

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

October 7, 2010

U. S. Army Corps of Engineers
Regulatory Field Office
Post Office Box 1000
Washington, NC 27889-1000

N.C. Dept. of Environment and Natural Resources
Division of Coastal Management
400 Commerce Avenue
Morehead City, NC 28557

ATTN: Mr. William J. Biddlecome
NCDOT Coordinator

ATTN: Mr. Stephen Lane
NCDOT Coordinator

Subject: **Permit Modification Request for the Individual Section 404 Permit, Individual Water Quality Certification, and CAMA Permit** for the widening of US 158/NC 34 from East of Pasquotank River to the US 158/NC 34 split in Camden County. Federal Aid Project No. STP-158(2), Division 1, TIP Nos. R-2414 A&B. Debit \$570 from WBS 34430.1.1.

Reference: Original Permit Application requested October 15, 2008
Section 404 Individual Permit issued January 14, 2009; USACE Permit No. SAW- 1994-02124
Section 401 Water Quality Certification issued December 18, 2008; NCDWQ Project No. 003774
Division of Coastal Management Permit issued January 13, 2009; DCM Permit No. 03-09

Dear Gentlemen:

Please see the enclosed revised utility drawings, geotechnical drawings, mass soil mixing specifications, and revised EEP Acceptance Letter dated September 20, 2010 for the above referenced project. Due to the following design changes, a modification is requested by the Department.

Soil Improvements

Due to need to prevent subsidence around the three culverts along the project, a stabilization method termed “mass soil mixing” will be used. This activity will occur on the approaches of the three culverts sites, previously identified as Permit Sites 3, 6, and 7. Protective sheet piles will be installed to provide a complete barrier between the activity and the surrounding jurisdictional resources abutting this activity.

To accommodate for this protection, an additional foot of impact will be required beyond the currently permitted toe-of-slope at Permit Sites 3, 6, and 7, as shown in the attached Geotechnical Drawings included in this modification request. A portion of this area was previously identified as hand clearing, but has now changed to mechanized clearing in wetlands to allow for any stumps to be removed, if necessary, for the mass soil mixing equipment. Compensatory mitigation for the additional 0.04 acre of wetland impact will be provided by EEP. A copy of the acceptance letter is included with this request.

Utilities

Due to the use of piles to support culverts, the utilities that were previously shown to be directionally bored under the culverts (Permit Sites 3, 6, and 7) have been moved to prevent conflicts. The utilities will still be directionally bored, but will be bored outside of this activity.

As in the previous applications, there will be no additional impacts from this change. Revised Utility drawings have been attached to illustrate this modification.

Section 404 Permit: NCDOT requests that the U.S. Army Corps of Engineers (USACE) review this application and issue a modification for the Individual 404 Permit issued January 14, 2009, as required for the above-described activities.

Section 401 Permit: NCDOT requests that the NCDWQ review this application and issue a modification for the Individual 401 Certification issued December 18, 2008, as required for the above-described activities. In accordance with 15A NCAC 2H .0501(a) we are providing five copies of this modification request to the North Carolina Department of Environmental and Natural Resources for their approval and \$570 to act as payment for processing the permit modification (see subject line).

CAMA Permit: NCDOT requests that the Division of Coastal Management review this application and issue a modification for the permit issued January 13, 2009, as required for the above-described activities.

Thank you for your assistance with this project. If you have any questions or need additional information, please contact Michael Turchy at maturchy@ncdot.gov or (919) 431-6696.

