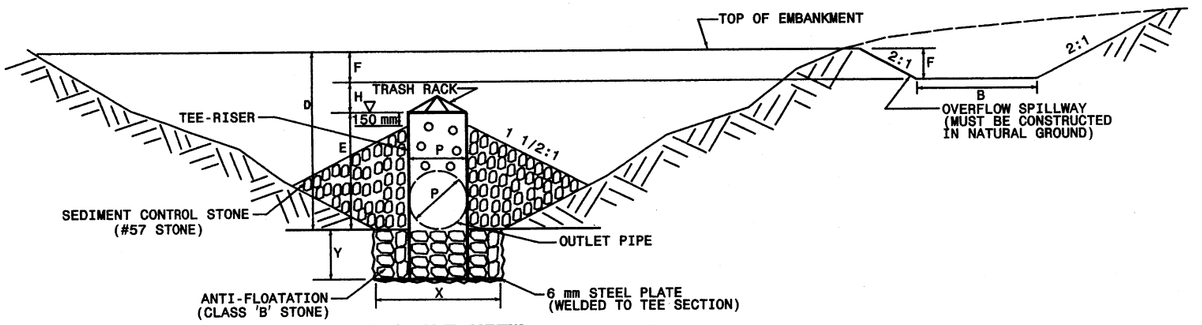
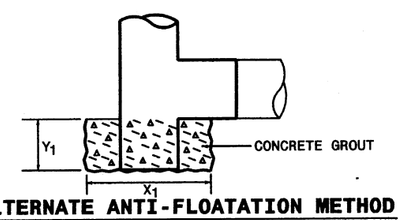


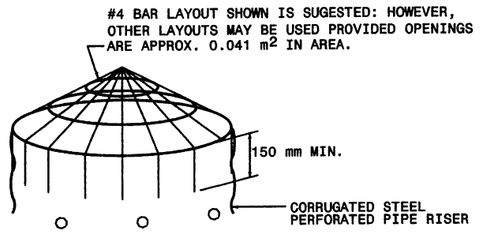
SECTIONAL VIEW



PROFILE VIEW



ALTERNATE ANTI-FLOATATION METHOD

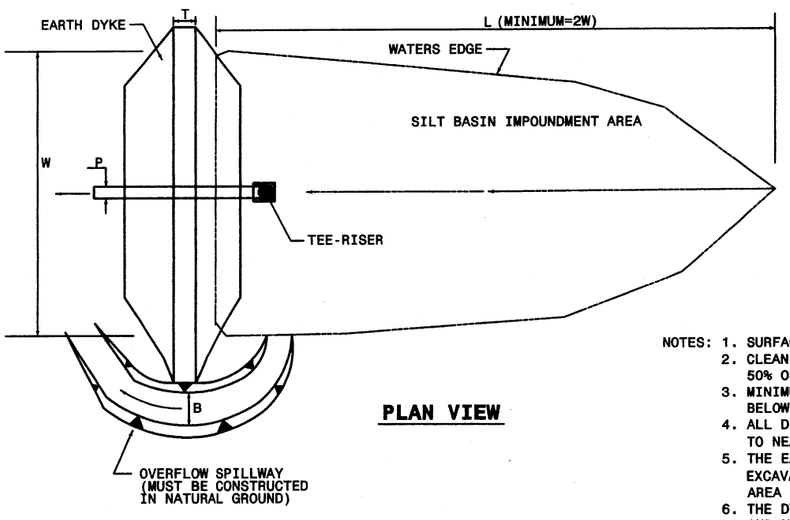


RISER DETAIL

SHEET 2 OF 2

SPECIAL DETAIL FOR TYPE "A" SILT BASIN

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS
RALEIGH, N.C.



PLAN VIEW

NOTES:
1. SURFACE AREA AND VOLUME ARE TO BE SITE SPECIFIC.
2. CLEAN OUT SEDIMENT WHEN STORAGE VOLUME REACHES 50% OF MIN. STORAGE VOLUME.
3. MINIMUM SURFACE AREA AND MINIMUM VOLUME ARE MEASURED BELOW THE TOP OF PRINCIPLE SPILLWAY (TOP OF RISER).
4. ALL DIMENSIONS OF BASIN WILL NOT REQUIRE CONSTRUCTION TO NEAT LINES.
5. THE EARTH DYKE MAY BE CONSTRUCTED ALONG ONE OR MORE SIDES. EXCAVATION MAY BE REQUIRED TO PROVIDE MINIMUM SURFACE AREA AND/OR MINIMUM STORAGE VOLUME.
6. THE DYKE SHALL BE CONSTRUCTED OF MATERIAL SUITABLE FOR AND MEETING ROADWAY EMBANKMENT SPECIFICATIONS.
7. TO FACILITATE DETERMINATION OF MAINTENANCE CLEANOUT REQUIREMENT A MARKER SHOULD BE PLACED IN THE BASIN INDICATING THE 50% VOLUME LEVEL.

BASIN #	APPROX. STA.	P	H	T (min)	D*	E	F	B (min)	X (min)	Y (min)	X_1 (min)	Y_1 (min)	SURFACE AREA (min)	STORAGE VOLUME (min)	SED. CONTROL STONE
		mm	m	m	m	m	m	m	m	m	m	m	m^2	m^3	m.ton
1	-LREV- LT 19+40	900	0.3	1.8	2.8	1.8	0.5	2.4	2.2	0.6	2.0	0.6	310	1095	30
2	-LREV- LT 30+70	800	0.3	1.8	3.6	1.85	0.45	2.44	1.6	0.6	1.8	0.6	241	720	30
3	-LREV- RT 43+20	450	0.3	1.8	3.6	1.67	0.3	2.4	1.4	0.3	1.2	0.3	300	91	17
4	-LREV- LT 50+50	600	0.3	1.8	2.8	1.2	0.5	2.1	1.7	0.3	1.5	0.3	300	660	7
5	-LREV- RT 72+20	900	0.3	1.8	3.6	1.8	0.5	2.4	2.2	0.6	2.0	0.6	322	642	27

* SHALL NOT EXCEED 3.7 m

HYDRAULICS ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 20737 ENGINEER JONATHAN KENNING SCARCE

P.E.

SIGNATURE

SHEET 1 OF 2

SPECIAL DETAIL FOR TYPE "A" SILT BASIN

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS
RALEIGH, N.C.

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977A	2-0	
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION

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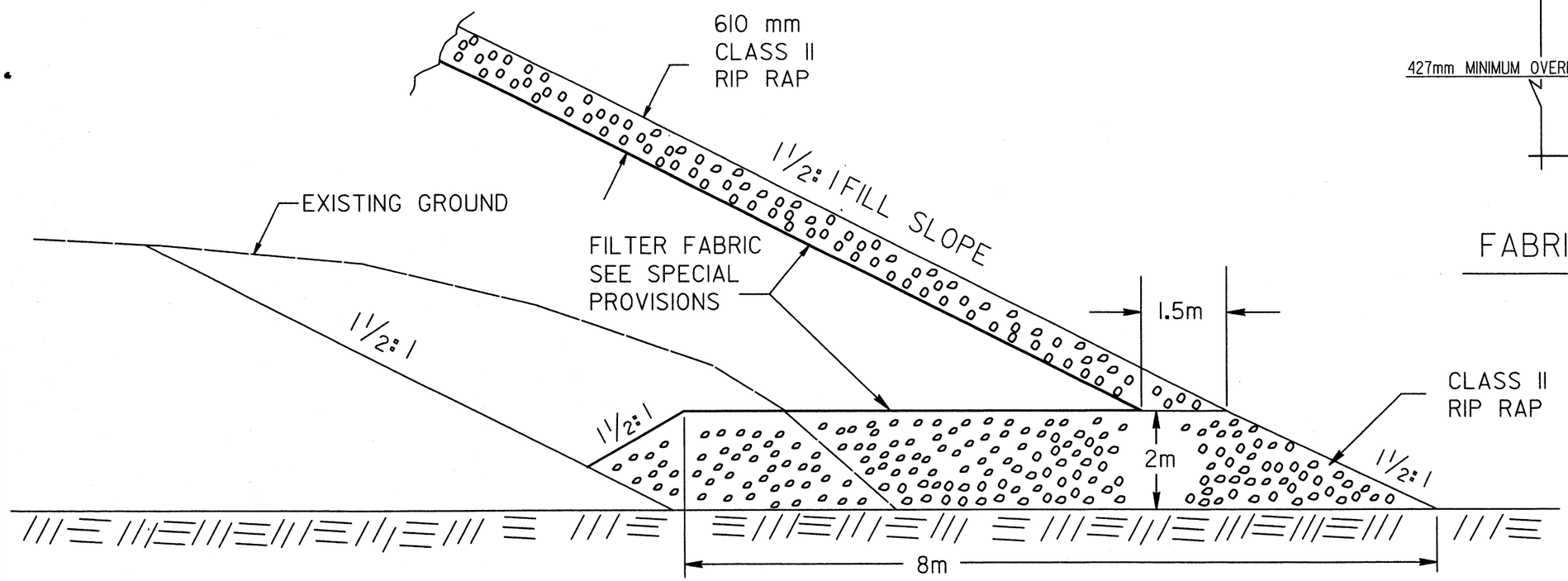
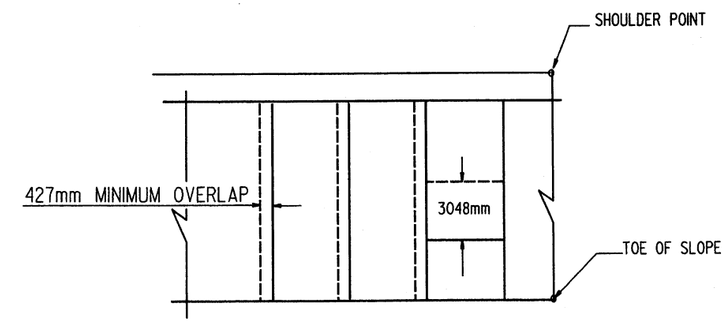
PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977A	2-Q	
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION



ROCK FILL DETAIL

ALL ROCK CLASS II RIP RAP

STATION 26+60 TO 28+23 -LREV- RIGHT
STATION 67+00 TO 67+45 -LREV- LEFT (RIP RAP NOT REQUIRED ON SLOPE)
BOTH END SLOPES, BRIDGE OVER HIWASSEE RIVER @ STA. 16+02.280 -LCIB-
BOTH END SLOPES, BRIDGE OVER HIWASSEE RIVER @ STA. 68+58.000 -LREV-
SEE STRUCTURE PLANS FOR RIP RAP SLOPE PROTECTION ON END SLOPES



FABRIC OVERLAP DETAIL

N.T.S.

DRAWN BY JDS DATE 6/98
CHECKED BY NS DATE 7/98

PROJECT R-977A
CHEROKEE COUNTY
STATION

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

ROCK FILL
DETAIL

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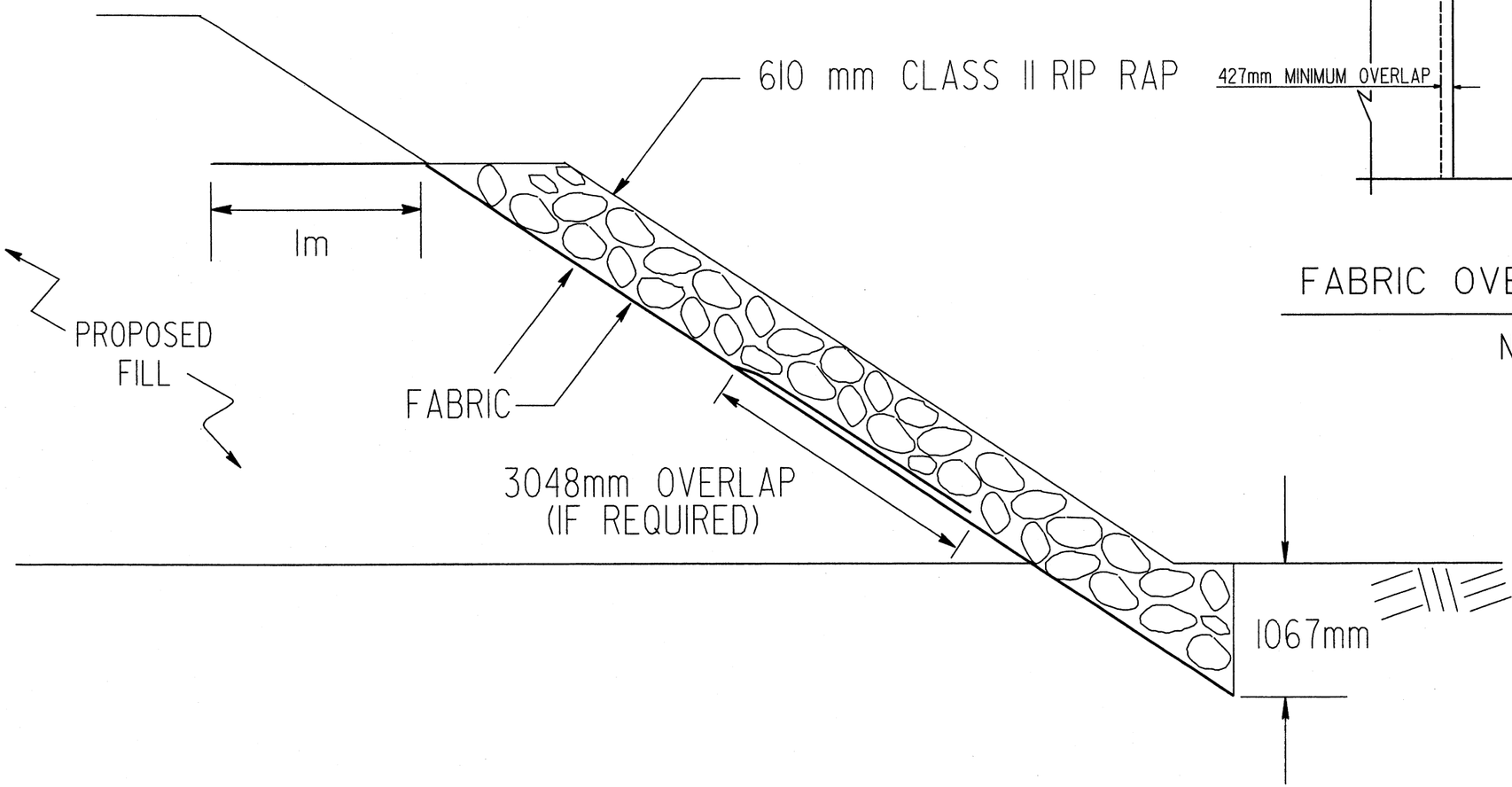
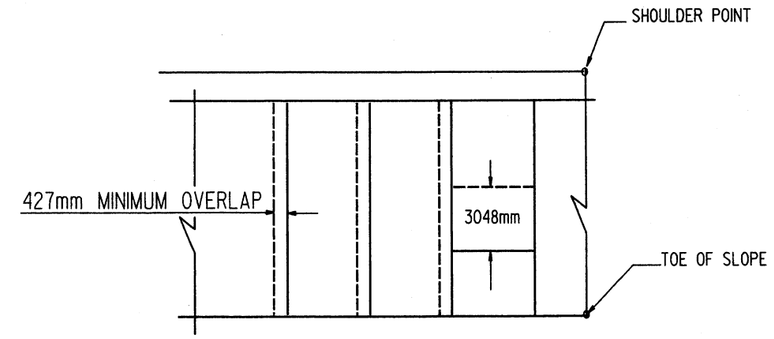
PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-977A	2-R	
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION



RIP RAP SLOPE PROTECTION DETAIL

N.T.S.



FABRIC OVERLAP DETAIL

N.T.S.

PROJECT R-977A
CHEROKEE COUNTY
STATION

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

SLOPE PROTECTION DETAIL

DRAWN BY NS DATE 7/98
CHECKED BY GRT DATE 7/98

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STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

SUMMARY OF QUANTITIES

METRIC

PROJ. REFERENCE NO.	SHEET NO.
R-977A	3

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COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

Station	Structure No. From	Structure No. To	Top Elevation	Invert Elevation	Invert Elevation	Slope Critical	Class III R.C.P. (Unless Noted Otherwise) 300	375	450	600	750	900	1050	1200	Bituminous Coated C.S. Pipe Type B (Unless Noted Otherwise) 300 / 1.63	400 / 1.63	450 / 1.63	600 / 1.63	600 / 1.63 (Uncoated)	600 / 2.01	800 / 2.01	800	900 / 2.01	900	1000 / 2.77	1000	1200 / 2.77	1200 / 3.51	150mm Perforated HDPE Pipe	600 Bore and Jack	375mm Side Drain Pipe	450mm Side Drain Pipe	600mm Side Drain Pipe	900mm Side Drain Pipe	Modified Concrete Flume (See Sheet 2-P)	Endwalls Std. 838.01 or Std. 838.11 (Unless Noted Otherwise) R.C.P. (CM)	C.S.P. (CM)	Quantities: Structures Per Each (0 thru 1.50)	For Drainage *Total M for Pay Quantity Shall Be Col. 'A' + (1.3 x Col. 'B') Meters A 1.50 thru 3.00	Meters B 3.00 and Above	375 x 375 x 375 Tee	C.B. Std. 840.01 or 840.02	Frame, Grates, and Hood Std. 840.03 Type of Grate E	F	G		D.I. Std. 840.14 or Std. 840.15	D.I. Frame & Grate Std. 840.16	M.D.I. Type "A" Std. 840.17 or 840.26	M.D.I. Type "B" Std. 840.18 or 840.27	M.D.I. Type "D" Std. 840.19 or 840.28	M.D.I. Frame with Grate Std. 840.20	M.D.I. Frame with Two Grates Std. 840.22	M.D.I. (N.S.) Frame with Two Grates Std. 840.29	M.D.I. (N.S.) Frame with Two Grates Std. 840.24	J.B. Std. 840.31 or 840.32	T.B.J.B. Std. 840.34	M.H. Std. 840.51, 840.52, or 840.53	M.H. Frame & Cover Std. 840.54	O.T.C.B. Std. 840.04 or 840.05	Spring Box Std. 840.41	150mm C.S. Pipe, 1.63mm Thick (Spring Box)	Perforated 150mm C.S. Pipe Stub 1.63mm Thick	T.B.D.I. Std. 840.35	M.D.I. Frame with Two Grates Std. 840.33 (Angle Vane)	900 x 900 x 900mm Perf C.S.P. Tee Riser 2.01mm Thick	800 x 800 x 800mm Perf C.S.P. Tee Riser 2.01mm Thick	600 x 600 x 600mm Perf C.S.P. Tee Riser 1.63mm Thick	450 x 450 x 450mm Perf C.S.P. Tee Riser 1.63mm Thick	Sluise Gate (For 600 C.S.P.)	Conc. Collars Cl. "A" CM Std 840.72	Conc. & Brick Pipe Plug C.M. Std. 840.71	Adjust Existing D.I.	Pipe Removal (Linear Meter	C.S. Elbows No.	C.S. Elbows Size	Remarks
-LC1B- 9+67 RT	1		498.30	497.39																																		1									1	1																													
-LC1B- 9+67 RT	1	2		497.39			3.6																																																																					CONNECTS TO EXISTING NETWORK
-LC1B- 10+17 LT	3	4			488.36											12.0																																																													CONNECTS TO EXISTING NETWORK
-LC1B- 10+28 LT	4		489.50	488.36																																		1									1	1																													
-LC1B- 10+28 LT	4	5		488.36	481.50												28.8																				0.8																																									1	450	
-LC1B- 10+60 LT	6	7		480.50	479.54												6.0																				0.8																																											REMOVE EXIST. HDWL; CONN. TO EXIST SYSTEM
-LC1B- 10+83 RT	8	9		468.17	465.50												39.6																																																												3.0	1	450	REMOVE EXIST HDWL & ELBOW; CONN. TO EXIST. SYST
-LC1B- 10+89 RT	10	11		465.50	464.90																																		1																							1	10.8	2.4														
-LC1B- 10+17 RT	–	–																																																																											15.0			REMOVE EXIST 300mm PLASTIC PIPE
-LC1B- 11+10 RT	12		490.06	489.25																																		1				1		1																																		
-LC1B- 11+10 RT	12	13		489.25	488.34			15.6																																																																			
-LC1B- 11+25 RT	13		489.50	488.34																																		1																		1		1																		REMOVE EXIST CB; CONNECTS TO EXIST. SYSTEM
-LC1B- 11+20 LT	14	15		488.13	488.17				13.2																																																																					14.4			
-LC1B- 11+26 LT	15		489.40	488.17																																		1				1			1																																			
-LC1B- 11+26 LT	15	16		488.17					2.4																																																														0.3						REMOVE EXIST CB; CONNECTS TO EXIST. SYSTEM
-LC1B- 12+21 RT	17	18		466.09	464.36																		24.0																																																					3.0	1	900	REMOVE EXIST ELBOW; CONNECTS TO EXIST. SYSTEM
-LC1B- 12+74 LT	19	20		486.10	483.40			28.8																																																																				15.6			REMOVE EXIST 400mm PLASTIC PIPE
-LC1B- 12+80 RT	21		485.58	484.74																																		1											1			1																								
-LC1B- 12+80 RT	21	22		484.74	464.64											49.2																																																															2	400	
-YDET- 13+38 LT	23	24		479.00	472.50												21.6																				0.8																																									1	400	"L" HEADWALL (STD. 838.05 OR 838.15)
-YIDET- 13+58 LT	24		475.50	472.50														4.8																				1																			1	1																		
-YIDET- 13+58 LT	24	25		472.50	473.44													4.8																			1.1																																										
-YIDET- 13+58 LT	24	26		472.50	471.49													25.2																																																													REMOVE EXIST HDWL; CONN. TO EXIST. SYSTEM
-LC1B- 13+58 RT	27	28			465.13																																																																									CONNECTS TO EXISTING NETWORK
-LC1B- 13+64 RT	29		481.38	480.54																																		1											1			1																								
-LC1B- 13+64 RT	29	30		480.54	465.50											37.2																																																													2	400	
-LC1B- 14+58 RT	31		479.25	478.41																																		1											1			1																								
-LC1B- 14+58 RT	31	32		478.41	478.32			15.6																																																																					
-LC1B- 14+73 RT	32		478.16	478.32																																		1											1			1																								
-LC1B- 14+73 RT	32	33		478.32	464.80											32.4																																																													2	400	
-LC1B- 14+80 RT	34	35		470.00	467.69												26.4																																																												44.4			REMOVE EXISTING PIPE AND HDWL: TEMP PIPE
-LC1B- 15+05 RT	35		469.00	467.69																																		1																		1																					TEMPORARY JB; REMOVE TEMP JB
-YIDET- 15+14 CL	36	37		470.50	467.00					70.8 (CL IV)																																																																				METHOD "B" INSTALLATION
-YIDET- 15+56 RT	38		474.85	474.01																																		1											1			1																								
-YIDET- 15+56 RT	38	39		474.01	468.70											16.8																																																													2	400	
-LC1B- 16+73 RT	40	41		464.00	464.70													9.6																			1.1																																	1							
SHEET TOTAL							3.6	60.0	15.6							147.6	122.4	44.4		30.0			58.8														4.60	13				2		1	1		2	2		5			5			1	1	1	2		1	10.8	2.4							1	0.3			95.4	12		
										70.8 (CL IV)																																																																			

ABBREVIATIONS

- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

$$$$$$SYSTIME$$$$ $$$$$$DGN$$$$$$$$$$$$$$$$ $$$$USERNAME$$$$
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COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

6/20/00

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO. R-977A | SHEET NO. 3-B

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

ABBREVIATIONS
- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 (1.63)	400 (1.63)	450 (1.63)	600 (1.63)	600 (1.63 (UNCOATED))	600 (2.01)	800 (2.01)	800	900 (2.01)	900	1000 (2.77)	1000	1200 (2.77)	1200 (3.51)
-LC1B- 17+16 RT	42	43		464.70	475.81													31.2										
-LC1B- 17+16 RT	43		478.10	475.81																								
-LC1B- 17+16 RT	43	44		475.81	475.92					13.2																		
-LC1B- 17+29 RT	44		478.10	475.80																								
-LC1B- 17+29 CL	44	45		475.80	475.92					24.0																		
-LC1B- 17+29 LT	45			477.89	475.92																							
-Y1C1B- 11+60 LT	46		471.77	470.93																								
-Y1C1B- 11+60 CL	46	47		470.93	465.70											37.2												
-Y1C1B- 12+64 RT	48	49		465.00	465.10												1.2											
-Y1C1B- 12+64 CL	49	50		465.10	467.26												27.6											
-Y1C1B- 12+64 LT	50		468.15	467.26																								
-Y1C1B- 12+64 LT	50	51		467.26	468.15												9.6											
-Y1C1B- 13+47 RT	52	53		466.99	464.80												8.4											
-L1C1B- 17+75 LT	54		477.54	476.27																								
-L1C1B- 17+29 LT	45	54		475.92	476.27				46.8																			
-L1C1B- 18+01 LT	55		477.29	476.40																								
-LC1B- 17+75 LT	54	55		476.27	476.40				26.4																			
-LC1B- 18+01 LT	55	56		476.40	476.61				4.8																			
-LC1B- 18+31 CL	57	58		463.58	465.90									66.0														
-LC1B- 18+31 RT	58		468.00	465.90																								
-LC1B- 18+30 RT	58	59		465.90	466.50									20.4														
-LC1B- 18+48 RT	59		468.26	466.50																								
-LC1B- 18+48 RT	59	60		467.11	468.70													6.0										
-LC1B- 18+48 RT	59	61		466.50	470.14									67.2														
-Y2- 13+76 LT	62	63		463.52	463.60																		16.8					
-Y2- 13+84 LT	64	65		463.60	465.52																		26.4					
-Y2- 13+86 RT	65		469.00	465.52																								
-Y2- 13+86 LT	65	66		467.25	475.41																		21.6					
-LC1B- 18+90 LT	66		477.16	475.41																								
-LC1B- 18+90 LT	66	67		475.41	477.32			27.6																				
-LC1B- 19+04 RT	67		478.43	477.32																								
-LC1B- 19+04 CL	67	68		477.32	477.60			36.0																				
-LC1B- 19+40 CL	68		478.44	477.60																								
-LC1B- 19+04 RT	67	69		477.32	477.44			25.2																				
-LC1B- 19+20 RT	69		478.28	477.44																								
-LC1B- 18+90 LT	66	70		475.41	476.13							103.2																
SHEET TOTAL								88.8	78.0	37.2		103.2		154		37.2	46.8	37.2			18.0	78.0						

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B') METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G		D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-LC1B- 17+16 RT																											
-LC1B- 17+16 RT										1	0.79										1				1		
-LC1B- 17+16 RT																											
-LC1B- 17+29 RT										1	0.80										1				1		
-LC1B- 17+29 CL																											
-LC1B- 17+29 LT							1			1	0.47											1			1		
-Y1C1B- 11+60 LT										1												1				1	
-Y1C1B- 11+60 CL																											
-Y1C1B- 12+64 RT																											
-Y1C1B- 12+64 CL									0.8																		
-Y1C1B- 12+64 LT										1												1				1	
-Y1C1B- 12+64 LT																											
-Y1C1B- 13+47 RT									0.8																		
-L1C1B- 17+75 LT										1												1			1		
-L1C1B- 17+29 LT																											
-L1C1B- 18+01 LT										1												1			1		
-LC1B- 17+75 LT																											
-LC1B- 18+01 LT							2																				
-LC1B- 18+31 CL																											
-LC1B- 18+31 RT										1	0.60										1				1		
-LC1B- 18+30 RT																											
-LC1B- 18+48 RT										1	0.26																
-LC1B- 18+48 RT									1.1																		
-LC1B- 18+48 RT								4.60																			
-Y2- 13+76 LT																											
-Y2- 13+84 LT																											
-Y2- 13+86 RT										1	1.50	0.48									1				1		
-Y2- 13+86 LT																											
-LC1B- 18+90 LT										1	0.25										1				1		
-LC1B- 18+90 LT																											
-LC1B- 19+04 RT										1																	
-LC1B- 19+04 CL																											
-LC1B- 19+40 CL										1												1			1		
-LC1B- 19+04 RT																											
-LC1B- 19+20 RT										1												1			1		
-LC1B- 18+90 LT																											
SHEET TOTAL							2	4.60	2.70	14	4.67	0.48									5	7			10	2	

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
-LC1B- 17+16 RT																				2	600	600
-LC1B- 17+16 RT																						
-LC1B- 17+16 RT																						
-LC1B- 17+29 RT																						
-LC1B- 17+29 CL																						
-LC1B- 17+29 LT																						
-Y1C1B- 11+60 LT																						
-Y1C1B- 11+60 CL																			7.0	2	400	
-Y1C1B- 12+64 RT																			1.2			
-Y1C1B- 12+64 CL																			12.0	1	450	REMOVE EXIST. HDWL
-Y1C1B- 12+64 LT																						
-Y1C1B- 12+64 LT																				1	450	
-Y1C1B- 13+47 RT																				2	450	RETAIN & EXTEND EXIST.
-L1C1B- 17+75 LT																						
-L1C1B- 17+29 LT																						
-L1C1B- 18+01 LT																						
-LC1B- 17+75 LT																						
-LC1B- 18+01 LT																						
-LC1B- 18+31 CL																					21.6	REMOVE 2 EXIST. 1200 CMP PIPE
-LC1B- 18+31 RT																						
-LC1B- 18+30 RT																						
-LC1B- 18+48 RT	1																					
-LC1B- 18+48 RT																						
-LC1B- 18+48 RT																						
-Y2- 13+76 LT											1											PERMANENT
-Y2- 13+84 LT																						
-Y2- 13+86 RT																						
-Y2- 13+86 LT																				2	900	
-LC1B- 18+90 LT																						
-LC1B- 18+90 LT																						
-LC1B- 19+04 RT	1			1																		
-LC1B- 19+04 CL																						
-LC1B- 19+40 CL																						
-LC1B- 19+04 RT																						
-LC1B- 19+20 RT																						
-LC1B- 18+90 LT																						
SHEET TOTAL	2			1							1								41.8	10		

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

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STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

ABBREVIATIONS
- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

STATION	STRUCTURE NO. FROM	TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200
-LC1B- 20+00 LT	70		477.88	476.13										
-LC1B- 20+00 LT	70	71		476.13	477.87			21.6			96.0			
-LC1B- 20+00 CL	71		478.71	477.87										
-LC1B- 20+00 RT	71	72		477.87	478.08			21.6						
-LC1B- 20+00 RT	72		478.92	478.08										
-LC1B- 20+00 LT	70	73		476.13	476.98									
-LC1B- 21+00 LT	73		478.58	476.98										
-LC1B- 21+00 LT	73	74		476.98	478.31				21.6		98.4			
-LC1B- 21+00 CL	74		479.15	478.31										
-LC1B- 21+00 RT	74	75		472.31	478.70			22.8						
-LC1B- 21+00 RT	75		479.54	478.70										
-LC1B- 21+00 LT	73	76		476.98	477.91									
-LC1B- 22+00 LT	76		479.51	477.91										
-LC1B- 22+00 LT	76	77		477.91	478.52				22.8					
-LC1B- 22+00 CL	77		479.86	478.52										
-LC1B- 22+00 RT	77	78		478.52	478.79			22.8						
-LC1B- 22+00 RT	78		479.63	478.79										
-LC1B- 22+00 LT	76	79		477.91	478.70					100.8				
-LC1B- 23+00 LT	79		480.15	478.70										
-LC1B- 23+00 LT	79	80		478.70	479.02				22.8					
-LC1B- 23+00 CL	80		480.56	479.02										
-LC1B- 23+00 RT	80	81		479.02	479.31			22.8						
-LC1B- 23+00 RT	81		480.15	479.31										
-LC1B- 23+80 RT	82			–	–									
-LC1B- 25+05 CL	83		481.71	480.59										
-LCB1- 25+05 RT	83	84		480.59	480.37			19.2						
-LCB1- 25+05 RT	84		482.24	480.37										
-LCB1- 25+05 RT	84	85		480.37	472.00									
-LC1B- 26+22 RT	86		486.59	485.52										
-LC1B- 26+22 RT	86	87		485.52	483.50									
-LC1B- 27+24 LT	88	89		487.65	487.56				14.4					
-LC1B- 27+20 CL	89		488.57	487.56										
-LREV- 27+20 RT	89	90		487.56	487.38				19.2					
-LREV- 27+15 RT	90		488.83	487.38										
-LREV- 27+15 RT	90	91		487.38	472.30									
-LREV- 28+88 CL	92	93		489.30	476.60									
SHEET TOTAL								130.8	100.8	100.8	194.4			

BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) — SIZE / THICKNESS OR GAUGE

STATION (FROM–TO)	300 1.63	400 1.63	450 1.63	600 1.63	600 1.63 (UNCOATED)	600 2.01	800 2.01	800	900 2.01	900	1000 2.77	1000	1200 2.77	1200 3.51
-LCB1- 25+05 RT (84–85)			25.2											
-LC1B- 26+22 RT (86–87)		9.6												
-LREV- 27+15 RT (90–91)			32.4											
-LREV- 28+88 CL (92–93)									79.2					
SHEET TOTAL		9.6	57.6						79.2					

STATION (FROM–TO)	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE *TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B') METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02
-LC1B- 20+00 LT (70)										1	0.25			
-LC1B- 20+00 CL (71)										1				
-LC1B- 20+00 RT (72)										1				
-LC1B- 21+00 LT (73)										1	0.10			
-LC1B- 21+00 CL (74)										1				
-LC1B- 21+00 RT (75)										1				
-LC1B- 22+00 LT (76)										1	0.10			
-LC1B- 22+00 CL (77)										1				
-LC1B- 22+00 RT (78)										1				
-LC1B- 23+00 LT (79)										1				
-LC1B- 23+00 CL (80)										1	0.04			
-LC1B- 23+00 RT (81)										1				
-LC1B- 23+80 RT (82)							1							
-LC1B- 25+05 CL (83)										1				
-LCB1- 25+05 RT (84)										1	0.37			
-LC1B- 26+22 RT (86)										1				
-LC1B- 27+20 CL (89)										1				
-LREV- 27+15 RT (90)										1				
-LREV- 27+15 RT (90–91)									0.8					
-LREV- 28+88 CL (92–93)										1				
SHEET TOTAL							1		0.8	19	0.86			

STATION (FROM–TO)	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mm THICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER)	C.S. ELBOWS NO.	SIZE	REMARKS
-LC1B- 20+00 LT (70)						1				1																								
-LC1B- 20+00 LT (70–71)																																		CONNECTS TO EXISTING NETWORK
-LC1B- 20+00 CL (71)							1			1																								CONNECTS TO EXISTING NETWORK
-LC1B- 20+00 RT (71–72)																																		
-LC1B- 20+00 RT (72)							1			1																								
-LC1B- 20+00 LT (70–73)																																		REMOVE EXIST. HDWL; CONN. TO EXIST SYSTEM
-LC1B- 21+00 LT (73)						1				1																								REMOVE EXIST HDWL & ELBOW; CONN. TO EXIST. SYST
-LC1B- 21+00 LT (73–74)																																		
-LC1B- 21+00 CL (74)							1			1																								REMOVE EXIST 300mm PLASTIC PIPE
-LC1B- 21+00 RT (74–75)																																		
-LC1B- 21+00 RT (75)							1			1																								
-LC1B- 21+00 LT (73–76)																																		REMOVE EXIST CB; CONNECTS TO EXIST. SYSTEM
-LC1B- 22+00 LT (76)						1				1																								
-LC1B- 22+00 LT (76–77)																																		
-LC1B- 22+00 CL (77)							1			1																								REMOVE EXIST CB; CONNECTS TO EXIST. SYSTEM
-LC1B- 22+00 RT (77–78)																																		REMOVE EXIST ELBOW; CONNECTS TO EXIST. SYSTEM
-LC1B- 22+00 RT (78)							1			1																								REMOVE EXIST 400mm PLASTIC PIPE
-LC1B- 22+00 LT (76–79)																																		
-LC1B- 23+00 LT (79)						1				1																								
-LC1B- 23+00 LT (79–80)																																		"L" HEADWALL (STD. 838.05 OR 838.15)
-LC1B- 23+00 CL (80)							1			1																								
-LC1B- 23+00 RT (80–81)																																		
-LC1B- 23+00 RT (81)							1			1																								REMOVE EXIST HDWL; CONN. TO EXIST. SYSTEM
-LC1B- 23+80 RT (82)																																		CONNECTS TO EXISTING NETWORK
-LC1B- 25+05 CL (83)							1			1																								
-LCB1- 25+05 RT (83–84)																																		
-LCB1- 25+05 RT (84)							1			1																								REMOVE EXISTING PIPE AND HDWL: TEMP PIPE
-LCB1- 25+05 RT (84–85)																																		TEMPORARY JB; REMOVE TEMP JB
																																2	450	
-LC1B- 26+22 RT (86)							1			1																								METHOD "B" INSTALLATION
-LC1B- 26+22 RT (86–87)																																2	400	
-LC1B- 27+24 LT (88–89)							1																											
-LC1B- 27+20 CL (89)										1																								
-LREV- 27+20 RT (89–90)																																		
-LREV- 27+15 RT (90)							1			1																								
-LREV- 27+15 RT (90–91)																																2	450	
-LREV- 28+88 CL (92–93)																																		
SHEET TOTAL						4	13			17																						6		

6/20/99

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-D

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200
-LREV- 28+78 RT	94	94a		477.20	476.50									
-LREV- 29+52 LT	95	96		497.00	497.36			13.2						
-LREV- 29+65 CL	96		498.17	497.36										
-LREV- 29+65 RT	96	97		497.36	497.82			22.8						
-LREV- 29+65 RT	97		498.63	497.82										
-LREV- 30+57 LT	98	99		498.20	500.47									
-LREV- 30+70 CL	99		501.54	500.47										
-LREV- 30+70 RT	99	100		500.47	501.10				22.8					
-LREV- 30+70 RT	100		501.99	501.10										
-LREV- 30+70 RT	100	101		501.10	504.54									
-LREV- 30+71 LT	102	103		–	–									
-LREV- 33+05 CL	104	105		–	–									
-LREV- 33+10 RT	106	107		–	–									
-LREV- 33+18 RT	108	109		505.90	504.48					30.0				
-LREV- 33+35 CL	109		505.55	504.48										
-LREV- 33+35 LT	109	110		504.48	504.20					9.60				
-LREV- 33+30 LT	111	112		–	–									
-LREV- 34+62 RT	113	114		480.00	478.00									
-LREV- 34+55 RT	115	116		483.20	483.07				24.0					
-LREV- 34+77 RT	116		484.35	483.07										
-LREV- 34+77 RT	116	117		483.07	481.11									
-LREV- 34+97 RT	117		481.85	481.11										
-LREV- 34+97 RT	117	118		481.11	473.50									
-LREV- 35+32 RT	119	120		473.50	475.96									
-LREV- 35+41 RT	120		476.85	475.96										
-LREV- 35+41 RT	120	122		475.96	481.56									
-LREV- 35+51 RT	122		482.45	481.56										
-LREV- 35+51 RT	122	121		481.56	503.78									
-LREV- 35+51 RT	121		504.69	503.78										
-LREV- 35+51 RT	122	123		481.56	482.80									
-LREV- 34+60 LT	124	125		492.00	487.11									
-LREV- 34+82 LT	125		487.85	487.11										
-LREV- 34+82 LT	125	126		487.11	470.00									
-LREV- 35+12 LT	127	128		469.50	479.40									
-LREV- 35+90 LT	128		481.00	479.40										
-LREV- 35+90 LT	128	129		479.40	502.65									
SHEET TOTAL								36.0	46.8	39.6				

STATION	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 / 1.63	400 / 1.63	450 / 1.63	600 / 1.63	600 / 1.63 (UNCOATED)	600 / 2.01	800 / 2.01	800	900 / 2.01	900	1000 / 2.77	1000	1200 / 2.77	1200 / 3.51	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)
-LREV- 28+78 RT																							
-LREV- 29+52 LT																							
-LREV- 29+65 CL																							
-LREV- 29+65 RT																							
-LREV- 29+65 RT																							
-LREV- 30+57 LT				18.0																			
-LREV- 30+70 CL																							
-LREV- 30+70 RT																							
-LREV- 30+70 RT																							
-LREV- 30+70 RT		13.2																					
-LREV- 30+71 LT							18.0																
-LREV- 33+05 CL																	7.2						
-LREV- 33+10 RT																	6.0						
-LREV- 33+18 RT																							
-LREV- 33+35 CL																							
-LREV- 33+35 LT																							
-LREV- 33+30 LT				13.2																			
-LREV- 34+62 RT																							
-LREV- 34+55 RT																							
-LREV- 34+77 RT																							
-LREV- 34+77 RT			21.6																				
-LREV- 34+97 RT																							
-LREV- 34+97 RT			31.2																				
-LREV- 35+32 RT			10.8																				
-LREV- 35+41 RT																							
-LREV- 35+41 RT			13.2																				
-LREV- 35+51 RT																							
-LREV- 35+51 RT		52.8																					
-LREV- 35+51 RT																							
-LREV- 35+51 RT			30.0																				0.9
-LREV- 34+60 LT			25.2																				0.9
-LREV- 34+82 LT																							
-LREV- 34+82 LT			42.0																				
-LREV- 35+12 LT							84.0																
-LREV- 35+90 LT																							
-LREV- 35+90 LT		51.6																					
SHEET TOTAL		117.6	174.0	31.2			102.0										13.2						1.8

STATION	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL. 'A' + (1.3 X COL. 'B')" METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05
-LREV- 28+78 RT	1																					
-LREV- 29+52 LT																						
-LREV- 29+65 CL	1											1			1							
-LREV- 29+65 RT																						
-LREV- 29+65 RT	1											1			1							
-LREV- 30+57 LT																						
-LREV- 30+70 CL	1											1			1							
-LREV- 30+70 RT																						
-LREV- 30+70 RT	1											1			1							
-LREV- 30+70 RT																						
-LREV- 30+71 LT																						
-LREV- 33+05 CL																						
-LREV- 33+10 RT																						
-LREV- 33+18 RT																						
-LREV- 33+35 CL	1											1			1							
-LREV- 33+35 LT																						
-LREV- 33+30 LT																						
-LREV- 34+62 RT	1																					
-LREV- 34+55 RT																						
-LREV- 34+77 RT	1																					1
-LREV- 34+77 RT																						
-LREV- 34+97 RT	1																					1
-LREV- 34+97 RT																						
-LREV- 35+32 RT																						
-LREV- 35+41 RT	1																					1
-LREV- 35+41 RT																						
-LREV- 35+51 RT	1																					1
-LREV- 35+51 RT																						
-LREV- 35+51 RT	1											1			1							
-LREV- 35+51 RT																						
-LREV- 34+60 LT																						
-LREV- 34+82 LT	1																					1
-LREV- 34+82 LT																						
-LREV- 35+12 LT																						
-LREV- 35+90 LT	1	0.1									1				1							
-LREV- 35+90 LT																						
SHEET TOTAL	14	0.1									1	6			7							5

STATION	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mm THICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
-LREV- 28+78 RT	1	3.6	3.6														
-LREV- 29+52 LT																	
-LREV- 29+65 CL																	
-LREV- 29+65 RT																	
-LREV- 29+65 RT																	
-LREV- 30+57 LT																	
-LREV- 30+70 CL																	
-LREV- 30+70 RT																	
-LREV- 30+70 RT																	
-LREV- 30+70 RT															1	400	
-LREV- 30+71 LT							1										PERMANENT
-LREV- 33+05 CL																	
-LREV- 33+10 RT																	
-LREV- 33+18 RT																	
-LREV- 33+35 CL																	
-LREV- 33+35 LT																	
-LREV- 33+30 LT								1									PERMANENT
-LREV- 34+62 RT	1	4.8	52.8												1	150	
-LREV- 34+55 RT																	
-LREV- 34+77 RT																	
-LREV- 34+77 RT																	
-LREV- 34+97 RT																	
-LREV- 34+97 RT															1	450	
-LREV- 35+32 RT															1	450	
-LREV- 35+41 RT																	
-LREV- 35+41 RT															2	450	
-LREV- 35+51 RT																	
-LREV- 35+51 RT															2	400	
-LREV- 35+51 RT																	
-LREV- 35+51 RT																	"L" HEADWALL (STD. 838.05 OR 838.15)
-LREV- 34+60 LT																	"L" HEADWALL (STD. 838.05 OR 838.15)
-LREV- 34+82 LT																	
-LREV- 34+82 LT															2	450	
-LREV- 35+12 LT																	
-LREV- 35+90 LT																	
-LREV- 35+90 LT															2	400	
SHEET TOTAL	2	8.4	56.4				1	1							13		

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

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

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.: R-977A | SHEET NO.: 3-E

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200
-LREV- 35+90 LT	129		504.04	502.65										
-LREV- 35+90 LT	129	130		502.65	502.70			18.0						
-LREV- 35+90 CL	130		503.51	502.70										
-LREV- 35+90 LT	128	131		479.4	483.05									
-LREV- 36+26 LT	131		485.50	483.05										
-LREV- 36+26 LT	131	132		483.05	485.60					170.4 (CL IV)				
-LREV- 36+26 LT	131	133		483.05	483.45									
-LREV- 36+26 LT	133		485.70	483.45										
-LREV- 36+26 LT	133	134		483.05	491.20									
-LREV- 37+05 LT	134		493.50	491.20										
-LREV- 37+05 LT	134	135		491.20	497.40									
-LREV- 37+33 LT	135		499.00	497.40										
-LREV- 37+33 LT	135	136		497.40	501.27									
-LREV- 37+53 LT	136		502.08	501.27										
-LREV- 37+33 LT	135	137		497.40	500.58					31.2				
-LREV- 37+33 CL	137		502.03	500.58										
-LREV- 37+33 RT	137	138		500.58	501.79			18.0						
-LREV- 37+33 RT	138		502.58	501.79										
-LREV- 36+55 RT	139		503.15	502.23										
-LREV- 36+55 RT	139	140		502.23	501.00									
-LREV- 37+04 RT	141	142		495.00	485.60									
-LREV- 37+60 RT	143	144		485.60	491.60									
-LREV- 38+71 CL	145		503.38	501.93										
-LREV- 37+33 CL	137	145		500.58	501.93					139.2				
-LREV- 38+71 RT	145	146		501.93	502.21			24.0						
-LREV- 38+71 RT	146		503.02	502.21										
-LREV- 40+57 RT	147			-	-									
NOT IN USE	148													
-Y3- 10+49 CL	149	150		478.79	503.15					21.6				
NOT IN USE	150													
-Y3- 11+25 RT	151			485.00	484.00									
-Y3- 11+60 LT	36	37		486.40	486.20									
SHEET TOTAL								60.0		192.0				
										170.4 (CL IV)				

SIZE / THICKNESS OR GAUGE

STATION	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 / 1.63	400 / 1.63	450 / 1.63	600 / 1.63	600 / 1.63 (UNCOATED)	2.01	800 / 2.01	800	900 / 2.01	900	1000 / 2.77	1000	1200 / 2.77	1200 / 3.51
-LREV- 35+90 LT (128–131)							37.2							
-LREV- 36+26 LT (131–133)							4.8							
-LREV- 36+26 LT (133–134)							78.0							
-LREV- 37+05 LT (134–135)							30.0							
-LREV- 37+33 LT (135–136)		22.8												
-LREV- 36+55 RT (139–140)		10.8												
-LREV- 37+04 RT (141–142)			56.4											
-LREV- 37+60 RT (143–144)			20.4											
-Y3- 11+25 RT (151)														10.8
-Y3- 11+60 LT (36–37)			12.0											
SHEET TOTAL		33.6	88.8				150.0							10.8

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B')" METERS A 1.50 THRU 3.00	METERS B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-LREV- 35+90 LT (129)										1											1			1		
-LREV- 35+90 CL (130)										1											1			1		
-LREV- 36+26 LT (131)										1	0.95									1				1		
-LREV- 36+26 LT (133)										1	0.75									1				1		
-LREV- 37+05 LT (134)										1	0.80									1				1		
-LREV- 37+33 LT (135)										1	0.10									1				1		
-LREV- 37+53 LT (136)										1											1			1		
-LREV- 37+33 CL (137)										1										1				1		
-LREV- 37+33 RT (138)										1											1					1
-LREV- 36+55 RT (139)										1											1			1		
-LREV- 37+04 RT (141–142)									1.7																	
-LREV- 37+60 RT (143–144)									1.7																	
-LREV- 38+71 CL (145)										1										1				1		
-LREV- 38+71 RT (146)										1											1			1		
-LREV- 40+57 RT (147)							1																			
-Y3- 11+25 RT (151)										1	0.56									1				1		
SHEET TOTAL							1		3.4	13	3.16									7	6			12		1

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
-LREV- 36+26 LT (131–132)																						METHOD "B" INSTALLATION
-LREV- 36+55 RT (139–140)																				2	450	
-LREV- 37+04 RT (141–142)																				1	450	"L" HEADWALL (STD. 838.05 OR 838.15)
-LREV- 37+60 RT (143–144)																				2	450	"L" HEADWALL (STD. 838.05 OR 838.15)
-Y3- 10+49 CL (149–150)																			20.4			
-Y3- 11+60 LT (36–37)																			12.0			
SHEET TOTAL																			32.4	5		