Sincerely,



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

Cc:

W/attachment

Mr. Brian Wrenn, NCDWQ (5 copies)
Ms. Jennifer Derby, USEPA
Ms. Cathy Brittingham, NCDCM

W/o attachment (see website for attachments)

Mr. Scott McLendon, USACE, Wilmington
Mr. Travis Wilson, NCWRC
Mr. Gary Jordan, USFWS
Mr. Ron Sechler, NMFS
Ms. Anne Deaton, NCDMF
Dr. David Chang, P.E., Hydraulics
Mr. Greg Perfetti, P.E., Structure Design
Mr. Mark Staley, Roadside Environmental
Mr. Dewayne Sykes, P.E., Utilities Unit
Mr. Jerry Jennings, P.E., Division 1 Engineer
Mr. Clay Willis, Division 1 Environmental Officer
Mr. Jay Bennett, P.E., Roadway Design
Mr. Majed Alghandour, P. E., Programming and TIP
Mr. Art McMillan, P.E., Highway Design
Ms. Beth Harmon, EEP
Mr. Phillip Ayscue, NCDOT External Audit Branch
Ms. Michele James, PDEA Project Planning Engineer
Mr. Drew Joyner, PE, Human Environment Unit Head
Mr. Clarence W. Coleman, P.E., FHWA



October 1, 2010

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

Dear Dr. Thorpe:

Subject: EEP Mitigation Acceptance Letter:

R-2414A, US 158/NC 34 Widening from East of the Pasquotank River to SR 1257 (Havenwood Drive), Camden County

References: USACE 404 Individual Permit issued February 5, 2009 and Individual Modification issued July 1, 2010 (USACE Action ID 1994-02124-115)

NCDWQ 401 Water Quality Certification issued December 18, 2008 and Modification issued 6/28/2010 (NCDWQ Project ID 2008-1602)

NCDCM Major CAMA Permit issued January 12, 2009 and modification issued 7/1/2010 (NCDEM Permit Number 03-09)

The purpose of this letter is to notify you that the Ecosystem Enhancement Program (EEP) will provide the additional riparian wetland mitigation for the subject project. Based on the information supplied by you on September 15 and 29, 2010, the additional impacts are located in CU 03010205 of the Pasquotank River Basin in the Northern Outer Coastal Plain (NOCP) Eco-Region, and are as follows:

Table 1 – Additional Impacts and Associated Anticipated Mitigation Credits from EEP

Pasquotank 03010205 NOCP	Stream			Wetlands			Buffer (Sq. Ft.)	
	Cold	Cool	Warm	Riparian	Non-Riparian	Coastal Marsh	Zone 1 (3:1)	Zone 2 (1.5:1)
Impacts (feet/acres)	0	0	0	0.04	0	0	0	0
Mitigation Units (Credits-up to 2:1)	0	0	0	0.08	0	0	0	0

This mitigation acceptance letter replaces the mitigation acceptance letters issued on September 20, 2010. EEP is currently providing stream and riparian wetland mitigation for the impacts associated with this project located in Pasquotank 03010205 as required by the 404, 401, and CAMA Major permits that were issued February 5, 2009, December 18, 2008, and January 12, 2009, respectively, as shown in the below table (in mitigation credits):

Table 2 – Total Impacts and Associated Anticipated Mitigation Credits from EEP

Impact Type	Permitted Impacts	Mitigation Required (Credits)	Additional Impact (for approval)	Anticipated Additional Mitigation (Credits)	Revised Total Impacts	Revised Total Anticipated Mitigation (Credits)
Stream	246.0	492.0	0.0	0.0	246.0	492.0
Riparian	4.66	9.32	0.04	0.08	4.70	9.40
Non-riparian	0.0	0.0	0.0	0.0	0.0	0.0

EEP commits to implementing sufficient riparian wetland mitigation credits to offset the additional impacts associated with this project in accordance with the N.C. Department of Environment and Natural Resources' Ecosystem Enhancement Program In-Lieu Fee Instrument dated July 28, 2010. If the above referenced impact amounts are revised, then this mitigation acceptance letter will no longer be valid and a new mitigation acceptance letter will be required from EEP.

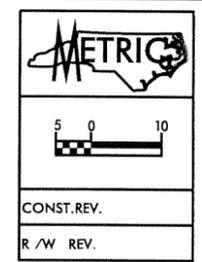
If you have any questions or need additional information, please contact Ms. Beth Harmon at 919-715-1929.