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

6/20/00
$$$$$SYSTIME$$$$$ $$$$$DGN$$$$$ $$$$$USERNAME$$$$$
...\R0977_RDY_PSHA-0 (SUM).dgn 8/17/2004 9:16:03 AM

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-F

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION / SIZE / THICKNESS OR GAUGE	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 / 1.63	400 / 1.63	450 / 1.63	600 / 1.63	600 / 1.63 (UNCOATED)	2.01	800 / 2.01	800	900 / 2.01	900	1000 / 2.77	1000	1200 / 2.77	1200 / 3.51
-Y3- 11+44 RT	151	154		483.44	485.71									39.6														
-Y3- 12+00 RT	154		488.30	485.71																								
-Y3- 12+00 RT	154	155		485.71	486.38									21.6														
-Y3- 12+00 RT	154	156		485.71	485.80					21.6																		
-Y3- 12+01 LT	156		487.25	485.80																								
-Y3- 12+01 LT	156	157		485.80	491.11												8.4											
-LREV- 41+84 RT	157		491.75	491.11																								
-LREV- 41+84 RT	157	158		491.11	498.11												20.4											
-LREV- 42+00RT	158		498.75	497.86																								
-LREV- 42+00RT	158	159		497.86	507.09											25.2												
-LREV- 42+00RT	159		508.71	507.09																								
-LREV- 41+84 RT	159	160		507.09	507.26			24.0																				
-LREV- 42+00 RT	158	161		498.11	507.05											67.2												
-LREV- 42+65 RT	161		508.97	507.05																								
-LREV- 42+65 RT	161	162		507.05	508.52			24.0																				
-LREV- 42+65 CL	162		509.33	508.52																								
-Y3- 13+12 RT	163	164		490.30	490.44					30.0																		
-Y3- 13+29 LT	164		491.25	490.44																								
-Y3- 13+29 LT	164	165		490.44	492.00													12.0										
-LREV- 43+03 RT	166	167		–	–												15.6											
-LREV- 43+20 RT	168	169		501.10	506.40			74.4 (CL IV)																				
-LREV- 43+25 RT	170	171		501.18	510.39												48.0											
-LREV- 43+70 RT	171		511.28	510.39																								
-LREV- 43+70 RT	171	172		510.39	511.03			26.4																				
-LREV- 43+80 CL	172		511.84	511.03																								
-Y3- 14+18 LT	173		495.61	494.80																								
-Y3- 14+18 LT	173	174		494.80	494.16			25.2																				
-Y3- 13+92 RT	175	176		–	–																							
-Y3- 15+21 RT	177		501.28	500.37																								
-Y3- 15+21 RT	177	178		500.37	497.96											10.8												
-LREV- 44+70 RT	179		514.28	513.47																								
-LREV- 44+70 RT	179	180		513.47	513.06			21.6																				
-LREV- 44+80 CL	180		513.94	512.00																								
-LREV- 44+80 LT	180	181		512.00	512.78				13.2																			
-LREV- 44+80 LT	180	182		512.00	501.05												58.8											
-Y3- 15+37 LT	182		501.94	501.05																								
SHEET TOTAL								121.2		51.6				61.2		103.2	151.2	12.0										
								74.4 (CL IV)																				

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B')" METERS A 1.50 THRU 3.00	METERS B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	
-Y3- 11+44 RT								4.5										
-Y3- 12+00 RT										1	1.09							
-Y3- 12+00 RT								4.5										
-Y3- 12+00 RT																		
-Y3- 12+01 LT										1								
-Y3- 12+01 LT																		
-LREV- 41+84 RT										1								
-LREV- 41+84 RT																		
-LREV- 42+00RT										1								
-LREV- 42+00RT																		
-LREV- 42+00RT										1	0.12							
-LREV- 41+84 RT																		
-LREV- 42+00 RT																		
-LREV- 42+65 RT										1	0.42							
-LREV- 42+65 RT																		
-LREV- 42+65 CL										1								
-Y3- 13+12 RT																		
-Y3- 13+29 LT										1								
-Y3- 13+29 LT																		
-LREV- 43+03 RT																		
-LREV- 43+20 RT																		
-LREV- 43+25 RT									0.8									
-LREV- 43+70 RT										1								
-LREV- 43+70 RT																		
-LREV- 43+80 CL										1								
-Y3- 14+18 LT										1								
-Y3- 14+18 LT																		
-Y3- 13+92 RT						9.6		2.6										
-Y3- 15+21 RT										1								
-Y3- 15+21 RT																		
-LREV- 44+70 RT										1								
-LREV- 44+70 RT																		
-LREV- 44+80 CL										1	0.44							
-LREV- 44+80 LT																		
-LREV- 44+80 LT																		
-Y3- 15+37 LT										1								
SHEET TOTAL						9.6		11.6	0.8	15	2.07							

STATION	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB, 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUICE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
-Y3- 11+44 RT																												57.6			
-Y3- 12+00 RT										1			1																		
-Y3- 12+00 RT																															"L" HDWL (STD. 838.05 OR 838.15)
-Y3- 12+00 RT																															
-Y3- 12+01 LT					1	1	1																								3GI
-Y3- 12+01 LT																													2	450	
-LREV- 41+84 RT														1																	
-LREV- 41+84 RT																															
-LREV- 42+00RT														1																	
-LREV- 42+00RT																													2	400	
-LREV- 42+00RT				1			1																								
-LREV- 41+84 RT																															
-LREV- 42+00 RT																															
-LREV- 42+65 RT				1			1																								
-LREV- 42+65 RT																															
-LREV- 42+65 CL				1			1																								
-Y3- 13+12 RT																												58.8			
-Y3- 13+29 LT					1				1																						
-Y3- 13+29 LT																													1	600	
-LREV- 43+03 RT																							1								PERMANENT
-LREV- 43+20 RT																															
-LREV- 43+25 RT																													1	450	
-LREV- 43+70 RT				1			1																								
-LREV- 43+70 RT																															
-LREV- 43+80 CL				1			1																								
-Y3- 14+18 LT				1					1																						
-Y3- 14+18 LT																												13.2			
-Y3- 13+92 RT																												8.4			
-Y3- 15+21 RT				1															1												
-Y3- 15+21 RT																													2	400	
-LREV- 44+70 RT				1															1												
-LREV- 44+70 RT																															
-LREV- 44+80 CL				1			1																								
-LREV- 44+80 LT																															
-LREV- 44+80 LT																															
-Y3- 15+37 LT				1					1																						
SHEET TOTAL				10	2	1	7		3	1			1	2					2				1					138.0	8		

ABBREVIATIONS

- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

6/20/00
$$$$SYSTIME$$$$ $$$$USERNAME$$$$ DGN$$$$
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COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

PROJECT REFERENCE NO. R-977A — SHEET NO. 3-G

METRIC

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 1.63	400 1.63	450 1.63	600 1.63	600 1.63 (UNCOATED)	600 2.01	800 2.01	800	900 2.01	900	1000 2.77	1000	1200 2.77	1200 3.51
-Y3- 15+37 LT	182	183		501.05	501.90			14.4																				
-Y3- 15+37 LT	182	184		501.05	498.72				27.6																			
-Y3- 15+56 RT	185	186		499.48	502.88							62.4																
-Y3- 16+20 RT	186		504.00	502.88																								
-Y3- 16+20 RT	186	187		502.88	507.00												30.0											
-Y3- 16+20 RT	186	188		502.88	506.91											10.8												
-Y3- 16+20 RT	188		507.82	506.91																								
-Y3- 16+20 RT	186	189		502.88	505.85							33.6																
-LREV- 46+01 RT	189		507.60	505.85																								
-LREV- 46+01 RT	189	190		505.85	515.69											24.0												
-LREV- 45+99 RT	190		517.08	515.69																								
-LREV- 45+99 RT	190	191		515.69	515.74			18.0																				
-LREV- 45+98 CL	191		516.55	515.74																								
-LREV- 46+02 CL	189	194		505.85	506.80					78.0 (CL IV)																		
-LREV- 45+81 LT	192	193		512.50	506.80												22.8											
-LREV- 46+01 RT	189	195		505.85	509.70						78.0																	
-LREV- 46+80 RT	195		511.30	509.70																								
-LREV- 46+80 RT	195	196		509.70	518.11											16.8												
-LREV- 46+80 RT	196		519.02	518.11																								
-LREV- 46+80 RT	195	203		509.70	511.21						60.0																	
-Y3- 16+98 RT	197		513.80	512.29																								
-Y3- 16+98 RT	197	198		512.29	510.20											7.2												
-LREV- 47+00 LT	199	200		517.63	513.66												18.0											
-LREV- 47+17 LT	200		514.20	513.66																								
-LREV- 47+17 LT	200	201		513.66	511.90				24.0																			
-LREV- 47+17 LT	202	203		511.90	511.21					68.4 (CL IV)																		
-LREV- 47+40 RT	203		513.50	511.21																								
-LREV- 47+40 RT	203	204		511.21	519.54																							
-LREV- 47+40 RT	203	205		511.21	515.00				56.4																			
-LREV- 47+40 RT	203	206		511.21	519.31				39.6																			
-LREV- 47+77 RT	206		520.20	519.31																								
-LREV- 47+77 RT	206	207		519.31	519.58			24.0																				
-LREV- 47+85 CL	207		520.58	519.58																								
-Y3- 18+16 LT	208	209		519.50	519.69			12.0																				
-Y3- 18+28 LT	209		520.50	519.69																								
-Y3- 18+28 RT	209	210		519.69	519.79			20.4																				
SHEET TOTAL								88.88	147.6		138.0	96.0				58.8	70.8											
										146.4 (CL IV)																		

STATION	FROM	TO	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B') METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G		D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-Y3- 15+37 LT	182	183																											
-Y3- 15+37 LT	182	184																											
-Y3- 15+56 RT	185	186																											
-Y3- 16+20 RT	186											1																	
-Y3- 16+20 RT	186	187									0.9																		
-Y3- 16+20 RT	186	188																											
-Y3- 16+20 RT	188																							1					
-Y3- 16+20 RT	186	189										1																	
-LREV- 46+01 RT	189											1	0.25										1						1
-LREV- 46+01 RT	189	190																											
-LREV- 45+99 RT	190											1												1					
-LREV- 45+99 RT	190	191																											
-LREV- 45+98 CL	191											1												1			1		
-LREV- 46+02 CL	189	194																											
-LREV- 45+81 LT	192	193									1.7																		
-LREV- 46+01 RT	189	195																											
-LREV- 46+80 RT	195											1	0.10										1				1		
-LREV- 46+80 RT	195	196																											
-LREV- 46+80 RT	196											1												1					
-LREV- 46+80 RT	195	203																											
-Y3- 16+98 RT	197											1	0.01											1					
-Y3- 16+98 RT	197	198																											
-LREV- 47+00 LT	199	200									0.9																		
-LREV- 47+17 LT	200											1																	
-LREV- 47+17 LT	200	201																											
-LREV- 47+17 LT	202	203																											
-LREV- 47+40 RT	203											1	0.79										1				1		
-LREV- 47+40 RT	203	204										1																	
-LREV- 47+40 RT	203	205																											
-LREV- 47+40 RT	203	206																											
-LREV- 47+77 RT	206											1												1			1		
-LREV- 47+77 RT	206	207																											
-LREV- 47+85 CL	207											1												1			1		
-Y3- 18+16 LT	208	209																											
-Y3- 18+28 LT	209											1												1					1
-Y3- 18+28 RT	209	210																											
SHEET TOTAL											3.5	14	1.15										3	8			5		2

STATION	FROM	TO	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	SIZE	REMARKS
-Y3- 15+37 LT	182	183																						
-Y3- 15+37 LT	182	184																						
-Y3- 15+56 RT	185	186																						
-Y3- 16+20 RT	186						1																	
-Y3- 16+20 RT	186	187																						"L" HEADWALL (STD. 838.05 OR 838.15)
-Y3- 16+20 RT	186	188																				2	400	
-Y3- 16+20 RT	188											1												
-Y3- 16+20 RT	186	189																						
-LREV- 46+01 RT	189																							
-LREV- 46+01 RT	189	190																			16.8	2	400	
-LREV- 45+99 RT	190											1												
-LREV- 45+99 RT	190	191																						
-LREV- 45+98 CL	191																							
-LREV- 46+02 CL	189	194																						METHOD "B" INSTALLATION
-LREV- 45+81 LT	192	193																				1	450	"L" HEADWALL (STD. 838.05 OR 838.15)
-LREV- 46+01 RT	189	195																						
-LREV- 46+80 RT	195																							
-LREV- 46+80 RT	195	196																				2	400	
-LREV- 46+80 RT	196											1												
-LREV- 46+80 RT	195	203																						
-Y3- 16+98 RT	197											1												
-Y3- 16+98 RT	197	198																				2	400	
-LREV- 47+00 LT	199	200																						"L" HEADWALL (STD. 838.05 OR 838.15)
-LREV- 47+17 LT	200						1																	SIDES OPEN
-LREV- 47+17 LT	200	201																						
-LREV- 47+17 LT	202	203																			6.8			
-LREV- 47+40 RT	203																							
-LREV- 47+40 RT	203	204						1	37.2	2.4														
-LREV- 47+40 RT	203	205																						
-LREV- 47+40 RT	203	206																						
-LREV- 47+77 RT	206																							
-LREV- 47+77 RT	206	207																						
-LREV- 47+85 CL	207																							
-Y3- 18+16 LT	208	209																						
-Y3- 18+28 LT	209																							
-Y3- 18+28 RT	209	210																						
SHEET TOTAL							2	1	37.2	2.4		4									22.8	9		

ABBREVIATIONS

- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

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6/20/00

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO. R-977A SHEET NO. 3-H

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 (1.63)	400 (1.63)	450 (1.63)	600 (1.63)	600 (1.63 (UNCOATED))	600 (2.01)	800 (2.01)	800	900 (2.01)	900	1000 (2.77)	1000	1200 (2.77)	1200 (3.51)
-Y3- 18+32 RT	210		520.60	519.79																								
-Y4- 12+53 RT	211		521.53	520.72																								
-Y4- 12+53 LT	211	212		520.72	520.55			32.4																				
-Y4- 12+63 LT	212		521.84	520.55																								
-Y4- 12+63 LT	212	213		520.55	520.00				14.4																			
-Y4- 13+23 RT	214		521.34	520.53																								
-Y4- 13+23 RT	214	215		520.53	515.30			62.4																				
-Y4- 14+37 RT	216	217																										
-LREV- 50+32 RT	218	219		515.00	512.00				81.6 (CL IV)																			
-LREV- 50+30 LT	221	220		517.70	512.00													28.8										
-LREV- 50+51 LT	222	223	522.46	512.00	516.20												19.2											
-LREV- 50+80 RT	224			521.54																								
-LREV- 50+80 RT	224	225		521.54	520.00											13.2												
-LREV- 51+08 LT	226	227		519.98	520.07			30.0																				
-LREV- 51+25 CL	227		521.39	520.07																								
-LREV- 51+25 RT	227	228		520.07	520.20			27.6																				
-LREV- 51+40 RT	228		521.01	520.20																								
-LREV- 52+64 RT	229		519.04	518.23																								
-LREV- 52+64 RT	229	230		518.23	517.89			24.0																				
-LREV- 52+70 CL	230		518.70	517.89																								
-LREV- 52+70 LT	230	231		517.89	517.12			25.2																				
-LREV- 52+76 LT	231		518.01	517.12																								
-LREV- 52+76 LT	231	232		517.12	508.06												55.2											
-LREV- 53+30 LT	232		508.85	508.06																								
-LREV- 53+30 LT	232	234		508.06	504.21													48.0										
-LREV- 53+79 LT	234		505.00	504.21																								
-LREV- 53+79 LT	234	235		504.21	495.78													42.0										
-LREV- 53+30 LT	232	233		508.06	509.40												4.8											
-LREV- 53+63 RT	236	237		499.00	494.30							139 (CL V)																
-LREV- 54+02 LT	238	239		496.23	494.30																							
-LREV- 53+87 RT	240	241		499.25	508.50												30.0											
-LREV- 54+70 RT	242	243		511.50	513.05			34.8																				
-LREV- 54+91 CL	243		513.86	513.05																								
-LREV- 55+49 RT	244		512.92	512.11																								
-LREV- 55+49 RT	244	245		512.11	512.00			7.2																				
-LREV- 56+25 RT	246	247		493.18	495.80																							
SHEET TOTAL								243.6	14.4							13.2	109.2	118.2										
									81.6 (CL IV)			139 (CL V)																

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B') METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-Y3- 18+32 RT										1											1					1
-Y4- 12+53 RT										1											1			1		
-Y4- 12+53 LT																										
-Y4- 12+63 LT										1											1			1		
-Y4- 12+63 LT																										
-Y4- 13+23 RT										1											1			1		
-Y4- 13+23 RT																										
-Y4- 14+37 RT			9.6																							
-LREV- 50+32 RT																										
-LREV- 50+30 LT									2.2																	
-LREV- 50+51 LT									1.6																	
-LREV- 50+80 RT										1											1					
-LREV- 50+80 RT																										
-LREV- 51+08 LT																										
-LREV- 51+25 CL										1											1			1		
-LREV- 51+25 RT																										
-LREV- 51+40 RT										1											1			1		
-LREV- 52+64 RT										1											1			1		
-LREV- 52+64 RT																										
-LREV- 52+70 CL										1											1			1		
-LREV- 52+70 LT																										
-LREV- 52+76 LT										1											1			1		
-LREV- 52+76 LT																										
-LREV- 53+30 LT										1																
-LREV- 53+30 LT																										
-LREV- 53+79 LT										1																
-LREV- 53+79 LT									1.1																	
-LREV- 53+30 LT																										
-LREV- 53+63 RT								2.6																		
-LREV- 54+02 LT										1																
-LREV- 53+87 RT									1.7																	
-LREV- 54+70 RT																										
-LREV- 54+91 CL										1											1			1		
-LREV- 55+49 RT										1											1			1		
-LREV- 55+49 RT																										
-LREV- 56+25 RT										1																
SHEET TOTAL			9.6					2.6	6.6	16											12			10		1

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB, 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	SIZE	REMARKS
-Y3- 18+32 RT																						
-Y4- 12+53 RT																						
-Y4- 12+53 LT																						
-Y4- 12+63 LT																						
-Y4- 12+63 LT																						
-Y4- 13+23 RT																						
-Y4- 13+23 RT																						
-Y4- 14+37 RT																			7.2			
-LREV- 50+32 RT																						
-LREV- 50+30 LT																				1	600	
-LREV- 50+51 LT																				1	450	
-LREV- 50+80 RT										1												
-LREV- 50+80 RT																				2	400	
-LREV- 51+08 LT																						
-LREV- 51+25 CL																						
-LREV- 51+25 RT																						
-LREV- 51+40 RT																						
-LREV- 52+64 RT																						
-LREV- 52+64 RT																						
-LREV- 52+70 CL																						
-LREV- 52+70 LT																						
-LREV- 52+76 LT																						
-LREV- 52+76 LT																						
-LREV- 53+30 LT					1																	
-LREV- 53+30 LT																						
-LREV- 53+79 LT					1																	
-LREV- 53+79 LT																				1	600	
-LREV- 53+30 LT																						
-LREV- 53+63 RT																						METHOD "B" INSTALLATION
-LREV- 54+02 LT						1	68.4	3.6														
-LREV- 53+87 RT																				2	450	"L" HDWL (STD 838.05 OR 838.15) @INLET
-LREV- 54+70 RT																						
-LREV- 54+91 CL																						
-LREV- 55+49 RT																						
-LREV- 55+49 RT																						
-LREV- 56+25 RT						1	80.4	3.6														
SHEET TOTAL					2	2	148.8	7.2		1									7.2	7		

ABBREVIATIONS

- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

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

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6/20/00

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-1

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200
-LREV- 55+84 LT	248	249		493.18	498.14					110.4 (CL IV)				
-LREV- 56+41 RT	249		502.30	498.14										
-LREV- 56+41 RT	249	250		498.14	500.00					37.2				
-LREV- 56+41 RT	249	251		498.14	498.28					28.8				
-LREV- 55+85 LT	252	253		493.18	499.81									
-LREV- 56+13 LT	253		500.45	499.81										
-LREV- 56+13 LT	253	254		499.81	500.81									
-LREV- 56+33 LT	254		501.70	500.81										
-LREV- 56+33 LT	254	255		500.81	502.50									
-LREV- 56+33 LT	254	256		500.81	507.51									
-LREV- 56+61 LT	256		508.05	507.51										
-LREV- 56+61 LT	256	257		507.51	509.09			30.0						
-LREV- 56+70 CL	257		509.90	509.09										
-LREV- 57+71 LT	258		507.21	506.40										
-LREV- 57+71 LT	258	259		506.40	495.40									
-LREV- 57+83 LT	260	261		495.40	497.80					105.6 (CL IV)				
-LREV- 58+14 RT	262		507.01	506.20										
-LREV- 58+14 RT	262	263		506.20	497.80									
-LREV- 57+84 LT	264	265		495.40	504.91									
-LREV- 58+41 LT	265		505.55	504.91										
-LREV- 58+41 LT	265	266		504.91	507.00									
-LREV- 58+41 LT	265	267		504.91	504.97			31.2						
-LREV- 58+60 CL	267		505.78	504.97										
-LREV- 61+18 LT	268	269		498.40	498.28					24.0				
-LREV- 61+27 CL	269		500.04	498.28										
-LREV- 61+27 RT	269	270		498.28	498.05					25.2				
-LREV- 61+36 RT	270		499.65	498.05										
-LREV- 61+36 RT	270	271		498.05	492.57									
-LREV- 61+41 RT	272	273		493.80	492.57									
-LREV- 63+20 RT	274		497.74	496.93										
-LREV- 63+20 RT	274	275		496.93	496.80			9.6						
-LREV- 63+80 CL	276		497.92	497.03										
-LREV- 63+80 RT	276	277		497.03	496.85				18.0					
-LREV- 63+80 RT	277		498.08	496.85										
-LREV- 63+80 RT	277	278		496.85	483.78									
-LREV- 64+34 CL	279	280		496.85	483.78									
SHEET TOTAL								70.8	18.0	115.2				
										216 (CL IV)				

STATION	FROM	TO	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 / 1.63	400 / 1.63	450 / 1.63	600 / 1.63	600 / 1.63 (UNCOATED)	600 / 2.01	800 / 2.01	800	900 / 2.01	900	1000 / 2.77	1000	1200 / 2.77	1200 / 3.51	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)
-LREV- 55+84 LT	248	249																					
-LREV- 56+41 RT	249																						
-LREV- 56+41 RT	249	250																					
-LREV- 56+41 RT	249	251																					
-LREV- 55+85 LT	252	253			31.2																		
-LREV- 56+13 LT	253																						
-LREV- 56+13 LT	253	254			21.6																		
-LREV- 56+33 LT	254																						
-LREV- 56+33 LT	254	255			7.2																		
-LREV- 56+33 LT	254	256		30.0																			
-LREV- 56+61 LT	256																						
-LREV- 56+61 LT	256	257																					
-LREV- 56+70 CL	257																						
-LREV- 57+71 LT	258																						
-LREV- 57+71 LT	258	259		25.2																			
-LREV- 57+83 LT	260	261																					
-LREV- 58+14 RT	262																						
-LREV- 58+14 RT	262	263		43.2																			
-LREV- 57+84 LT	264	265			60.0																		
-LREV- 58+41 LT	265																						
-LREV- 58+41 LT	265	266		7.2																			
-LREV- 58+41 LT	265	267																					
-LREV- 58+60 CL	267																						
-LREV- 61+18 LT	268	269																					
-LREV- 61+27 CL	269																						
-LREV- 61+27 RT	269	270																					
-LREV- 61+36 RT	270																						
-LREV- 61+36 RT	270	271							32.4														
-LREV- 61+41 RT	272	273																					
-LREV- 63+20 RT	274																						
-LREV- 63+20 RT	274	275																					
-LREV- 63+80 CL	276																						
-LREV- 63+80 RT	276	277																					
-LREV- 63+80 RT	277																						
-LREV- 63+80 RT	277	278			33.6																		
-LREV- 64+34 CL	279	280														133.2							
SHEET TOTAL				105.6	153.6				32.4							133.2							

STATION	FROM	TO	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE *TOTAL M FOR PAY QUANTITY SHALL BE COL. 'A' + (1.3 X COL. 'B') METERS A 1.50 THRU 3.00	METERS B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-LREV- 55+84 LT	248	249																			
-LREV- 56+41 RT	249				1	1.50	1.16														
-LREV- 56+41 RT	249	250																			
-LREV- 56+41 RT	249	251																			
-LREV- 55+85 LT	252	253																			
-LREV- 56+13 LT	253				1																
-LREV- 56+13 LT	253	254																			
-LREV- 56+33 LT	254				1											1			1		
-LREV- 56+33 LT	254	255																			
-LREV- 56+33 LT	254	256																			
-LREV- 56+61 LT	256				1																
-LREV- 56+61 LT	256	257																			
-LREV- 56+70 CL	257				1											1			1		
-LREV- 57+71 LT	258				1											1			1		
-LREV- 57+71 LT	258	259		0.5																	
-LREV- 57+83 LT	260	261	1.8																		
-LREV- 58+14 RT	262				1											1			1		
-LREV- 58+14 RT	262	263		0.5																	
-LREV- 57+84 LT	264	265		0.8																	
-LREV- 58+41 LT	265				1																
-LREV- 58+41 LT	265	266																			
-LREV- 58+41 LT	265	267																			
-LREV- 58+60 CL	267				1											1			1		
-LREV- 61+18 LT	268	269																			
-LREV- 61+27 CL	269				1	0.26										1			1		
-LREV- 61+27 RT	269	270																			
-LREV- 61+36 RT	270				1	0.10									1				1		
-LREV- 61+36 RT	270	271		1.5																	
-LREV- 61+41 RT	272	273			1																
-LREV- 63+20 RT	274				1											1			1		
-LREV- 63+20 RT	274	275																			
-LREV- 63+80 CL	276				1											1			1		
-LREV- 63+80 RT	276	277																			
-LREV- 63+80 RT	277				1											1					
-LREV- 63+80 RT	277	278		0.8																	
-LREV- 64+34 CL	279	280		3.7																	
SHEET TOTAL			1.8	7.8	15	1.86	1.16								1	9			9		

STATION	FROM	TO	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	SIZE	REMARKS
-LREV- 55+84 LT	248	249																						METHOD "B" INSTALLATION
-LREV- 56+41 RT	249						1																	
-LREV- 56+41 RT	249	250																						
-LREV- 56+41 RT	249	251																						
-LREV- 55+85 LT	252	253																						
-LREV- 56+13 LT	253						1																	
-LREV- 56+13 LT	253	254																						
-LREV- 56+33 LT	254																							
-LREV- 56+33 LT	254	255																				1	450	
-LREV- 56+33 LT	254	256																						
-LREV- 56+61 LT	256						1																	
-LREV- 56+61 LT	256	257																						
-LREV- 56+70 CL	257																							
-LREV- 57+71 LT	258																							
-LREV- 57+71 LT	258	259																				2	400	
-LREV- 57+83 LT	260	261																						METHOD "B" INSTALLATION
-LREV- 58+14 RT	262																							
-LREV- 58+14 RT	262	263																				1	400	
-LREV- 57+84 LT	264	265																						
-LREV- 58+41 LT	265						1																	
-LREV- 58+41 LT	265	266																				1	400	
-LREV- 58+41 LT	265	267																						
-LREV- 58+60 CL	267																							
-LREV- 61+18 LT	268	269																						
-LREV- 61+27 CL	269																							
-LREV- 61+27 RT	269	270																						
-LREV- 61+36 RT	270																							
-LREV- 61+36 RT	270	271																				1	800	
-LREV- 61+41 RT	272	273						1	33.6	3.6														
-LREV- 63+20 RT	274																							
-LREV- 63+20 RT	274	275																						
-LREV- 63+80 CL	276																							
-LREV- 63+80 RT	276	277																						
-LREV- 63+80 RT	277											1												
-LREV- 63+80 RT	277	278																				2	450	
-LREV- 64+34 CL	279	280																			33.6	6	1200	15° ELBOWS; METHOD "B" INSTALL. W/BEVELED "L" HDWL)
SHEET TOTAL							4	1	33.6	3.6		1									33.6	14		

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

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

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6/20/00

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-J

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

ABBREVIATIONS
- C.B. CATCH BASIN
- N.D.I. NARROW DROP INLET
- D.I. DROP INLET
- M.D.I. MEDIAN DROP INLET
- M.D.I. (N.S.) MEDIAN DROP INLET (NARROW SLOT)
- J.B. JUNCTION BOX
- M.H. MANHOLE
- T.B.D.I. TRAFFIC BEARING DROP INLET
- T.B.J.B. TRAFFIC BEARING JUCTION BOX

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 / 1.63	400 / 1.63	450 / 1.63	600 / 1.63	600 / 1.63 (UNCOATED)	2.01	800 / 2.01	800	900 / 2.01	900	1000 / 2.77	1000	1200 / 2.77	1200 / 3.51
LREV- 63+83 RT	281	282		483.73	483.83												9.6											
LREV- 63+93 RT	282		484.57	483.83																								
LREV- 63+93 RT	282	283		483.83	485.50												4.8											
LREV- 93+92 RT	282	284		483.83	487.11			18.0									40.8											
LREV- 64+33 RT	284		487.75	487.11																								
LREV- 64+33 RT	284	285		487.11	496.06											42.0												
LREV- 64+69 RT	285		497.33	496.06					30.0																			
LREV- 64+69 RT	285	286		496.06	496.43																							
LREV- 64+69 RT	286		497.24	496.43																								
LREV- 67+01 CL	287		495.32	494.43																								
LREV- 67+01 RT	287	288		494.43	493.26																							
LREV- 67+19 RT	288		494.71	493.26				25.2																				
LREV- 67+19 RT	288	289		493.26	477.30													57.6										
LREV- 68+01 RT	290	291																10.8										
LREV- 69+71 RT	295	296		477.30	478.30													12.0										
LREV- 69+73 LT	292	293		492.64	492.50																							
LREV- 69+81 RT	293		493.53	492.50																								
LREV- 69+81 RT	293	294		492.50	478.30												36.0											
LREV- 70+06 RT	297	298																										
LREV- 70+58 CL	299		492.83	491.74																								
LREV- 70+58 RT	299	290		491.74	491.69				18.0																			
LREV- 70+58 RT	300		493.63	491.69																								
LREV- 70+58 RT	300	301		491.69	480.70												39.6											
LREV- 71+20 RT	302	303																										
LREV- 71+31 RT	304	305		486.55	492.95											30.0												
LREV- 71+26 RT	305		493.87	492.95																								
LREV- 72+05 RT	306		494.95	494.03																								
LREV- 72+05 RT	306	307		494.03	490.90											13.2												
LREV- 72+19 RT	308	309		486.50	487.50																			16.8				
LREV- 72+26 RT	310	311		488.90	492.04						72.0																	
Y5- 12+41 RT	312	313		493.70	494.36					44.4																		
LREV- 74.41 RT	314	315		495.90	496.80				14.4																			
LREV- 74+50 RT	315		497.69	496.80																								
LREV- 74+50 RT	315	316		496.80	496.94				22.8																			
LREV- 74+57 CL	316		497.95	496.94																								
LREV- 76+40 RT	317	318		508.30	500.82											20.4												
SHEET TOTAL								43.2	85.2	44.4	72.0					105.6	130.8	80.4						16.8				

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B')" METERS A 1.50 THRU 3.00	METERS B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G		D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
LREV- 63+83 RT																											
LREV- 63+93 RT										1																	
LREV- 63+93 RT																											
LREV- 93+92 RT																											
LREV- 64+33 RT										1																	
LREV- 64+33 RT																											
LREV- 64+69 RT										1												1					
LREV- 64+69 RT																											
LREV- 64+69 RT										1												1			1		
LREV- 67+01 CL										1												1			1		
LREV- 67+01 RT																											
LREV- 67+19 RT										1											1			1	1		
LREV- 67+19 RT									1.1																		
LREV- 68+01 RT																											
LREV- 69+71 RT									1.1																		
LREV- 69+73 LT																											
LREV- 69+81 RT										1												1					
LREV- 69+81 RT																											
LREV- 70+06 RT				9.6																							
LREV- 70+58 CL										1											1			1	1		
LREV- 70+58 RT																											
LREV- 70+58 RT										1	0.44											1				1	
LREV- 70+58 RT																											
LREV- 71+20 RT			7.2																								
LREV- 71+31 RT																											
LREV- 71+26 RT										1												1					
LREV- 72+05 RT										1												1					
LREV- 72+05 RT																											
LREV- 72+19 RT																											
LREV- 72+26 RT																											
Y5- 12+41 RT																											
LREV- 74.41 RT																											
LREV- 74+50 RT										1												1			1		
LREV- 74+50 RT																											
LREV- 74+57 CL										1												1			1		
LREV- 76+40 RT																											
SHEET TOTAL			7.2	9.6					2.2	13	0.44										2	9		2	6	1	

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
LREV- 63+83 RT																						
LREV- 63+93 RT					1																	
LREV- 63+93 RT																				1	450	
LREV- 93+92 RT																						
LREV- 64+33 RT					1																	
LREV- 64+33 RT																						
LREV- 64+69 RT										1												
LREV- 64+69 RT																						
LREV- 64+69 RT																						
LREV- 67+01 CL																						
LREV- 67+01 RT																						
LREV- 67+19 RT																						3GI
LREV- 67+19 RT																				2	600	
LREV- 68+01 RT													1						10.8			TEMP. PIPE AND RISER
LREV- 69+71 RT															1							
LREV- 69+73 LT																	0.03					
LREV- 69+81 RT										1												
LREV- 69+81 RT																				2	450	
LREV- 70+06 RT																						
LREV- 70+58 CL																						3GI
LREV- 70+58 RT																						
LREV- 70+58 RT																						
LREV- 70+58 RT																				2	450	
LREV- 71+20 RT																						
LREV- 71+31 RT																				2	400	
LREV- 71+26 RT										1												
LREV- 72+05 RT										1												
LREV- 72+05 RT																				2	400	
LREV- 72+19 RT											1											PERMANENT
LREV- 72+26 RT																						
Y5- 12+41 RT																						
LREV- 74.41 RT																						
LREV- 74+50 RT																						
LREV- 74+50 RT																			13.2			
LREV- 74+57 CL																						
LREV- 76+40 RT																				1	400	
SHEET TOTAL					2					4	1		1		1		0.03		24.0	12		

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

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COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-K

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION / SIZE / THICKNESS OR GAUGE	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 1.63	400 1.63	450 1.63	600 1.63	600 1.63 (UNCOATED)	600 2.01	800 2.01	800	900 2.01	900	1000 2.77	1000	1200 2.77	1200 3.51
-LREV- 76+40 RT	318		501.71	500.82																								
-LREV- 76+40 RT	318	319		500.82	498.23				67.2																			
-LREV- 76+08 LT	320	321		497.84	498.00							55.2																
-LREV- 76+65 LT	321		499.75	498.00																								
-LREV- 76+65 LT	321	322		498.00	503.00												13.2											
-LREV- 76+65 LT	321	323		498.00	500.66							70.8																
-LREV- 77+11 RT	323		502.41	500.66																								
-LREV- 77+11 RT	323	324		500.66	501.75						19.2																	
-Y6- 16+12 RT	325	326		506.07	503.73											8.4												
-Y6- 16+11 RT	326		504.62	503.73																								
-Y6- 16+11 RT	326	327		503.73	502.50				30.0																			
-LREV- 77+11 RT	323	328		500.66	502.93					122.4																		
-LREV- 78+30 RT	328		504.57	502.93																								
-LREV- 78+30 RT	328	329		502.93	503.17				25.2																			
-LREV- 78+40 CL	329		504.42	503.17																								
-LREV- 78+30 RT	328	330		502.93	505.98					133.2																		
-LREV- 79+60 RT	330		507.98	505.98																								
-LREV- 79+60 RT	330	331		505.98	519.08												28.8											
-LREV- 79+60 RT	330	332		505.98	506.17				25.2																			
-LREV- 79+70 CL	332		507.34	506.17																								
-LREV- 79+60 RT	330	333		505.98	509.44			122.4																				
-LREV- 80+80 RT	333		510.25	509.44																								
-LREV- 80+80 RT	333	334		509.44	533.00											49.2												
-LREV- 81+59 CL	335		511.72	510.91																								
-LREV- 81+59 LT	335	336		510.91	506.00											32.4												
-Y8- 10+52 LT	337	338																										
-LREV- 81+63 LT	339	340		505.60	506.00																							
-LREV- 83+00 CL	343		515.20	513.70																								
-LREV- 83+00 RT	343	344		513.70	510.30				33.6																			
-Y9REV- 10+49 RT	345	346		510.45	511.05									64.8														
-Y9REV- 10+70 RT	347	348															15.6											
-Y9REV- 11+16 LT	349	350																										
-LREV- 84+35 RT	353	354		514.20	514.50																							
-LREV- 84+40 RT	355	356		514.70	521.45													49.2										
-LREV- 84+87 RT	356		522.00	521.45																								
-LREV- 84+87 RT	356	357		521.45	522.40													34.8										
SHEET TOTAL								122.4	181.2	255.6	19.2	126.0		64.8		90.0	57.6	84.0										

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE *TOTAL M FOR PAY QUANTITY SHALL BE COL. 'A' + (1.3 X COL. 'B') METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G		D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-LREV- 76+40 RT										1												1			1		
-LREV- 76+40 RT																											
-LREV- 76+08 LT																											
-LREV- 76+65 LT										1	0.25										1			1	1		
-LREV- 76+65 LT																											
-LREV- 76+65 LT																											
-LREV- 77+11 RT										1	0.25										1				1		
-LREV- 77+11 RT																											
-Y6- 16+12 RT																											
-Y6- 16+11 RT										1												1			1		
-Y6- 16+11 RT																											
-LREV- 77+11 RT																											
-LREV- 78+30 RT										1	0.14										1				1		
-LREV- 78+30 RT																											
-LREV- 78+40 CL										1												1			1		
-LREV- 78+30 RT																											
-LREV- 79+60 RT										1											1				1		
-LREV- 79+60 RT																											
-LREV- 79+60 RT																											
-LREV- 79+70 CL										1												1			1		
-LREV- 79+60 RT																											
-LREV- 80+80 RT										1												1			1		
-LREV- 80+80 RT																											
-LREV- 81+59 CL										1												1			1		
-LREV- 81+59 LT									0.50																		
-Y8- 10+52 LT			9.6																								
-LREV- 81+63 LT										1																	
-LREV- 83+00 CL										1												1			1		
-LREV- 83+00 RT																											
-Y9REV- 10+49 RT								6.10																			
-Y9REV- 10+70 RT																											
-Y9REV- 11+16 LT			18.0																								
-LREV- 84+35 RT										1																	
-LREV- 84+40 RT																											
-LREV- 84+87 RT										1																	
-LREV- 84+87 RT									1.30																		
SHEET TOTAL			28					6.10	1.80	14	0.64											4	7		1	11	

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB, 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	SIZE	REMARKS
-LREV- 76+40 RT																						
-LREV- 76+40 RT																						
-LREV- 76+08 LT																						
-LREV- 76+65 LT																						3GI
-LREV- 76+65 LT																				1	450	
-LREV- 76+65 LT																						
-LREV- 77+11 RT																						
-LREV- 77+11 RT																			15.6			
-Y6- 16+12 RT																				1	400	
-Y6- 16+11 RT																						
-Y6- 16+11 RT																						
-LREV- 77+11 RT																						
-LREV- 78+30 RT																						
-LREV- 78+30 RT																						
-LREV- 78+40 CL																						
-LREV- 78+30 RT																						
-LREV- 79+60 RT																						
-LREV- 79+60 RT																				1	450	
-LREV- 79+60 RT																						
-LREV- 79+70 CL																						
-LREV- 79+60 RT																						
-LREV- 80+80 RT																						
-LREV- 80+80 RT																				1	400	
-LREV- 81+59 CL																						
-LREV- 81+59 LT																				2	400	
-Y8- 10+52 LT																						
-LREV- 81+63 LT							1	33.6	2.4													
-LREV- 83+00 CL																						
-LREV- 83+00 RT																						
-Y9REV- 10+49 RT																			30.0			2 - 1200mm @ 32.4m
-Y9REV- 10+70 RT																						
-Y9REV- 11+16 LT																			25.2			
-LREV- 84+35 RT							1	15.6	2.4													
-LREV- 84+40 RT																				1	600	
-LREV- 84+87 RT						1																
-LREV- 84+87 RT																				1	600	"L" HDWL (STD. 838.05 OR 838.15)
SHEET TOTAL						1	2	49.2	4.8										70.8	8		

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

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COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-L

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 1.63	400 1.63	450 1.63	600 1.63	600 1.63 (UNCOATED)	2.01	800 2.01	800	900 2.01	900	1000 2.77	1000	1200 2.77	1200 3.51
-LREV- 85+43 RT	358	359		523.21	523.30																							
-LREV- 85+03 LT	362	363		516.80	518.80																							
-LREV- 85+05 LT	364	365		516.90	521.88													36.0										
-LREV- 85+39 LT	365		523.33	521.88																								
-LREV- 85+39 LT	365	366		521.88	522.37					24.0																		
-LREV- 85+39 CL	366		523.82	522.37																								
-LREV- 85+39 CL	366	367		522.37	526.37					130.8																		
-LREV- 86+70 CL	367		529.71	526.37																								
-LREV- 86+70 LT	367	368		526.37	526.52					30.0																		
-LREV- 50+55 LT	369	370		510.37	511.37													12.0										
-Y6REV- 8+35 RT	371	372																										
-Y6REV- 8+80 LT	373	374		495.66	495.39											6.0												
-Y6REV- 8+86 LT	374		496.28	495.39																								
-Y6REV- 8+86 LT	374	375		495.39	495.94										6.0													
-Y6REV- 8+85 LT	375		496.85	495.94													37.2											
-Y6REV- 8+86 LT	374	376		495.39	495.21																							
-Y6REV- 9+81 RT	377	378																										
-Y7REV- 75+91 LT	379	380																										
-Y7REV- 75+98 RT	381	382																										
-Y6REV- 11+09 LT	383																											
-Y6REV- 11+06 RT	384		496.05	495.14																								
-Y6REV- 11+06 RT	384	385		495.14	493.48		42.0																					
-Y6REV- 11+48 RT	385		494.77	493.48																								
-Y6REV- 11+48 RT	385	386		493.48	493.57						24.0																	
-Y6REV- 11+42 LT	386		494.79	493.57																								
-Y6REV- 11+42 LT	386	387		493.57	495.09																10.8							
-Y6REV- 11+48 RT	385	388		493.48	495.10						14.4																	
-Y6REV- 11+53 RT	388		494.32	493.10																								
-Y6REV- 11+53 RT	388	389		493.10	492.88						12.0																	
-Y6REV- 11+54 RT	389		494.28	492.88																								
-Y6REV- 11+54 RT	389	390		492.88	492.78					16.8																		
-Y6REV- 11+55 RT	390		493.58	492.78																								
-Y6REV- 11+73 LT	391	392																										
-Y10- 10+00 LT	397		493.47	491.47																								
-Y10- 10+00 LT	399	400		492.17	491.42									18.0														
-Y6- 13+73 LT	401	402																										
SHEET TOTAL							42.0			201.6	50.4			18.0	6.0	6.0	37.2	48.0			10.8							

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-F)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B')" METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G		D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
-LREV- 85+43 RT					15.6																						
-LREV- 85+03 LT										1																	
-LREV- 85+05 LT																											
-LREV- 85+39 LT										1											1				1		
-LREV- 85+39 LT																											
-LREV- 85+39 CL										1											1				1		
-LREV- 85+39 CL																											
-LREV- 86+70 CL										1	1.50	0.34									1				1		
-LREV- 86+70 LT																											
-LREV- 50+55 LT																											
-Y6REV- 8+35 RT			9.6																								
-Y6REV- 8+80 LT																											
-Y6REV- 8+86 LT										1												1					1
-Y6REV- 8+86 LT																											
-Y6REV- 8+85 LT										1									1	1							
-Y6REV- 8+86 LT																											
-Y6REV- 9+81 RT			7.2																								
-Y7REV- 75+91 LT			9.6																								
-Y7REV- 75+98 RT			8.4																								
-Y6REV- 11+09 LT																											
-Y6REV- 11+06 RT										1				1		1											
-Y6REV- 11+06 RT																											
-Y6REV- 11+48 RT										1												1					1
-Y6REV- 11+48 RT																											
-Y6REV- 11+42 LT										1												1					1
-Y6REV- 11+42 LT																											
-Y6REV- 11+48 RT																											
-Y6REV- 11+53 RT										1												1					1
-Y6REV- 11+53 RT																											
-Y6REV- 11+54 RT										1									1	1							
-Y6REV- 11+54 RT																											
-Y6REV- 11+55 RT																											
-Y6REV- 11+73 LT			8.4																								
-Y10- 10+00 LT										1	0.50																
-Y10- 10+00 LT																											
-Y6- 13+73 LT			8.4																								
SHEET TOTAL			51.6		15.6					12	2.00	0.34		1		1			2	2	3	4			3		4

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
-LREV- 85+43 RT																			13.2			
-LREV- 85+03 LT						1	49.2	2												1	150	
-LREV- 85+05 LT																						
-LREV- 85+39 LT																						
-LREV- 85+39 LT																						
-LREV- 85+39 CL																			15.6			
-LREV- 85+39 CL																						
-LREV- 86+70 CL																						
-LREV- 86+70 LT																						
-LREV- 50+55 LT													1									PERMANENT
-Y6REV- 8+35 RT																			8.4			
-Y6REV- 8+80 LT																						
-Y6REV- 8+86 LT																						
-Y6REV- 8+86 LT																						
-Y6REV- 8+85 LT																						
-Y6REV- 8+86 LT																			25.2			
-Y6REV- 9+81 RT																						
-Y7REV- 75+91 LT																			10.8			
-Y7REV- 75+98 RT																						
-Y6REV- 11+09 LT																	0.02					
-Y6REV- 11+06 RT																						
-Y6REV- 11+06 RT																						
-Y6REV- 11+48 RT																						
-Y6REV- 11+48 RT																			10.8			
-Y6REV- 11+42 LT																						
-Y6REV- 11+42 LT																			20.4			
-Y6REV- 11+48 RT																						
-Y6REV- 11+53 RT																						
-Y6REV- 11+53 RT																			27.6			
-Y6REV- 11+54 RT																						REMOVE AND REPLACE EXISTING D.I.
-Y6REV- 11+54 RT																						
-Y6REV- 11+55 RT																		1				
-Y6REV- 11+73 LT																						
-Y10- 10+00 LT	1			1																		
-Y10- 10+00 LT																						(SEE STRUCTURE NO. 397–398)
-Y6- 13+73 LT																						
SHEET TOTAL	1			1		1	49.2	2					1				0.02	1	132	1.00		

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

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

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COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-M

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 1.63	400 1.63	450 1.63	600 1.63	600 1.63 (UNCOATED)	2.01	800 2.01	800	900 2.01	900	1000 2.77	1000	1200 2.77	1200 3.51
-YIDET- 15+06 RT																												
-LREV- 81+03 LT																												
-LREV- 82+35 RT																												
-LREV- 82+43 RT																												
SHEET TOTAL																												

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL 'A' + (1.3 X COL 'B') METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
-YIDET- 15+06 RT																																												1.2			
-LREV- 81+03 LT																																												12.0			
-LREV- 82+35 RT																																												17.0			
-LREV- 82+43 RT																																												6.0			
SHEET TOTAL																																												36.2			

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

6/20/00
$$$$$SYSTIME$$$$$ $$$$$$$$$$$$$$$$DGN$$$$$$$$$$$$$$$$ $$$$USERNAME$$$$
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6/20/00

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO. R-977A | SHEET NO. 3-N

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1200 mm & UNDER)

STATION / SIZE / THICKNESS OR GAUGE	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 300	375	450	600	750	900	1050	1200	BITUMINOUS COATED C.S. PIPE TYPE B (UNLESS NOTED OTHERWISE) 300 1.63	400 1.63	450 1.63	600 1.63	600 1.63 (UNCOATED)	600 2.01	800 2.01	800 3.51	900 2.01	900	1000 2.77	1000	1200 2.77	1200 3.51
SHEET 3-A TOTAL							2.4	60.0	15.6							147.6	122.4	44.4		30.0		58.8						
										70.8 (CL IV)																		
SHEET 3-B TOTAL								88.8	78.0	37.2		103.2		153.6		37.2	46.8	37.2			18.0	78.0						
SHEET 3-C TOTAL								130.8	100.8	100.8	194.4					9.6	57.8											
SHEET 3-D TOTAL								36.0	46.8	39.6						117.5	174.0	31.2			102.0							
SHEET 3-E TOTAL								60.0		192.0						33.6	68.8				150.0							10.8
										170.4 (CL IV)																		
SHEET 3-F TOTAL								121.2	13.2	51.6				61.2		103.2	151.2	12.0										
								74.4 (CL IV)																				
SHEET 3-G TOTAL								88.8	147.6		138.0	96.0				58.8	70.8											
										146.4 (CL IV)																		
SHEET 3-H TOTAL								243.6	14.4							13.2	109.2	118.9										
									81.6 (CL IV)		139.2 (CL IV)																	
SHEET 3-I TOTAL								70.8	18.0	115.2						105.6	153.6				32.4							133.2
										216 (CL IV)																		
SHEET 3-J TOTAL								43.2	85.2	44.4	72.0					105.6	130.8	80.4					16.8					
SHEET 3-K TOTAL								122.4	181.2	255.6	19.2	126.0		64.8		90.0	57.6	84.0										
SHEET 3-L TOTAL							42.0			201.6	50.4			18.0	6.0	6.0	37.2	48.0			10.8							
SHEET 3-M TOTAL																												
GRAND TOTAL ALL SHEETS							44.4	1065.6	700.8	1038.0	474.0	325.2		297.6	6.0	828.0	1200.0	456.0		30.0	313.2	78.0	75.6					144.0
						CL IV/V SUMMARY			74.4	81.6	603.6	139.2																

STATION	150mm PERFORATED HDPE PIPE	600 BORE AND JACK	375mm SIDE DRAIN PIPE	450mm SIDE DRAIN PIPE	600mm SIDE DRAIN PIPE	900mm SIDE DRAIN PIPE	MODIFIED CONCRETE FLUME (SEE SHEET 2-P)	ENDWALLS STD. 838.01 OR STD. 838.11 (UNLESS NOTED OTHERWISE) R.C.P. (CM)	C.S.P. (CM)	QUANTITIES: STRUCTURES PER EACH (0 THRU 1.50)	FOR DRAINAGE "TOTAL M FOR PAY QUANTITY SHALL BE COL. 'A' + (1.3 X COL. 'B')" METERS A 1.50 THRU 3.00	B 3.00 AND ABOVE	375 x 375 x 375 TEE	C.B. STD. 840.01 OR 840.02	FRAME, GRATES, AND HOOD STD. 840.03 TYPE OF GRATE E	F	G		D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME & GRATE STD. 840.16	M.D.I. TYPE "A" STD. 840.17 OR 840.26	M.D.I. TYPE "B" STD. 840.18 OR 840.27	M.D.I. TYPE "D" STD. 840.19 OR 840.28	M.D.I. FRAME WITH GRATE STD. 840.20	M.D.I. FRAME WITH TWO GRATES STD. 840.22	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.29	M.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24
SHEET 3-A TOTAL									4.6	13.0				2		1	1		2	2		5			5		
SHEET 3-B TOTAL							2	4.6	2.7	14.0	4.67	0.48									5	7			10	2	
SHEET 3-C TOTAL							1		0.8	18.0	0.86										4	13			17		
SHEET 3-D TOTAL			13.2						1.8	14.0	0.10										1	6			7		
SHEET 3-E TOTAL							1	11.6	3.4	13.0	3.16										7	6			12		1
SHEET 3-F TOTAL						9.6			0.8	15.0	2.07											10	2	1	7		3
SHEET 3-G TOTAL									3.5	14.0	1.15										3	8			5		2
SHEET 3-H TOTAL			9.6					2.6	6.6	16.0												12			10		1
SHEET 3-I TOTAL								1.8	7.8	15.0	1.86	1.16									1	9			9		
SHEET 3-J TOTAL			7.2	9.6					2.2	13.0	0.44										2	9		2	6	1	
SHEET 3-K TOTAL			27.6					6.1	1.8	14.0	0.64										4	7		1	11		
SHEET 3-L TOTAL			51.6		15.6					12.0	2.00	0.34		1		1			2	2	3	4			3		4
SHEET 3-M TOTAL																											
GRAND TOTAL ALL SHEETS			109.2	9.6	15.6	9.6	4	26.7	36.0	171	16.95	1.98		3		2	1		4	4	30	96	2	4	102	3	11

STATION	J.B. STD. 840.31 OR 840.32	T.B.J.B. STD. 840.34	M.H. STD. 840.51, 840.52, OR 840.53	M.H. FRAME & COVER STD. 840.54	O.T.C.B. STD. 840.04 OR 840.05	SPRING BOX STD. 840.41	150mm C.S. Pipe, 1.63mm THICK (SPRING BOX)	PERFORATED 150mm C.S. Pipe STUB. 1.63mmTHICK	T.B.D.I. STD. 840.35	M.D.I. FRAME WITH TWO GRATES STD. 840.33 (ANGLE VANE)	900 x 900 x 900mm PERF C.S.P. TEE RISER 2.01mm THICK	800 x 800 x 800mm PERF C.S.P. TEE RISER 2.01mm THICK	600 x 600 x 600mm PERF C.S.P. TEE RISER 1.63mm THICK	450 x 450 x 450mm PERF C.S.P. TEE RISER 1.63mm THICK	SLUISE GATE (FOR 600 C.S.P.)	CONC. COLLARS CL. "A" CM STD 840.72	CONC. & BRICK PIPE PLUG C.M. STD. 840.71	ADJUST EXISTING D.I.	PIPE REMOVAL (LINEAR METER	C.S. ELBOWS NO.	C.S. ELBOWS SIZE	REMARKS
SHEET 3-A TOTAL	1	1	1	2		1	10.8	2							1	0.33			95.0	12		
SHEET 3-B TOTAL	2			1							1								42.0	10		
SHEET 3-C TOTAL																				6		
SHEET 3-D TOTAL					5	2	8.4	56				1	1							13		
SHEET 3-E TOTAL																			32.4	5		
SHEET 3-F TOTAL	1			1	2					2				1					138.0	8		
SHEET 3-G TOTAL					2	1	37.2	2		4									22.8	9		
SHEET 3-H TOTAL					2	2	148.8	7		1									7.2	7		
SHEET 3-I TOTAL					4	1	33.6	4		1									33.6	14		
SHEET 3-J TOTAL					2					4	1		1		1		0.03		24.0	12		
SHEET 3-K TOTAL					1	2	49.2	5											70.8	8		
SHEET 3-L TOTAL	1			1		1	49.2	2					1					1	132.0	1		
SHEET 3-M TOTAL																			36.2			
GRAND TOTAL ALL SHEETS	5	1	1	5	18	10		79		12	2	1	3	1	2	0.33	0.03	1	634.2	105		
							337.2															

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

COMPUTED BY: C.M.W DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

METRIC

PROJECT REFERENCE NO.	SHEET NO.
R-977A	3-0

LIST OF PIPES, ENDWALLS, ETC. (FOR PIPES 1350 mm & OVER)

STATION	LOCATION (LT, RT, OR CL)	STRUCTURE NO. FROM	STRUCTURE NO. TO	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE) 1350	1500	1650	1800	1950	2100	BITUMINOUS COATED C.S. PIPE TYPE B 1400 2.77	1400 3.51	1400 4.27	1500 2.77	1500 3.51	1650	1650	2200	2200	SHOP ELONGATED	STRUCTURAL PLATE PIPE 1500 2.77	1500 3.51	1500 4.27	1650 2.77	1650 3.51	1650 4.27	1800 2.77	1800 3.51	1800 4.27	REINFORCED ENDWALLS CLASS "A" CONC. WITH R.C. cu. m.	WITH C.S. cu. m.	SPECIAL JB (SEE DETAIL SHEETS 2-M & 2-N)	M.H. FRAME &COVER STD. 840.54	REINF. CONC. FLARED END SECTION NO. & SIZE	CORR. STEEL FLARED END SECTIONS NO. & SIZE	REINF. CONC. ELBOWS NO. & SIZE	CORR. STEEL ELBOWS NO. & SIZE	CONC. COLLARS, CL. "B" m^3 STD.840.72	PIPE REMOVAL (meters)	REMARKS
SIZE																																												
THICKNESS OR GAUGE																																												
-LREV- 82+10	CL	341	342		506.60	507.87			111.6																								4.3										
-LREV- 84+20	RT	351	352		512.60	513.82											22.8																										75X25mm CORR; CONN. TO EXIST PIPE
-LREV- 84+70	LT	360	361		514.66	515.40											37.2																	4.3									75X25mm CORR; CONN. TO EXIST PIPE; REMOVE EXIST HDWL
-Y8- 12+74	LT	393	394		493.00	492.86				6.0																							4.8										EXTEND EXISTING PIPE
-Y8- 12+74	LT	394		494.70	492.66																														1	1							
-Y8- 12+70	RT	395		494.50	492.62																																						SEE DETAIL 2-K (FOR HDWL)
-Y8- 12+70	RT	395	396		492.62	492.55			6.0												9.6													7.2									
-Y8- 10+00	LT	397	398		491.92	491.42																																					TWO HDWL'S SEE DETAIL 2-L (SEE STRUC. NO. 399-400)
TOTAL									117.6	6.0							60.0				9.6												9.1	11.5	1	1							

ABBREVIATIONS

C.B.	CATCH BASIN
N.D.I.	NARROW DROP INLET
D.I.	DROP INLET
M.D.I.	MEDIAN DROP INLET
M.D.I. (N.S.)	MEDIAN DROP INLET (NARROW SLOT)
J.B.	JUNCTION BOX
M.H.	MANHOLE
T.B.D.I.	TRAFFIC BEARING DROP INLET
T.B.J.B.	TRAFFIC BEARING JUCTION BOX

ASPHALT PAVEMENT REMOVAL SUMMARY

LINE	STATION TO STATION	SQUARE METERS	COMMENTS
-Y1DET-	13+76 TO 14+92	722	TEMPORARY PAVEMENT
-Y1REV- (RT)	10+73 TO 12+50	895	INCLUDES TEMPORARY PAVEMENT
-Y3- (LT)	15+65 TO 15+81	28	
-LREV- (LT)	47+17 TO 47+88	804	ABANDONED SR 1558
-LREV- (RT)	47+89 TO 48+15	212	ABANDONED SR 1558
-LREV- (RT)	48+65	91	ABANDONED SR 1558
-LREV- (RT)	74+65	105	ABANDONED SR 1549
-LREV- (LT)	74+70	430	ABANDONED SR 1549
-LREV-	DISTRESSED PAVEMENT	210	(PER NCDOT GEOLOGY UNIT - SEE TYPICAL SECTION NO. 7)
-Y8-	10+53 TO 11+53	619	
-Y7-	75+08 TO 75+76	515	
-Y6REV- (RT)	11+69 TO 12+26	322	ABANDONED SR 1549
	TOTAL	4953	
	SAY	5000	

PIPE REMOVAL SUMMARY

LINE	STATION	METERS	LINE	STATION	METERS
-LC1B-	10+20 (RT)	SAY 15.0			
-LC1B-	12+80 (LT)	13.2	-LREV-	74+65 (RT)	12.0
-Y1C1B-	10+29	18.0	-Y6-	15+49	15.6
-LC1B-	15+15 (RT)	6.0	-LREV-	82+30 (RT)	17.0
-Y1C1B-	12+65	10.8	-LREV-	83+25 (RT)	7.2
-Y3-	10+49	20.4	-LREV-	83+35 (RT)	19.2
-Y3-	11+64	10.8	-Y9REV-	10+75 (RT)	25.2
-Y3-	11+80 (RT)	57.6	-LREV-	85+45 (LT)	15.6
-Y3-	13+00 (RT)	58.8	-LREV-	85+50 (RT)	13.2
-Y3-	13+95 (RT)	8.4	-Y7REV-	75+95 (LT)	10.8
-LREV-	45+93 (RT)	15.6	-Y1DET-	15+05 (RT)	9.6
-LREV-	47+05	7.2			
-Y4-	14+40 (RT)	7.2			
-LREV-	64+45 (LT)	18.0			
-LREV-	64+50 (LT)	8.4			
-LREV-	64+52 (LT)	6.0			
-LREV-	68+00 (RT)	9.6			
				TOTAL	437.4
				SAY	452.4

"N" = DISTANCE FROM EDGE OF LANE TO FACE OF GUARDRAIL.
TOTAL SHOULDER WIDTH = DISTANCE FROM EDGE OF TRAVEL LANE TO SHOULDER BREAK POINT.
FLARE LENGTH = DISTANCE FROM LAST SECTION OF PARALLEL GUARDRAIL TO END OF GUARDRAIL.
W = TOTAL WIDTH OF FLARE FROM BEGINNING OF FLARE TO END OF FLARE.

TEMPORARY GUARDRAIL SUMMARY

SURVEY LINE	BEG. STA.	END STA.	LOCATION	LENGTH STRAIGHT	LENGTH SHOP CURVED	LENGTH DOUBLE FACED	WARRANT POINT APPROACH END	WARRANT POINT TRAILING END	"N" DIST. FROM E.O.L.	TOTAL SHOUL. WIDTH	FLARE LENGTH APPROACH END	FLARE LENGTH TRAILING END	W APPROACH END	W TRAILING END	TEMPORARY ANCHORS GRAU-350	TEMPORARY ANCHORS BIC	COMMENTS
-Y1DET-	13+00	10+73 -Y1C1B-	LT	240.03			15+00	13+30	2.0	3.0	40.0	15.24	4.03	0.3	1	1	BURY APPROACH END IN CUT
-Y1DET-	13+30	15+28.543	RT	194.31			13+60		2.0	3.0	15.24	40.0	0.3	1.4	1		CONNECT TO PERM. GUARDRAIL
-Y1C1B-	10+57.059	12+60	RT	209.55				12+40	0.6	1.6		15.24		0.3	1		CONNECT TO PERM. GUARDRAIL
-Y1C1B-	11+00	13+20	RT	220.98			11+10	OFF PROJ. LIMIT	0.6	1.6	15.6		1.2		1		ALONG TEMP. WIDENING: *(CONNECT TO PERM. GUARDRAIL)*
-Y4DET-	10+00	11+50	LT	152.40			10+10 +/-	11+354 +/-	1.2	2.2		15.0		0.3	1	1	BURY APPROACH END IN CUT
		SUB-TOTAL		1017.27											5	2	
		LESS ANCHORS	5 @ 15.240	-76.2													
			2 @ 3.810	-7.62													
			TOTAL =	933.45											5	2	
			SAY =	943.89													

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

6/04/99
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"N" = DISTANCE FROM EDGE OF LANE TO FACE OF GUARDRAIL.
TOTAL SHOULDER WIDTH = DISTANCE FROM EDGE OF TRAVEL LANE TO SHOULDER BREAK POINT.
FLARE LENGTH = DISTANCE FROM LAST SECTION OF PARALLEL GUARDRAIL TO END OF GUARDRAIL.
W = TOTAL WIDTH OF FLARE FROM BEGINNING OF FLARE TO END OF FLARE.

COMPUTED BY: S.C.B. DATE: AUGUST 14, 2004
CHECKED BY: T.A.M. & B.D.K. DATE: AUGUST 14, 2004

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS
GUARDRAIL SUMMARY

METRIC

PROJ. REFERENCE NO.	SHEET NO.
R-977A	3-P

SURVEY LINE	BEG. STA.	END STA.	LOCATION	LENGTH STRAIGHT	LENGTH SHOP CURVED	LENGTH DOUBLE FACED	WARRANT POINT APPROACH END	WARRANT POINT TRAILING END	"N" DIST. FROM E.O.L.	TOTAL SHOUL. WIDTH	FLARE LENGTH APPROACH END	FLARE LENGTH TRAILING END	W APPROACH END	W TRAILING END	ANCHORS GRAU-350	M-350	CAT-1	TYPE III	TYPE XI MOD.	TYPE XIII	TYPE VI MOD.	BIC	TERM. SECT.	AT-1	IMPACT ATTENUATOR TYPE 350	SINGLE FACED CONCRETE BARRIER	REMOVE EXISTING GUARDRAIL	REMOVE & STOCKPILE EXISTING GUARDRAIL	COMMENTS
-LCIB-	9+80	12+43.7 -Y-	RT	133.35	57.15		10+10	12+43.7 -Y-	3.8	4.8	15.24	0	0.3	0	1														TIE TO EXIST. GR ON -Y-
-LCIB-	9+95	11+35	LT	140.97			11+05	10+15	3.8	4.8	15.24	15.24	0.3	0.3	2														
-LCIB-	12+10.9 -Y-	14+75.7	RT	255.27	38.10		12+30.9 -Y-	BRIDGE	3.6	4.6	0	0	0	0				1											TIE TO EXIST. GR ON -Y-
-LCIB-	13+06.5	10+73 -YICIB-	LT	217.17	30.48		10+47.5-YIREV-	13+60	3.6/2.4	4.6/3.4	15.24	15.24	0.3	0.3	2														
-LCIB-	15+94.8	10+56 -YICIB-	LT				BRIDGE	10+56 -YIREV-	3.6/2.4	4.6/3.4	0	0	0	0															(FUTURE)
-LCIB-	14+89.6	13+84 -YICIB-	LT	445.77	22.86		BRIDGE	OFF PROJ. LIMIT	3.6/2.4	3.6/3.4	0	15.24	0	0.3	1			1											GR ENDS AT SHL'D. PULLOFF
-LCIB-	17+05.3	17+94	RT	87.63			BRIDGE	BRIDGE	3.0	4.6	0	0	0	0				2											
-LCIB-	17+17	18+00	MED RT	64.77			BRIDGE	BRIDGE	3.0	4.6	0	0	0	0				2											
-LCIB-	17+19	18+08	LT				BRIDGE	BRIDGE	3.0	4.6	0	0	0	0															(FUTURE)
-LCIB-	18+48	19+25.8	RT	80.08			BRIDGE	BRIDGE	3.6	4.6	0	34.29	0	0.69	1			1											
-LCIB-	18+55	19+17	MED RT	64.77			BRIDGE	BRIDGE	3.6	2.4	15.24	0	0.3	0		1		1											
-LCIB-	18+67	19+45	LT				BRIDGE	BRIDGE	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LCIB-	23+00	23+87	RT	91.44			BRIDGE	29+20	3.6	4.6	15.24	0	0.3	0	1			1											
-LCIB-	23+41	23+80.5	LT	38.10			BRIDGE	BRIDGE	3.6	4.6	0	15.24	0	0.3	1			1											
-LCIB-	23+48.5	23+74	MED LT				BRIDGE	BRIDGE	3.6	4.6	0	11.43	0	1.22															(FUTURE)
-LCIB-	25+54	29+54-LREV-	RT	449.58			BRIDGE	BRIDGE	3.6	4.6	0	15.24	0	0.3	1			1											
-LCIB-	25+47	25+81-LREV-	MED RT	91.44			BRIDGE	BRIDGE	3.6	2.4	15.24	0	0.3	0		1		1											
-LCIB-	25+44	25+86-LREV-	MED LT				BRIDGE	BRIDGE	3.6	1.8	0	11.43	0	1.22															(FUTURE)
-LCIB-	25+34	25+66-LREV-	LT				BRIDGE	BRIDGE	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	33+82.5	38+77.5	RT	495.30			34+20	38+40	3.6	4.6	15.24	15.24	0.3	0.3	2														
-LREV-	34+05	37+87.5	LT				37+50	34+05	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	39+78.2	40+69.6	RT	91.44			BRIDGE	BRIDGE	3.6	4.6	15.24	0	0.3	0	1			1											
-LREV-	40+21.2	40+63.1	MED. RT	41.91			BRIDGE	BRIDGE	3.6	2.4	0	34.29	0	0.69		1		1											
-LREV-	40+28.81	40+56.7	MED. LT				BRIDGE	BRIDGE	1.2	1.8	0	11.43	0	1.22															(FUTURE)
-LREV-	41+66.6	43+10	LT				42+72.5	BRIDGE	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	41+72	42+82.0	MED. LT				BRIDGE	BRIDGE	3.6	1.8	11.43	0	1.22	0															(FUTURE)
-LREV-	41+82.9	42+74.3	MED. RT	91.44			BRIDGE	BRIDGE	3.6	2.4	15.24	0	0.3	0		1		1											
-LREV-	41+92.7	47+77.5	RT	579.12			BRIDGE	47+40	3.6	4.6	0	15.24	0	0.3	1			1											
-LREV-	43+60	44+37.5	LT				44+00	43+60	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	45+65	48+05	LT				47+67.5	43+65	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	13+80 -Y4-	50+97.5	RT	160.02	15.24		13+60 -Y4-	50+60	2.4/3.6	3.4/4.6	15.24	15.24	0.3	0.3	2														
-LREV-	49+80	51+27.5	LT				50+90	49+80	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	52+42.5	58+97.5	RT	666.75			52+80	58+60	3.6	4.6	15.24	15.24	0.3	0.3	2														
-LREV-	52+90	58+67.5	LT				58+30	52+90	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	61+10.0	62+07.5	RT	99.06			61+47.5	61+70	3.6	4.6	15.24	15.24	0.3	0.3	2														
-LREV-	63+02.5	64+77.5	RT	171.45			63+40	64+40	3.6	4.6	15.24	15.24	0.3	0.3	2														
-LREV-	63+90	65+80	LT				65+42.5	63+90	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	66+65.9	67+57.3	RT	91.44			BRIDGE	BRIDGE	3.6	4.6	15.24	0	0.3	0	1			1											(FUTURE)
-LREV-	66+80	67+48.7	LT				BRIDGE	66+80	3.6	4.6	0	0	0	0															
-LREV-	67+12.6	67+54.5	MED. RT	41.91			BRIDGE	BRIDGE	3.6	2.4	0	15.24	0	0.3		1		1											
-LREV-	67+20.2	67+51.5	MED. LT				BRIDGE	BRIDGE	1.2	1.8	0	11.43	0	1.22															(FUTURE)
-LREV-	69+53.6	72+15	LT				71+77.5	BRIDGE	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	69+59.8	70+65.3	MED. LT				BRIDGE	BRIDGE	1.2	1.8	11.43	0	1.22	0															(FUTURE)
-LREV-	69+66.2	70+57.6	MED. RT	91.44			BRIDGE	BRIDGE	3.6	2.4	15.24	0	0.3	0		1		1											
-LREV-	69+72.4	73+17.5	RT	335.28			BRIDGE	72+80	3.6	4.6	15.24	15.24	0.3	0.3	3			1											DRIVE OPENING AT 71+20
-LREV-	81+50	82+67.5	LT				82+30	81+50	3.6	4.6	15.24	0	0.3	0															(FUTURE)
-LREV-	81+62.5	10+77.5 -Y9R-	RT	217.17	30.48		82+00	10+67 -Y9R-	3.6/1.2	4.6/2.2	15.24	15.24	0.3	0.3	2														GR TERMINATES AT DRIVE
-LREV-	11+00 -Y9R-	84+97.5	RT	171.45	38.10		10+90 -Y9R-	84+60	1.2/3.6	2.2/4.6	15.24	15.24	0.3	0.3	2														
-LREV-	81+92.5	83+17.5	MED. RT	125.73			82+30	82+80	3.6	2.4	15.24	15.24	0.3	0.3	2														
-LREV-	84+65	85+60	LT				85+22.5	84+65	3.6	4.6	15.24	0	0.3	0															
-Y3-	13+00	13+94	RT	95.25			13+30	13+70	2.4	3.4	15.24	15.24	0.3	0.3	2														
-Y3-	15+20	18+50	RT	327.66			15+50	18+20	2.4	3.4	15.24	15.24	0.3	0.3	2														
-Y6REV-	12+61.5	13+04.5 -Y6-	LT	45.72			12+73	12+73	2.4	3.4	15.24	15.24	0.3	0.3	2														
-Y6-	16+10	17+22	LT	99.06	15.24		OFF PROJ. LIMIT	16+40	2.4	3.4	N/A	15.24	0.3	0.3	1									1					GR TERMINATES AT DRIVE
-Y8-	10+05	10+54	RT	19.05	45.72		WIDENING	DEAD-END	0.6	1.5	15.24	7.62	0.3	0.3	2														
			SUB-TOTAL	6217.99	293.37										41	6		16						1					
	LESS ANCHORS:	GRAU-350	41 @ 15.240=	-624.84	-15.24																								
		M-350	6 @ 11.430=	-68.58																									
		AT-1	1 @ 1.905=		-1.905																								
		TYPE III, III(MOD.)	20 @ 7.620=	-152.40																									
			TOTAL	5372.17	276.225										41	6		20						1					
			SAY	5410.20	278.13		ADDITIONAL GUARDRAIL POSTS = 10 EA.																						

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

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STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

SUMMARY OF EARTHWORK

IN CUBIC METERS

LOCATION	UNCL. EXCAVATION	EMBT+15%	BORROW	WASTE
SUMMARY #1				
(-LCIB-) 10+00 TO (-LCIB-) 15+00	971	149,712	148,741	0
(-Y1DET-) 12+00 TO (-Y1DET-) 15+28.543	17,926	12,226	0	5,700
(-Y1DET-) TEMP. FILL REMOVAL	417	0	0	417
(-Y1CIB-) 9+80 TO (-Y1CIB-) 13+07	205,870	10,226	0	195,644
(-Y1CIB-) 10+40 TO (-Y1CIB-) 13+47 TEMP.	138	2,436	2,298	0
(-Y1CIB- TEMP) TEMP. FILL REMOVAL	2,120	0	0	2,120
TOTAL (SUMMARY #1)	227,442	174,600	151,039	203,881
SUMMARY #2				
(-LCIB-) 15+60 TO (-LCIB-) 18+20	0	86,356	86,356	0
(-Y2-) 11+70 TO (-Y2-) 13+50	1,862	9,387	7,525	0
TOTAL (SUMMARY #2)	1,862	95,743	93,881	0
SUMMARY #3				
(-LCIB-) 18+40 TO (-LCIB-) 25+57.129	1,051,386	22,768	0	1,028,618
SUMMARY #4				
(-LREV-) 25+00 TO (-LREV-) 31+00	112,442	62,523	0	49,919
SUMMARY #5				
(-LREV-) 31+00 TO (-LREV-) 41+00	453,038	661,432	208,394	0
SUMMARY #6				
(-LREV-) 41+40 TO (-LREV-) 51+40	79,008	190,811	111,803	0
(-Y3-) 10+60 TO (-Y3-) 20+83	39,570	46,377	6,807	0
(-Y3-) 14+20 TO (-Y3-) 15+97.681 TEMP	1,910	2	0	1,908
(-Y4-) 9+60 TO (-Y4-) 14+50	69,011	2,021	0	66,990
(-Y4DET-) 9+60.006 TO (-Y4DET-) 11+37.517	222	338	116	0
(-Y4DET-) TEMP. FILL REMOVAL	370	0	0	370
TOTAL (SUMMARY #6)	194,203	245,510	120,575	69,268
SUMMARY #7				
(-LREV-) 51+40 TO (-LREV-) 61+40	206,052	239,660	33,608	0
SUMMARY #8				
(-LREV-) 61+40 TO (-LREV-) 68+80	198,808	227,250	28,442	0
SUMMARY #9				
(-LREV-) 69+20 TO (-LREV-) 79+20	191.862	129,544	0	62,318
DRIVEWAY (-LREV-) 70+20 TO (-LREV-) 71+40	0	4,377	4,377	0
(-Y5-) 12+18.712 TO (-Y5-) 14+10	192	5,459	5,267	0
(-Y6-) 7+97.444 TO (-Y6-) 17+40	5,703	1,735	0	3,968
(-Y7REV-) 75+39.123 TO (-Y7REV-) 76+60	719	74	0	645
(-Y10-) 9+90 TO (-Y10-) 10+75.396	633	28	0	605
TOTAL (SUMMARY #9)	199,109	141,217	9,644	67,536
SUMMARY #10				
(-LREV-) 79+20 TO (-LREV-) 87+20	287,043	55,650	0	231,393
-Y8- CUL-DE-SAC	100	235	135	0
(-Y9REV) 10+20 TO (-Y9REV-) 11+35	448	8,626	8,178	0
TOTAL (SUMMARY #10)	287,591	64,511	8,313	231,393
SUB-TOTAL OF SUMMARIES #1-#10	2,931,933	1,935,214	653,896	1,650,615
ESTIMATED UNCLASSIFIED LOSS DUE TO CLEARING AND GRUBBING	-84,000	0	0	-84,000
ROCK TO REPLACE BORROW	0		-19,798	-19,798
ADJUST FOR ROCK WASTE	0	-2,970	-2,970	0
EARTH TO REPLACE BORROW	0	0	-670,724	-670,724
TOTAL	2,847,933	1,932,244	0	876,093
SAY	2,860,000			

*ESTIMATED DRAINAGE DITCH EXCAVATION 6,300 m^3
*ESTIMATED SHOULDER BORROW 12,650 m^3
*ESTIMATED BENCHING EXCAVATION 3,000 m^3
*ESTIMATED UNDERCUT EXCAVATION 1,700 m^3

COMPUTED BY: T.A.M. DATE: 8/28/03
CHECKED BY: B.K.S. DATE: 9/2/03

METRIC

PROJ. REFERENCE NO. R-977A
SHEET NO. 3-Q

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

COMPUTED BY: T.A.M.	DATE: 8/22/03
CHECKED BY: B.K.E.	DATE: 9/2/03
REVISED BY:	DATE:

METRIC

PROJ. REFERENCE NO.	SHEET NO.
R-977A	3-R

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

RIGHT OF WAY AREA DATA SHEET

PARCEL NO.	PROPERTY OWNERS NAME	TOTAL AREA	AREA TAKEN	AREA REMAINING RIGHT	AREA REMAINING LEFT	CONSTR. EASEMENT	PERMANENT DRAINAGE EASEMENT	TEMPORARY DRAINAGE EASEMENT	
2	TENNESSEE VALLEY AUTHORITY		22.306 HA						
			55.10 AC						
3Z	DORIS M. MYERS	7338 SM	809 SM		6529 SM	1157 SM			
		1.81 AC	8705 SF		1.61 AC	12449 SF			
3AZ	STEPHEN B. DICKEY		697 SM			2248 SM			
			7500 SF			24188 SF			
5Z	W. A. SHERILL & LAWRENCE E. POSEY	12.68 HA	486 SM		12.63 HA				
		31.32 AC	5229 SF		31.20 AC				
7	RALPH WARNER	2209 SM	445 SM	1764 SM					
		23769 SF	4788 SF	18981 SF					
13Z	JUDD & EVELYN STILES		763 SM						
			8210 SF						
13AZ	HARRY L. & JOIE A. STILES		494 SM						
			5315 SF						
14Z	RONALD EDWIN STILES	2817 SM	128 SM	2689 SM					
		30311 SF	1377 SF	28934 SF					
17Z	HUBERT WINSTON CRAIG	5.267 HA	528 SM	5.113 HA	1005 SM				
		13.01 AC	5671 SF	12.63 AC	10814 SF				
37	WILLARD BEAVER III KRISTY G. BEAVER ROGER K. SPIVA	628 SM	305 SM	323 SM					
		6757 SF	3282 SF	3475 SF					
38	DAVID HILTON HELEN W. HILTON	2.541 HA	5791 SM	1.962 HA					
		6.28 AC	1.43 AC	4.85 AC					

PARCEL NO.	PROPERTY OWNERS NAME	TOTAL AREA	AREA TAKEN	AREA REMAINING RIGHT	AREA REMAINING LEFT	CONSTR. EASEMENT	PERMANENT DRAINAGE EASEMENT	TEMPORARY DRAINAGE EASEMENT	

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

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	4
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

RIGHT OF WAY PLAN SHEETS 4 AND 5

SEE SHEET 4-A FOR DITCH DETAILS

NOTE: -Y- LINE EXISTING PAVEMENT TO BE RESURFACED WITH 30MM S9.5B

-Y-
PI Sta 10+37.809
Δ = 12° 19' 51.9" (RT)
L = 75.326
T = 37.809
R = 350.000
SE = EXIST.

-Y-
PIs Sta 11+10.399
θs = 8° 35' 39.7"
Ls = 105.000
LT = 70.083
ST = 35.075

SEE SHEET 2-H FOR INTERSECTION DETAILS
SEE PROFILES FOR DITCH GRADES

-Y- POC Sta. 10+60.000
BEGIN CONSTRUCTION

-Y- CS Sta. 10+75.324

BEGIN CONSTRUCTION
-LCIB- POT Sta. 9+60.000

-LCIB- POT Sta. 10+00.000 =
-LREV- POT Sta. 10+00.000

-Y- ST Sta. 11+80.324

-LCIB- POT Sta. 11+76.050 =
-Y- POT Sta. 11+81.353

-YIDET-
PI Sta 12+81.885
Δ = 8° 07' 01.3" (LT)
L = 70.834
T = 35.477
R = 500.000
Se = 0.06

STEPHEN B. DICKEY
DB 563 PG 21
(3A)

-YIDET- PC Sta. 12+46.408

-YIDET- PT Sta. 13+17.243

+55.303 -LREV-
25.572 (83.88 ft)

+40.000 -LREV-
48.000 (157.44 ft)

+40.000 -LREV-
38.000 (124.64 ft)

-LREV- SC Sta. 13+13.404

-LREV- TS Sta. 12+13.404

-LREV- CS Sta. 13+46.396

-YIDET- POT Sta. 12+80.000 LB =
-LCIB- POT Sta. 12+00.000 LA =

-LCIB- TS Sta. 13+06.539

MATCH LINE -LCIB- STA 13+50.000
SEE SHEET 5

90.0 UNIFORM TRANSITION LEFT (7.0 TO 9.0)

155.0 UNIFORM TRANSITION RIGHT (7.0 TO 12.6)

210.0 UNIFORM TRANSITION RIGHT (12.6 TO 8.4)

S 32° 27' 53.0" E
-LCIB-

Δ = 111° 11' 53.0"

+10.000 -LREV-
15.593 (51.15 ft)
BEGIN C/A
BEGIN W.W. FENCE

BEGIN STATE PROJECT R-977A
-LCIB- POT Sta. 10+00.000
N 159,489.895
E 151,244.170

PEYTON G. IVIE
DB 417 PG 244
DB 532 PG 136
DB 559 PG 174

+30.000 -LREV-
70.000 (229.66 ft)

+90.000 -Y-
65.102
(213.53 ft)
END W.W. FENCE
(TIE TO EXISTING)

+60.000 -Y-
62.019 (203.42 ft)
BEGIN W.W. FENCE
(TIE TO EXISTING)

+40.000 -LREV-
73.000 (239.44 ft)

TENNESSEE VALLEY AUTHORITY
HR 255-3

TENNESSEE VALLEY AUTHORITY
TRACT FBR-255

2004 ADT
2025 ADT

5100 / 8600	-LCIB- SR 1326		12900 / 22000
1100 / 1800	-Y- US 74/19/129	4800 / 8000	
1800 / 3000	-Y- US 74/19/129/64	6000 / 10200	
13400 / 22160			
16900 / 28800			

-LCIB-
PIs Sta 13+82.731
θs = 12° 33' 39.6"
Ls = 114.000
LT = 76.192
ST = 38.175

-LCIB-
PI Sta 14+54.381
Δ = 14° 49' 54.6" (RT)
L = 67.305
T = 33.842
R = 260.000
Se = 0.05
DS = 80 km/h

-LREV-
PIs Sta 12+80.082
θs = 3° 16' 26.6"
Ls = 100.000
LT = 66.578
ST = 33.344

-LREV-
PI Sta 13+29.902
Δ = 2° 09' 37.3" (RT)
L = 16.498
T = 32.992
R = 875.000
Se = 0.05
DS = 100 km/h

-LREV-
PIs Sta 13+79.740
θs = 3° 16' 26.6"
Ls = 100.000
LT = 66.578
ST = 33.344

DATUM DESCRIPTION

THE PROJECT WAS DEVELOPED PRIOR TO THE ESTABLISHMENT OF A LOCALIZED COORDINATE SYSTEM

ALL DISTANCES ARE GROUND HORIZONTAL DISTANCES

VERTICAL DATUM USED IS NGVD 29

-Y- POT Sta. 13+30.000
END CONSTRUCTION (AT BRIDGE)

SEE SHEET 30 FOR -YIDET- PLAN SEE SHEET 51 FOR -YIDET- PROFILE
SEE SHEET 31 FOR -LCIB- PROFILE
SEE SHEET 50 FOR -Y- PROFILE

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

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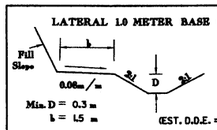
REVISIONS

METRIC 5 0 10	PROJECT REFERENCE NO.	SHEET NO.
	R-977A	4-A
	HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.		
R/W REV.		

DRAINAGE DETAILS FOR PLAN SHEET 4

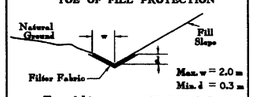
LATERAL 1.0 METER BASE DITCH



Min. D = 0.3 m
b = 1.5 m
(EST. D.D.E. = 128 cu.m)

FROM -LCIB- STA. 12+34 TO STA. 13+62 RT.

TOE OF FILL PROTECTION

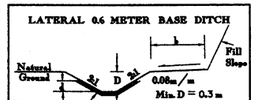


Max. w = 2.0 m
Min. d = 0.3 m

Type of Liner = CLASS 'I' RIP RAP

FROM -LCIB- STA. 10+28 TO STA. 10+54 LT.
(EST. RIP RAP = 32 m.tons, FIL. FAB. = 42 sm)

LATERAL 0.6 METER BASE DITCH



Min. D = 0.3 m
Min. d = 0.3 m
b = 1.5 m

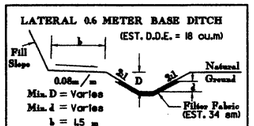
Type of Liner = CLASS 'I' RIP RAP

FROM STA. -LCIB- 10+54 TO STA. 10+60 LT.
(EST. D.D.E. = 13 cu.m, RIP RAP = 10 m.tons, FIL. FAB. = 12 sm)

FROM STA. -LCIB- 10+60 TO STA. 10+90 LT.
(EST. D.D.E. = 45 cu.m, RIP RAP = 48 m.tons, FIL. FAB. = 60 sm)

LATERAL 0.6 METER BASE DITCH

(EST. D.D.E. = 18 cu.m)



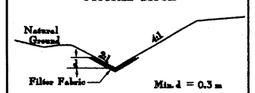
Min. D = Varies
Min. d = Varies
b = 1.5 m

Type of Liner = CLASS 'I' RIP RAP
(EST. 28 m.tons)

Filter Fabric (EST. 34 sm)

FROM -LCIB- STA. 10+84 TO STA. 10+97 RT.

TYPICAL DITCH

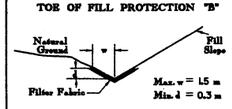


Min. d = 0.3 m

Type of Liner = CLASS 'B' RIP RAP

FROM -LCIB- STA. 12+11 TO STA. 12+40 LT.
(EST. RIP RAP = 25 m.tons, FIL. FAB. = 48 sm)

TOE OF FILL PROTECTION "B"

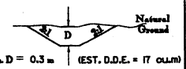


Max. w = 1.5 m
Min. d = 0.3 m

Type of Liner = CLASS 'B' RIP RAP

FROM -LCIB- STA. 12+40 TO STA. 12+75 LT.
(EST. RIP RAP = 42 m.tons, FIL. FAB. = 56 sm)

1.0 METER BASE TAIL DITCH

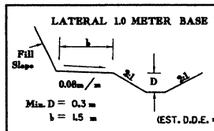


Min. D = 0.3 m (EST. D.D.E. = 17 cu.m)

FROM -LCIB- STA. 12+05 TO STA. 12+34 RT.

DRAINAGE DETAILS FOR PLAN SHEET 5

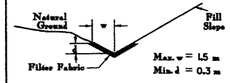
LATERAL 1.0 METER BASE DITCH



Min. D = 0.3 m
b = 1.5 m
(EST. D.D.E. = 128 cu.m)

FROM -LCIB- STA. 12+34 TO STA. 13+62 RT.

TOE OF FILL PROTECTION "B"



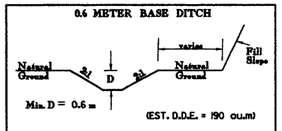
Max. w = 1.5 m
Min. d = 0.3 m

Type of Liner = CLASS 'B' RIP RAP

FROM -LCIB- STA. 13+00 TO STA. 13+36 LT.
(EST. RIP RAP = 44 m.tons, FIL. FAB. = 51 sm)

FROM -LCIB- STA. 13+67 TO STA. 14+29 LT.
(EST. RIP RAP = 80 m.tons, FIL. FAB. = 146 sm)

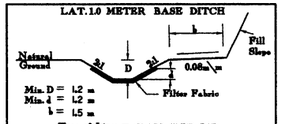
0.6 METER BASE DITCH



Min. D = 0.6 m
(EST. D.D.E. = 190 cu.m)

FROM -LCIB- STA. 16+25 TO STA. 16+75 RT.

LAT. 1.0 METER BASE DITCH

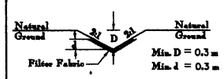


Min. D = 1.2 m
Min. d = 1.2 m
b = 1.5 m

Type of Liner = CLASS 'I' RIP RAP

FROM -LCIB- STA. 15+19 TO STA. 15+85 LT.
(EST. D.D.E. = 275 cu.m, RIP RAP = 201 m.tons, FIL. FAB. = 402 sm)

TAIL VEE DITCH



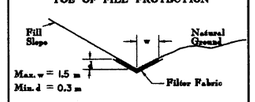
Min. D = 0.3 m
Min. d = 0.3 m

Type of Liner = CLASS 'I' RIP RAP

FROM STA. -YICIB- 10+85 RT.
(EST. D.D.E. = 6 cu.m, RIP RAP = 12 m.tons, FILTER FABRIC = 17 sm)

DRAINAGE DETAILS FOR PLAN SHEET 6

TOE OF FILL PROTECTION



Max. w = 1.5 m
Min. d = 0.3 m

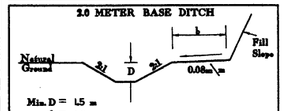
Type of Liner = CLASS 'B' RIP RAP

FROM -LCIB- STA. 18+26 TO STA. 19+08 RT.
(EST. RIP RAP = 80 m.tons, FIL. FAB. = 170 sm)

FROM -LCIB- STA. 18+12 TO STA. 18+36 RT.
(EST. RIP RAP = 20 m.tons, FIL. FAB. = 40 sm)

FROM -LCIB- STA. 17+60 TO STA. 18+00 RT.
(EST. RIP RAP = 36 m.tons, FIL. FAB. = 75 sm)

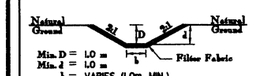
2.0 METER BASE DITCH



Min. D = 1.5 m
b = 1.5 m

FROM -LCIB- STA. 17+65 TO STA. 18+36 LT.
(EST. D.D.E. = 625 cu.m)

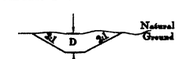
MIN. 1.0 METER BASE SPILLWAY CHANNEL



Min. D = 1.0 m
Min. d = 1.0 m
b = VARIES (1.0m MIN.)

Type of Liner = CLASS 'I' RIP RAP
-Y2- STA. 13+60 RT.
(EST. D.D.E. = 150 cu.m, RIP RAP = 180 m.tons, FIL. FAB. = 200 sm)

1.0 METER BASE TAIL DITCH



Min. D = 1.5 m (EST. D.D.E. = 360 cu.m)

-Y2- STA. 13+76 RT.

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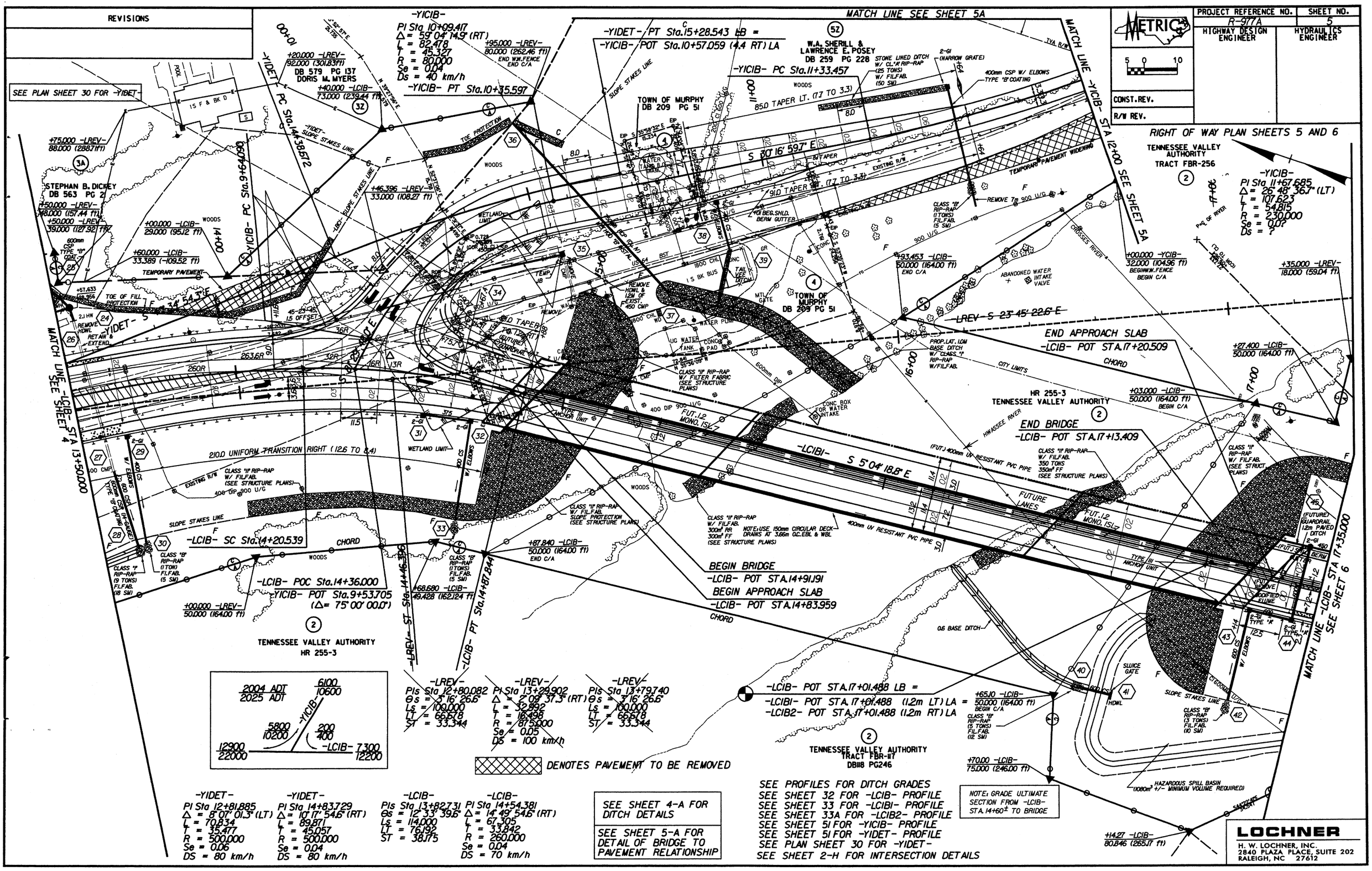
REVISIONS

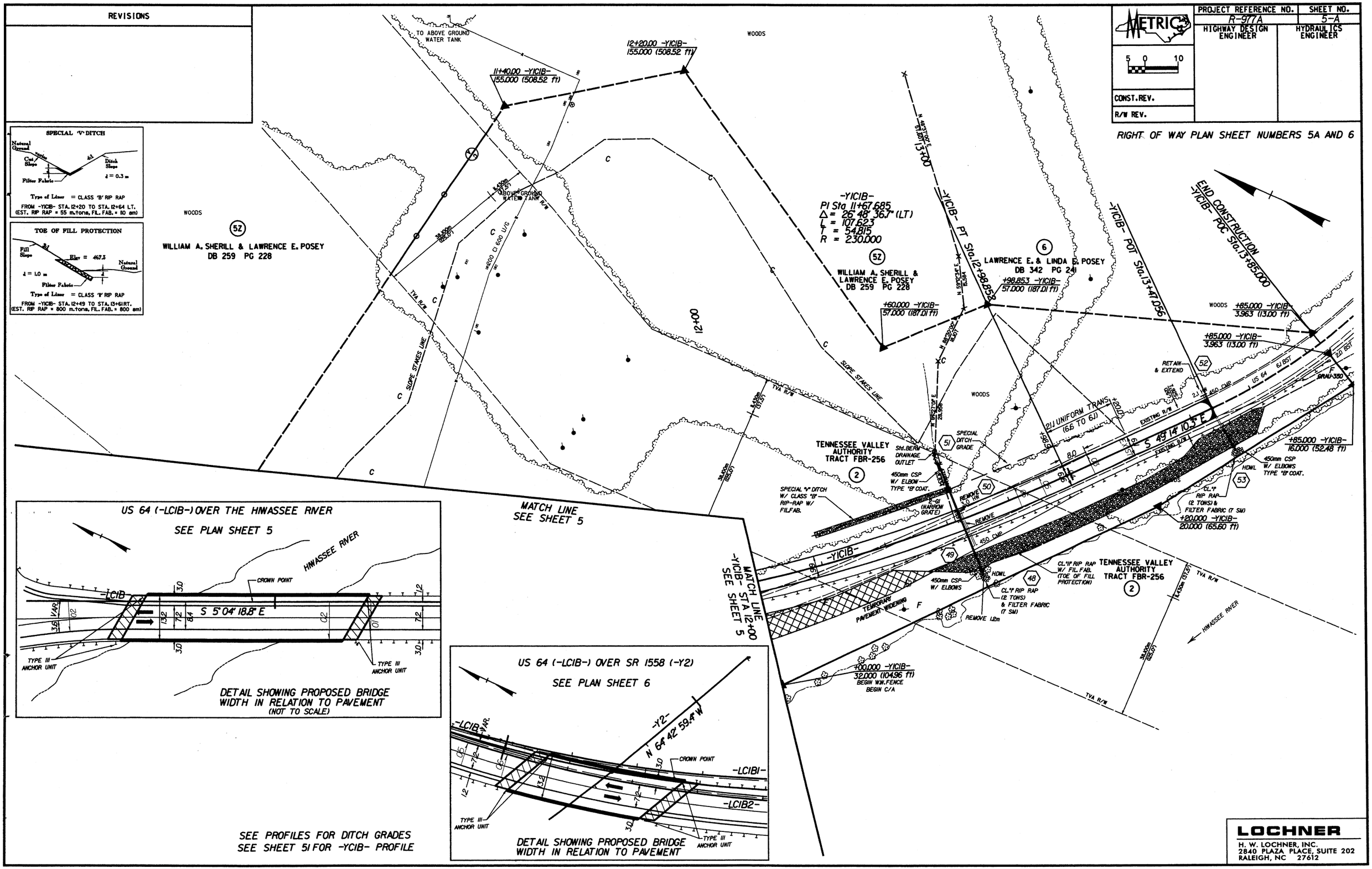
METRIC 5 0 10	PROJECT REFERENCE NO.	SHEET NO.
	R-977A	5
	HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.		
R/W REV.		



REVISIONS

METRIC	PROJECT REFERENCE NO.	SHEET NO.
5 0 10	R-977A	5-A
CONST. REV.	HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
R/W REV.		

RIGHT OF WAY PLAN SHEET NUMBERS 5A AND 6



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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	6
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

R/W REV.