Sincerely,



William D. Gilmore, P.E.
 EEP Director

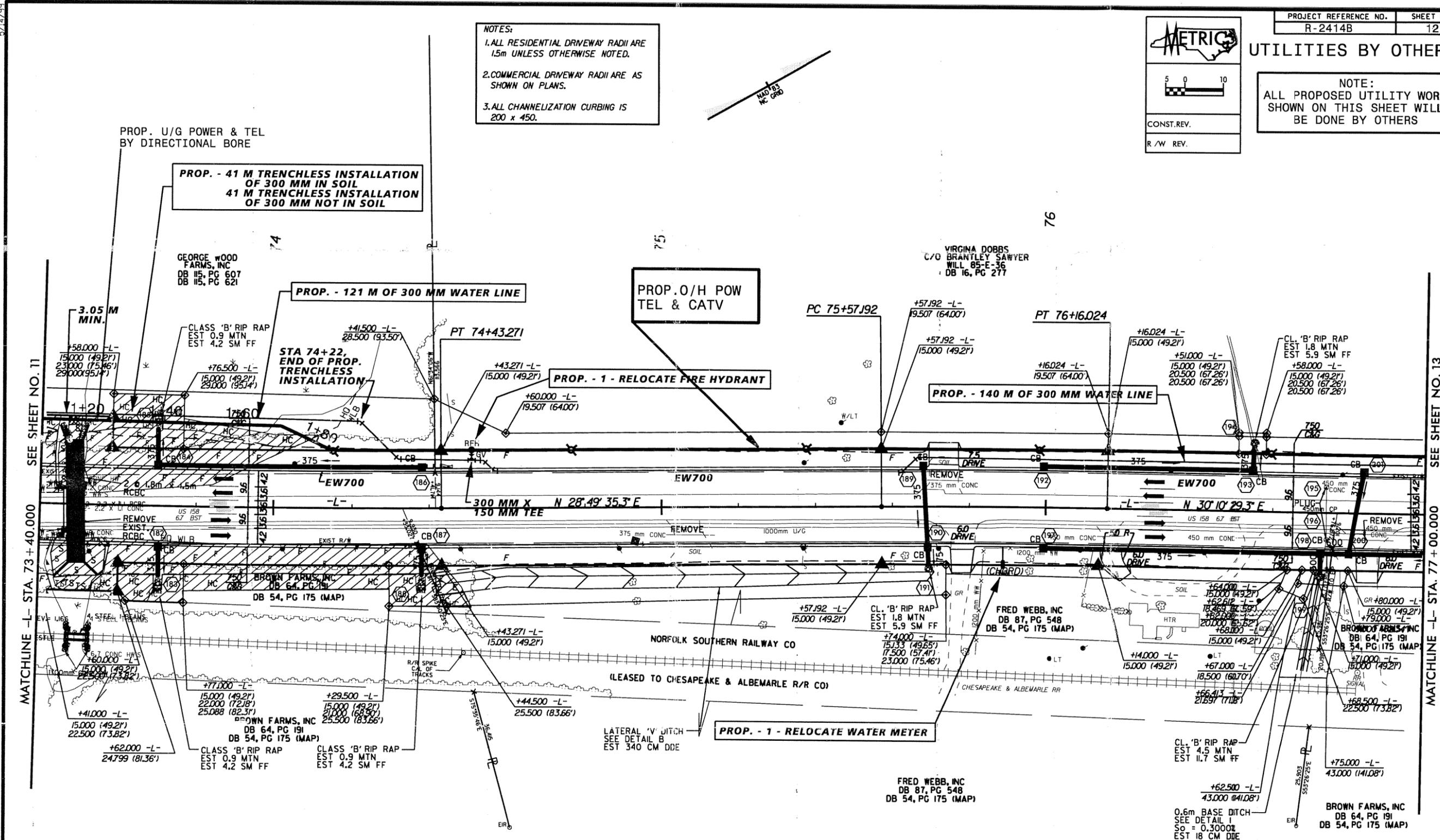
Cc: Ms. Bill Biddlecome, USACE – Washington Regulatory Field Office
 Mr. Brian Wrenn, NC Division of Water Quality
 File: R-2414A Additional



UTILITIES BY OTHERS

NOTE:
ALL PROPOSED UTILITY WORK SHOWN ON THIS SHEET WILL BE DONE BY OTHERS

NOTES:
1. ALL RESIDENTIAL DRIVEWAY RADII ARE 1.5m UNLESS OTHERWISE NOTED.
2. COMMERCIAL DRIVEWAY RADII ARE AS SHOWN ON PLANS.
3. ALL CHANNELIZATION CURBING IS 200 x 450.