RIGHT OF WAY PLAN SHEETS 6 AND 7

-LREV-
PIs Sta 20+64.384
Θs = 7° 15' 09.5"
Ls = 100.000
LT = 66.723
ST = 33.384

-LREV-
PI Sta 21+69.856
Δ = 20° 43' 25.6" (LT)
L = 142.871
T = 72.225
R = 395.000
DS = 100 km/h

-LREV-
PIs Sta 22+73.886
Θs = 7° 15' 09.5"
Ls = 100.000
LT = 66.723
ST = 33.384

-LCIB-
PI Sta 19+39.064
Δ = 46° 39' 38.8" (LT)
L = 321.682
T = 170.362
R = 395.000
Se = As Shown
DS = 80 km/h

-LCIB-
PIs Sta 21+23.767
Θs = 7° 15' 09.5"
Ls = 100.000
LT = 66.723
ST = 33.384

-LCIBI- (MEOP LT)
PI Sta 19+31.276
Δ = 46° 39' 38.8" (LT)
L = 321.682
T = 170.362
R = 395.000
DS = 80 km/h

-LCIBI- (MEOP LT)
PIs Sta 21+15.980
Θs = 7° 15' 09.5"
Ls = 100.000
LT = 66.723
ST = 33.384

-LCIB2- (MEOP RT)
PI Sta 19+46.851
Δ = 46° 39' 38.7" (LT)
L = 321.682
T = 170.362
R = 395.000
DS = 80 km/h

-LCIB2- (MEOP RT)
PIs Sta 21+31.554
Θs = 7° 15' 09.5"
Ls = 100.000
LT = 66.723
ST = 33.384

-LCIB- POT Sta.17+60.914
-LCIB2- POT Sta.17+60.914
-LCIBI- PC Sta.17+60.914

-LCIB- PC Sta.17+68.701

-LCIB2- PC Sta.17+76.488

BEGIN APPROACH SLAB
-LCIB- POC STA.18+01.720

BEGIN BRIDGE
-LCIB2- POC STA.18+09.550

BEGIN BRIDGE
-LCIB- POC STA.18+10.467

END BRIDGE
-LCIB- POC STA.18+54.835

END BRIDGE
-LCIB2- POC STA.18+54.509

END APPROACH SLAB
-LCIB2- POC STA.18+65.486

END APPROACH SLAB
-LCIB- POC STA.18+66.702

BEGIN APPROACH SLAB
-LCIB2- POC STA.18+00.831

-LCIB- POC Sta.18+33.040

-Y2- PT Sta.14+57.403

-Y2- POC Sta.14+33.306
Δ = 48° 57' 57.5"

-Y2- PC Sta.14+14.387

-Y2- PT Sta.13+79.255

-Y2- PC Sta.12+96.123

-Y2- PT Sta.12+62.501

-Y2- PCC Sta.12+30.666

-LREV- TS Sta.19+97.631

-LCIB2- CS Sta.20+98.170
-LCIB- CS Sta.20+90.383
-LCIBI- CS Sta.20+82.596

NOTE: GRADE ULTIMATE SECTION FROM -LCIB- STA.14+60± TO 23+80±

SEE SHEET 5-A FOR DETAILS OF BRIDGE TO PAVEMENT RELATIONSHIP

SEE SHEET 5 MATCH LINE -LCIB- STA 17+35.000

SEE SHEET 7 MATCH LINE -LCIB- STA 20+50.000

SEE PROFILES FOR DITCH GRADES
SEE SHEETS 33 AND 33B FOR -LCIBI- PROFILE
SEE SHEETS 33A AND 33B FOR -LCIB2- PROFILE
SEE SHEET 52 FOR -Y2- PROFILE

SEE SHEET 4-A FOR DITCH DETAILS

TENNESSEE VALLEY AUTHORITY TRACT FBR-256

HR 255-3 TENNESSEE VALLEY AUTHORITY TRACT FBR-119

WILLARD BEAVER III
KRISTY G. BEAVER
ROGER K. SPIVA
DB 718 PG 51

JAMES C. HILTON
HELEN W. HILTON
DB 286 PG 153

CHARLES S. JOHNSON
MARTHA JO JOHNSON
DB 333 PG 187

FUTURE LANES

FUTURE MONOLITHIC ISLAND

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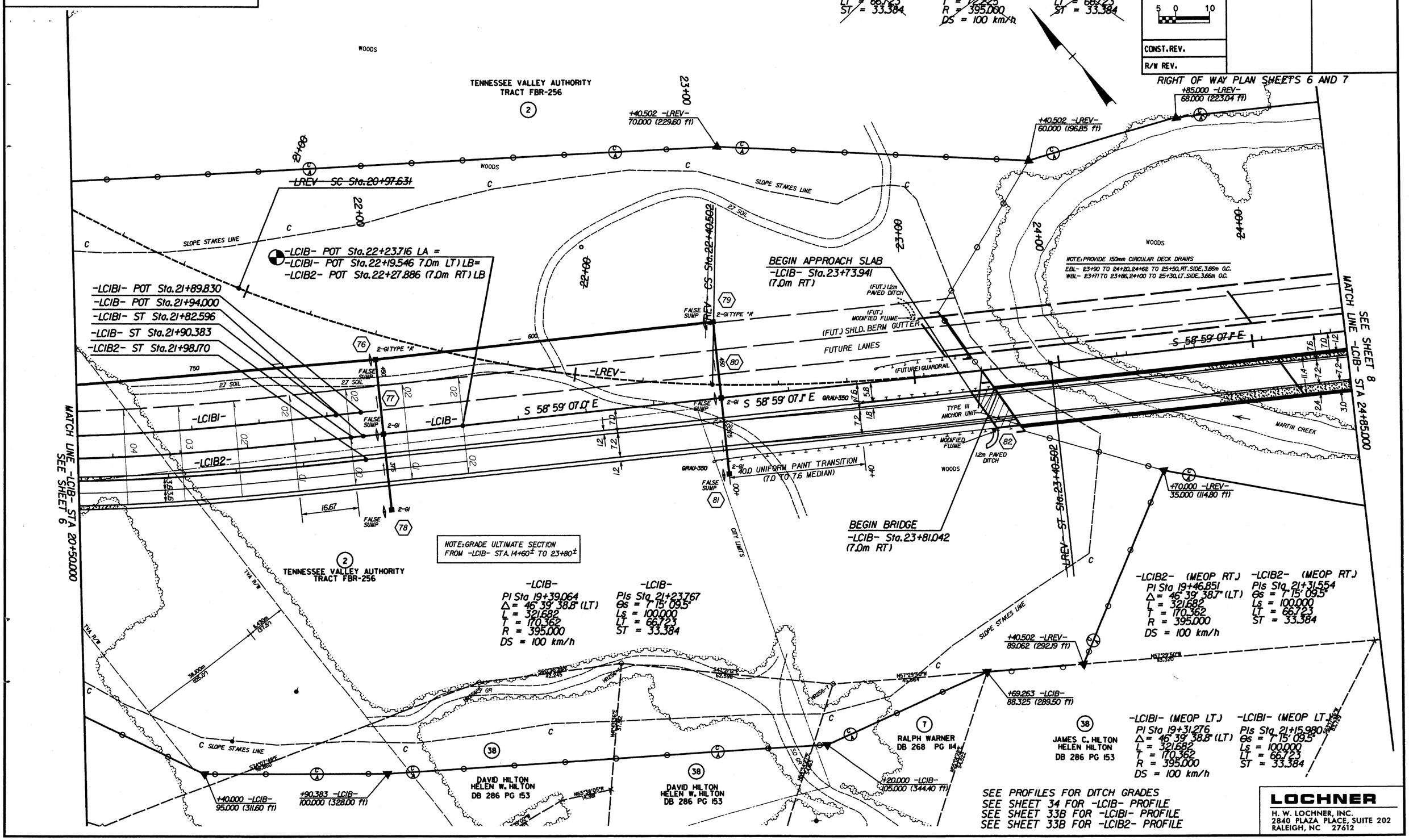
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	7
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

R/W REV.



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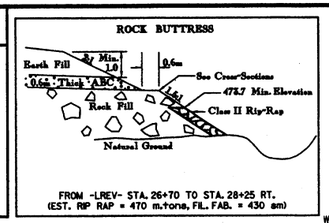
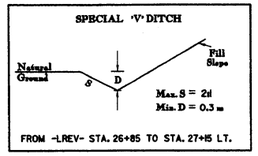
...\Design\R977_SDV_PS07.dgn 8/12/2004 8:47:36 AM

REVISIONS





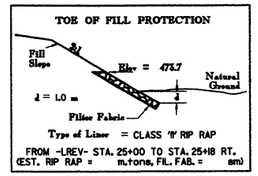
-LREV-
PIs Sta 28+62.544
Θs = 2°56'47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

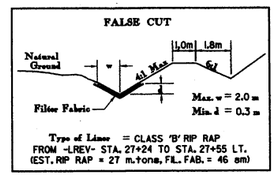
-LREV-
PI Sta 31+46.653
Δ = 32°23'19.1" (LT)
L = 494.627
T = 254.117
R = 875.000
Se = 0.06
DS = 105 km/h

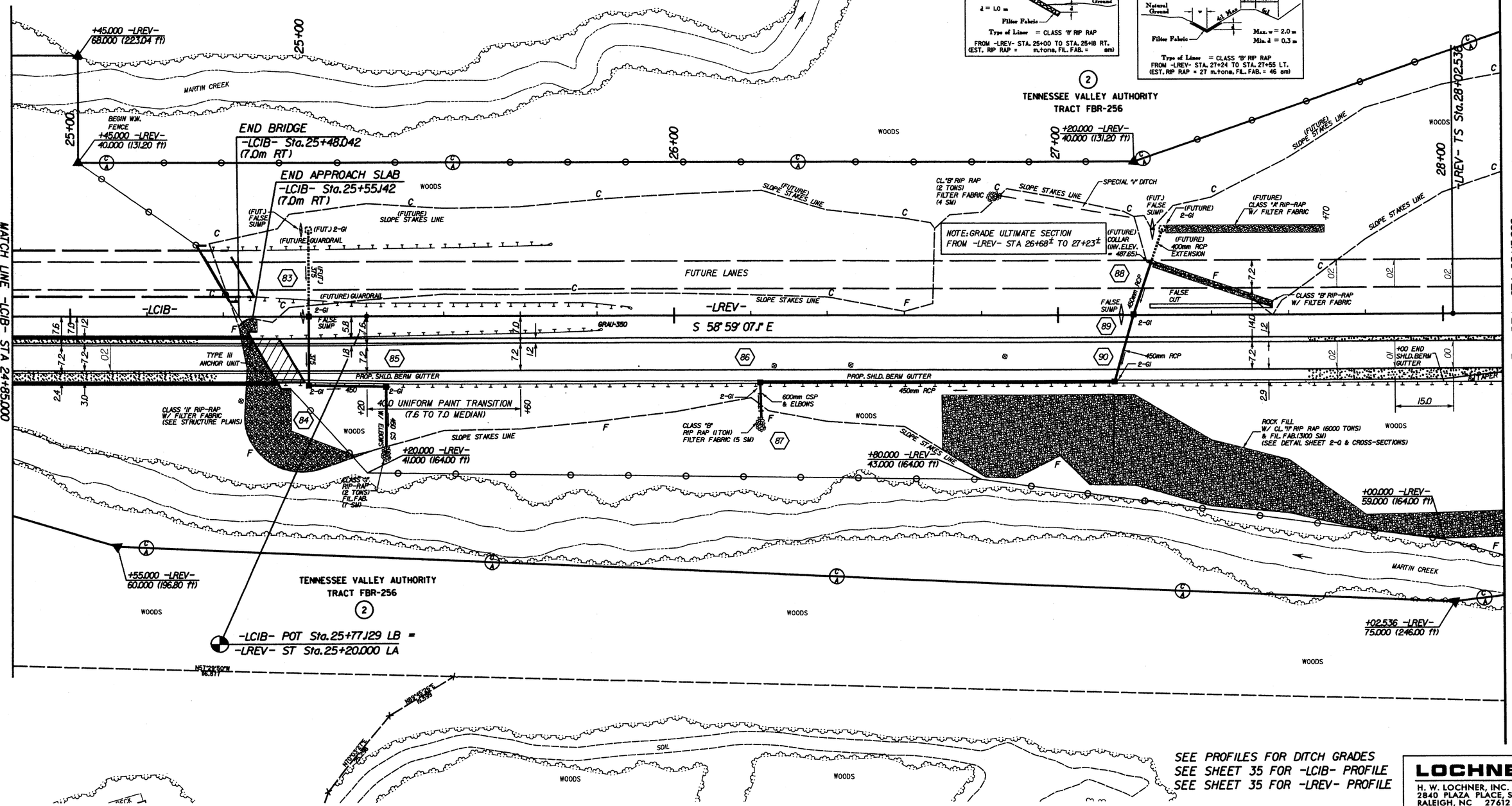
-LREV-
PIs Sta 34+17.171
Θs = 2°56'47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

METRIC 5 0 10	PROJECT REFERENCE NO.	SHEET NO.
	R-977A	8
	HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.		
R/W REV.		

RIGHT OF WAY PLAN SHEETS 7 AND 8







SEE PROFILES FOR DITCH GRADES
SEE SHEET 35 FOR -LCIB- PROFILE
SEE SHEET 35 FOR -LREV- PROFILE

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	9
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

-LREV-
PIs Sta 28+62.544
Θs = 2°56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-LREV-
PI Sta 31+46.653
Δ = 32°23' 19.1" (LT)
L = 494.527
T = 254.117
R = 875.000
Se = 0.06
DS = 105 km/h

-LREV-
PIs Sta 34+17.171
Θs = 2°56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-L-
PIs Sta 28+75.548
Θs = 1°57' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

-L-
PI Sta 31+38.854
Δ = 31°04' 44.1" (LT)
L = 474.626
T = 243.308
R = 875.000

-L-
PIs Sta 33+90.174
Θs = 1°57' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

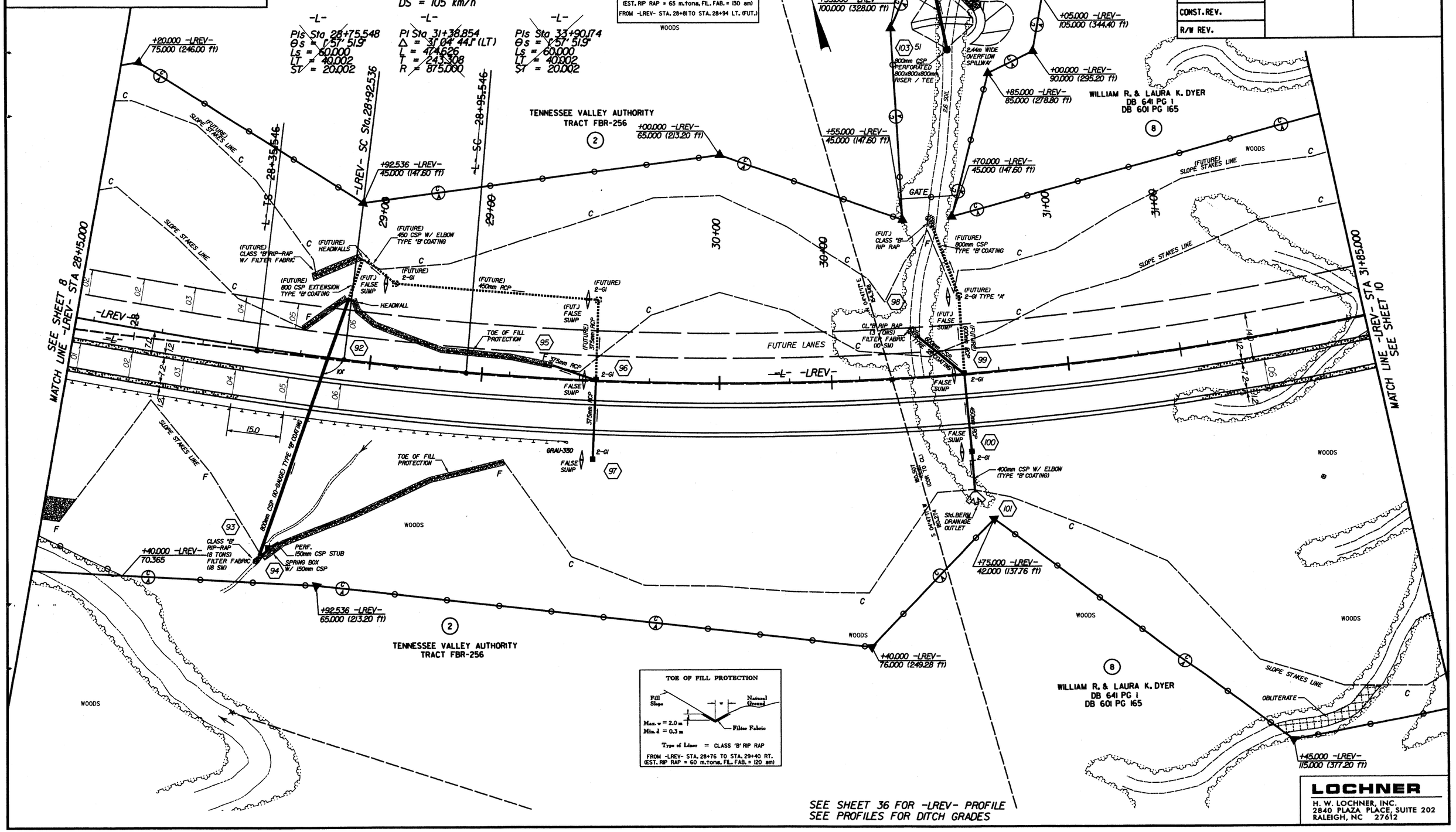
TOE OF FILL PROTECTION

Natural Ground — Fill Slope — Filter Fabric — Max. w = 2.0 m — Min. d = 0.3 m

Type of Liner = CLASS 'B' RIP RAP

FROM -LREV- STA. 28+80 TO STA. 29+53 LT.
(EST. RIP RAP = 65 m.tons, FIL. FAB. = 130 sm)

FROM -LREV- STA. 28+81 TO STA. 28+94 LT. (FUT.)



TOE OF FILL PROTECTION

Fill Slope — Natural Ground — Filter Fabric — Max. w = 2.0 m — Min. d = 0.3 m

Type of Liner = CLASS 'B' RIP RAP

FROM -LREV- STA. 28+76 TO STA. 29+40 RT.
(EST. RIP RAP = 60 m.tons, FIL. FAB. = 120 sm)

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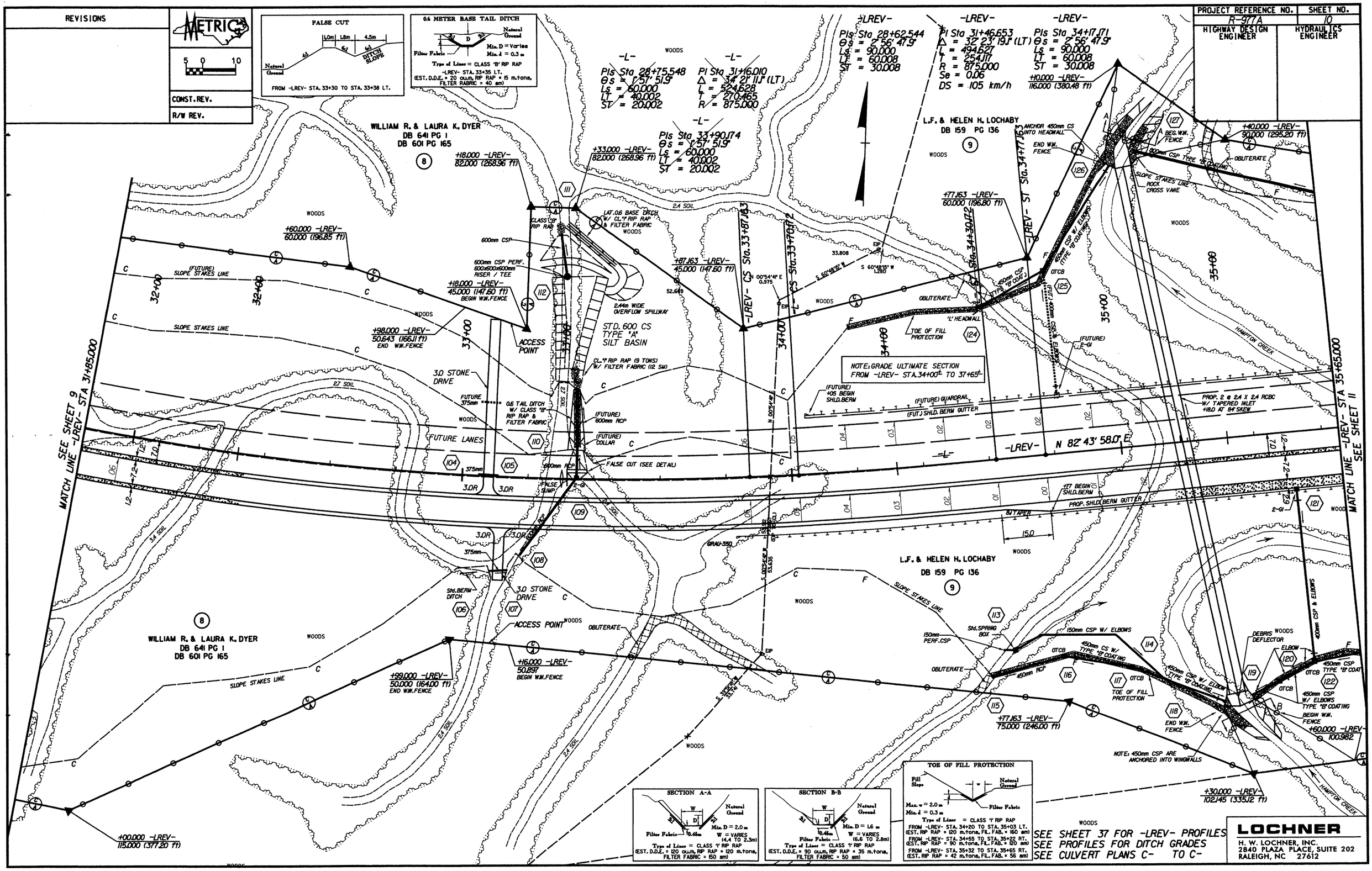
REVISIONS	METRIC 5 0 10
	CONST. REV.
	R/W REV.

PROJECT REFERENCE NO.	SHEET NO.
R-977A	10
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER



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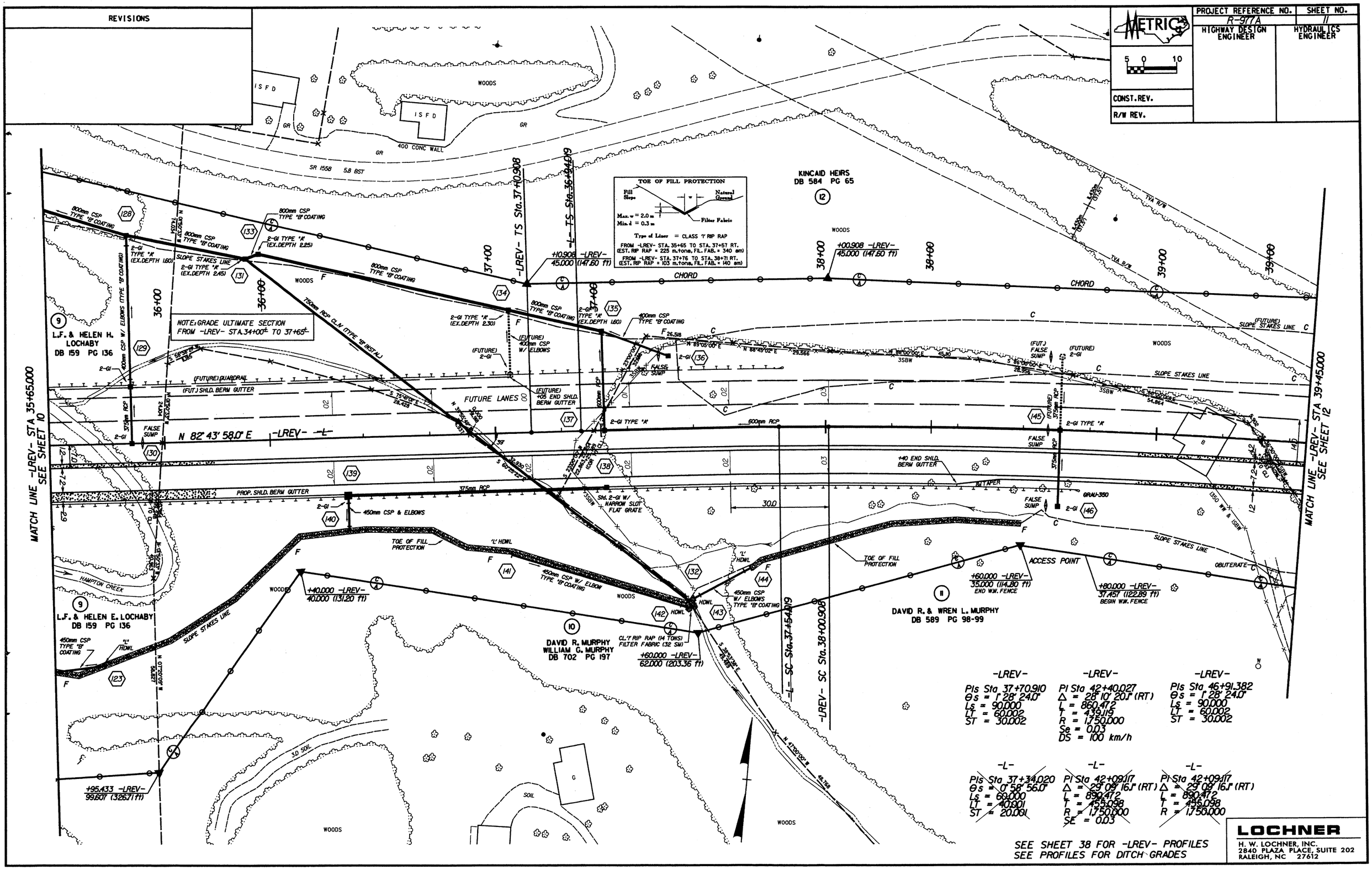
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	11
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

R/W REV.



PROJECT REFERENCE NO.	SHEET NO.
R-977A	12
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

R/W REV.

-LREV-
PIs Sta 37+70.910
Θs = 1° 28' 24.0"
Ls = 90.000
LT = 60.002
ST = 30.002

-LREV-
PI Sta 42+40.027
Δ = 28° 10' 20.1" (RT)
L = 860.472
T = 439.119
R = 1,750.000
Se = 0.03
DS = 100 km/h

-LREV-
PIs Sta 46+91.382
Θs = 1° 28' 24.0"
Ls = 90.000
LT = 60.002
ST = 30.002

-L-
PIs Sta 37+34.020
Θs = 0° 58' 56.0"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 42+09.117
Δ = 29° 09' 16.1" (RT)
L = 890.472
T = 455.098
R = 1,750.000

-L-
PIs Sta 46+64.493
Θs = 0° 58' 56.0"
Ls = 60.000
LT = 40.001
ST = 20.001

-Y3-
PI Sta 10+30.064
Δ = 22° 40' 00.0" (RT)
L = 59.341
T = 30.064
R = 150.000
Se = EXIST.

-Y3-
PI Sta 11+25.152
Δ = 11° 39' 00.0" (LT)
L = 43.716
T = 21.934
R = 215.000
Se = EXIST.

-Y3-
PI Sta 12+77.398
Δ = 39° 55' 53.3" (LT)
L = 55.755
T = 29.064
R = 80.001
Se = EXIST.

-Y3-
PI Sta 13+47.925
Δ = 18° 47' 06.6" (LT)
L = 86.884
T = 43.835
R = 265.000
Se = EXIST.

NOTE: GRADE ULTIMATE SECTION FROM -LREV- STA. 41+60± TO 42+40±

NOTE: GRADE ULTIMATE SECTION FROM -LREV- STA. 40+50± TO 41+80±

-Y3- POC Sta. 11+19.957 =
-L- POC Sta. 40+87.554
-Y3- POC Sta. 11+20.083 =
-LREV- POC Sta. 41+19.524

END BRIDGE
-LREV- POC STA. 41+89.545 (7m RT)

END APPROACH SLAB
-LREV- POC STA. 41+98.375 (7m RT)

BEGIN APPROACH SLAB
-LREV- POC STA. 40+56.560 (7m RT)

BEGIN BRIDGE
-LREV- POC STA. 40+63.931 (7m RT)

BEGIN CONSTRUCTION
-Y3- POC Sta. 11+90.00

MATCH LINE -LREV- STA 39+45.000 SEE SHEET 11

MATCH LINE -LREV- STA 43+25.000 SEE SHEET 13

PRESTON J. HENN
DB 146 PG 144

KINCAID HEIRS
DB 584 PG 65

BOB HATCHETT
DB 191 PG 165

DAVID R. & WREN L. MURPHY
DB 589 PG 98-99

JUDD & EVELYN STILES
DB 259 PG 268
DB 181 PG 185

DB 551 PG 194
RONALD EDWIN STILES

WILLIAM S. & MOLENE JOHNSON
DB 355 PG 69
DB 347 PG 28

HARRY L. & JOIE A. STILES
DB 784 PG 90-91

LATERAL 'V' DITCH

SPECIAL 450 CSP TYPE "A" SILT BASIN

SPECIAL 'V' DITCH

TOE OF FILL PROTECTION

US 64 (-LREV-) OVER SR 1558 (-Y3-)

DETAIL SHOWING PROPOSED BRIDGE WIDTH IN RELATION TO PAVEMENT (NOT TO SCALE)

SEE SHEET 39 FOR -LREV- PROFILE
SEE SHEET 52 FOR -Y3- PROFILE
SEE PROFILES FOR DITCH GRADES
SEE SRUCTURE PLANS S- TO S-

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	13
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

-L-
PIs Sta 37+34.020
Θs = 0°58'56.0"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 42+09.117
Δ = 29°09'16.1" (RT)
L = 890.472
T = 455.098
R = 1,750.000

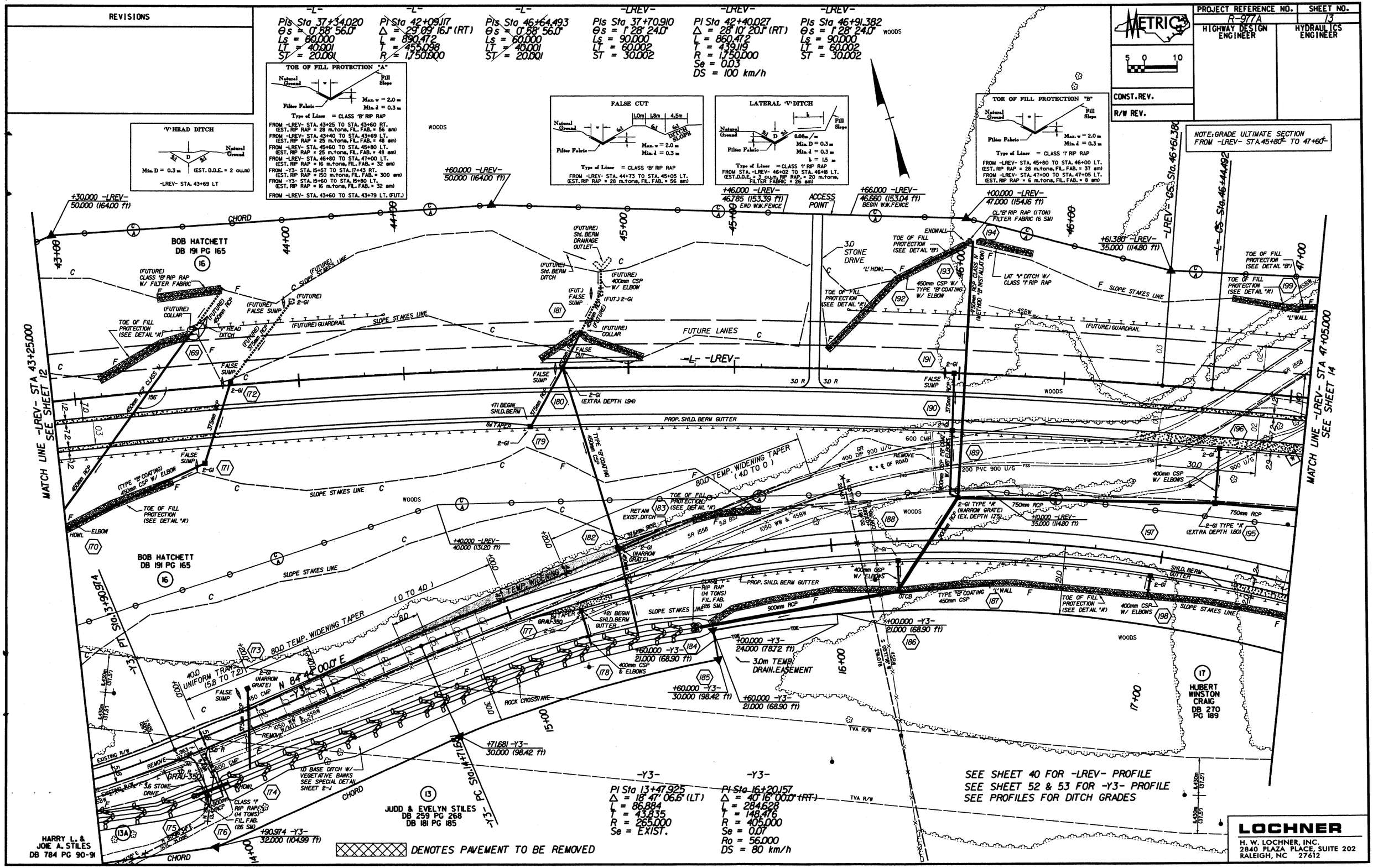
-L-
PIs Sta 46+64.493
Θs = 0°58'56.0"
Ls = 60.000
LT = 40.001
ST = 20.001

-LREV-
PIs Sta 37+70.910
Θs = 1°28'24.0"
Ls = 90.000
LT = 60.002
ST = 30.002

-LREV-
PI Sta 42+40.027
Δ = 28°10'20.1" (RT)
L = 860.472
T = 439.119
R = 1,750.000
Se = 0.03
DS = 100 km/h

-LREV-
PIs Sta 46+91.382
Θs = 1°28'24.0"
Ls = 90.000
LT = 60.002
ST = 30.002

NOTE: GRADE ULTIMATE SECTION FROM -LREV- STA. 45+80± TO 47+60±



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RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	14
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.

METRIC 5 0 10

NOTE: GRADE ULTIMATE SECTION FROM -LREV- STA. 45+80 TO 47+60

NOTE: GRADE ULTIMATE SECTION FROM -LREV- STA. 50+00 TO 51+20

-LREV-
PIs Sta 37+70.910
Θs = 1° 28' 24.0"
Ls = 90.000
LT = 60.002
ST = 30.002

-LREV-
PI Sta 42+40.027
Δ = 28° 10' 20.1" (RT)
L = 860.472
T = 439.119
R = 1,750.000
Se = 0.03
DS = 100 km/h

-LREV-
PIs Sta 46+91.382
Θs = 1° 28' 24.0"
Ls = 90.000
LT = 60.002
ST = 30.002

SEE SHEET 26
MATCH LINE -Y4- STA 12+28.533

SEE SHEET 13
MATCH LINE -LREV- STA 47+05.000

MATCH LINE -LREV- STA 50+85.000
SEE SHEET 15

-Y4- POT STA.12+87.672 =
-L- POT STA.49+50.510
-LREV- POT STA.49+72.371

-Y4- PC Sta.13+25.656

-Y4- PT Sta.13+76.105

-Y3- PT Sta.17+56.309

-Y3- POT Sta.20+83.000
-Y3- POT Sta.20+20.862
-Y4- POT Sta.14+02.287

-Y3- POT Sta.20+91.548

-Y4- POT Sta.14+50.000

END CONSTRUCTION

-Y4-
PI Sta 13+51.648
Δ = 34° 00' 22.0" (RT)
L = 50.449
T = 25.992
R = 85.000
Se = 0.05
Ro = AS SHOWN
DS = 45 km/h

-L-
PIs Sta 37+34.020
Θs = 0° 58' 56.0"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 42+09.117
Δ = 29° 09' 16.1" (RT)
L = 890.472
T = 455.098
R = 1,750.000

-L-
PIs Sta 46+64.493
Θs = 0° 58' 56.0"
Ls = 60.000
LT = 40.001
ST = 20.001

DENOTES PAVEMENT TO BE REMOVED

SEE SHEET 40 FOR -LREV- PROFILE
SEE SHEET 53 FOR -Y3- PROFILE
SEE SHEET 54 FOR -Y4- PROFILE
SEE PROFILES FOR DITCH GRADES

SEE SHEET 2-1 FOR INTERSECTION DETAILS

HUBERT WINSTON CRAIG
DB 270 PG 189

BOB HATCHETT
DB 191 PG 165

CHARLES H. WEST
WILLIAM J. WELLS
DB 438 PG 90
DB 320 PG 76
DB 559 PG 43

SIDNEY & MARIE ALLEN
DB 696 PG 57

THOMAS A. & SANDRA H. YORK
DB 429 PG 164

GILES C. & PAMELA A. ENNIS
DB 536 PG 26

SPECIAL DITCH
Type of Liner = CLASS 'B' RIP RAP
FROM -Y4- STA. 12+11 TO STA. 12+50 LT. (EST. RIP RAP = 40 m.tons, FIL. FAB. = 80 sm)
FROM -Y4- STA. 12+35 TO STA. 12+40 RT. (EST. RIP RAP = 5 m.tons, FIL. FAB. = 10 sm)

SPECIAL 'V' DITCH
Type of Liner = CLASS 'B' RIP RAP
FROM -Y4- STA. 12+50 TO STA. 12+63 LT. (EST. RIP RAP = 13 m.tons, FIL. FAB. = 26 sm)
FROM -Y4- STA. 12+40 TO STA. 12+63 RT. (EST. RIP RAP = 13 m.tons, FIL. FAB. = 26 sm)

LATERAL 'V' DITCH
Type of Liner = CLASS 'B' RIP RAP
FROM -LREV- STA. 50+32 TO STA. 50+80 RT. (EST. D.D.E. = 77 cu.m, RIP RAP = 39 m.tons, FILTER FABRIC = 67 sm)
FROM -LREV- STA. 50+67 TO STA. 50+85 LT. (EST. D.D.E. = 45 cu.m, RIP RAP = 15 m.tons, FILTER FABRIC = 25 sm)

LATERAL 'V' DITCH
Type of Liner = CLASS 'B' RIP RAP
FROM -LREV- STA. 49+90 TO STA. 50+20 LT. (EST. D.D.E. = 495 cu.m, RIP RAP = 22 m.tons, FILTER FABRIC = 42 sm)

FALSE CUT
FROM -LREV- STA. 47+80 TO STA. 47+91 LT.

TOE OF FILL PROTECTION "A"
Type of Liner = CLASS 'B' RIP RAP
FROM -Y3- STA. 17+43 TO STA. 18+14 RT. (EST. RIP RAP = 60 m.tons, FIL. FAB. = 120 sm)

TOE OF FILL PROTECTION "B"
Type of Liner = CLASS 'B' RIP RAP
FROM -LREV- STA. 47+05 TO STA. 47+17 LT. (EST. RIP RAP = 15 m.tons, FIL. FAB. = 19 sm)
FROM -Y3- STA. 17+69 TO STA. 18+17 LT. (EST. RIP RAP = 58 m.tons, FIL. FAB. = 77 sm)

SPECIAL 'V' DITCH
VARIES
FROM -Y3- STA. 19+27 TO STA. 19+36 RT.
FROM -Y3- STA. 20+40 TO STA. 20+80 RT.
FROM -Y4- STA. 14+20 TO STA. 14+37 RT.
FROM -Y4- STA. 14+20 TO STA. 14+40 LT.

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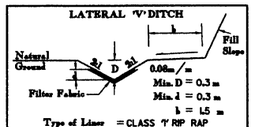
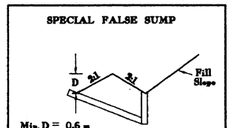
REVISIONS

LATERAL 'V' DITCH



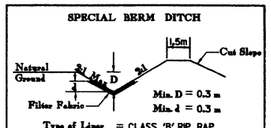
Type of Liner = CLASS 'I' RIP RAP
FROM STA. -LREV- 50+85 TO STA. 51+10 LT.
(EST. D.D.E. = 63 cu.m. RIP RAP = 23 m.tons, FILTER FABRIC = 40 sm)
FROM STA. -LREV- 53+78 TO STA. 53+87 RT.
(EST. D.D.E. = 6 cu.m. RIP RAP = 10 m.tons, FILTER FABRIC = 17 sm)

SPECIAL FALSE SUMP



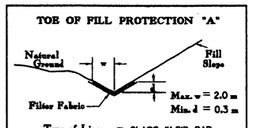
STA. 53+30 LT.

SPECIAL BERM DITCH



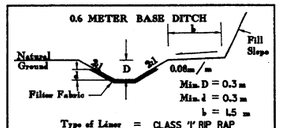
Type of Liner = CLASS 'B' RIP RAP
FROM -LREV- STA. 51+26 TO STA. 51+77 LT.
(EST. RIP RAP = 37 m.tons, FIL. FAB. = 73 sm)

TOE OF FILL PROTECTION "A"



Type of Liner = CLASS 'I' RIP RAP
FROM -LREV- STA. 53+79 TO STA. 54+19 LT.
(EST. RIP RAP = 50 m.tons, FIL. FAB. = 66 sm)

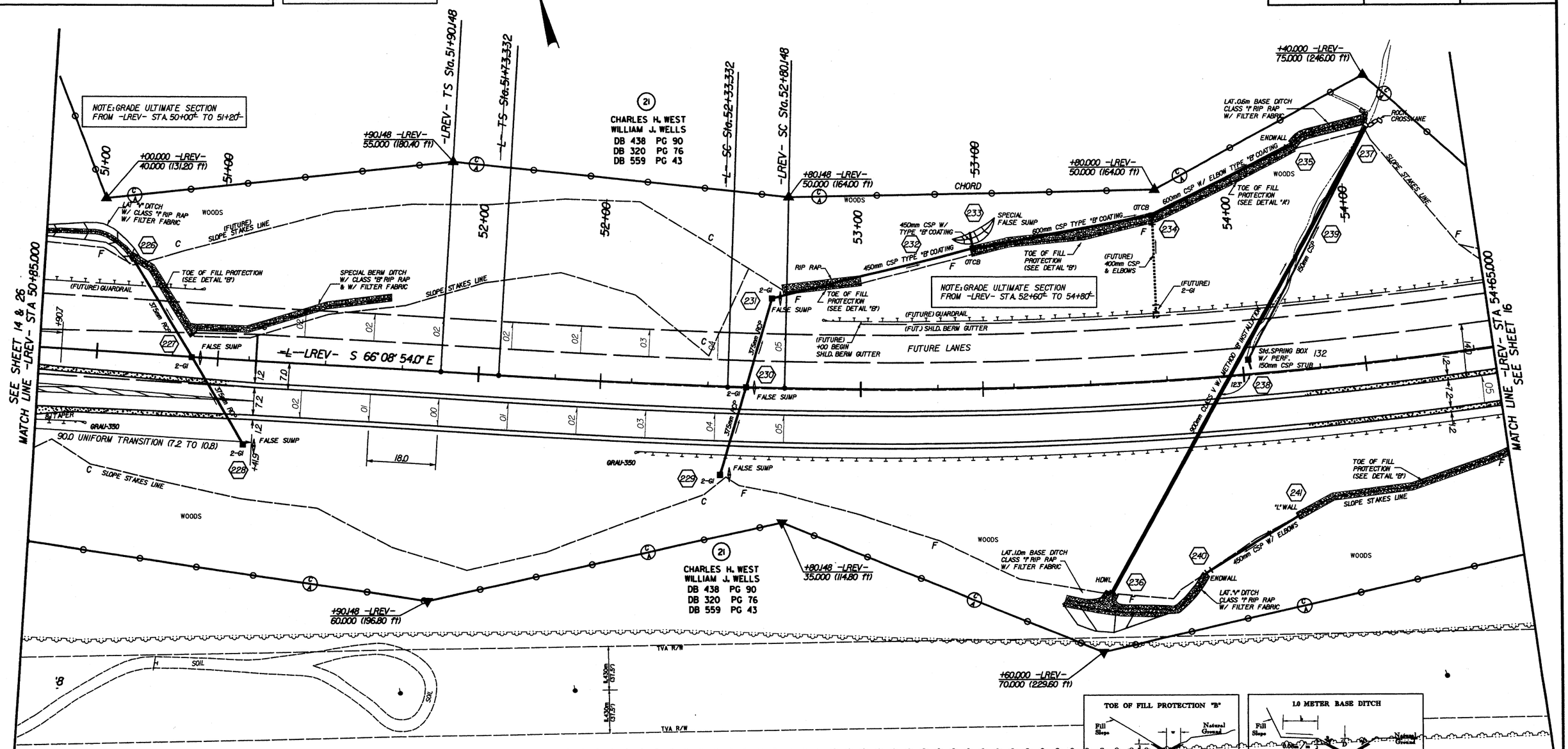
0.6 METER BASE DITCH



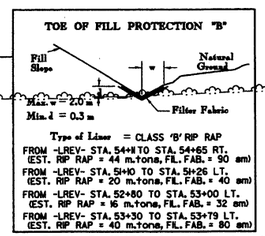
Type of Liner = CLASS 'I' RIP RAP
FROM -LREV- STA. 54+19 TO STA. 54+37 LT.
(EST. D.D.E. = 29 cu.m. RIP RAP = 29 m.tons, FILTER FABRIC = 36 sm)

METRIC 5 0 10

PROJECT REFERENCE NO.	SHEET NO.
R-977A	15
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

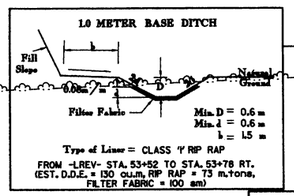


TOE OF FILL PROTECTION "B"



Type of Liner = CLASS 'B' RIP RAP
FROM -LREV- STA. 54+11 TO STA. 54+65 RT.
(EST. RIP RAP = 44 m.tons, FIL. FAB. = 90 sm)
FROM -LREV- STA. 51+10 TO STA. 51+26 LT.
(EST. RIP RAP = 20 m.tons, FIL. FAB. = 40 sm)
FROM -LREV- STA. 52+80 TO STA. 53+00 LT.
(EST. RIP RAP = 16 m.tons, FIL. FAB. = 32 sm)
FROM -LREV- STA. 53+30 TO STA. 53+79 LT.
(EST. RIP RAP = 40 m.tons, FIL. FAB. = 80 sm)

1.0 METER BASE DITCH



Type of Liner = CLASS 'I' RIP RAP
FROM -LREV- STA. 53+52 TO STA. 53+78 RT.
(EST. D.D.E. = 130 cu.m. RIP RAP = 73 m.tons, FILTER FABRIC = 100 sm)

-LREV-	-LREV-	-LREV-	-L-	-L-	-L-
Pls Sta 52+50.153	Pl Sta 55+58.285	Pls Sta 58+56.205	Pls Sta 52+13.333	Pl Sta 55+27.374	Pls Sta 58+29.386
θs = 2°12'41.3"	Δ = 26°51'19.4" (LT)	θs = 2°12'41.3"	θs = 1°28'31.5"	Δ = 28°19'50.9" (LT)	θs = 1°28'31.5"
Ls = 90.000	L = 546.053	Ls = 90.000	Ls = 60.000	L = 576.053	Ls = 60.000
LT = 60.005	T = 278.137	LT = 60.005	LT = 40.001	T = 294.042	LT = 40.001
ST = 30.004	R = 1,165.000	ST = 30.004	ST = 20.001	R = 1,165.000	ST = 20.001
	Se = 0.05				
	DS = 105 km/h				

SEE SHEET 41 FOR -LREV- PROFILE
SEE PROFILES FOR DITCH GRADES

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	16
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC

5 0 10

-LREV-
PIs Sta 52+50.153
Θs = 2°12'47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

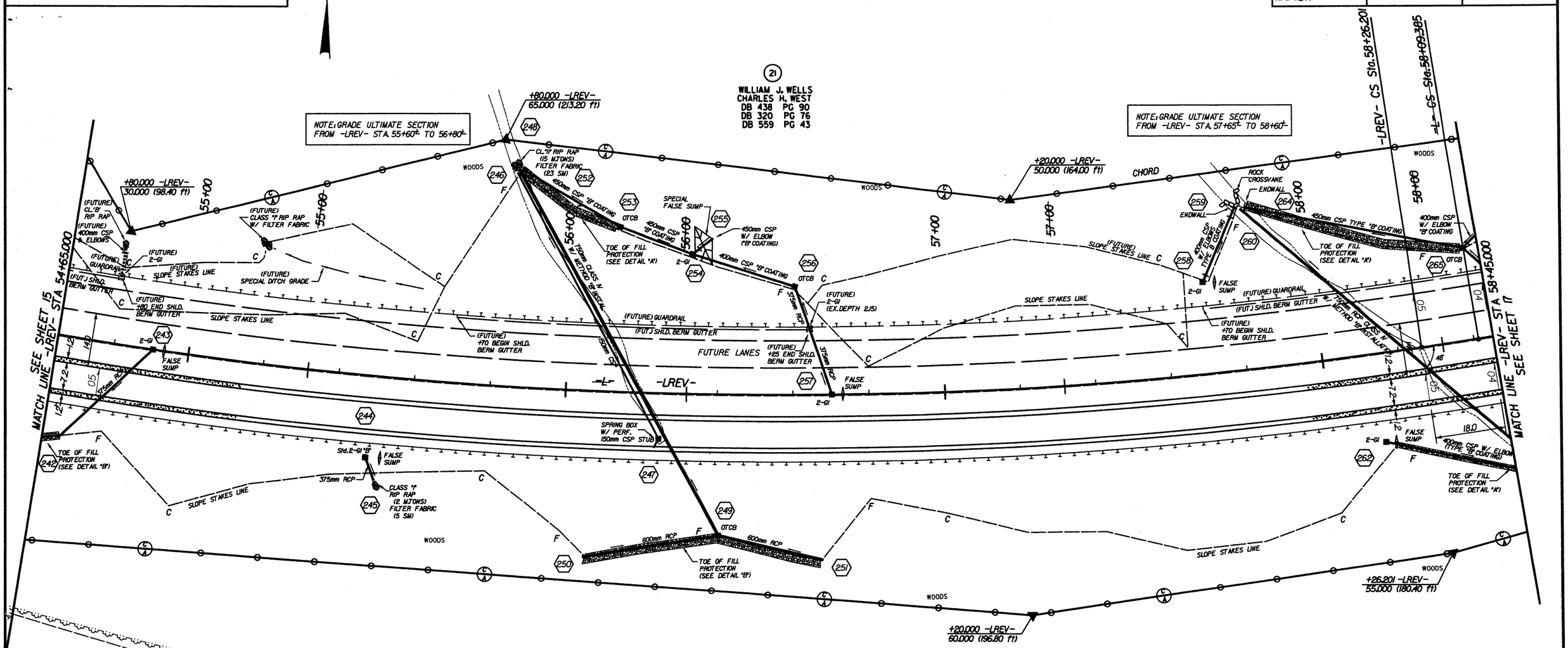
-LREV-
PI Sta 55+58.285
Δ = 26°51'19.4" (LT)
L = 546.053
T = 278.137
R = 1,165.000
Se = 0.05
DS = 105 km/h

-LREV-
PIs Sta 58+56.205
Θs = 2°12'47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

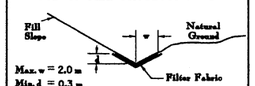
-L-
PIs Sta 52+13.333
Θs = 1°28'31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 55+27.374
Δ = 28°19'50.9" (LT)
L = 576.053
T = 294.942
R = 1,165.000

-L-
PIs Sta 58+29.386
Θs = 1°28'31.5"
Ls = 60.000
LT = 40.001
ST = 20.001



TOE OF FILL PROTECTION "B"

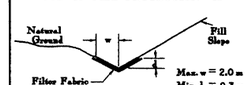


Type of Liner = CLASS 'B' RIP RAP

FROM -LREV- STA. 54+65 TO STA. 54+69 RT. (EST. RIP RAP = 4 m.tons, FIL. FAB. = 6 sm)

FROM -LREV- STA. 56+06 TO STA. 56+67 RT. (EST. RIP RAP = 50 m.tons, FIL. FAB. = 100 sm)

TOE OF FILL PROTECTION "A"



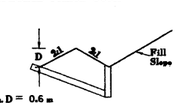
Type of Liner = CLASS 'I' RIP RAP

FROM -LREV- STA. 55+85 TO STA. 56+13 LT. (EST. RIP RAP = 36 m.tons, FIL. FAB. = 48 sm)

FROM -LREV- STA. 57+83 TO STA. 58+42 LT. (EST. RIP RAP = 73 m.tons, FIL. FAB. = 96 sm)

FROM -LREV- STA. 58+14 TO STA. 58+54 RT. (EST. RIP RAP = 32 m.tons, FIL. FAB. = 65 sm)

SPECIAL FALSE SUMP



STA. 56+37 LT.

SEE SHEET 42 FOR -LREV- PROFILE
SEE PROFILES FOR DITCH GRADES

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	17
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

-L-
Pls Sta 52+13.333
θs = 1° 28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

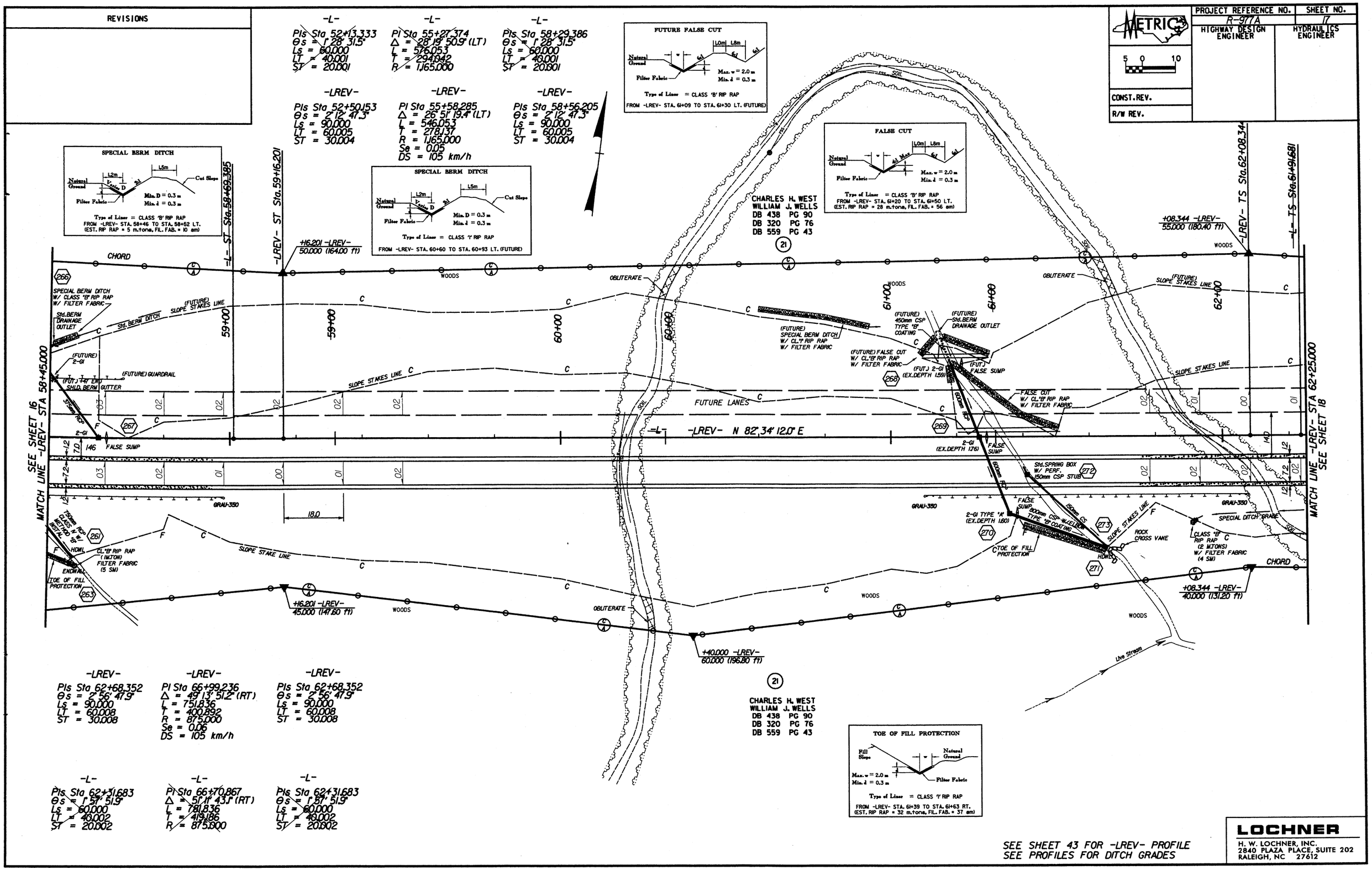
-L-
PI Sta 55+27.374
Δ = 28° 19' 50.9" (LT)
L = 576.053
T = 294.942
R = 1,165.000

-L-
Pls Sta 58+29.386
θs = 1° 28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

-LREV-
Pls Sta 52+50.153
θs = 2° 12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-LREV-
PI Sta 55+58.285
Δ = 26° 51' 19.4" (LT)
L = 546.053
T = 278.137
R = 1,165.000
Se = 0.05
DS = 105 km/h

-LREV-
Pls Sta 58+56.205
θs = 2° 12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004



-LREV-
Pls Sta 62+68.352
θs = 2° 56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-LREV-
PI Sta 66+99.236
Δ = 49° 13' 51.2" (RT)
L = 751.836
T = 400.892
R = 875.000
Se = 0.06
DS = 105 km/h

-LREV-
Pls Sta 62+68.352
θs = 2° 56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-L-
Pls Sta 62+31.683
θs = 1° 37' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

-L-
PI Sta 66+70.867
Δ = 51° 11' 43.1" (RT)
L = 781.836
T = 419.186
R = 875.000

-L-
Pls Sta 62+31.683
θs = 1° 37' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

SEE SHEET 43 FOR -LREV- PROFILE
SEE PROFILES FOR DITCH GRADES

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	18
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

-LREV-
Pls Sta 62+68.352
θs = 2°56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

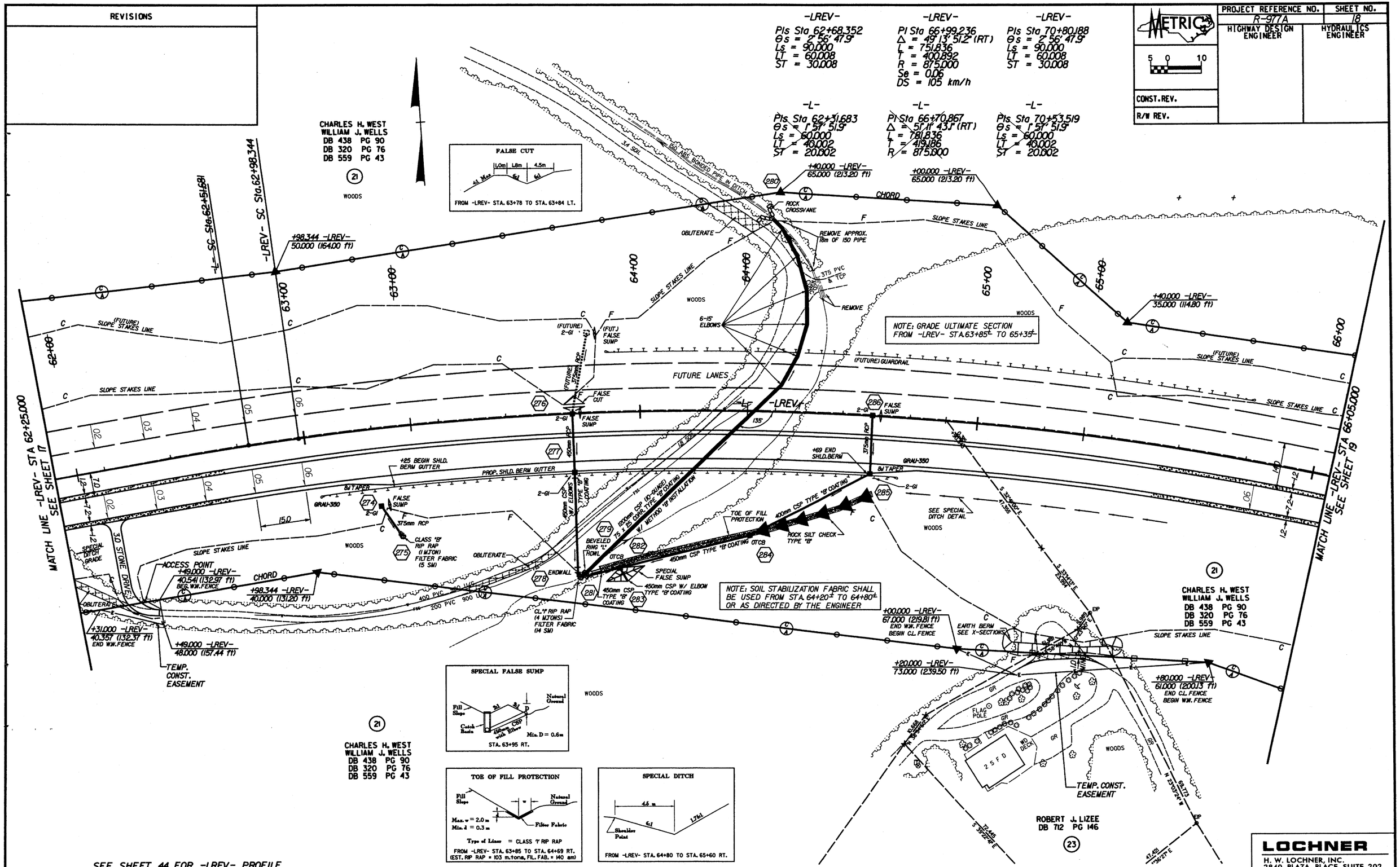
-LREV-
PI Sta 66+99.236
Δ = 49°13' 51.2" (RT)
L = 751.836
T = 400.892
R = 875.000
Se = 0.06
DS = 105 km/h

-LREV-
Pls Sta 70+80.188
θs = 2°56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-L-
Pls Sta 62+31.683
θs = 1°51' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

-L-
PI Sta 66+70.867
Δ = 51°11' 43.1" (RT)
L = 781.836
T = 419.186
R = 875.000

-L-
Pls Sta 70+53.519
θs = 1°51' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002



SEE SHEET 44 FOR -LREV- PROFILE
SEE PROFILES FOR DITCH GRADES

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	19
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

R/W REV.

-LREV-
Pls Sta 62+68.352
θs = 2° 56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

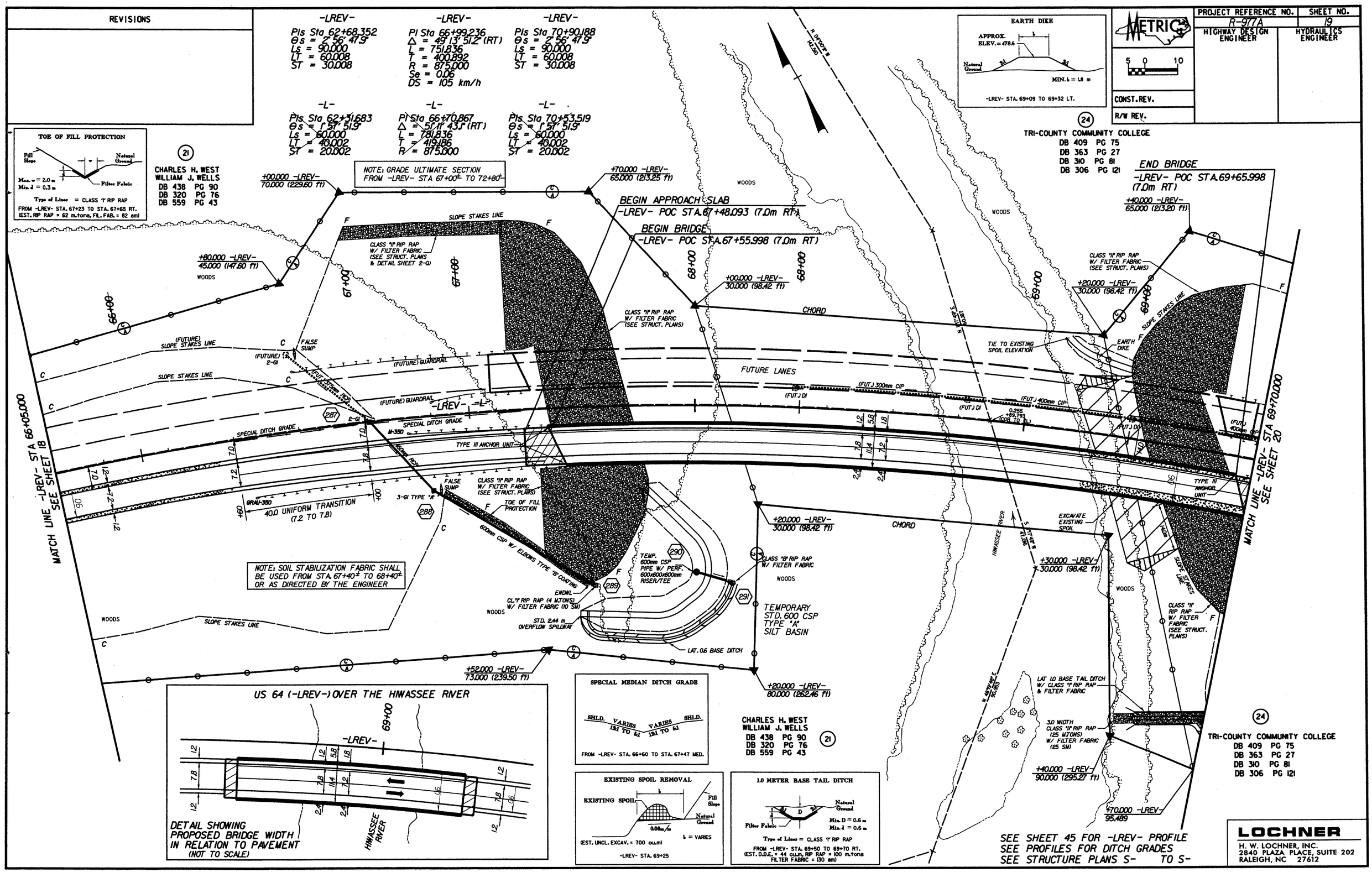
-LREV-
Pl Sta 66+99.236
Δ = 49° 13' 51.2" (RT)
L = 751.836
T = 400.892
R = 875.000
Se = 0.06
DS = 105 km/h

-LREV-
Pls Sta 70+90.188
θs = 2° 56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-L-
Pls Sta 62+31.683
θs = 1° 57' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002

-L-
Pl Sta 66+70.867
Δ = 57° 11' 43.1" (RT)
L = 781.836
T = 419.186
R = 875.000

-L-
Pls Sta 70+53.519
θs = 1° 57' 51.9"
Ls = 60.000
LT = 40.002
ST = 20.002



LOCHNER
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2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	20
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 1.0

-L-
PIs Sta 62+31.683
θs = 51° 52' 52.0"
Ls = 60.000
LT = 40.002
ST = 20.002

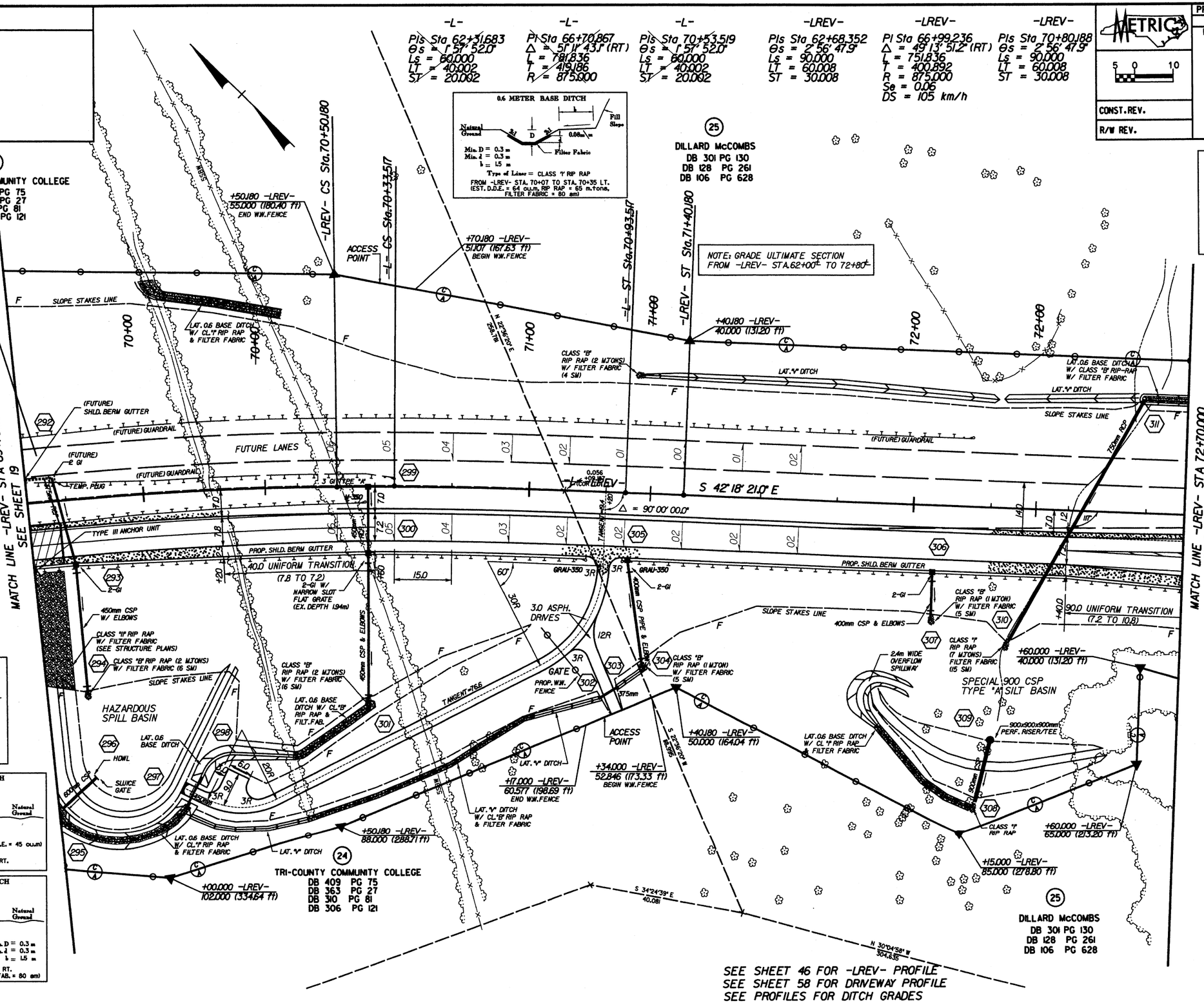
-L-
PI Sta 66+70.867
Δ = 51° 11' 43.1" (RT)
L = 781.836
T = 419.186
R = 875.000

-L-
PIs Sta 70+53.519
θs = 51° 52' 52.0"
Ls = 60.000
LT = 40.002
ST = 20.002

-LREV-
PIs Sta 62+68.352
θs = 2° 56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008

-LREV-
PI Sta 66+99.236
Δ = 49° 13' 51.2" (RT)
L = 751.836
T = 400.892
R = 875.000
Se = 0.06
DS = 105 km/h

-LREV-
PIs Sta 70+80.188
θs = 2° 56' 47.9"
Ls = 90.000
LT = 60.008
ST = 30.008



SEE SHEET 46 FOR -LREV- PROFILE
SEE SHEET 58 FOR DRIVEWAY PROFILE
SEE PROFILES FOR DITCH GRADES

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RALEIGH, NC 27612

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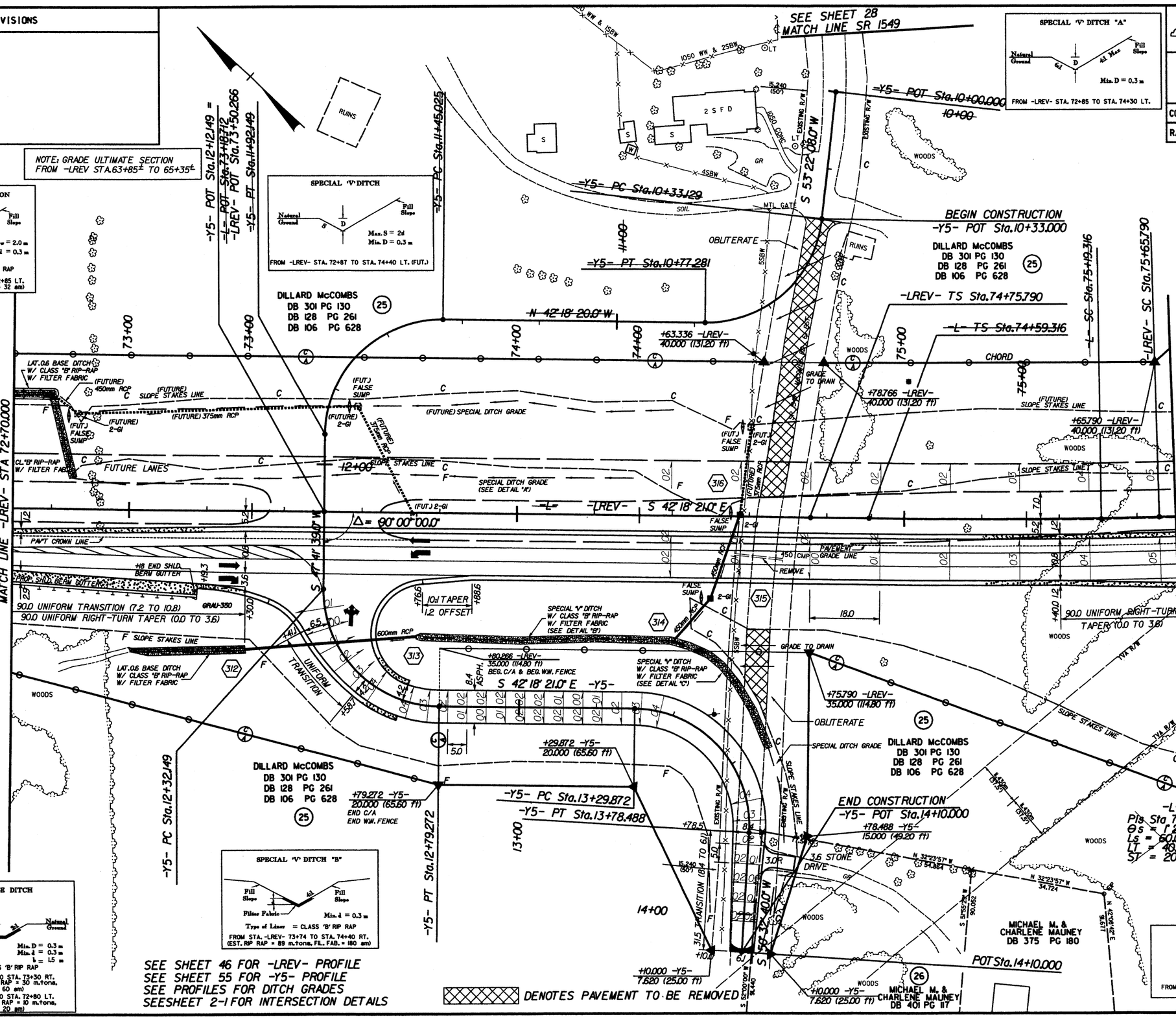
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	21
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10



-Y5-
PI Sta 13+61.403
Δ = 92°51' 01.0" (RT)
L = 48.616
T = 31.531
R = 30.000
Se = 0.04
Ro = 20.000
DS = 30 km/h

-Y5-
PI Sta 12+62.149
Δ = 90°00' 00.0" (LT)
L = 47.124
T = 30.000
R = 30.000
Se = 0.04
Ro = AS SHOWN
DS = 30 km/h

-Y5-
PI Sta 11+75.025
Δ = 90°00' 00.0" (LT)
L = 47.124
T = 30.000
R = 30.000

-Y5-
PI Sta 10+60.296
Δ = 84°19' 32.0" (RT)
L = 44.153
T = 27.167
R = 30.000

-LREV-
PIs Sta 75+35.795
θs = 2°12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-LREV-
PI Sta 81+02.675
Δ = 49°29' 05.4" (LT)
L = 1,006.179
T = 536.885
R = 1,165.000
Se = 0.05
DS = 105 km/h

-L-
PIs Sta 86+01.973
θs = 2°12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-L-
PIs Sta 74+99.317
θs = 1°28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 80+74.497
Δ = 50°57' 36.9" (LT)
L = 1,036.179
T = 555.181
R = 1,165.000

-L-
PIs Sta 85+75.496
θs = 1°28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

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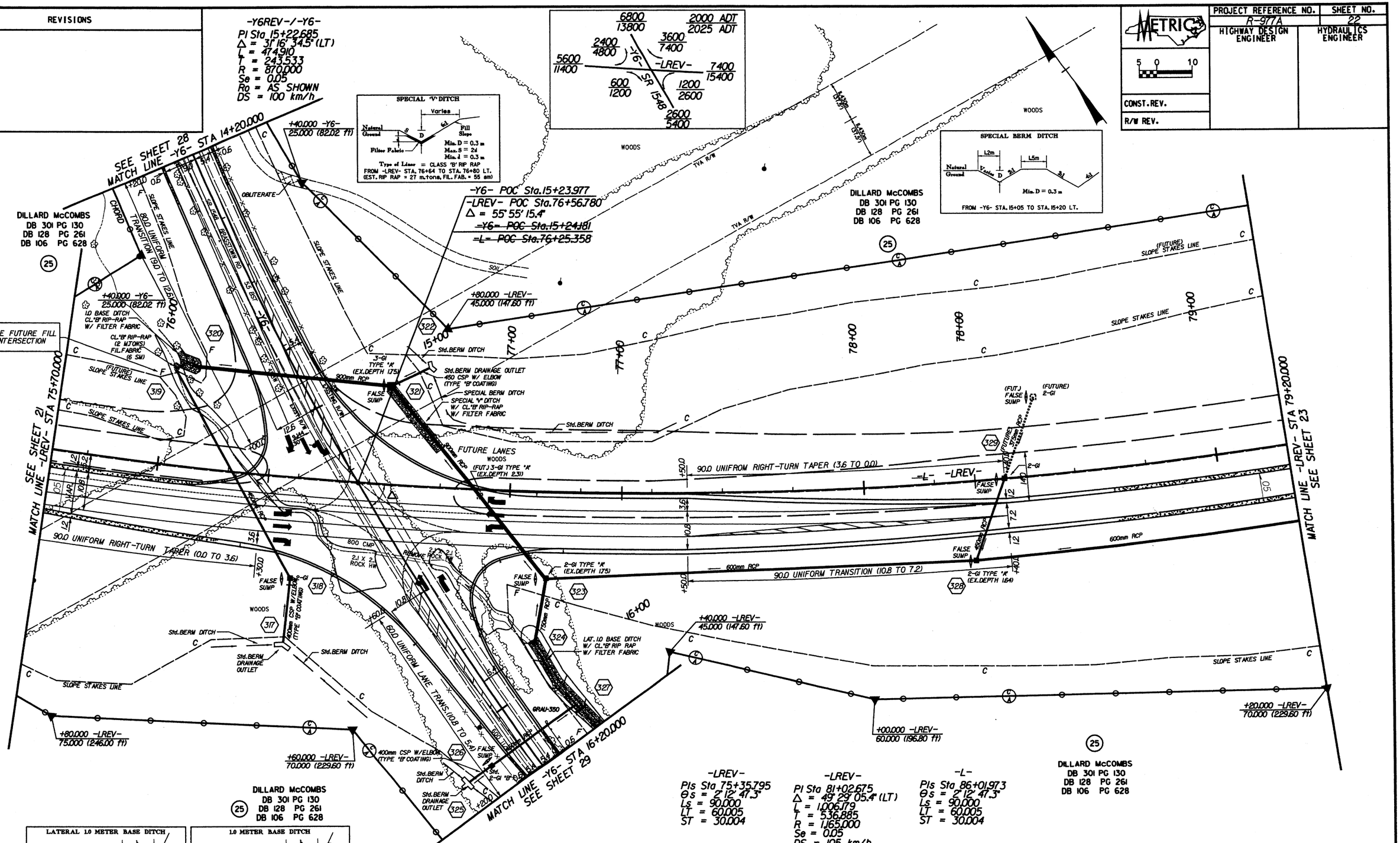
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	22
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC

5 0 10



-LREV-
Pls Sta 75+35.795
θs = 2° 12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-LREV-
PI Sta 81+02.675
Δ = 49° 29' 05.4" (LT)
L = 1,006.179
T = 536.885
R = 1,165.000
Se = 0.05
DS = 105 km/h

-L-
Pls Sta 86+01.973
θs = 2° 12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-L-
Pls Sta 74+99.317
θs = 1° 28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 80+74.497
Δ = 50° 57' 36.9" (LT)
L = 1,036.179
T = 555.181
R = 1,165.000

-L-
Pls Sta 85+75.496
θs = 1° 28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

SEE SHEET 47 FOR -LREV- PROFILE
SEE SHEET 57 FOR -Y6- PROFILE
SEE PROFILES FOR DITCH GRADES
SEE SHEET 2-H FOR INTERSECTION DETAILS

LOCHNER
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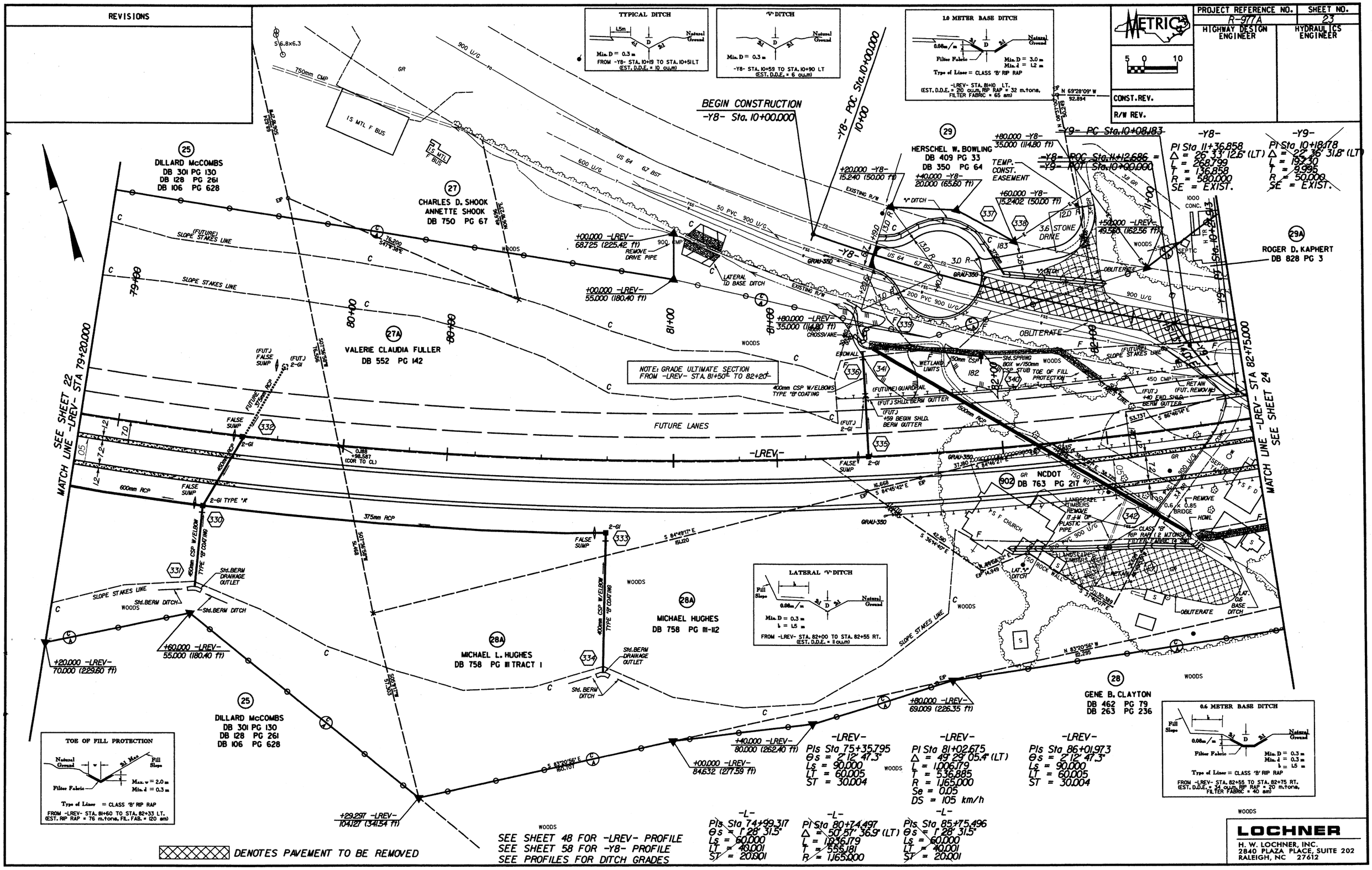
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	23
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

R/W REV.



LOCHNER

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2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	24
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 1.0

-LREV-
PI Sta 75+35.795
Θs = 2°12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

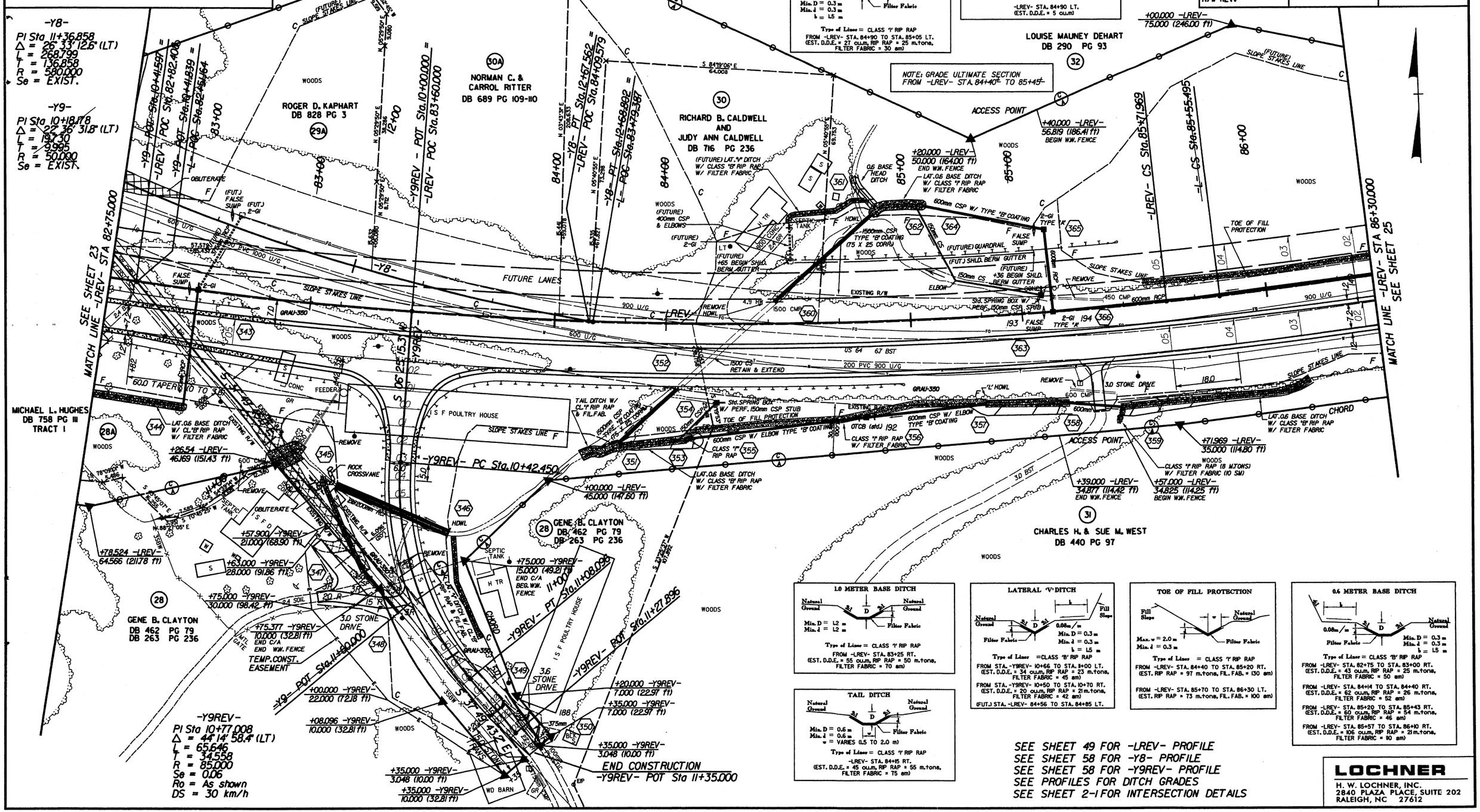
-LREV-
PI Sta 81+02.675
Δ = 49°29' 05.4" (LT)
L = 1,006.179
T = 536.885
R = 1,165.000
Se = 0.05
DS = 105 km/h

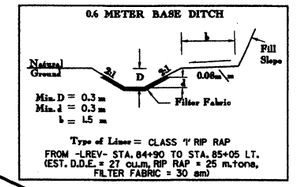
-LREV-
PI Sta 86+01.973
Θs = 2°12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

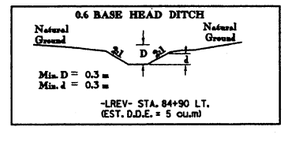
-L-
PI Sta 74+99.317
Θs = 1°28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001

-L-
PI Sta 80+74.497
Δ = 50°51' 36.9" (LT)
L = 1,036.179
T = 555.181
R = 1,165.000

-L-
PI Sta 85+75.496
Θs = 1°28' 31.5"
Ls = 60.000
LT = 40.001
ST = 20.001







SEE SHEET 49 FOR -LREV- PROFILE
SEE SHEET 58 FOR -Y8- PROFILE
SEE SHEET 58 FOR -Y9REV- PROFILE
SEE PROFILES FOR DITCH GRADES
SEE SHEET 2-1 FOR INTERSECTION DETAILS

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RALEIGH, NC 27612

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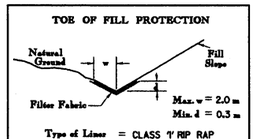
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	25
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

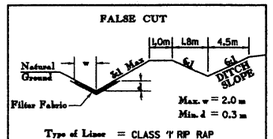
METRIC 5 0 10

TOE OF FILL PROTECTION

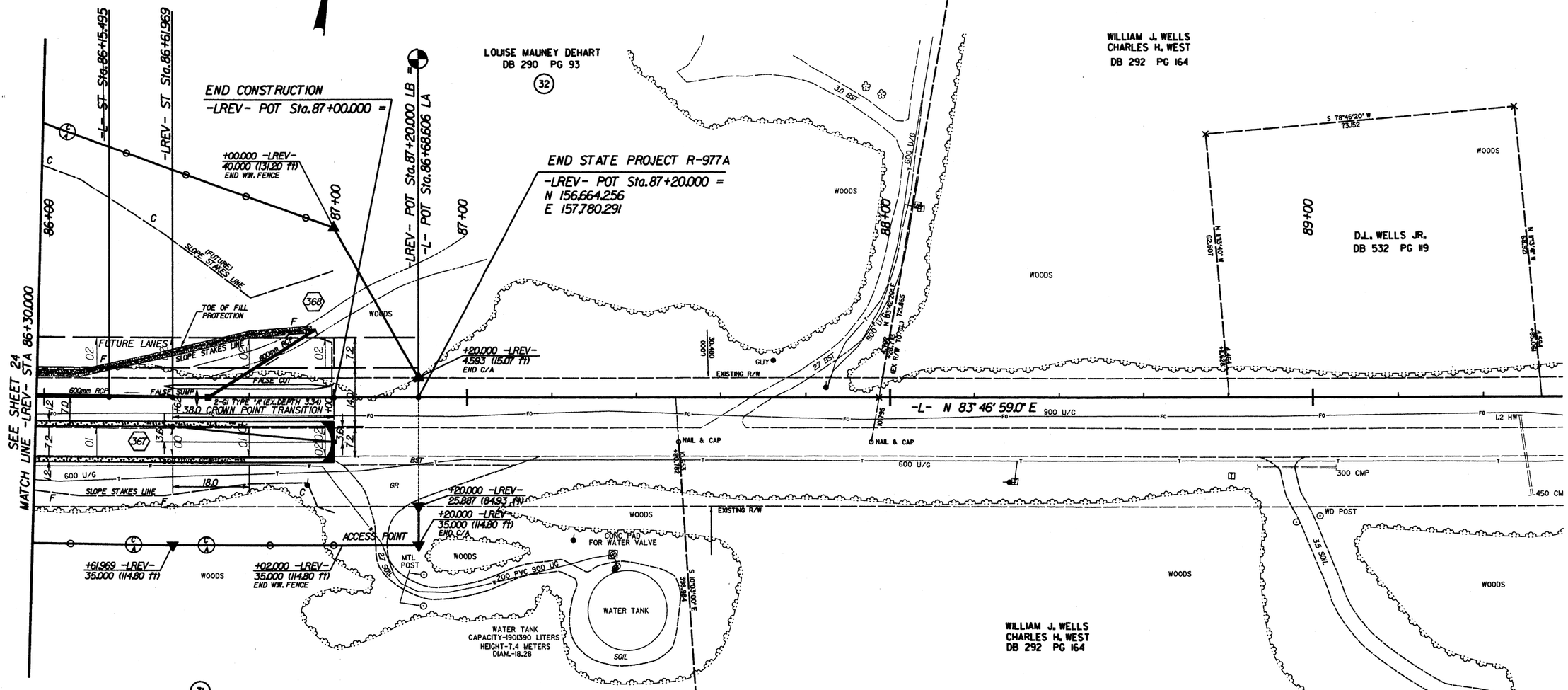


Type of Liner = CLASS 'I' RIP RAP
FROM -LREV- STA. 86+30 TO STA. 86+60 LT.
(EST. RIP RAP = 36 m.tons, FIL. FAB. = 42 sm)

FALSE CUT



Type of Liner = CLASS 'I' RIP RAP
FROM -LREV- STA. 86+60 TO STA. 87+00 LT.
(EST. RIP RAP = 48 m.tons, FIL. FAB. = 56 sm)



-LREV-
PIs Sta 75+35.795
Θs = 2°12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-LREV-
PI Sta 81+02.675
Δ = 49°29' 05.4" (LT)
L = 1,006.179
T = 536.885
R = 1,165.000
Se = 0.05
DS = 105 km/h

-L-
PIs Sta 86+01.973
Θs = 2°12' 47.3"
Ls = 90.000
LT = 60.005
ST = 30.004

-L-
~~PIs Sta 74+99.317~~
~~Θs = 1°28' 31.5"~~
~~Ls = 60.000~~
~~LT = 49.001~~
~~ST = 20.901~~

-L-
~~PI Sta 80+74.497~~
~~Δ = 50°57' 36.9" (LT)~~
~~L = 1,036.179~~
~~T = 555.181~~
~~R = 1,165.000~~

-L-
~~PIs Sta 85+75.496~~
~~Θs = 1°28' 31.5"~~
~~Ls = 60.000~~
~~LT = 49.001~~
~~ST = 20.901~~

SEE SHEET 50 FOR -LREV- PROFILE
SEE PROFILES FOR DITCH GRADES

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2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	26
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC

5 0 10

-Y4DETOUR-

-Y4- PT Sta.9+47.503 = -Y4DETOUR- POT Sta.9+47.503

BEGIN CONSTRUCTION
-Y4- Sta.POT 9+55.000
-Y4DETOUR- PC Sta.9+55.000

-Y4DETOUR- PT Sta.9+69.063

-Y4DETOUR- PC Sta.10+02.488

-Y4- PC Sta.10+20.000

-Y4- PT Sta.11+03.164

-Y4DETOUR- PT Sta.10+72.393

-Y4DETOUR- PC Sta.10+96.456

-Y4DETOUR- PT Sta.11+12.930

-Y4DETOUR- POT Sta.11+50.000

-Y4- S 3° 45' 00.0" W

S 59° 45' 28.5" W

S 26° 06' 58.5" W

S 33° 52' 58.0" W

TEMP. SLOPE STAKES LINE

TEMP. 3.0 STONE DRIVE

BURY IN CUT

20m UNIF. TRANS. (5.4 TO 4.9m)

25m UNIF. TRANS. (4.9m TO 6.6m)

40m UNIF. TRANS. (6.6m TO 7.7m)

30m UNIFORM TRANSITION (7.7m TO 6.6m)

CLASS "B" RIP RAP (2 TONS) FILTER FABRIC (4 SM)

CLASS "B" RIP RAP W/ FILTER FABRIC

SPECIAL DITCH

3.0 STONE DRIVE

MTL GATE

SLOPE STAKES LINE

EXISTING R/W

℄ OF ROAD

EXIST. R/W TO BE ABANDONED

SR 1561 49 GR

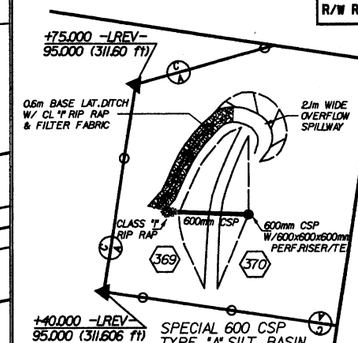
WOODS

CHARLES H. WEST
WILLIAM J. WELLS
(21) DB 438 PG 90
DB 320 PG 76
DB 559 PG 43

BOB HATCHETT
(16) DB 191 PG 165

MATCH LINE -LREV- STA 50+85.000
SEE SHEET 15

MATCH LINE -Y4- STA 12+28.533
SEE SHEET 14



SPECIAL 600 CSP TYPE "A" SILT BASIN

TYPICAL DITCH

Natural Ground — Filter Fabric — Min. d = 0.3 m

Type of Liner = CLASS "B" RIP RAP
FROM -Y4- STA. 10+75 TO STA. 12+35 LT
(EST. RIP RAP = 145 m.tons, FIL. FAB. = 310 sm)

-Y4-
PI Sta 8+87.154
Δ = 5° 32' 12.0" (RT)
L = 120.791
T = 60.443
R = 1250.000
Se = EXIST.

-Y4-
PI Sta 10+65.251
Δ = 56° 03' 30.0" (LT)
L = 83.164
T = 45.251
R = 85.000
Se = 0.08
Ro = 48.000
DS = 50 km/h

-Y4DETOUR-
PI Sta 9+62.064
Δ = 13° 25' 44.1" (RT)
L = 14.063
T = 7.064
R = 60.000
Se = NC
DS = 40 km/h

-Y4DETOUR-
PI Sta 10+39.553
Δ = 47° 07' 15.5" (LT)
L = 69.905
T = 37.066
R = 85.000
Se = NC
DS = 40 km/h

-Y4DETOUR-
PI Sta 11+04.706
Δ = 7° 51' 57.5" (RT)
L = 16.474
T = 8.250
R = 120.000
Se = NC
DS = 40 km/h

SEE SHEET 54 FOR -Y4- PROFILE
SEE SHEET 54 FOR -Y4DETOUR- PROFILE
SEE PROFILES FOR DITCH GRADES

LOCHNER
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2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	27
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

DENOTES PAVEMENT TO BE REMOVED

-Y7-
PIs Sta 74+27.218
Θs = 5°00'00.0"
Ls = 60.939
LT = 40.656
ST = 20.335

-Y7-
PI Sta 75+07.897
Δ = 19°36'51.0" (LT)
L = 119.568
T = 60.375
R = 349.276
Se = EXIST.

-Y7-
PIs Sta 75+87.425
Θs = 5°00'00.0"
Ls = 60.939
LT = 40.656
ST = 20.335

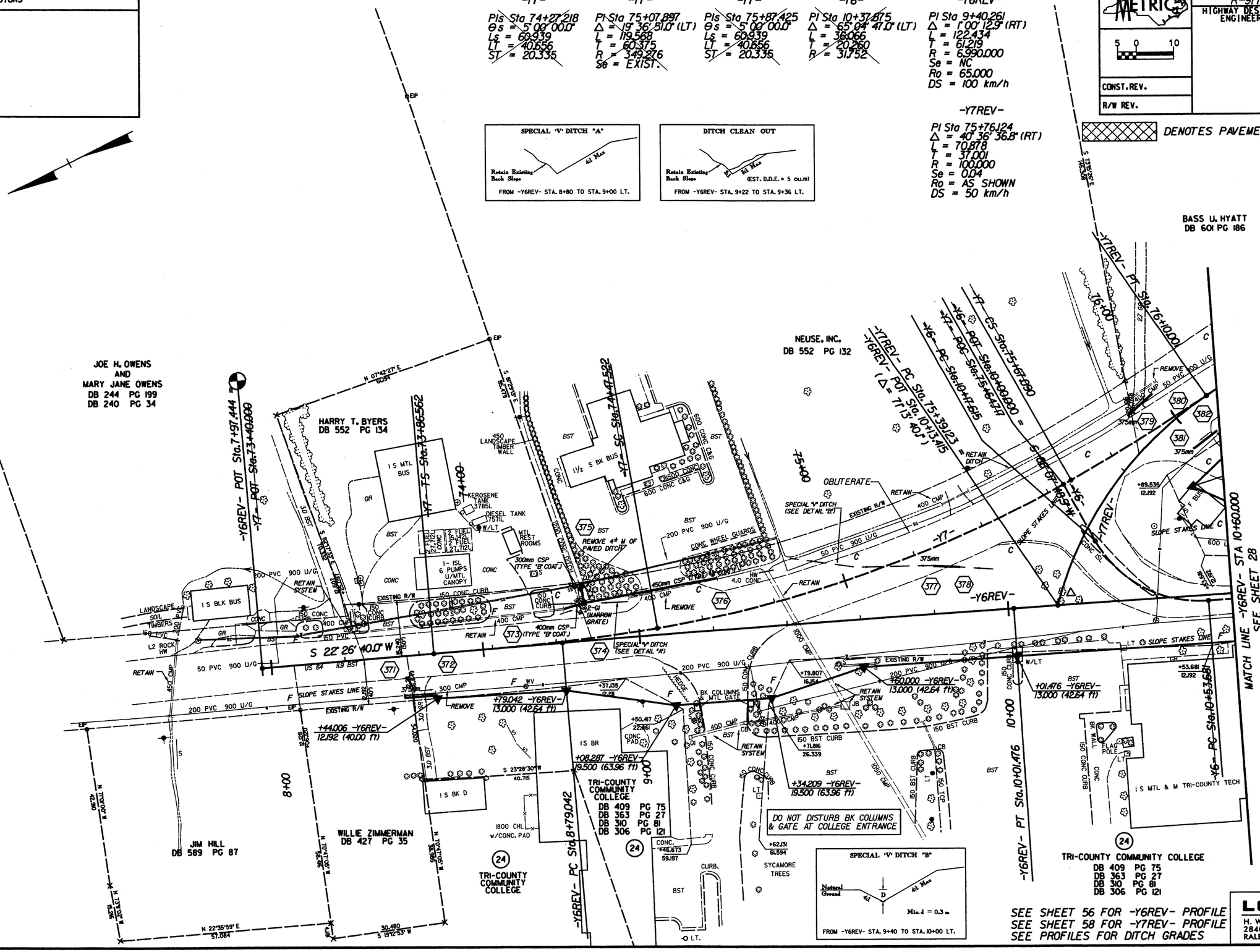
-Y6-
PI Sta 10+37.875
Δ = 65°04'47.0" (LT)
L = 36.066
T = 20.260
R = 31.752

-Y6REV-
PI Sta 9+40.261
Δ = 1°00'12.9" (RT)
L = 122.434
T = 61.219
R = 6,990.000
Se = NC
Ro = 65.000
DS = 100 km/h

-Y7REV-
PI Sta 75+76.124
Δ = 40°36'36.8" (RT)
L = 70.878
T = 37.001
R = 100.000
Se = 0.04
Ro = AS SHOWN
DS = 50 km/h

SPECIAL 'V' DITCH "A"
Retain Existing Back Slope
4:1 Max
FROM -Y6REV- STA. 8+80 TO STA. 9+00 LT.