MATCHLINE -L- STA. 73 + 40.000 SEE SHEET NO. 11

MATCHLINE -L- STA. 77 + 00.000 SEE SHEET NO. 13

-L-
PI Sta 72+27.319
Δ = 8' 5" 20" (LT)
L = 432.766
T = 216.815
R = 2,800.000
SE = NC
DS = 80 KM/H

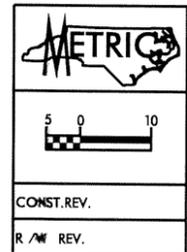
-L-
PI Sta 75+86.610
Δ = 1' 20" 54" (RT)
L = 58.832
T = 29.418
R = 2,500.000
SE = NC
DS = 80 KM/H

DETAIL B
LATERAL DITCH

DETAIL I

Utility
Permit Drawing
Sheet 10 of 15
revised 9/28/10

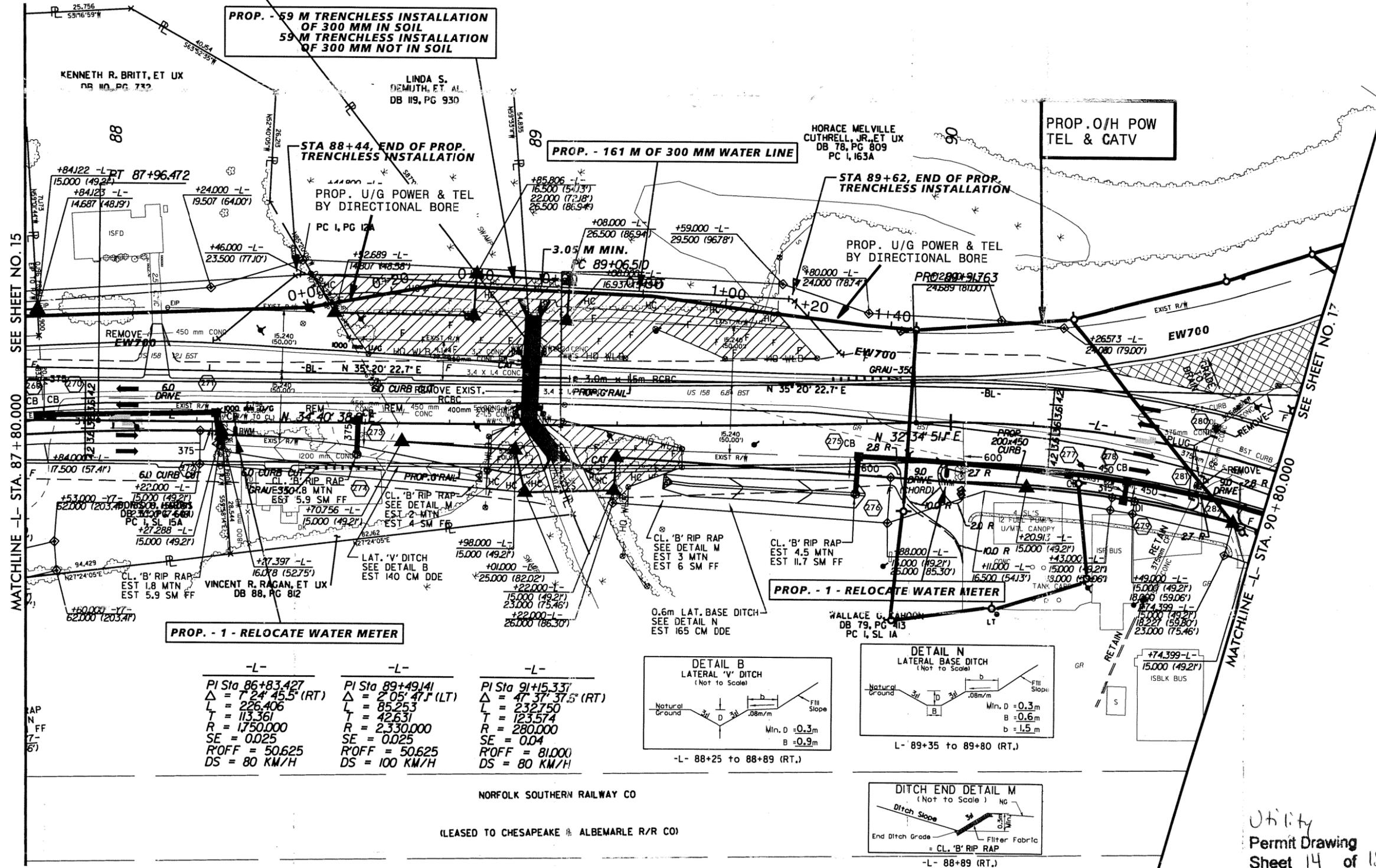
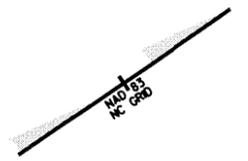
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UTILITIES BY OTHERS