DITCH CLEAN OUT
Retain Existing Back Slope
2:1 4:1 Max
(EST. D.D.E. = 5 cu.m)
FROM -Y6REV- STA. 9+22 TO STA. 9+36 LT.



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RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	28
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC 5 0 10

CONST. REV.

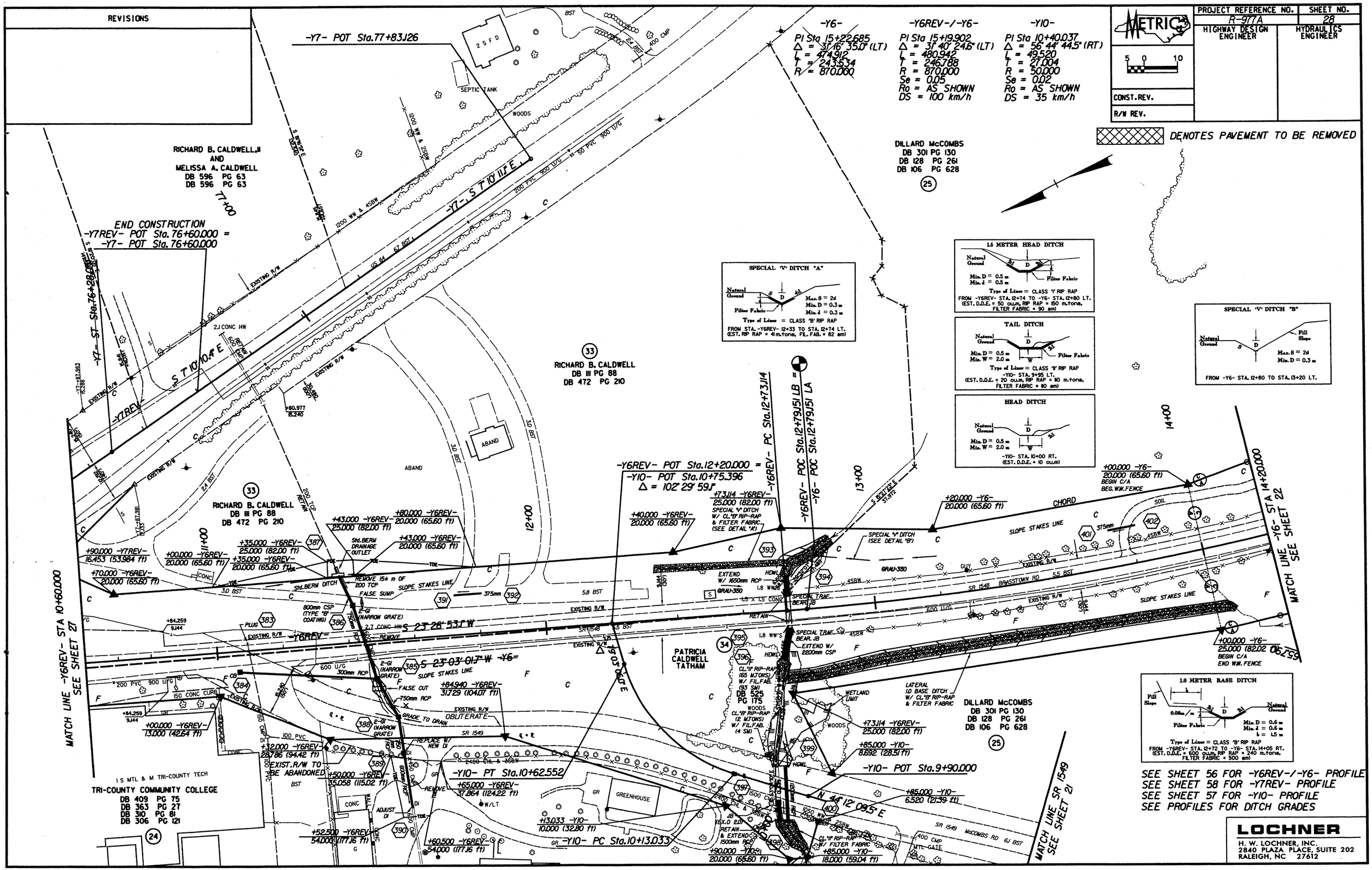
R/W REV.

DENOTES PAVEMENT TO BE REMOVED

-Y6-
PI Sta 15+22.685
Δ = 31°16' 35.0" (LT)
L = 474.912
T = 243.534
R = 870.000

-Y6REV-/-Y6-
PI Sta 15+19.902
Δ = 31°40' 24.6" (LT)
L = 480.942
T = 246.788
R = 870.000
Se = 0.05
Ro = AS SHOWN
DS = 100 km/h

-Y10-
PI Sta 10+40.037
Δ = 56°44' 44.5" (RT)
L = 49.520
T = 27.004
R = 50.000
Se = 0.02
Ro = AS SHOWN
DS = 35 km/h



SEE SHEET 56 FOR -Y6REV-/-Y6- PROFILE
SEE SHEET 58 FOR -Y7REV- PROFILE
SEE SHEET 57 FOR -Y10- PROFILE
SEE PROFILES FOR DITCH GRADES

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

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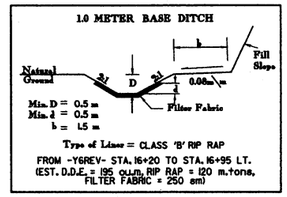
REVISIONS

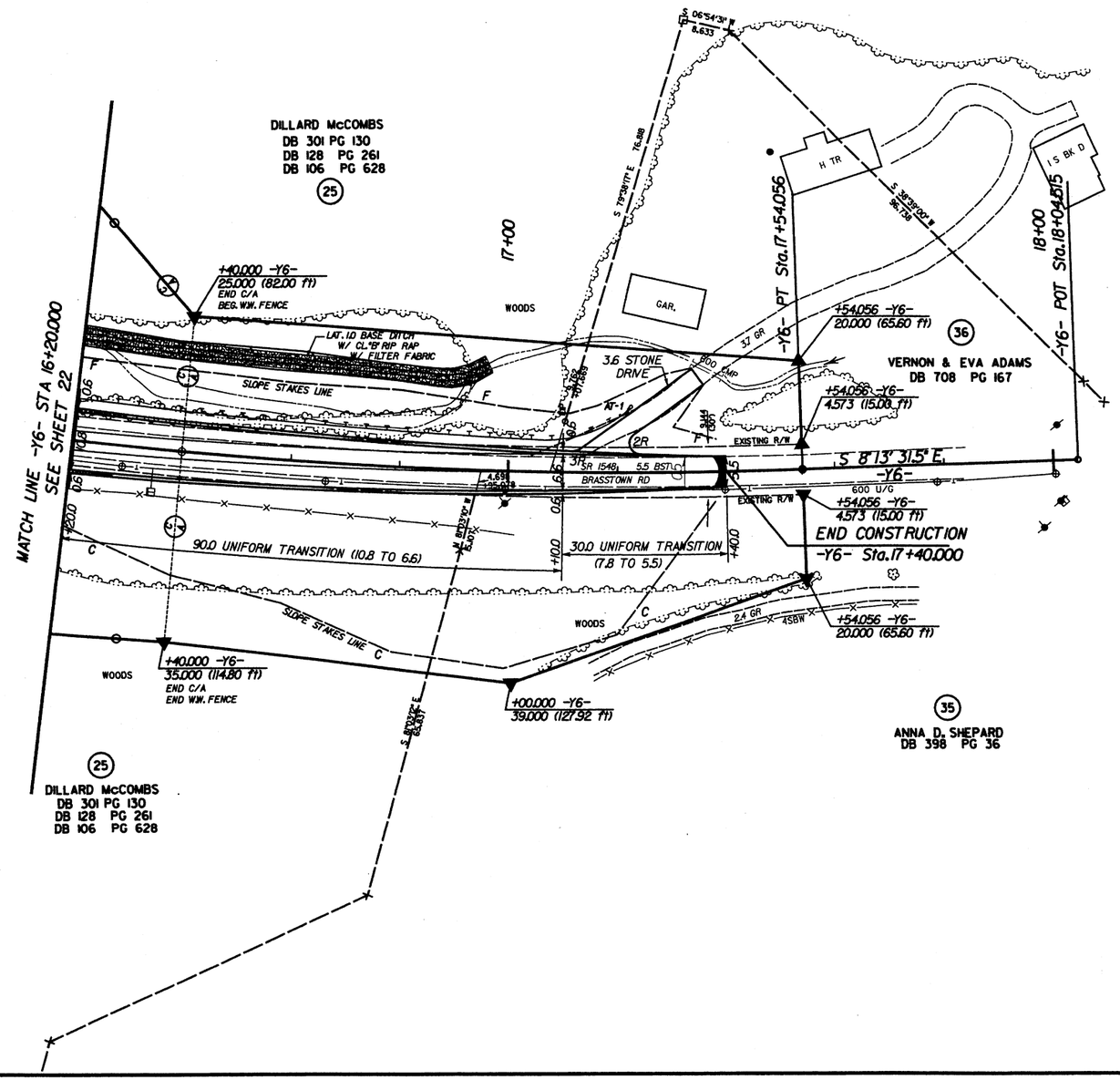
PROJECT REFERENCE NO.	SHEET NO.
R-977A	29
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 1.0

-Y6REV-/-Y6-

PI Sta 15+19.902
Δ = 31° 40' 24.6" (LT)
L = 480.942
T = 246.788
R = 870.000
Se = 0.05
Ro = AS SHOWN
DS = 100 km/h





SEE SHEET 57 FOR -Y6- PROFILE
SEE PROFILES FOR DITCH GRADES

LOCHNER
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2840 PLAZA PLACE, SUITE 202
RALEIGH, NC 27612

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REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
R-977A	30
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

METRIC 5 0 10

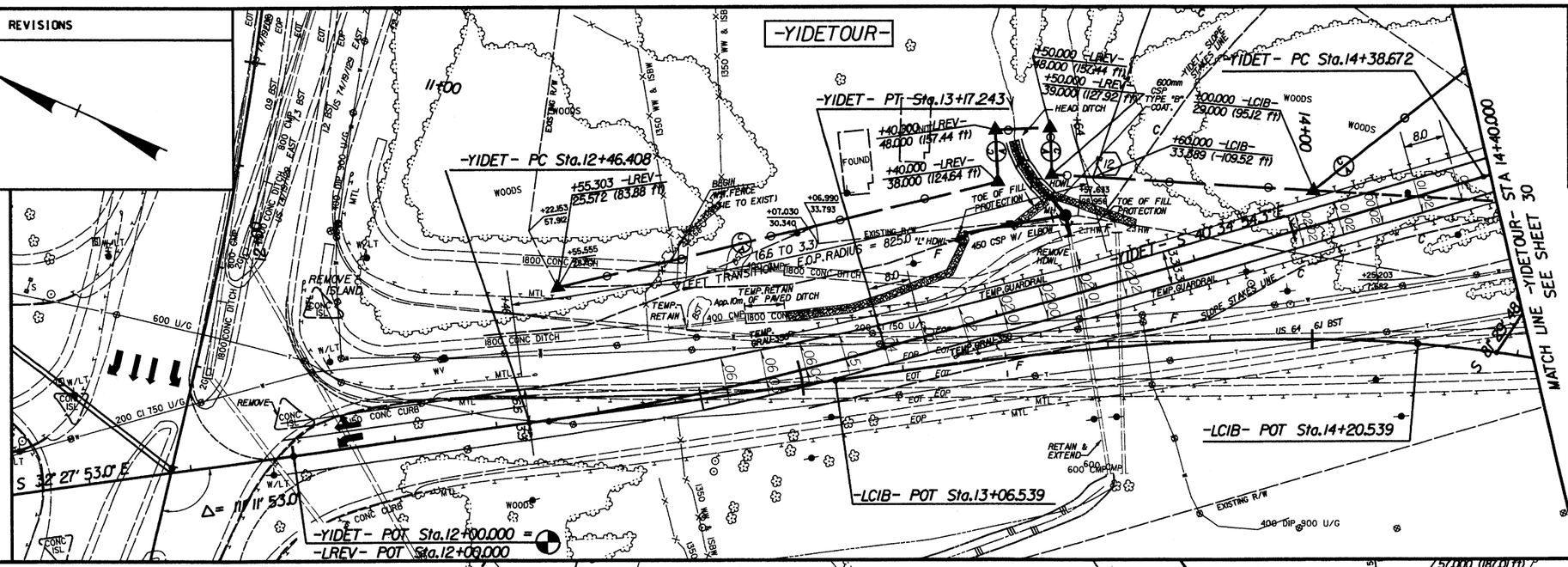
-YIDETOUR-

-YIDET-
PI Sta 12+81.885
Δ = 8° 07' 01.3" (LT)
L = 70.834
T = 35.477
R = 500.000
Se = 0.06
Ro = AS SHOWN
DS = 80 km/h

-YIDET-
PI Sta 15+05.307
Δ = 23° 44' 24.4" (RT)
L = 89.804
T = 45.190
R = 215.000
Se = 0.04
Ro = AS SHOWN
DS = km/h

-YICIB-
PI Sta 10+09.417
Δ = 59° 04' 14.9" (RT)
L = 82.478
T = 45.327
R = 80.000
Se = 0.04
Ro = AS SHOWN
DS = 40 km/h

-YICIB-
PI Sta 11+67.685
Δ = 26° 48' 36.7" (LT)
L = 107.623
T = 54.815
R = 230.000
Se = 0.06
Ro = AS SHOWN
DS = km/h



TOE OF FILL PROTECTION "B"

Max. w = 2.0 m
Min. d = 0.3 m

Type of Liner = CLASS 'B' RIP RAP

FROM -YIDET- STA. 13+00 TO STA. 13+38 LT. (EST. RIP RAP = 48 m.tons, FIL FAB. = 64 sm)

FROM -YIDET- STA. 13+47 TO STA. 13+55 LT. (EST. RIP RAP = 11m.tons, FIL FAB. = 14 sm)

FROM -YIDET- STA. 13+57 TO STA. 13+70 LT. (EST. RIP RAP = 16 m.tons, FIL FAB. = 27 sm)

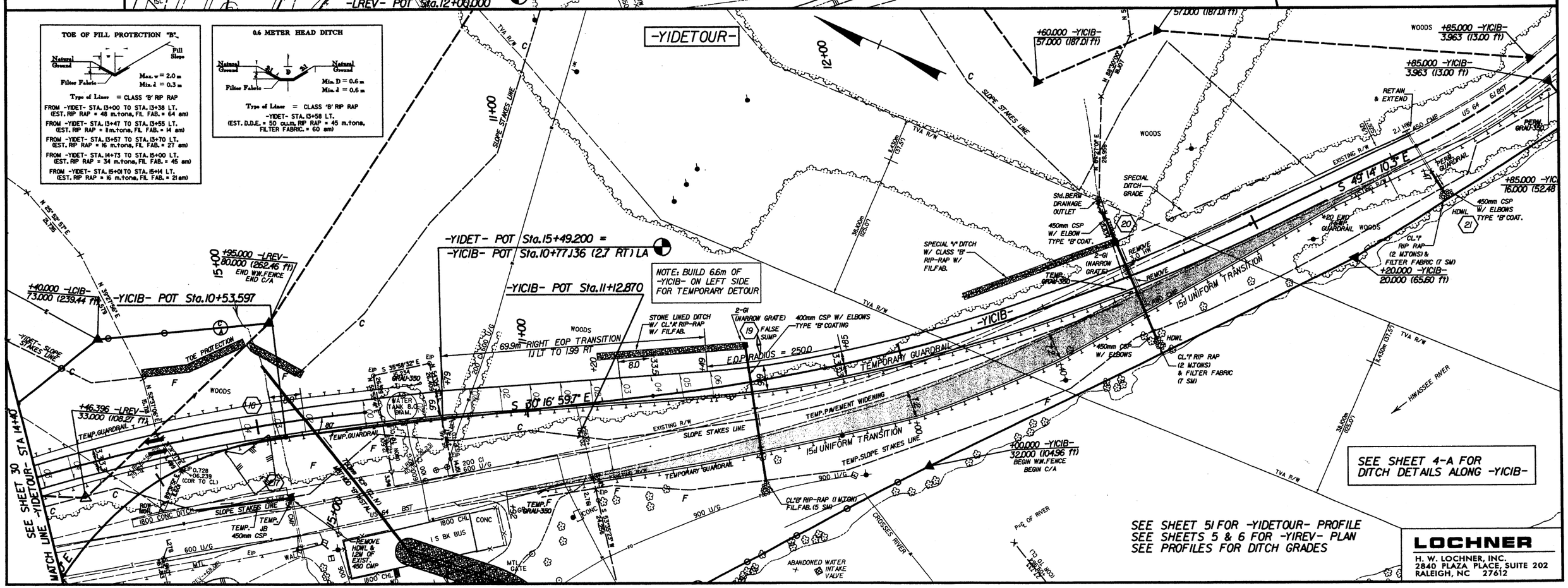
FROM -YIDET- STA. 14+73 TO STA. 15+00 LT. (EST. RIP RAP = 34 m.tons, FIL FAB. = 45 sm)

FROM -YIDET- STA. 15+01 TO STA. 15+14 LT. (EST. RIP RAP = 16 m.tons, FIL FAB. = 21 sm)

0.6 METER HEAD DITCH

Min. D = 0.6 m
Min. d = 0.6 m

Type of Liner = CLASS 'B' RIP RAP
-YIDET- STA. 13+58 LT.
(EST. D.D.E. = 50 cu.m, RIP RAP = 45 m.tons, FILTER FABRIC. = 60 sm)



LOCHNER
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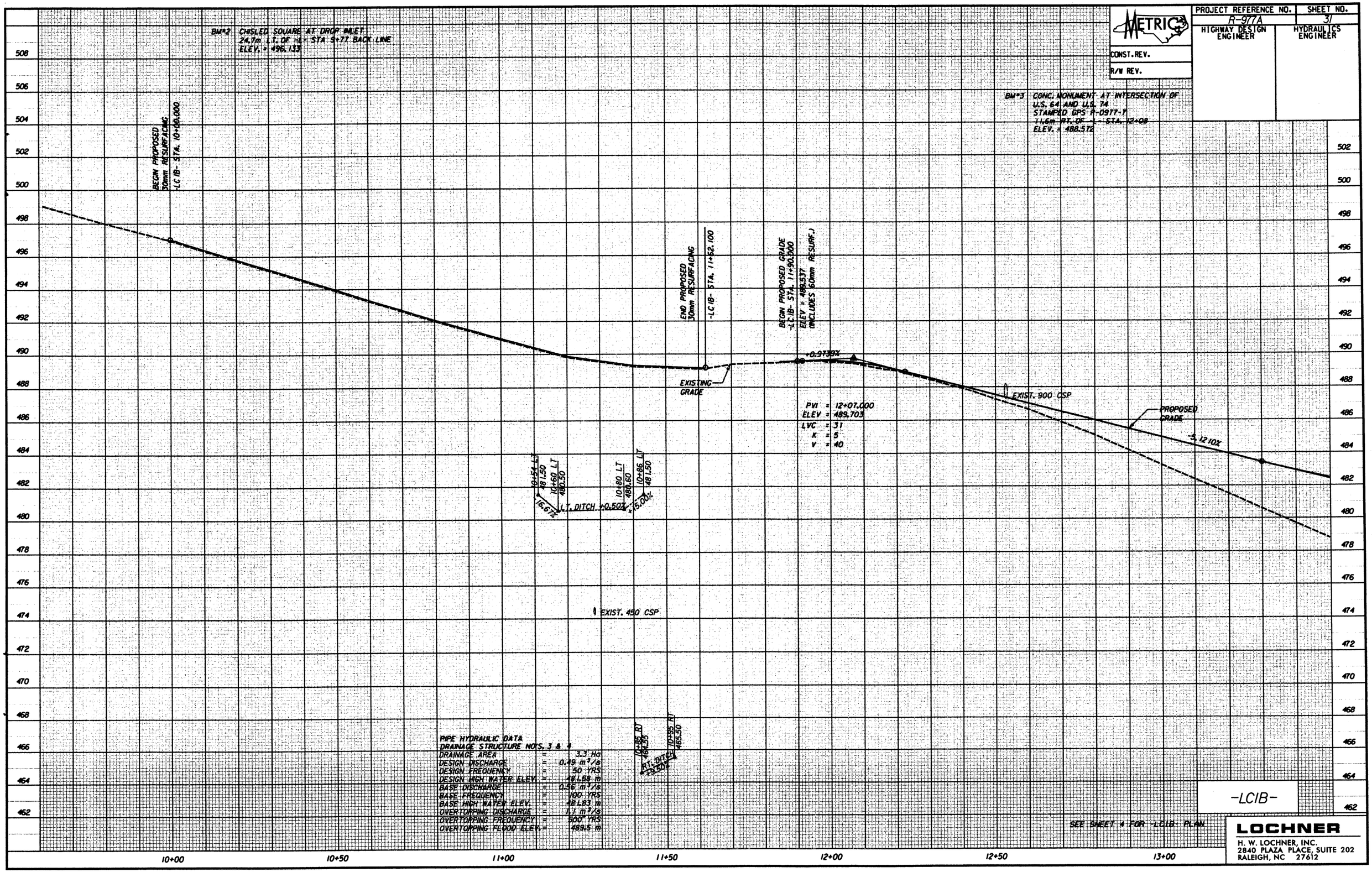
PROJECT REFERENCE NO.	SHEET NO.
R-977A	31
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



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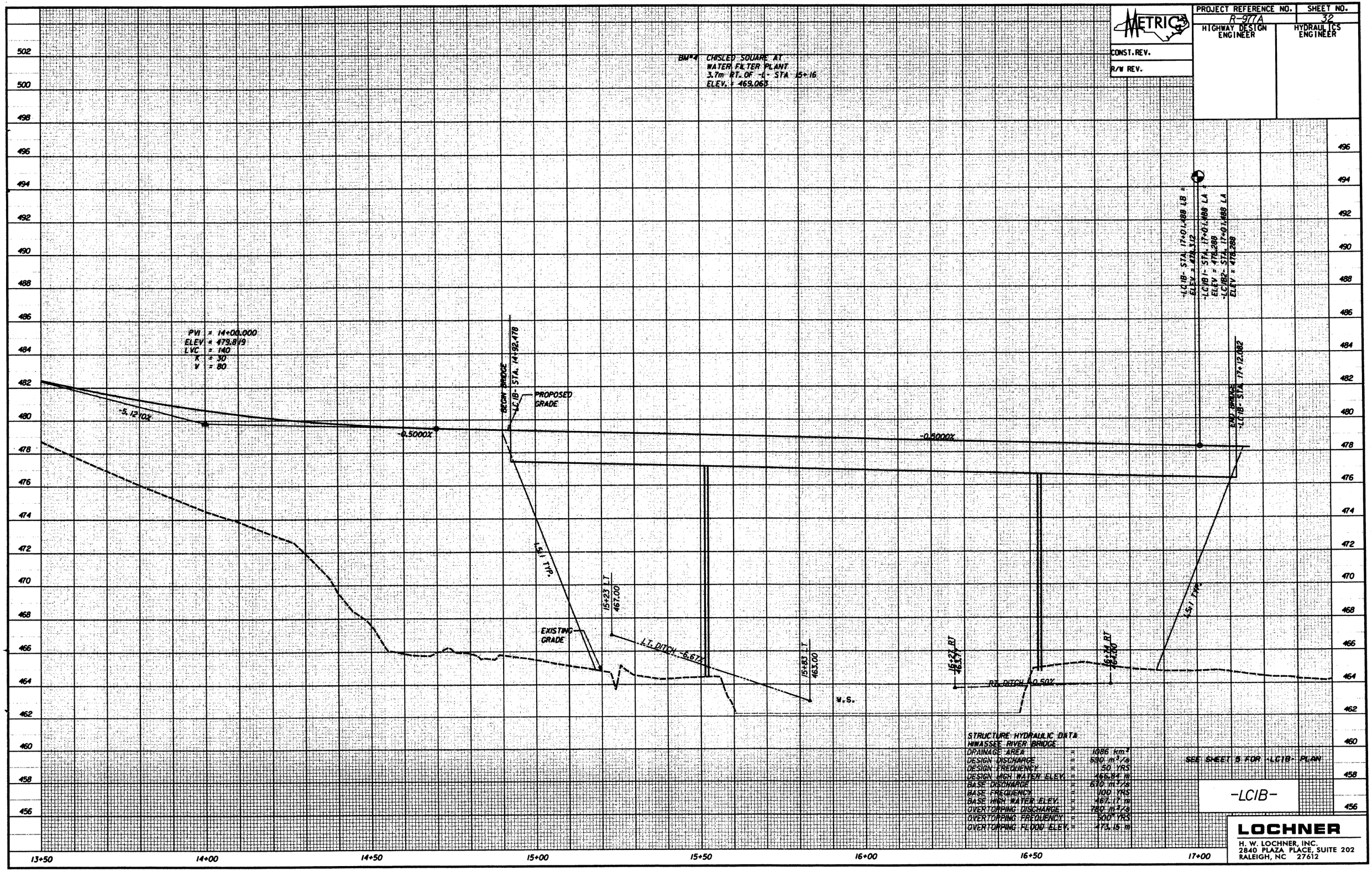
...\Design\R977_RDT_PROFL.dgn 8/12/2004 9:45:53 AM

PROJECT REFERENCE NO.	SHEET NO.
R-977A	32
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



STRUCTURE HYDRAULIC DATA
HIWASSEE RIVER BRIDGE

DRAINAGE AREA	=	1086 km^2
DESIGN DISCHARGE	=	590 m^3/s
DESIGN FREQUENCY	=	50 YRS
DESIGN HIGH WATER ELEV.	=	466.94 m
BASE DISCHARGE	=	670 m^3/s
BASE FREQUENCY	=	100 YRS
BASE HIGH WATER ELEV.	=	467.17 m
OVERTOPPING DISCHARGE	=	780 m^3/s
OVERTOPPING FREQUENCY	=	500 YRS
OVERTOPPING FLOOD ELEV.	=	473.15 m

SEE SHEET 5 FOR -LC1B- PLAN

-LC1B-

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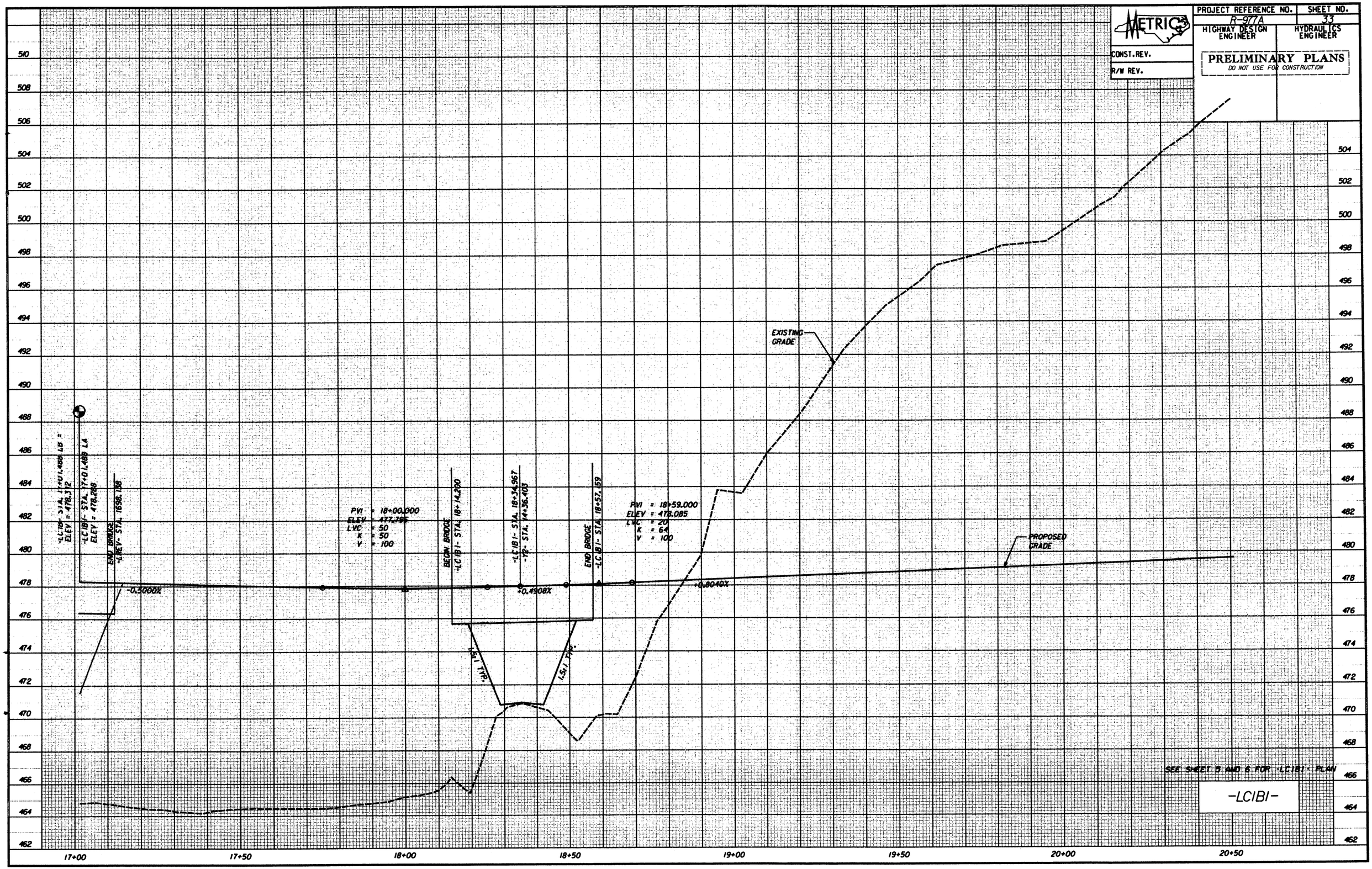
PROJECT REFERENCE NO.	SHEET NO.
R-977A	33
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION



SEE SHEET 5 AND 6 FOR -LC1B1- PLAN

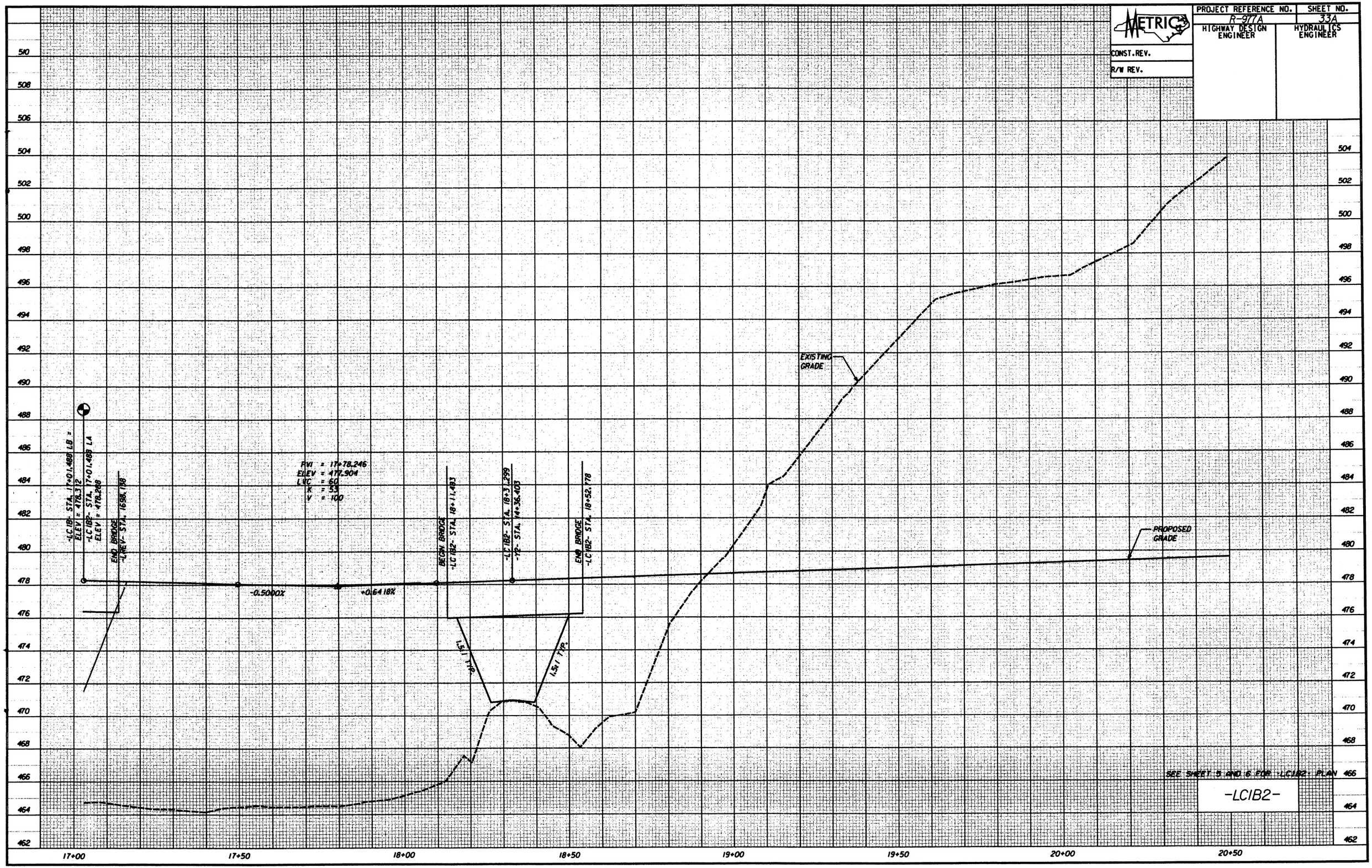
-LCIBI-

...\Design\R977_RDI_PROFL.dgn 8/12/2004 12:38:50 PM

PROJECT REFERENCE NO.	SHEET NO.
R-977A	33A
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



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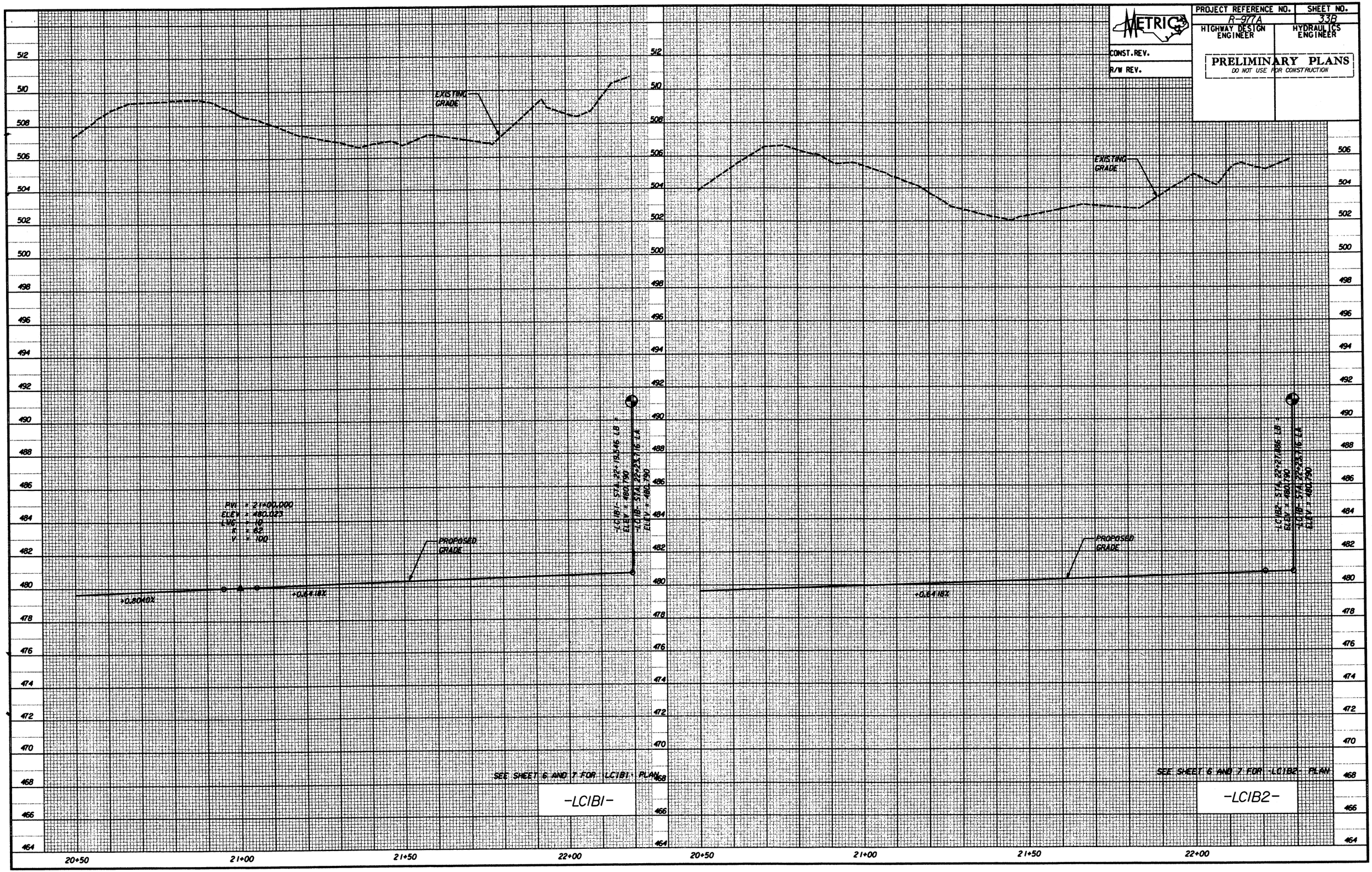
PROJECT REFERENCE NO.	SHEET NO.
R-977A	33B
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION



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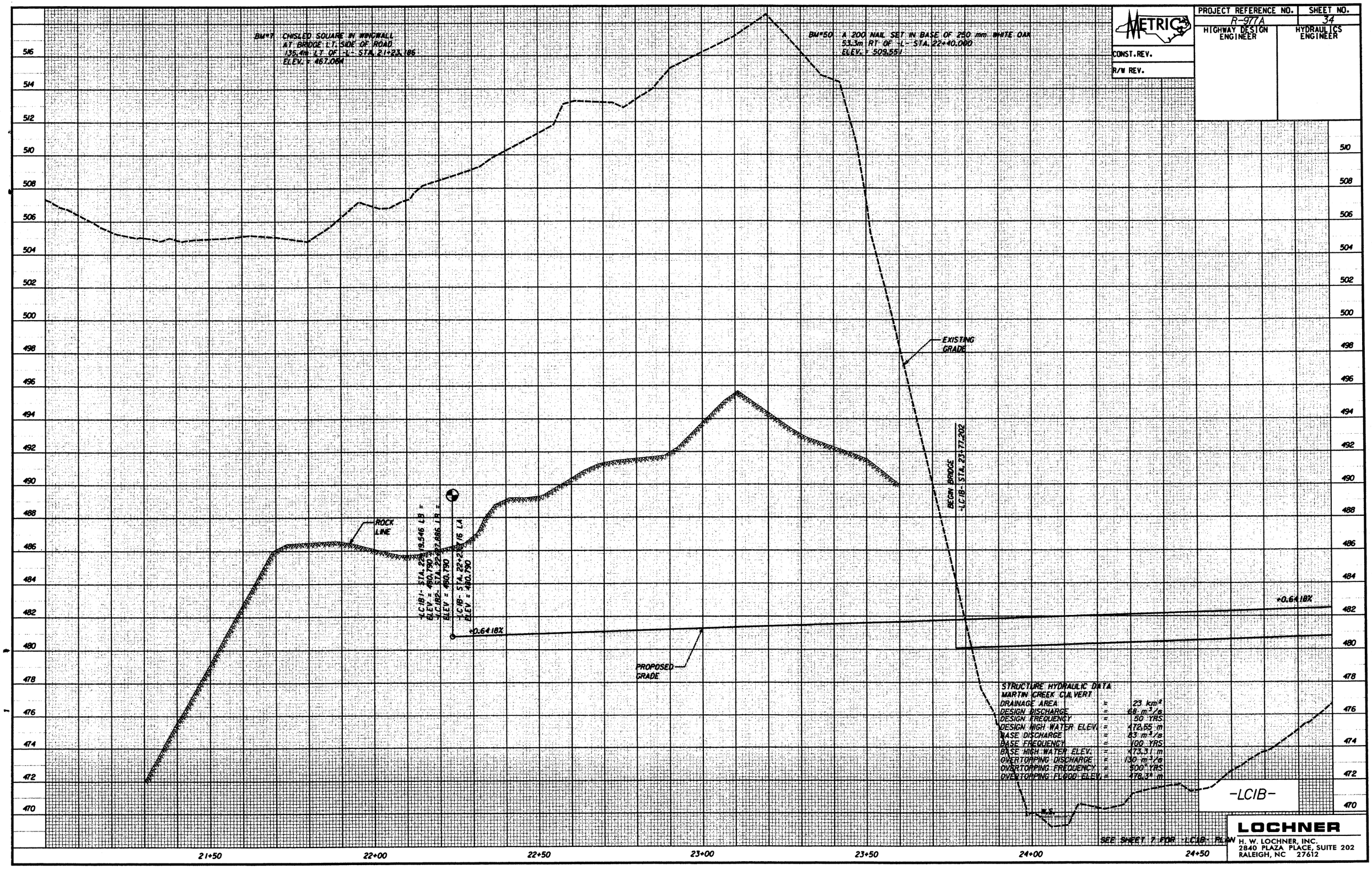
PROJECT REFERENCE NO.	SHEET NO.
R-977A	34
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



STRUCTURE HYDRAULIC DATA
MARTIN CREEK CULVERT

DRAINAGE AREA	=	23 km^2
DESIGN DISCHARGE	=	68 m^3/s
DESIGN FREQUENCY	=	50 YRS
DESIGN HIGH WATER ELEV.	=	478.55 m
BASE DISCHARGE	=	83 m^3/s
BASE FREQUENCY	=	100 YRS
BASE HIGH WATER ELEV.	=	479.31 m
OVERTOPPING DISCHARGE	=	130 m^3/s
OVERTOPPING FREQUENCY	=	500 YRS
OVERTOPPING FLOOD ELEV.	=	479.7* m

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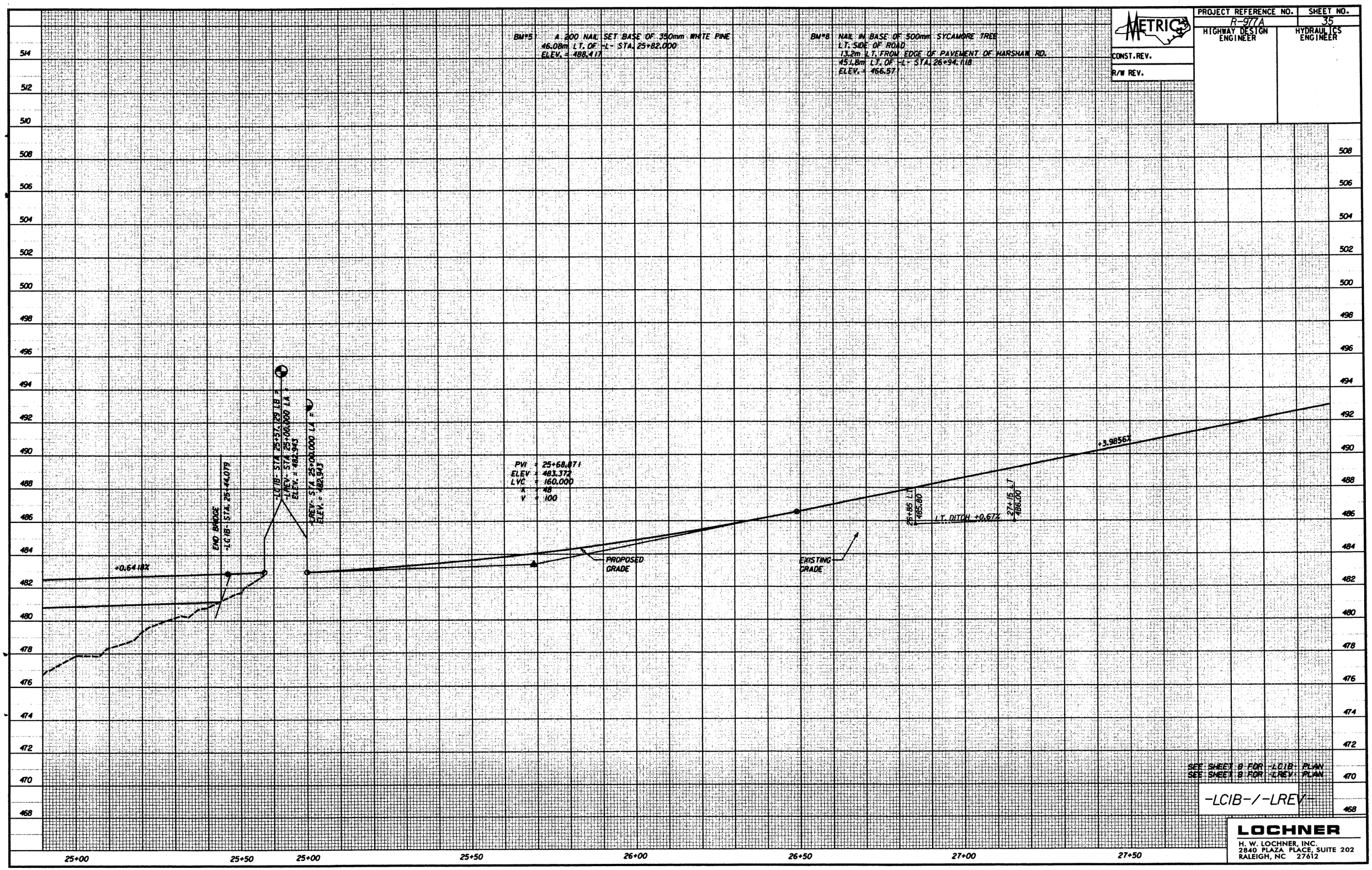
PROJECT REFERENCE NO.	SHEET NO.
R-977A	35
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



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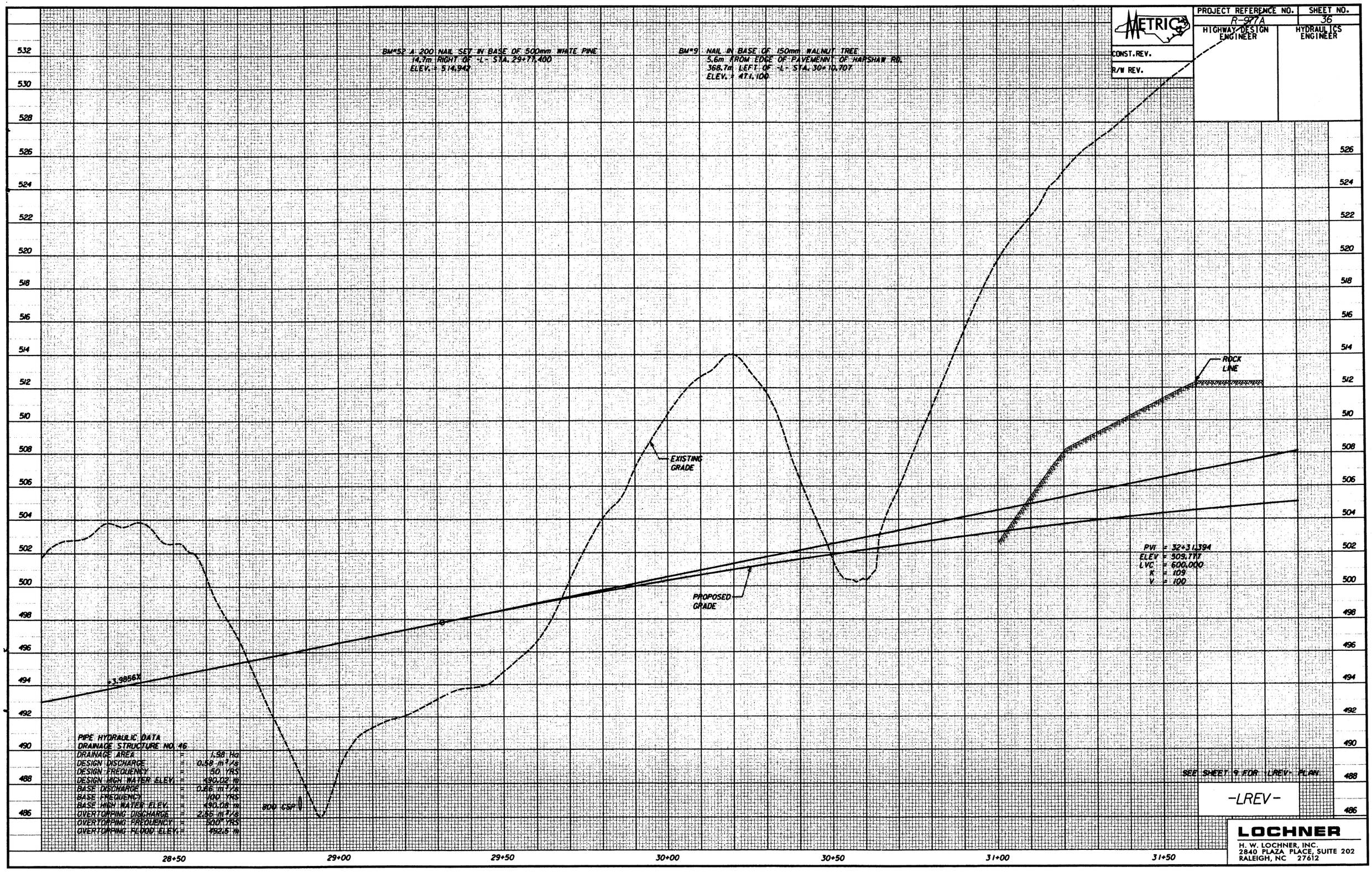
PROJECT REFERENCE NO.	SHEET NO.
R-977A	36
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 46

DRAINAGE AREA	=	1.98 Ha
DESIGN DISCHARGE	=	0.58 m^3/s
DESIGN FREQUENCY	=	50 YRS
DESIGN HIGH WATER ELEV.	=	490.02 m
BASE DISCHARGE	=	0.66 m^3/s
BASE FREQUENCY	=	100 YRS
BASE HIGH WATER ELEV.	=	490.08 m
OVERTOPPING DISCHARGE	=	2.55 m^3/s
OVERTOPPING FREQUENCY	=	500 YRS
OVERTOPPING FLOOD ELEV.	=	492.5 m

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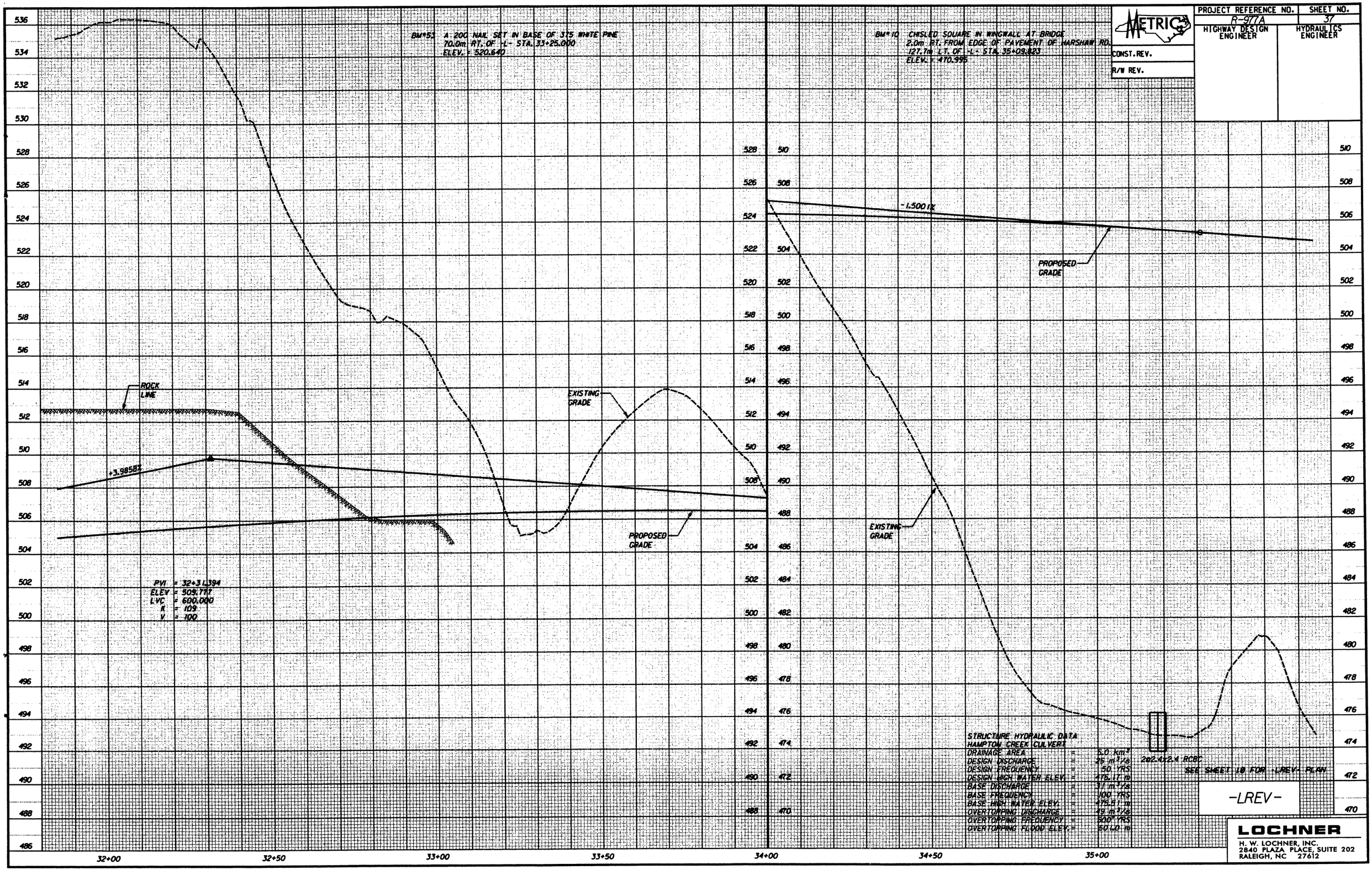
PROJECT REFERENCE NO.	SHEET NO.
R-977A	37
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



STRUCTURE HYDRAULIC DATA
HAMPTON CREEK CULVERT

DRAINAGE AREA	=	5.0 km^2
DESIGN DISCHARGE	=	25 m^3/s
DESIGN FREQUENCY	=	50 YRS
DESIGN HIGH WATER ELEV.	=	475.11 m
BASE DISCHARGE	=	31 m^3/s
BASE FREQUENCY	=	100 YRS
BASE HIGH WATER ELEV.	=	475.5 m
OVERTOPPING DISCHARGE	=	49 m^3/s
OVERTOPPING FREQUENCY	=	500 YRS
OVERTOPPING FLOOD ELEV.	=	50 LO m

-LREV-

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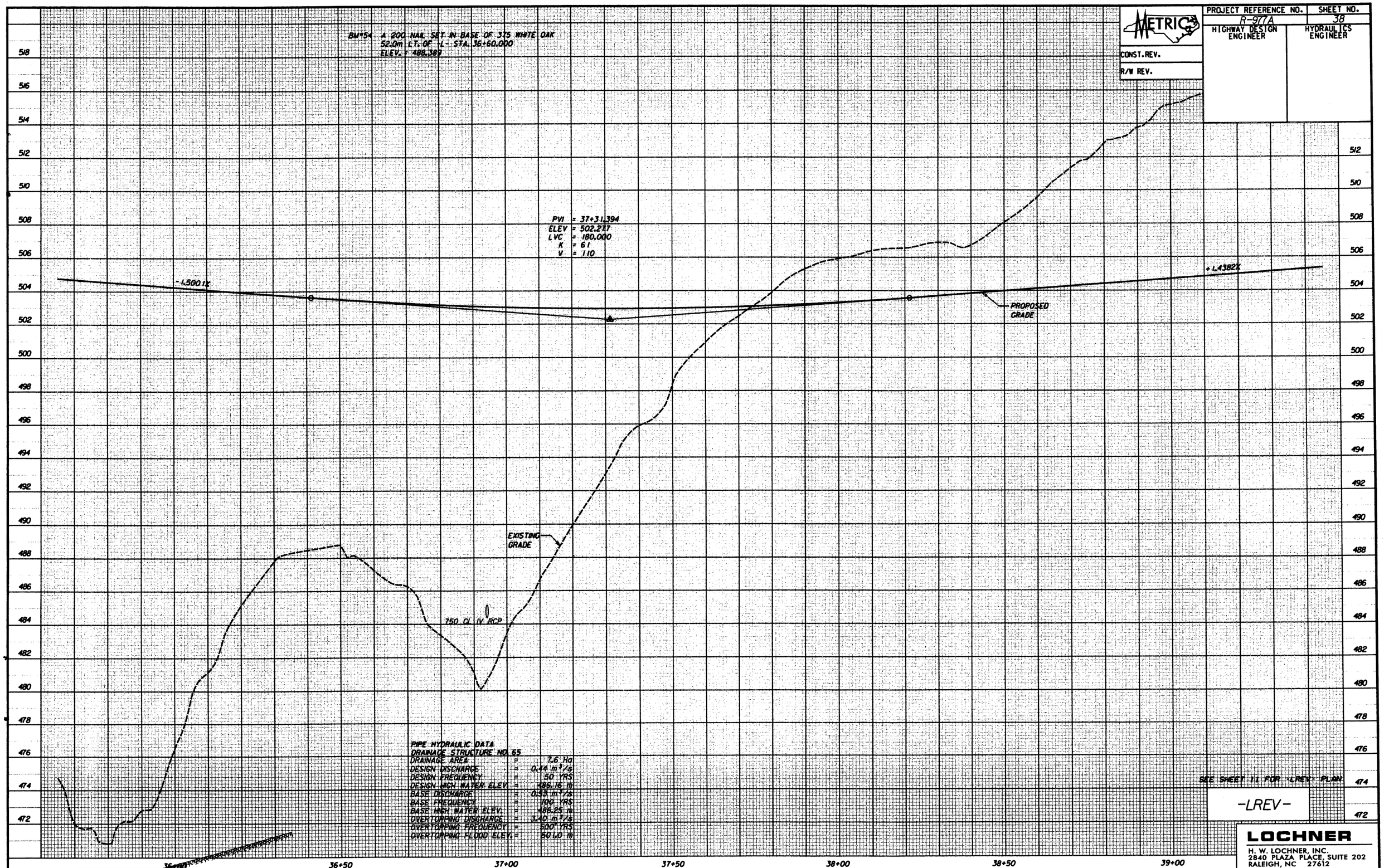
PROJECT REFERENCE NO.	SHEET NO.
R-977A	38
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



LOCHNER

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RALEIGH, NC 27612

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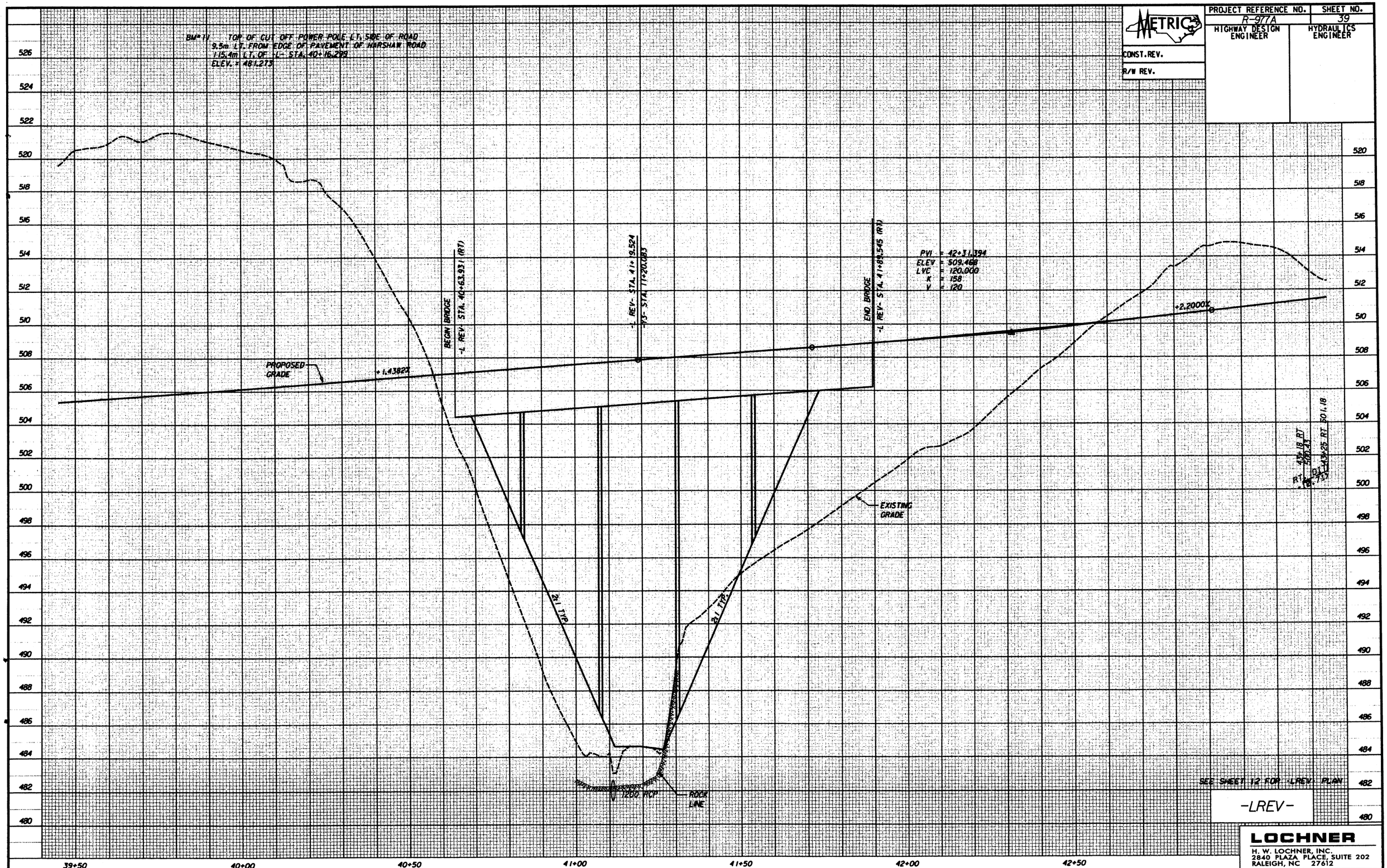
PROJECT REFERENCE NO.	SHEET NO.
R-977A	39
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



LOCHNER

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RALEIGH, NC 27612

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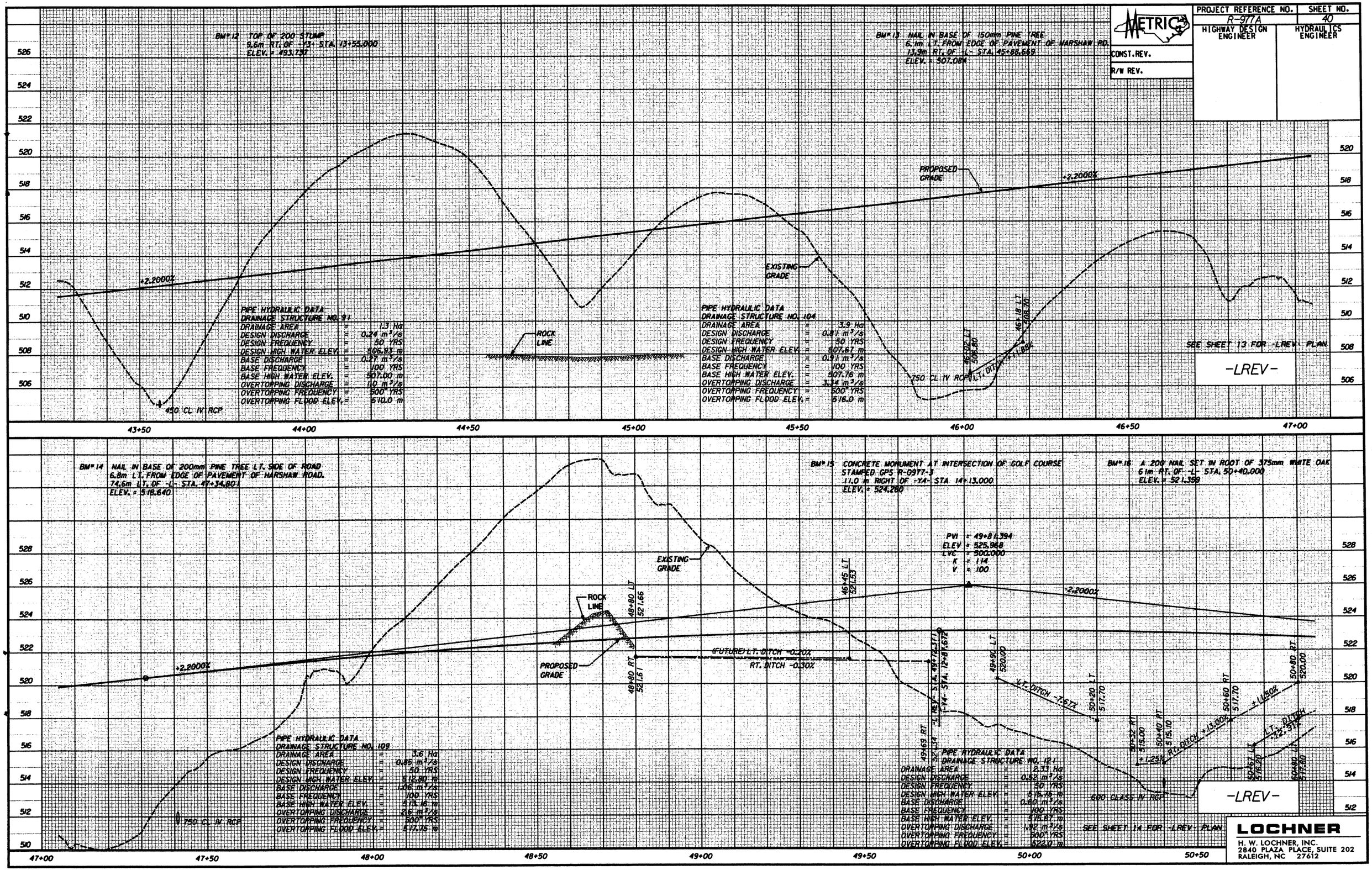
PROJECT REFERENCE NO.	SHEET NO.
R-977A	40
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



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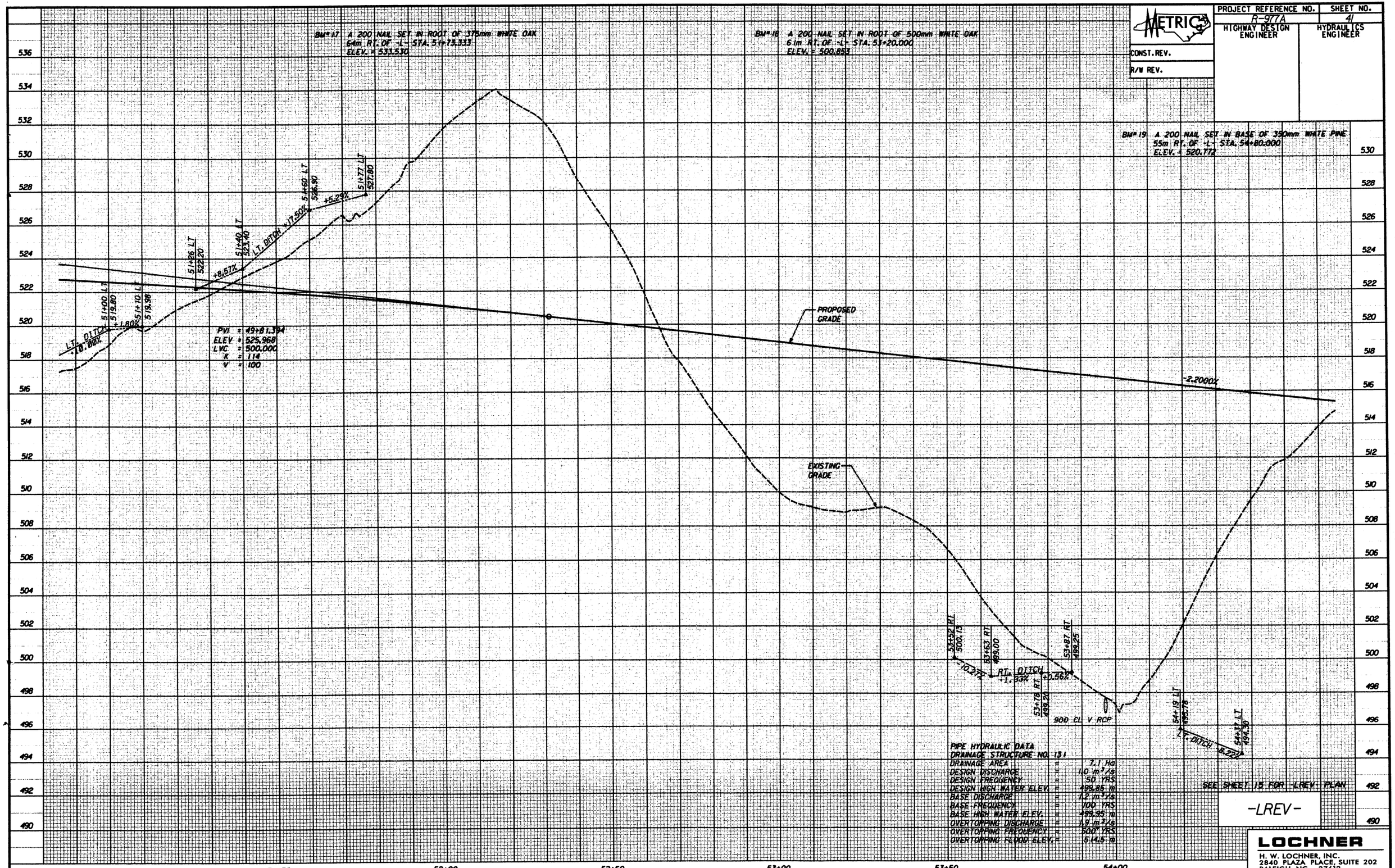
PROJECT REFERENCE NO.	SHEET NO.
R-977A	41
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

CONST. REV.

R/W REV.



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2840 PLAZA PLACE, SUITE 202
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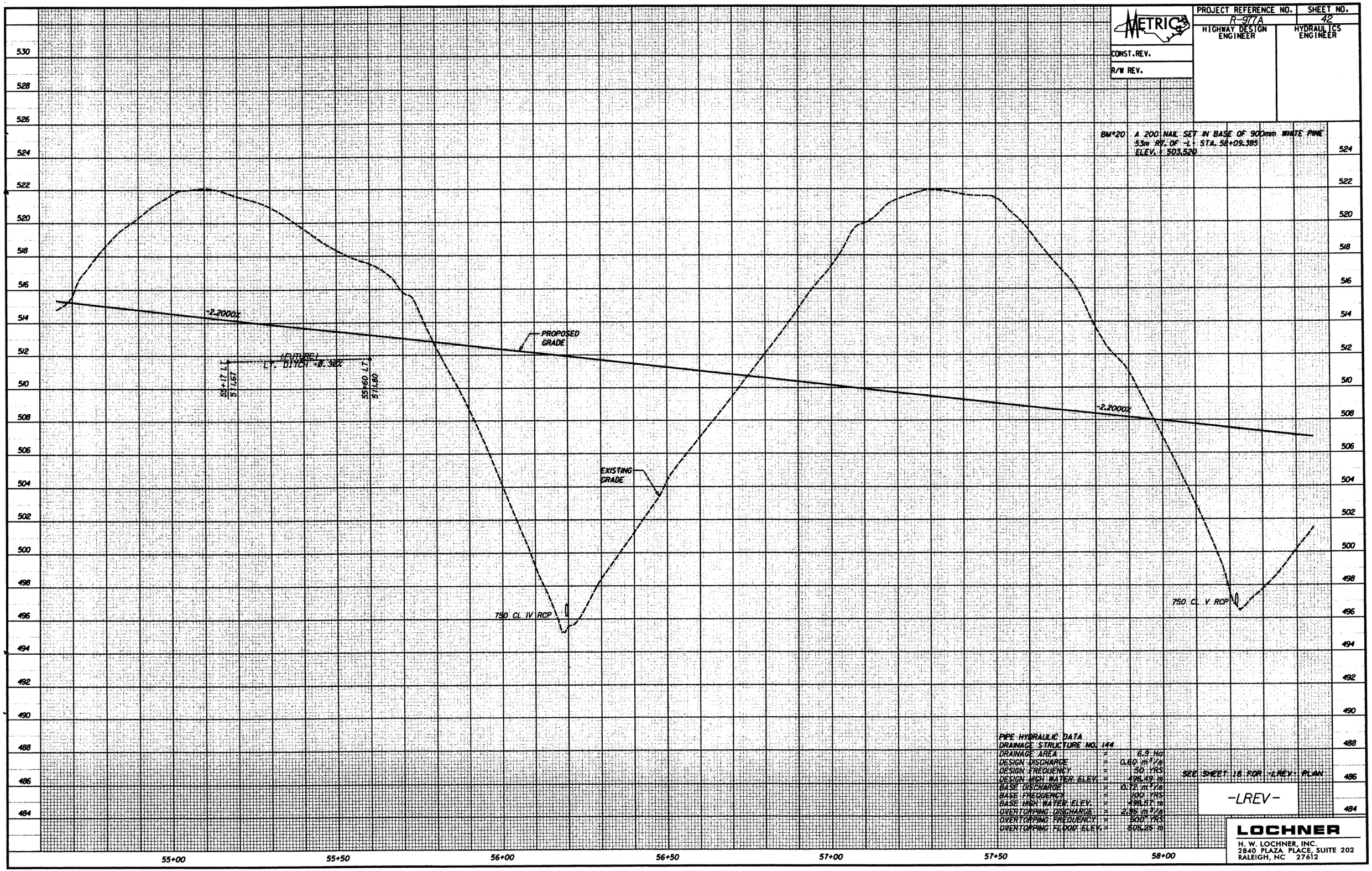
PROJECT REFERENCE NO.	SHEET NO.
R-977A	42
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 144
DRAINAGE AREA = 6.9 Ha
DESIGN DISCHARGE = 0.60 m^3/s
DESIGN FREQUENCY = 50 YRS
DESIGN HIGH WATER ELEV. = 498.49 m
BASE DISCHARGE = 0.72 m^3/s
BASE FREQUENCY = 100 YRS
BASE HIGH WATER ELEV. = 498.57 m
OVERTOPPING DISCHARGE = 2.35 m^3/s
OVERTOPPING FREQUENCY = 500 YRS
OVERTOPPING FLOOD ELEV. = 505.25 m

SEE SHEET 18 FOR -LREV- PLAN

-LREV-

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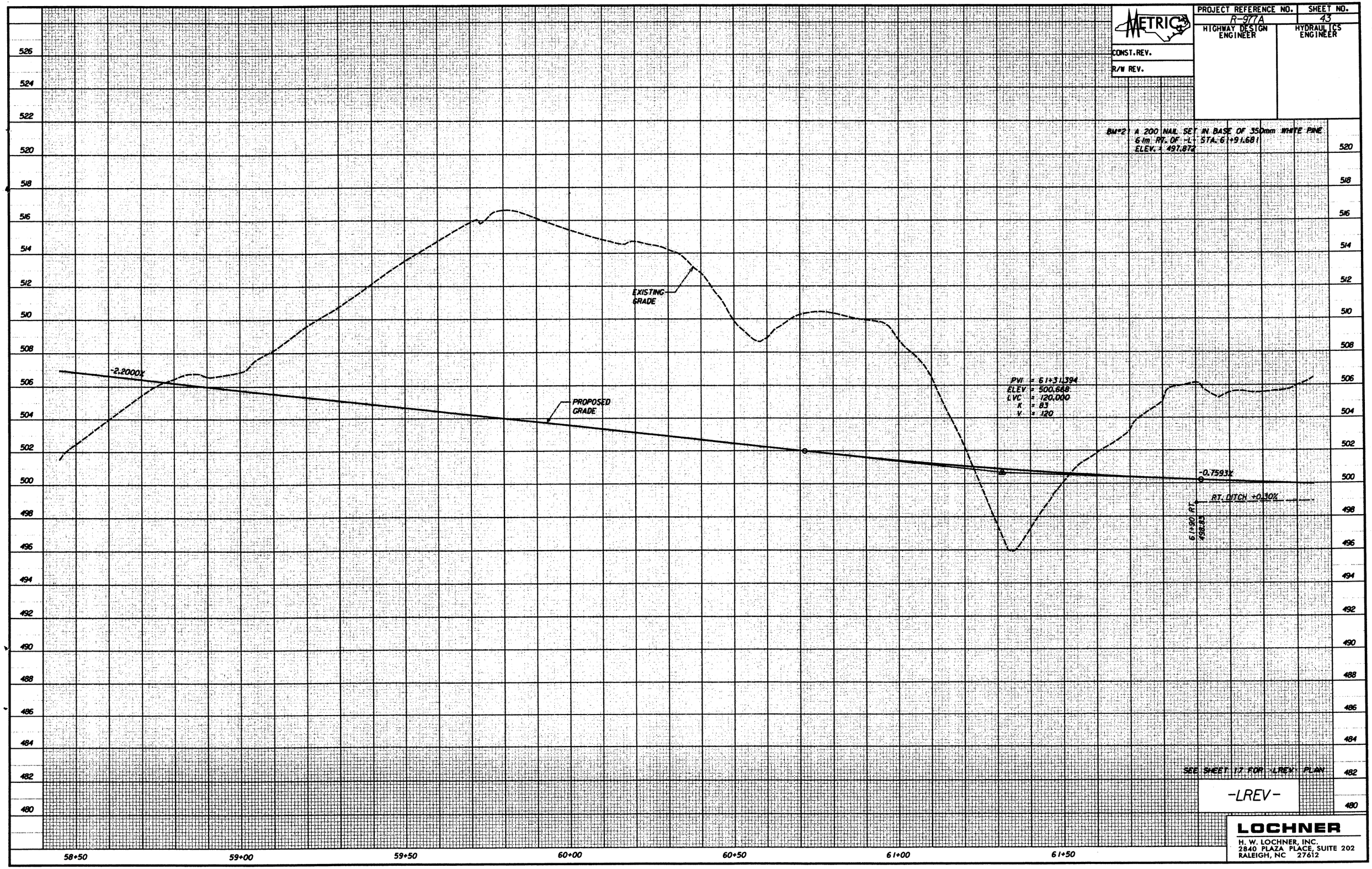
PROJECT REFERENCE NO.	SHEET NO.
R-977A	43
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



LOCHNER

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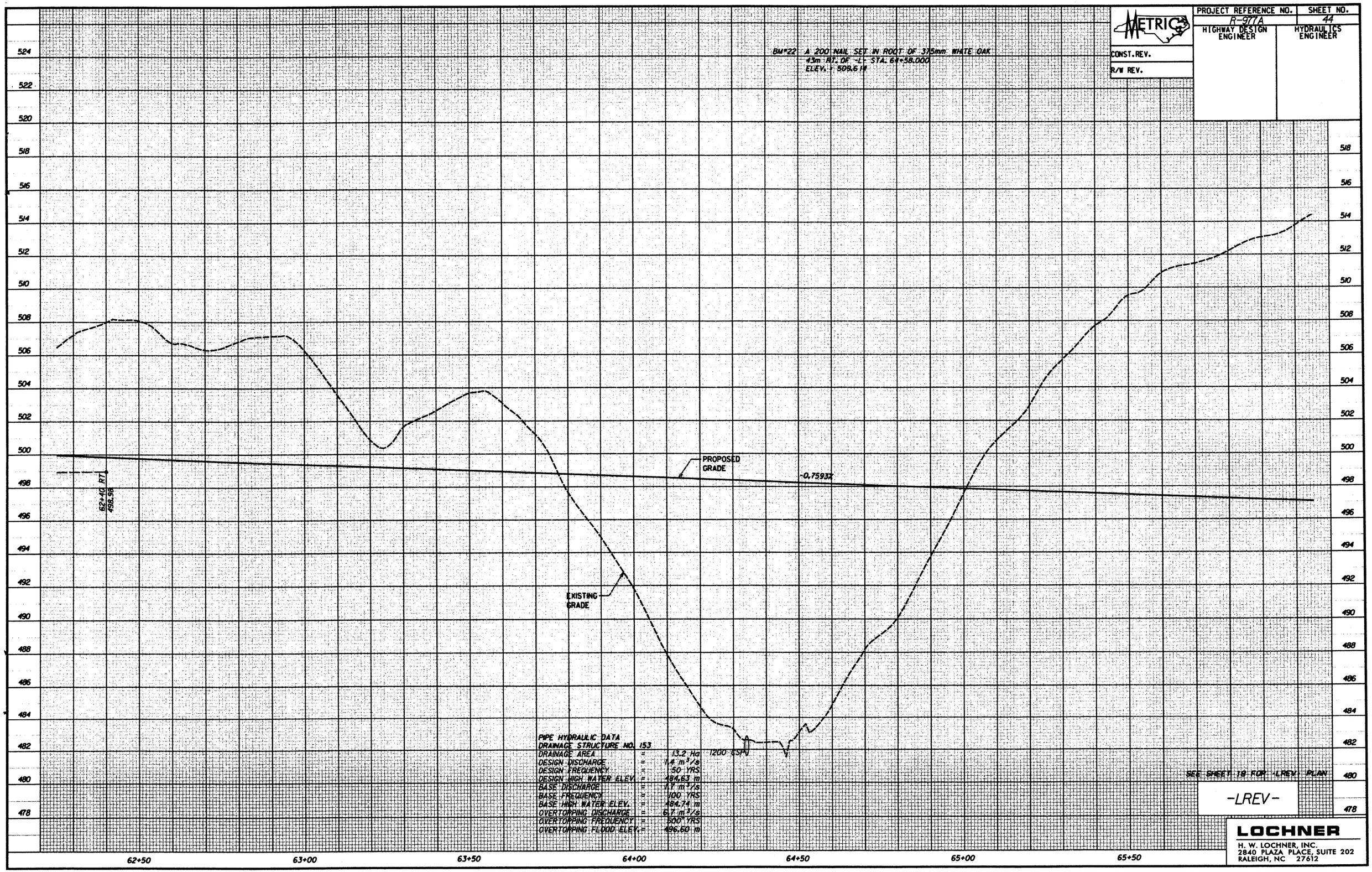
PROJECT REFERENCE NO.	SHEET NO.
R-977A	44
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



LOCHNER

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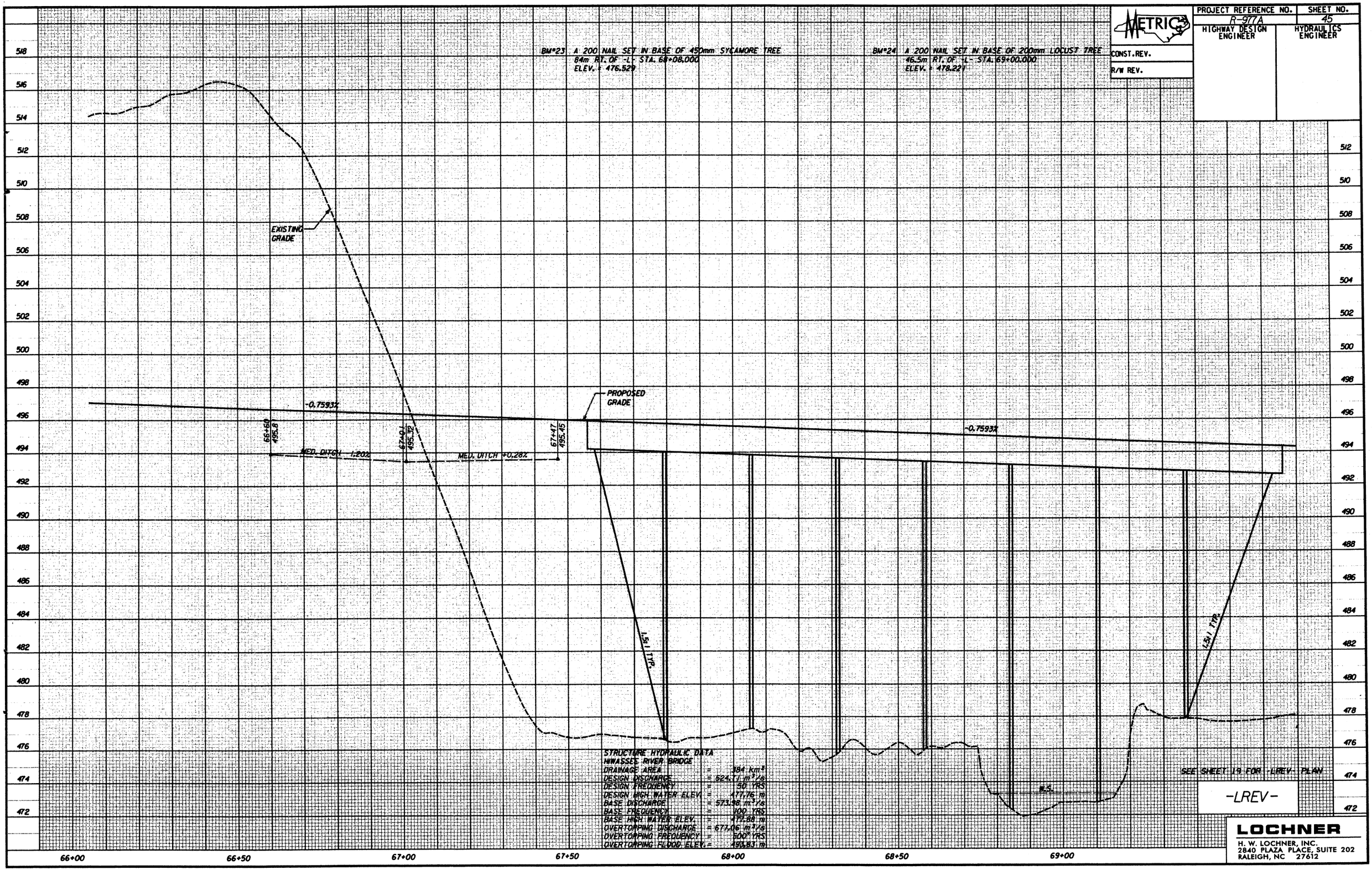
PROJECT REFERENCE NO.	SHEET NO.
R-977A	45
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



STRUCTURE HYDRAULIC DATA
HIWASSEE RIVER BRIDGE

DRAINAGE AREA	184 km^2
DESIGN DISCHARGE	524.11 m^3/s
DESIGN FREQUENCY	50 YRS
DESIGN HIGH WATER ELEV.	477.76 m
BASE DISCHARGE	573.98 m^3/s
BASE FREQUENCY	100 YRS
BASE HIGH WATER ELEV.	477.88 m
OVERTOPPING DISCHARGE	677.06 m^3/s
OVERTOPPING FREQUENCY	500* YRS
OVERTOPPING FLOOD ELEV.	490.83 m

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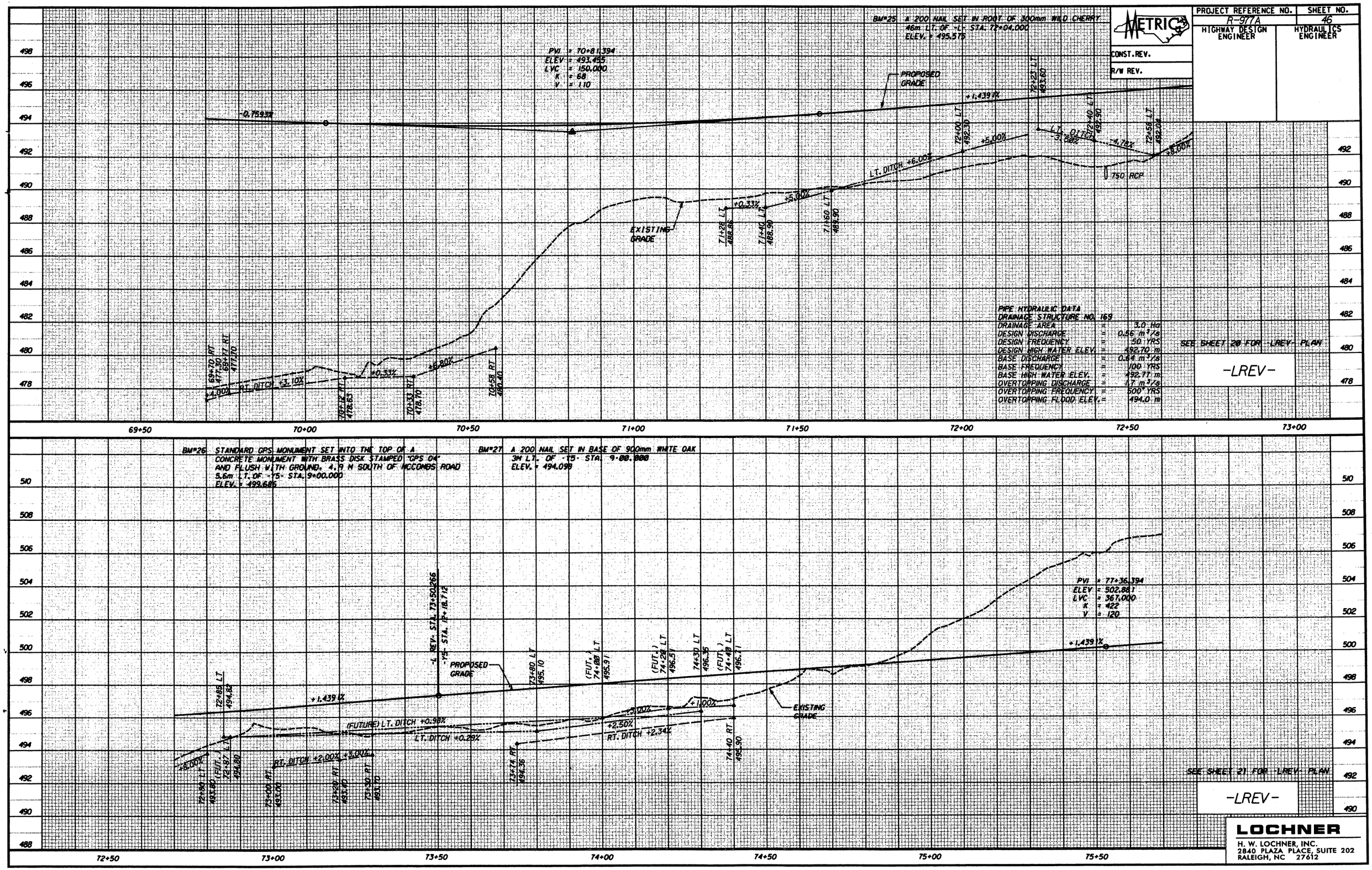
PROJECT REFERENCE NO.	SHEET NO.
R-977A	46
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



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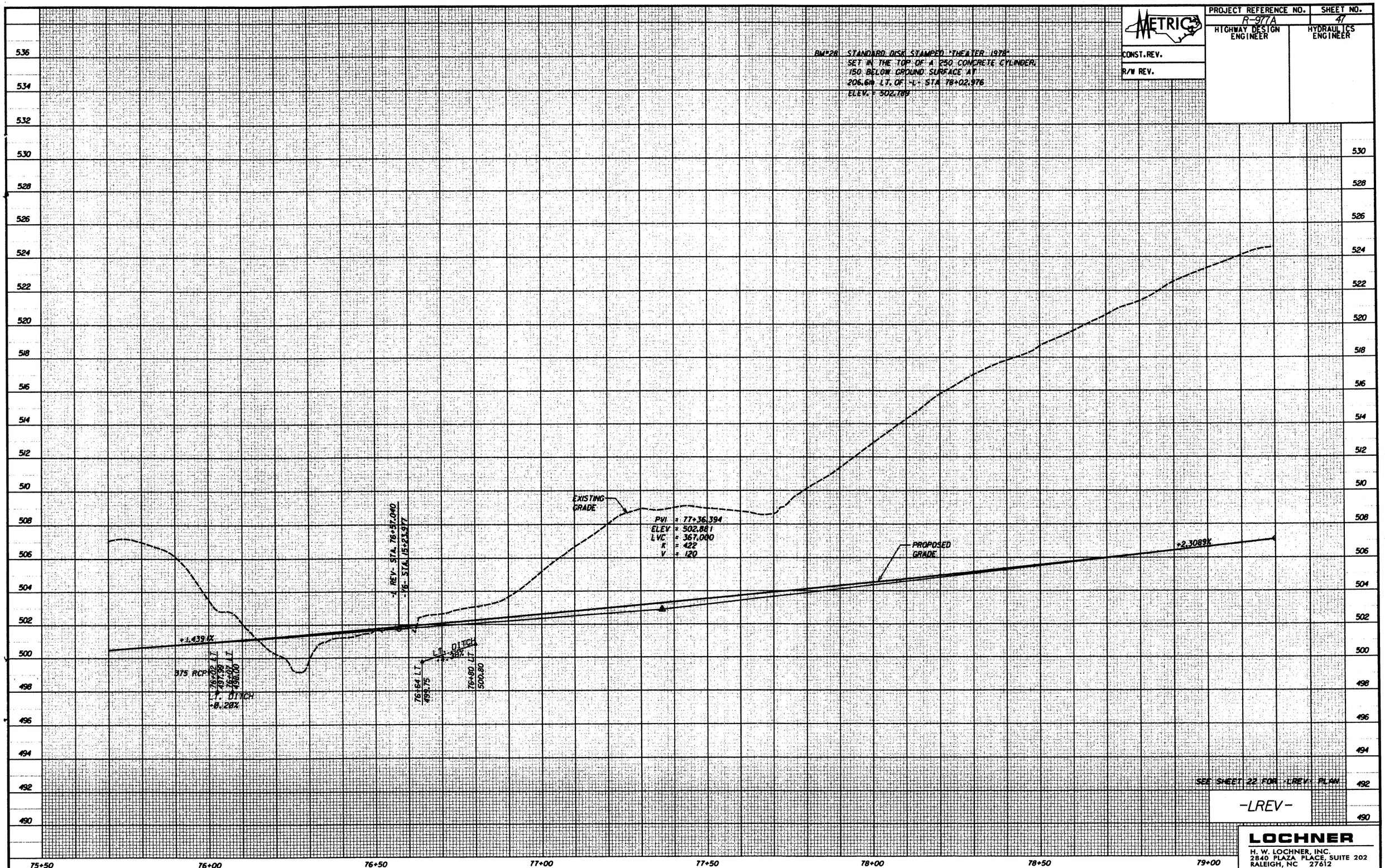
PROJECT REFERENCE NO.	SHEET NO.
R-977A	47
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



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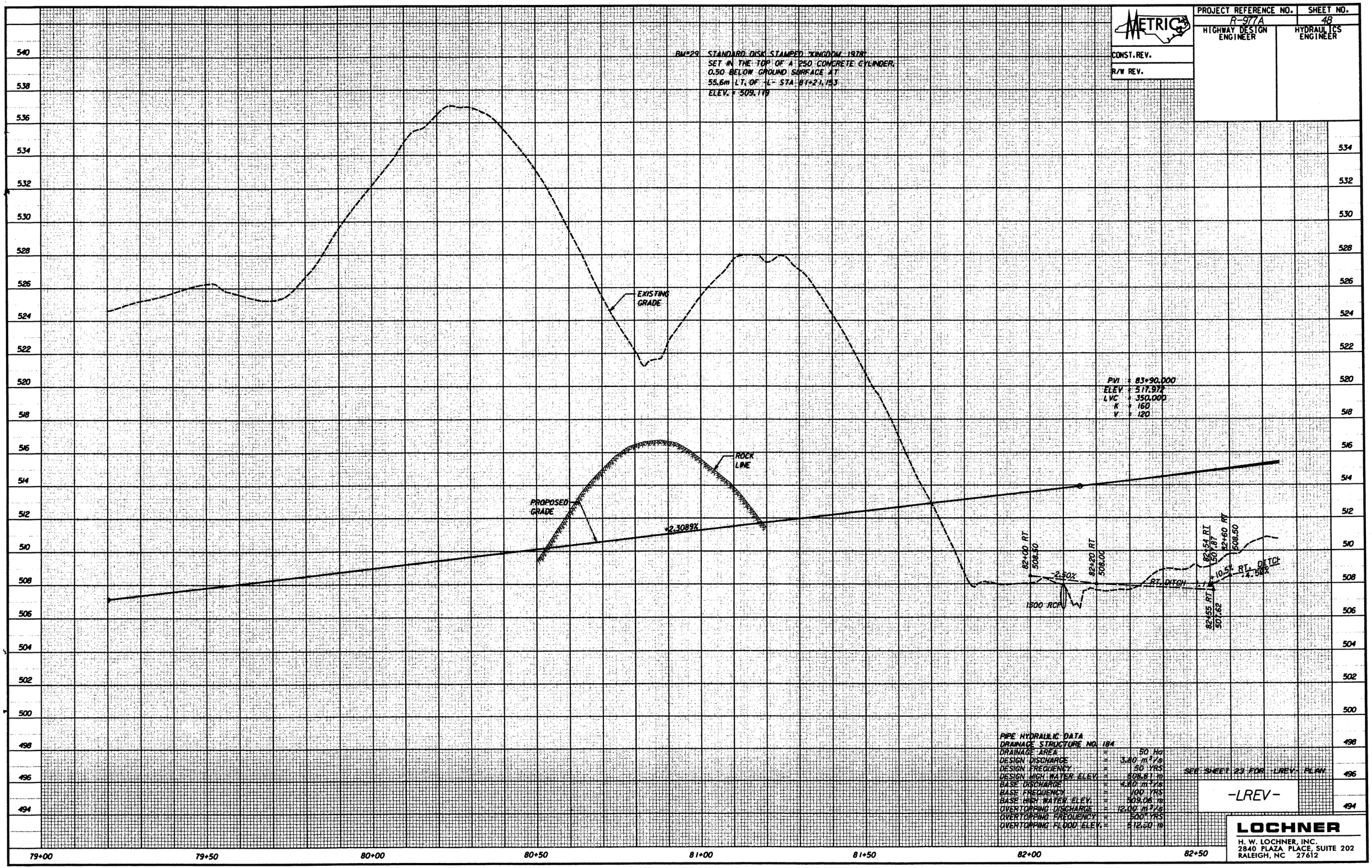
PROJECT REFERENCE NO.	SHEET NO.
R-977A	48
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



LOCHNER
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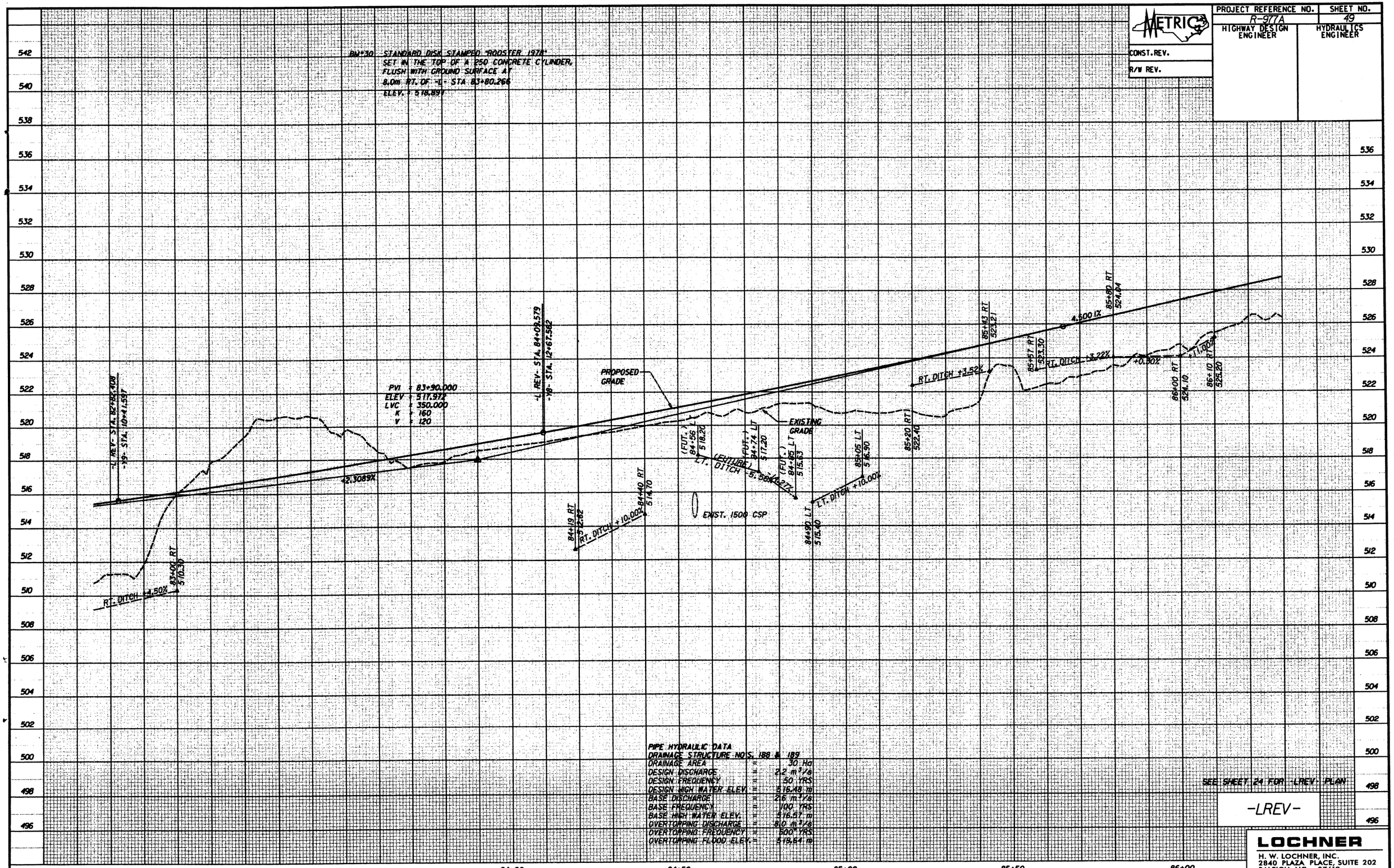
PROJECT REFERENCE NO.	SHEET NO.
R-977A	49
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

CONST. REV.

R/W REV.



PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO'S. 188 & 189

DRAINAGE AREA	30 Ha
DESIGN DISCHARGE	2.2 m^3/s
DESIGN FREQUENCY	50 YRS
DESIGN HIGH WATER ELEV.	516.48 m
BASE DISCHARGE	2.6 m^3/s
BASE FREQUENCY	100 YRS
BASE HIGH WATER ELEV.	516.57 m
OVERTOPPING DISCHARGE	8.0 m^3/s
OVERTOPPING FREQUENCY	500 YRS
OVERTOPPING FLOOD ELEV.	519.54 m

SEE SHEET 24 FOR -LREV- PLAN

-LREV-

LOCHNER
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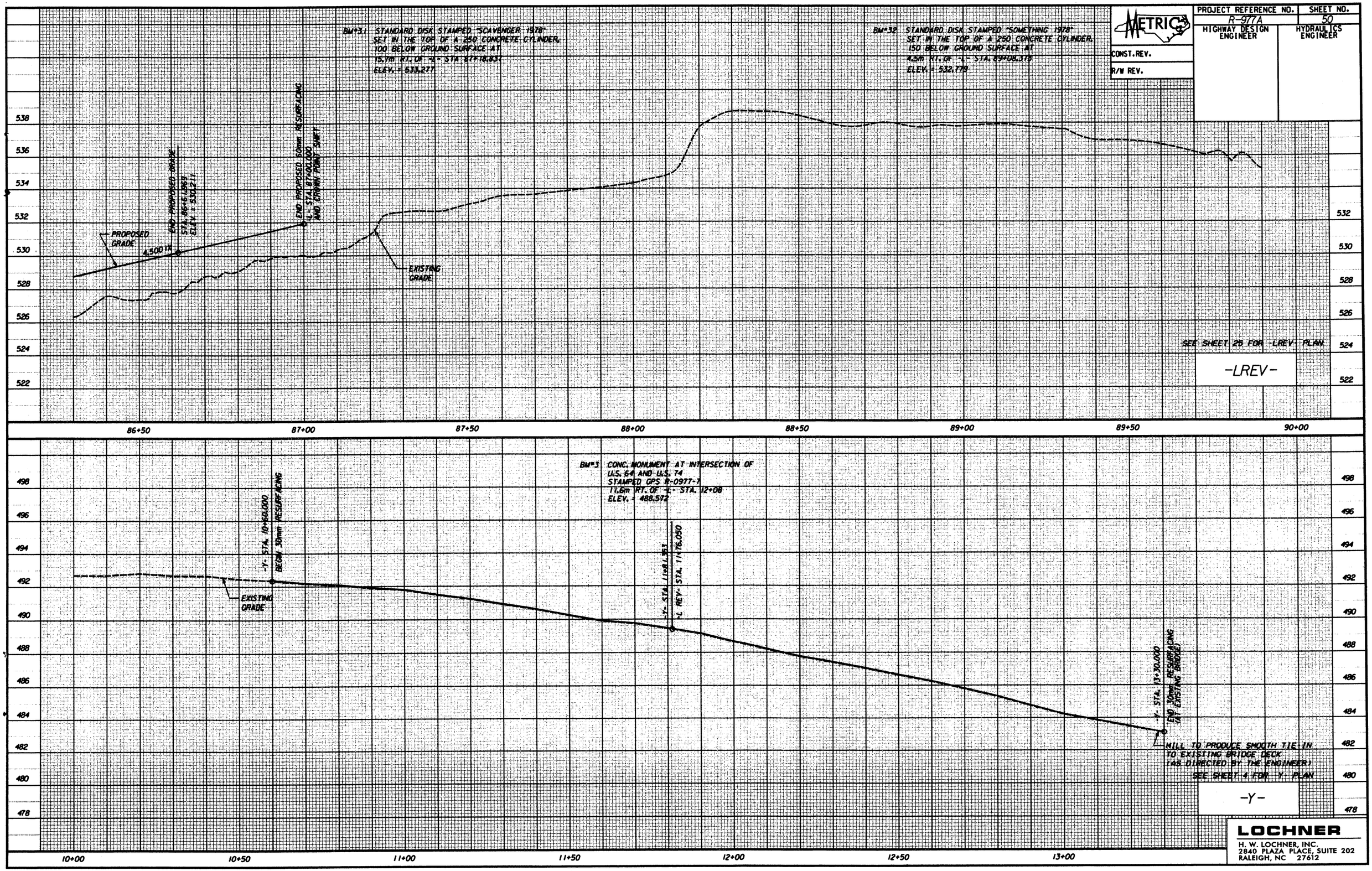
PROJECT REFERENCE NO.	SHEET NO.
R-977A	50
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



LOCHNER
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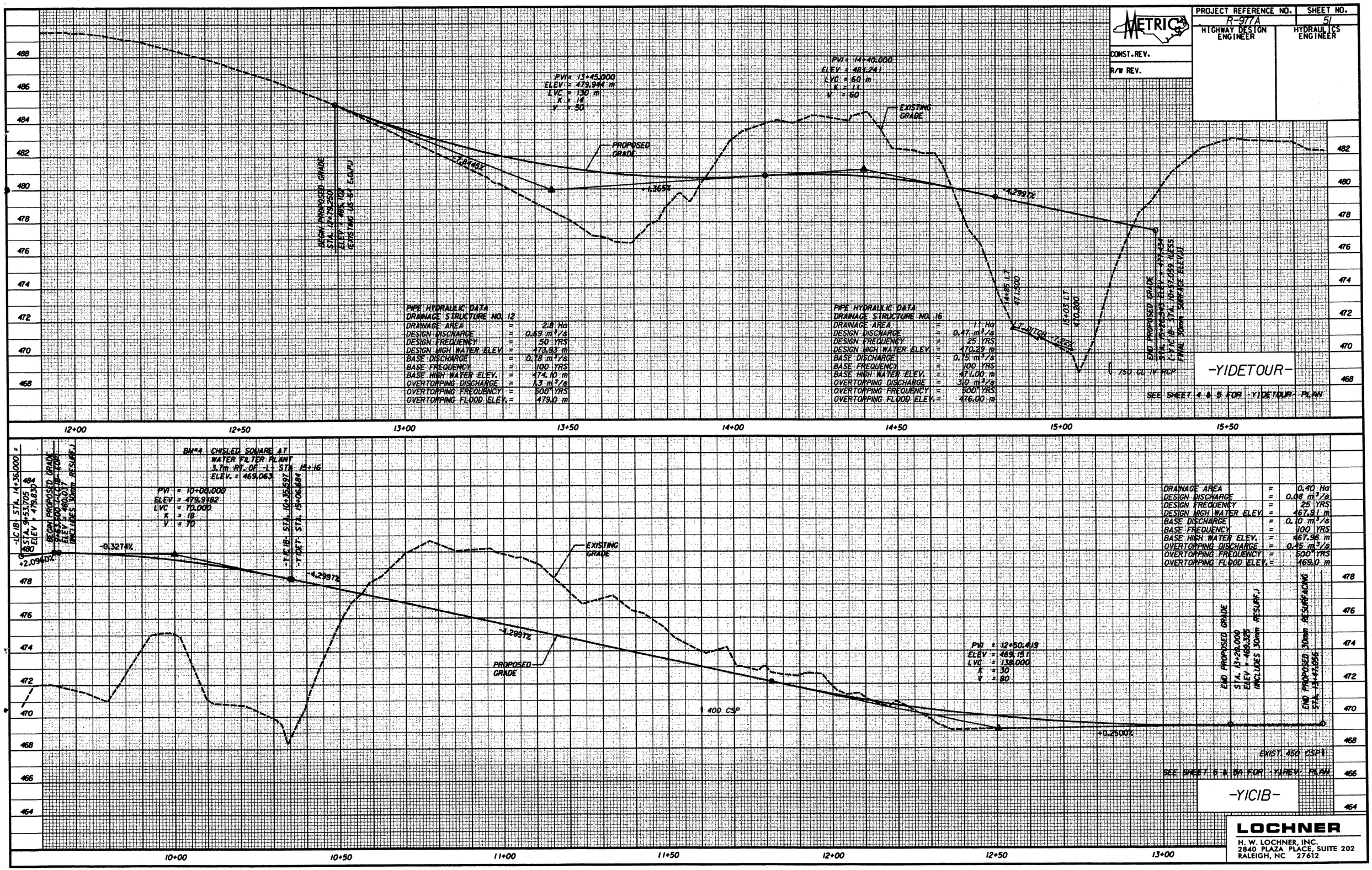
PROJECT REFERENCE NO.	SHEET NO.
R-977A	51
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



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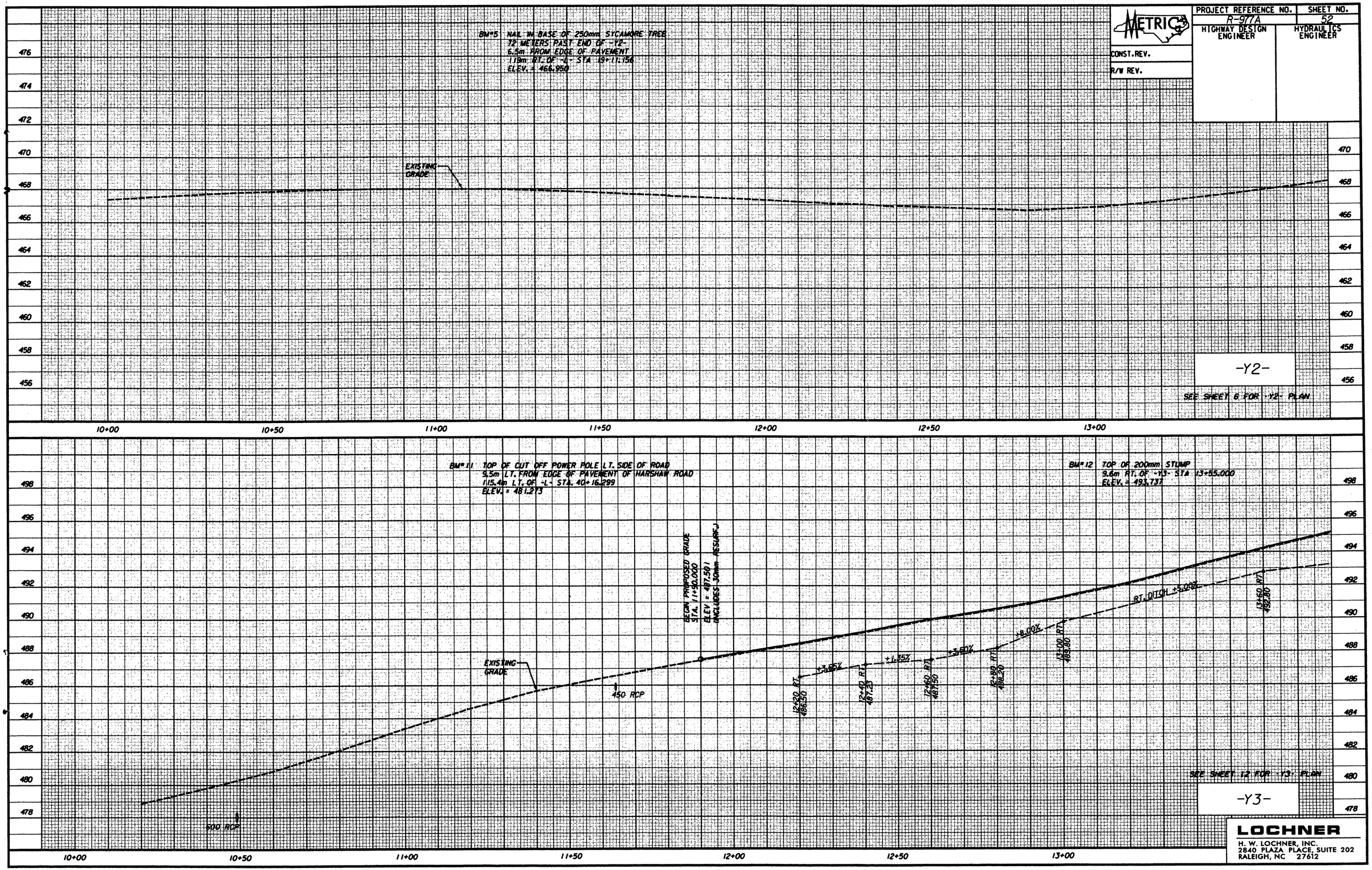
PROJECT REFERENCE NO.	SHEET NO.
R-977A	52
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	



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PROJECT REFERENCE NO.	SHEET NO.
R-977A	53
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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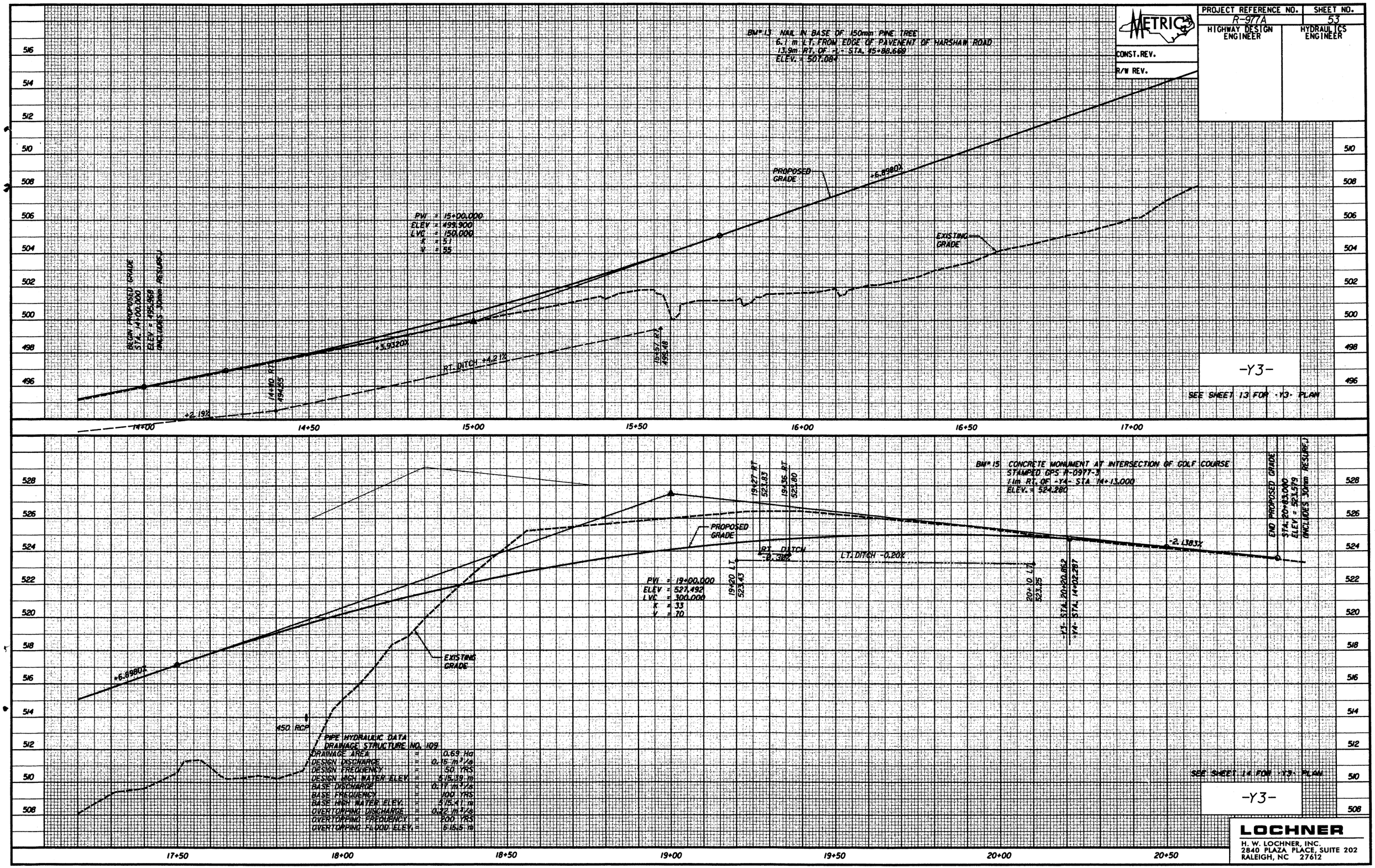

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PROJECT REFERENCE NO.	SHEET NO.
R-977A	54
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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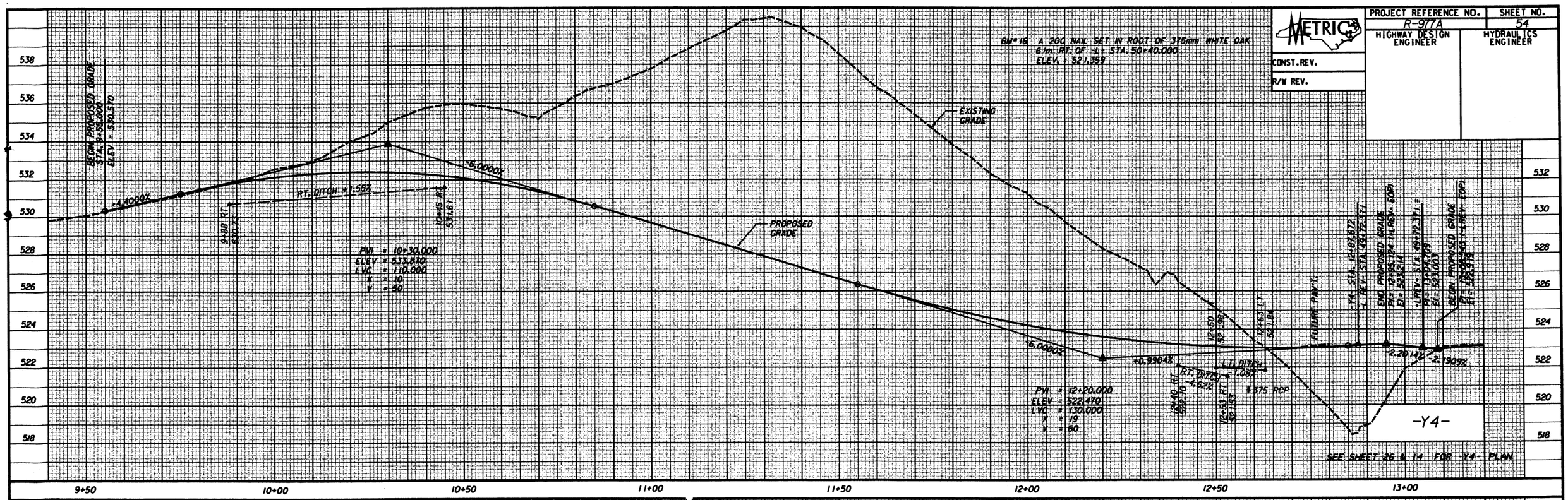
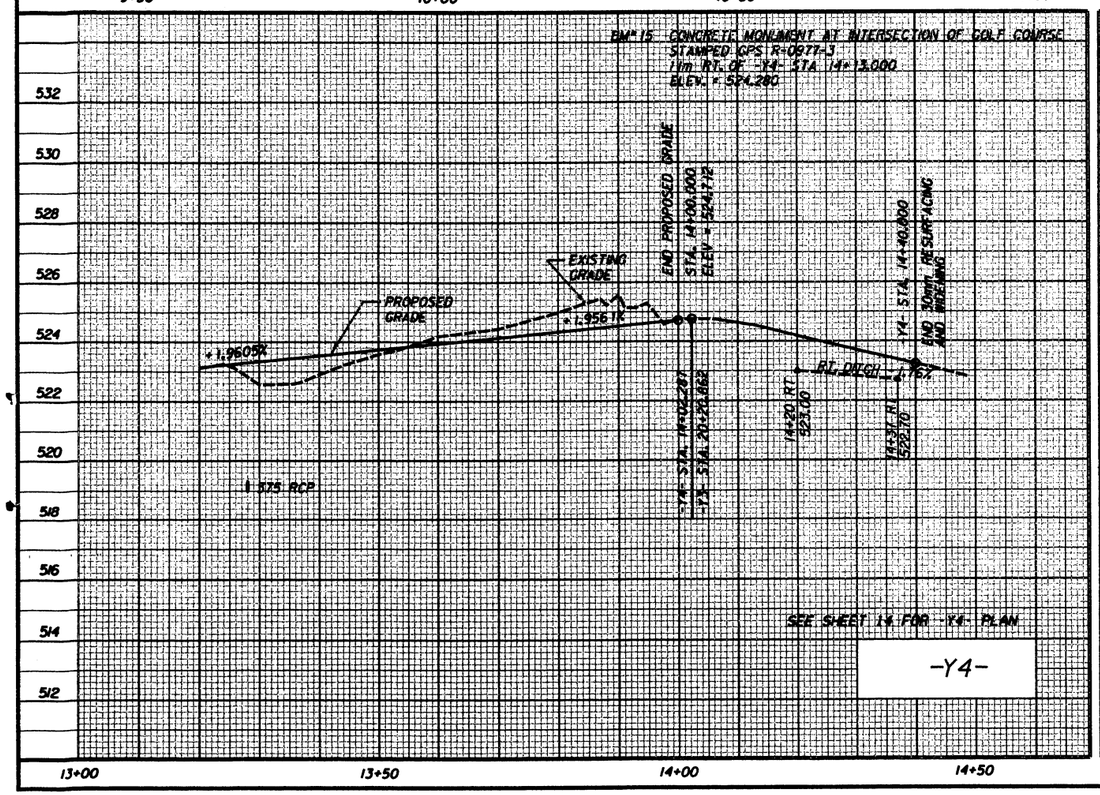
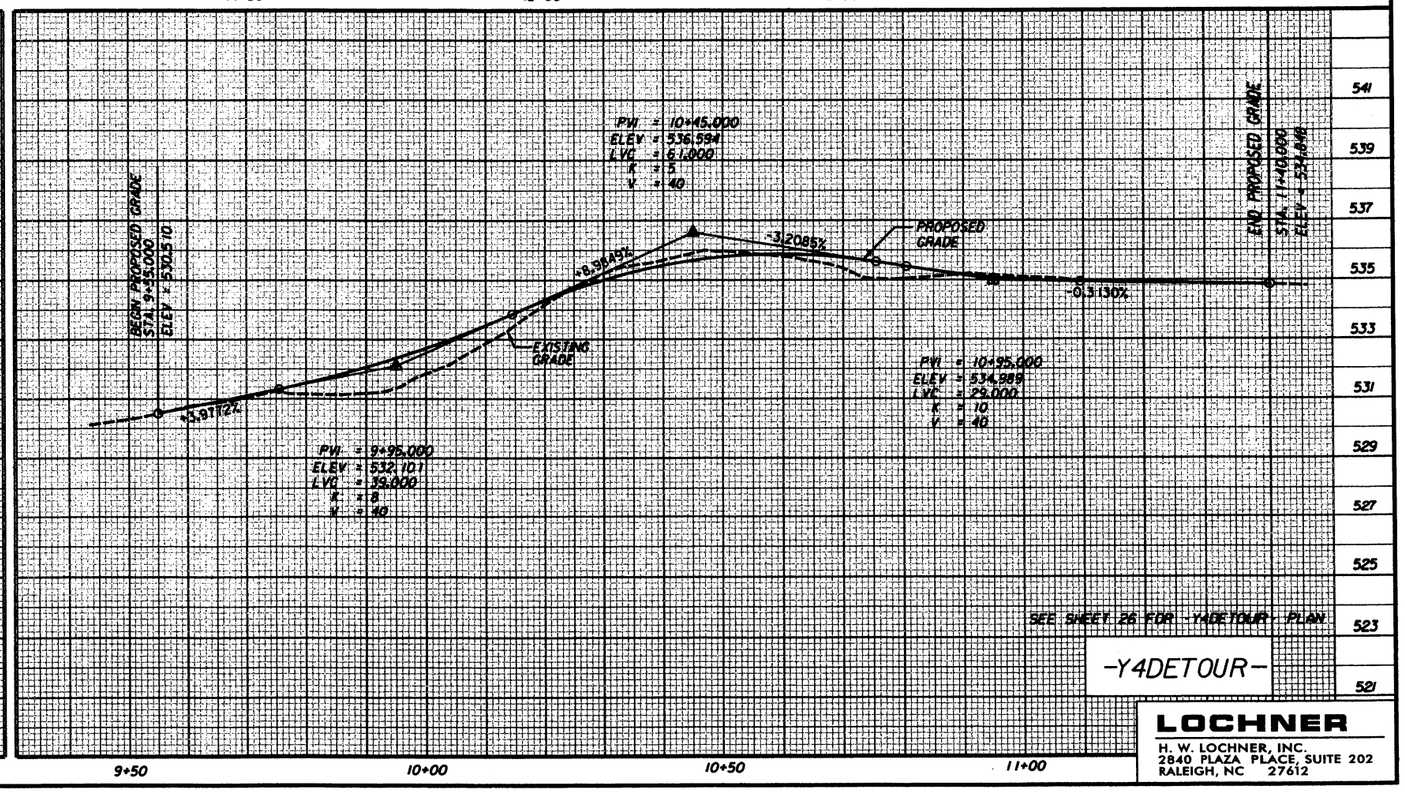
R/W REV.







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PROJECT REFERENCE NO.	SHEET NO.
R-977A	55
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
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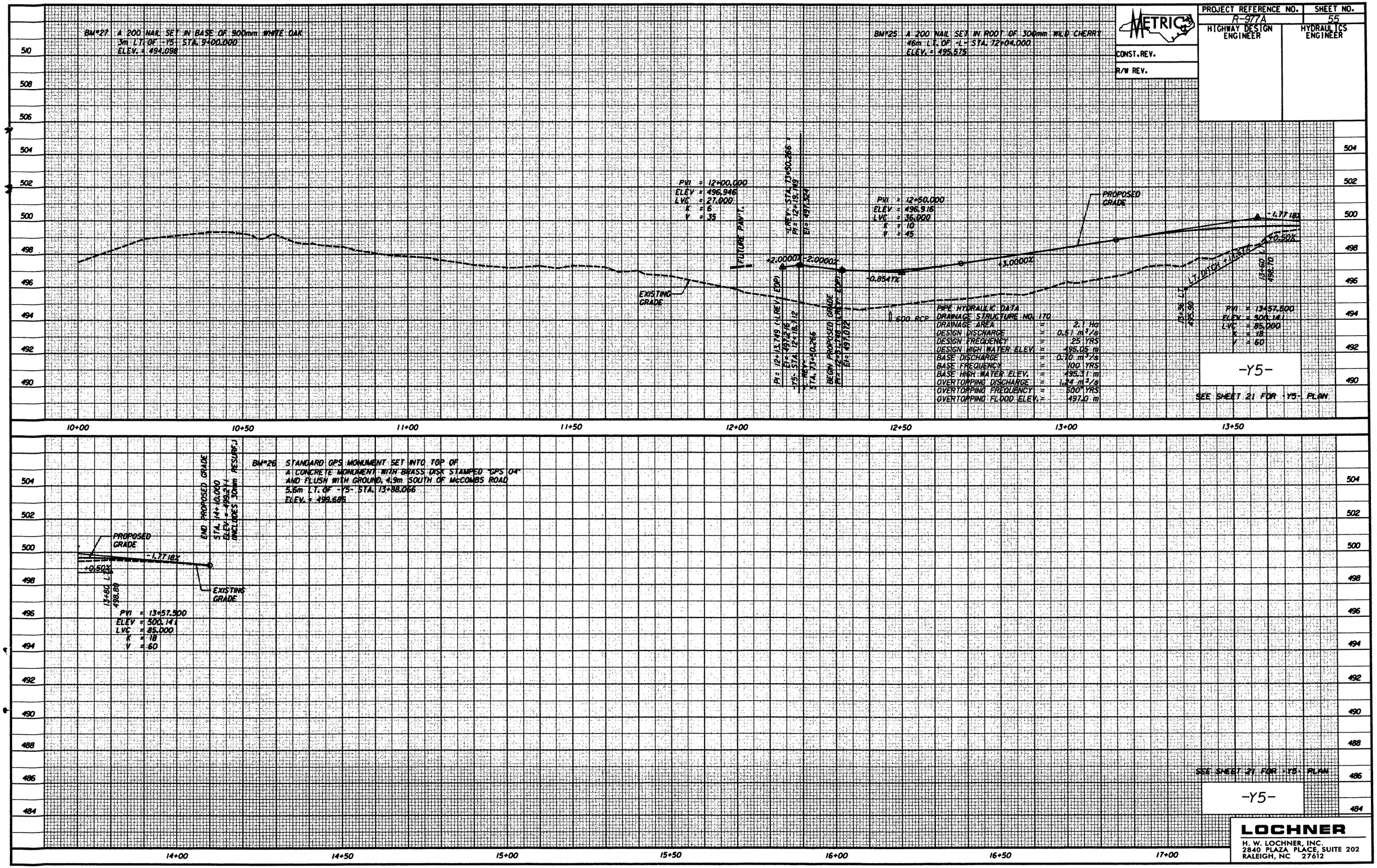
R/W REV.	



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PROJECT REFERENCE NO.	SHEET NO.
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HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
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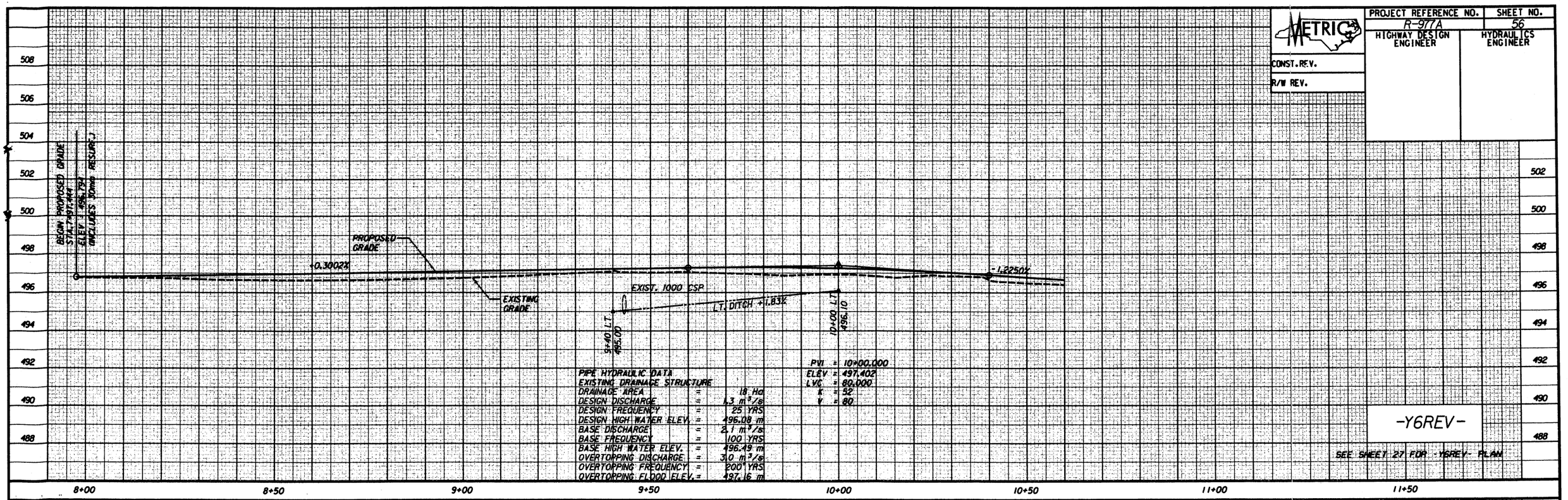
R/W REV.	



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PROJECT REFERENCE NO.	SHEET NO.
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HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

METRIC

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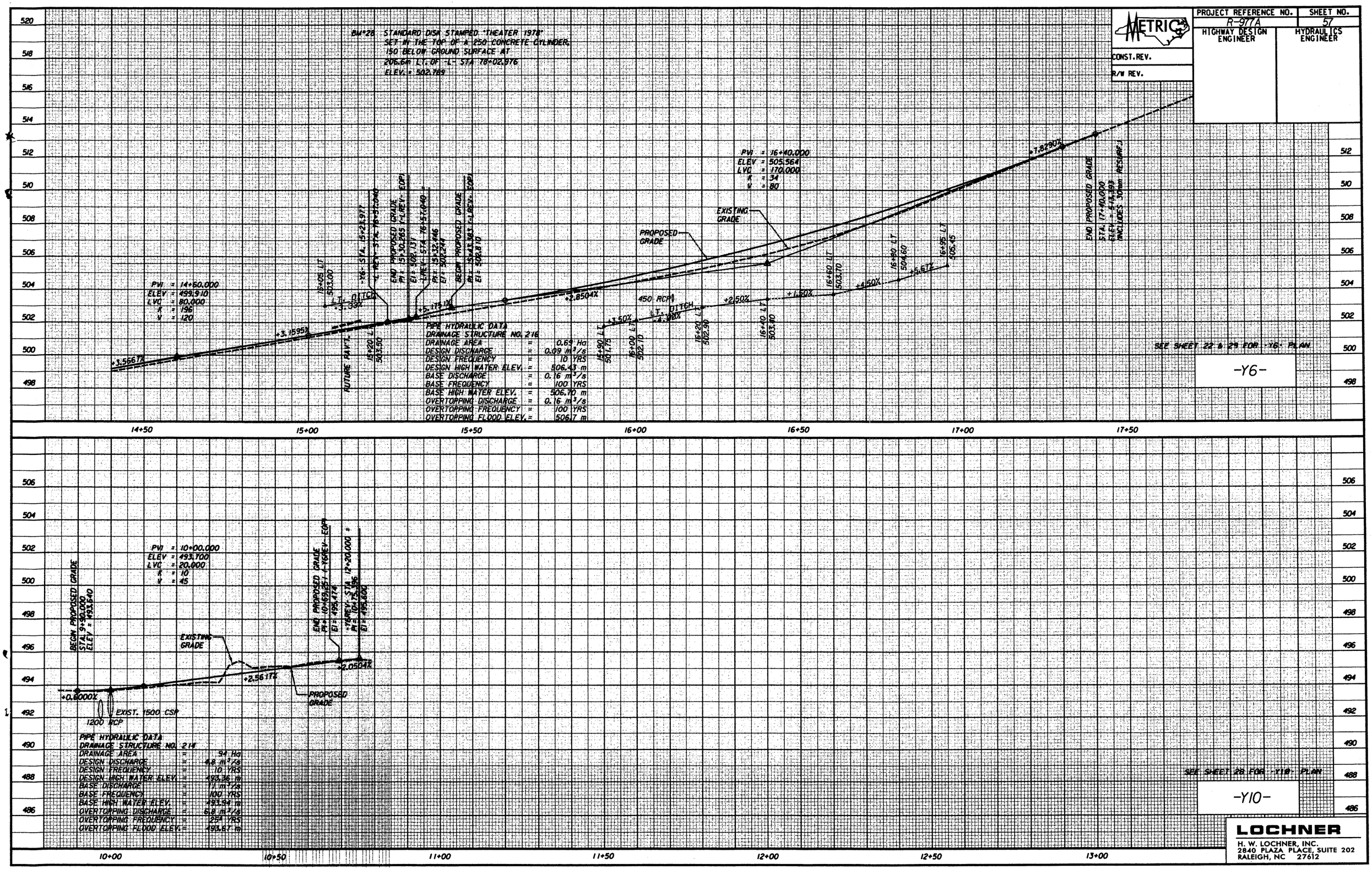
R/W REV.



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PROJECT REFERENCE NO.	SHEET NO.
R-977A	58
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
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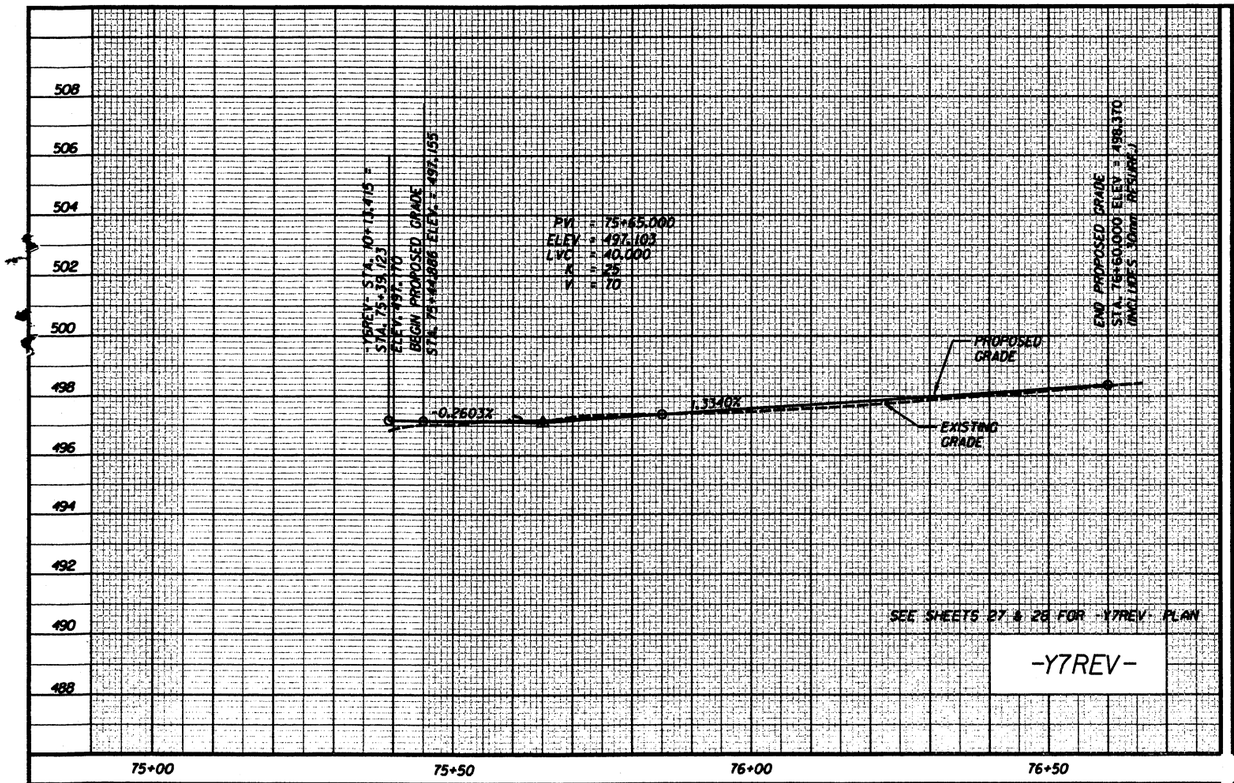
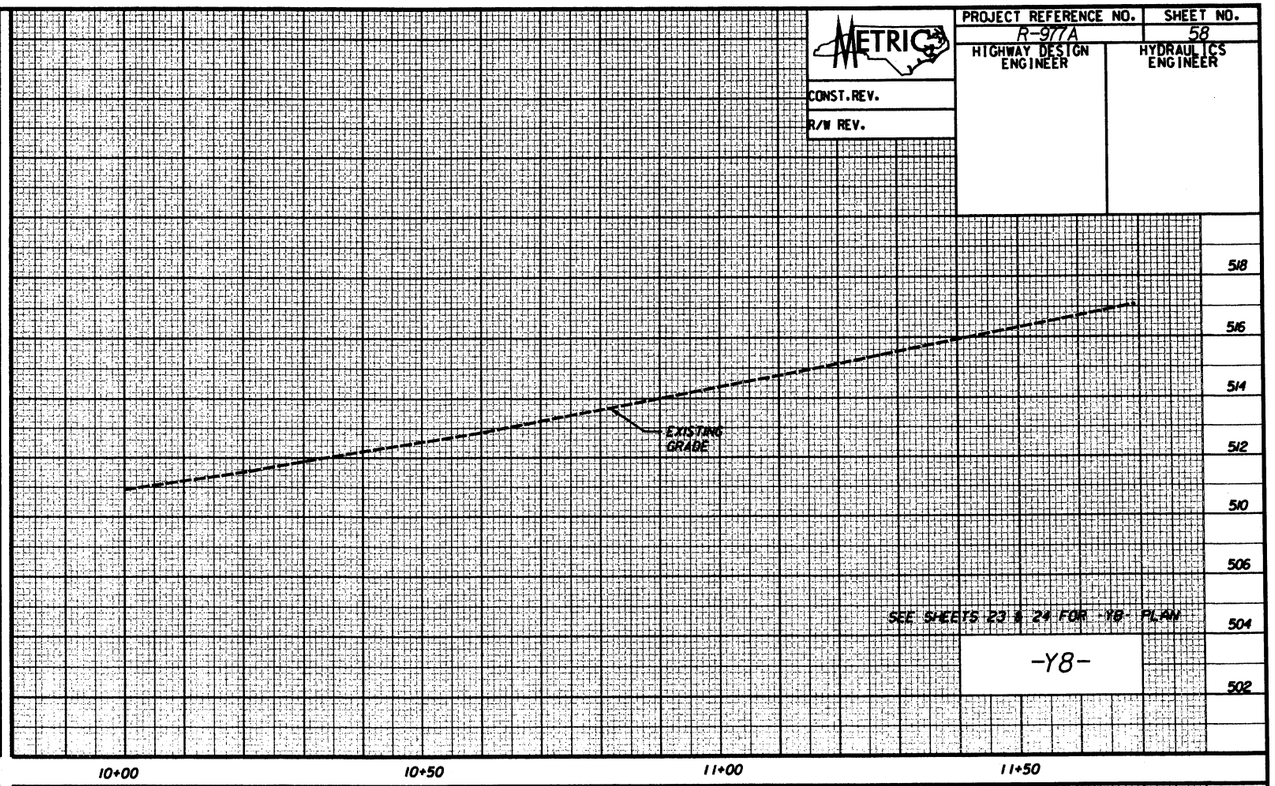
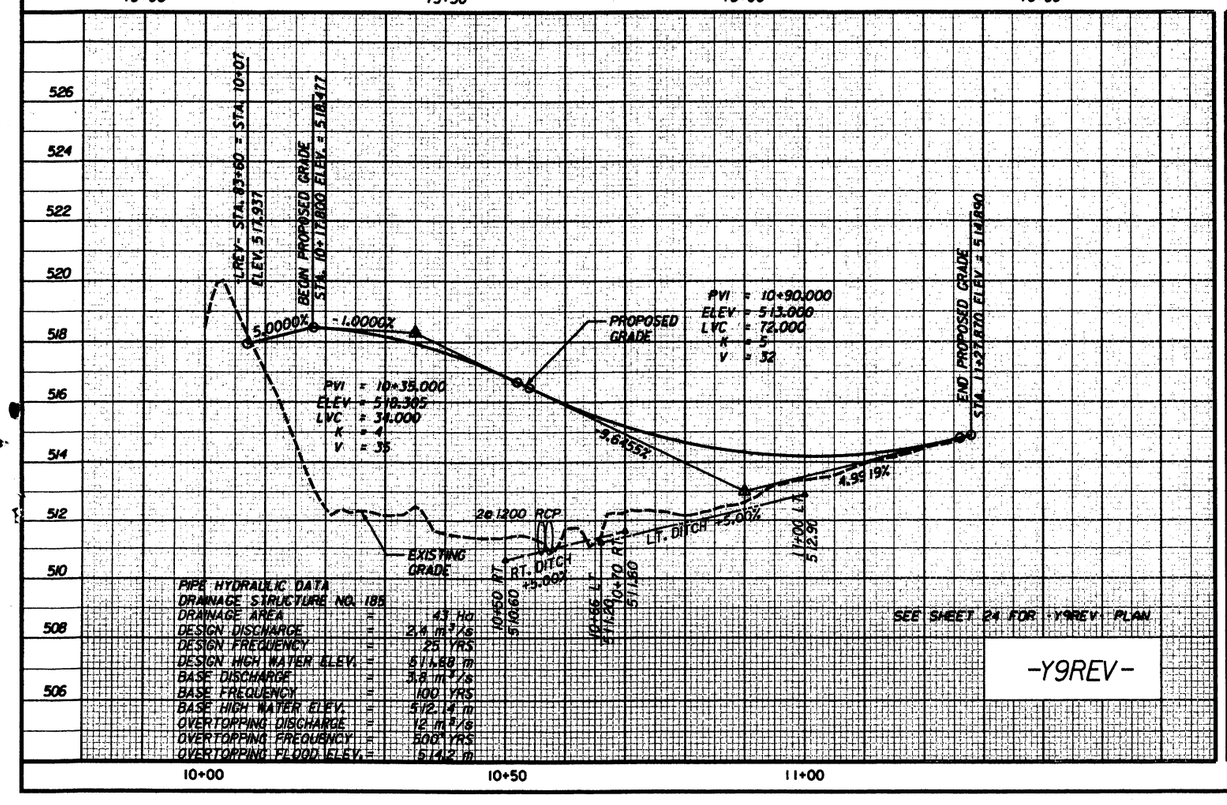
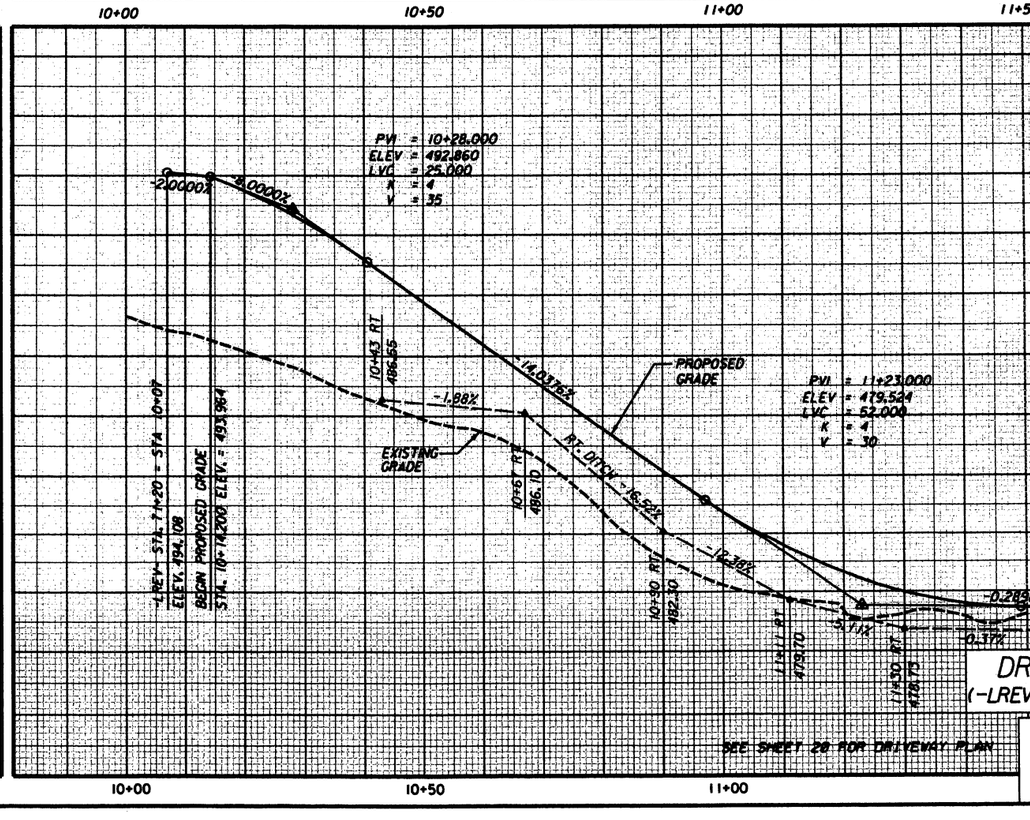
R/W REV.	









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