NOTE:
ALL PROPOSED UTILITY WORK SHOWN ON THIS SHEET WILL BE DONE BY OTHERS

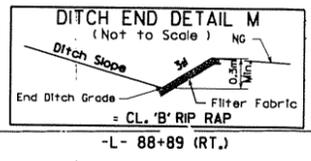
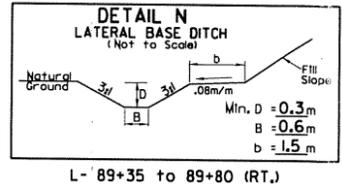
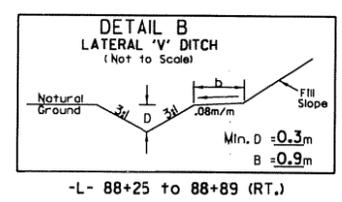
- NOTES:
1. ALL RESIDENTIAL DRIVEWAY RADII ARE 1.5m UNLESS OTHERWISE NOTED.
 2. COMMERCIAL DRIVEWAY RADII ARE AS SHOWN ON PLANS.
 3. ALL CHANNELIZATION CURBING IS 200 x 450.



SEE SHEET NO. 15
MATCHLINE -L- STA. 87 + 80.00

SEE SHEET NO. 17
MATCHLINE -L- STA. 90 + 80.00

-L-	-L-	-L-
PI Sta 86+83.427	PI Sta 89+49.141	PI Sta 91+15.337
$\Delta = 7^{\circ} 24' 45.5''$ (RT)	$\Delta = 2^{\circ} 05' 47.1''$ (LT)	$\Delta = 47^{\circ} 37' 37.5''$ (RT)
L = 226.406	L = 85.253	L = 232.750
T = 113.361	T = 42.631	T = 123.574
R = 1750.000	R = 2330.000	R = 280.000
SE = 0.025	SE = 0.025	SE = 0.04
R'OFF = 50.625	R'OFF = 50.625	R'OFF = 81.000
DS = 80 KM/H	DS = 100 KM/H	DS = 80 KM/H



NORFOLK SOUTHERN RAILWAY CO
(LEASED TO CHESAPEAKE & ALBEMARLE R/R CO)

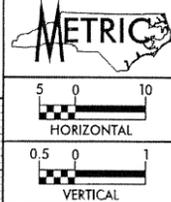
Utility
Permit Drawing
Sheet 14 of 15
revised 9/28/10

5/14/99
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 10/28/10

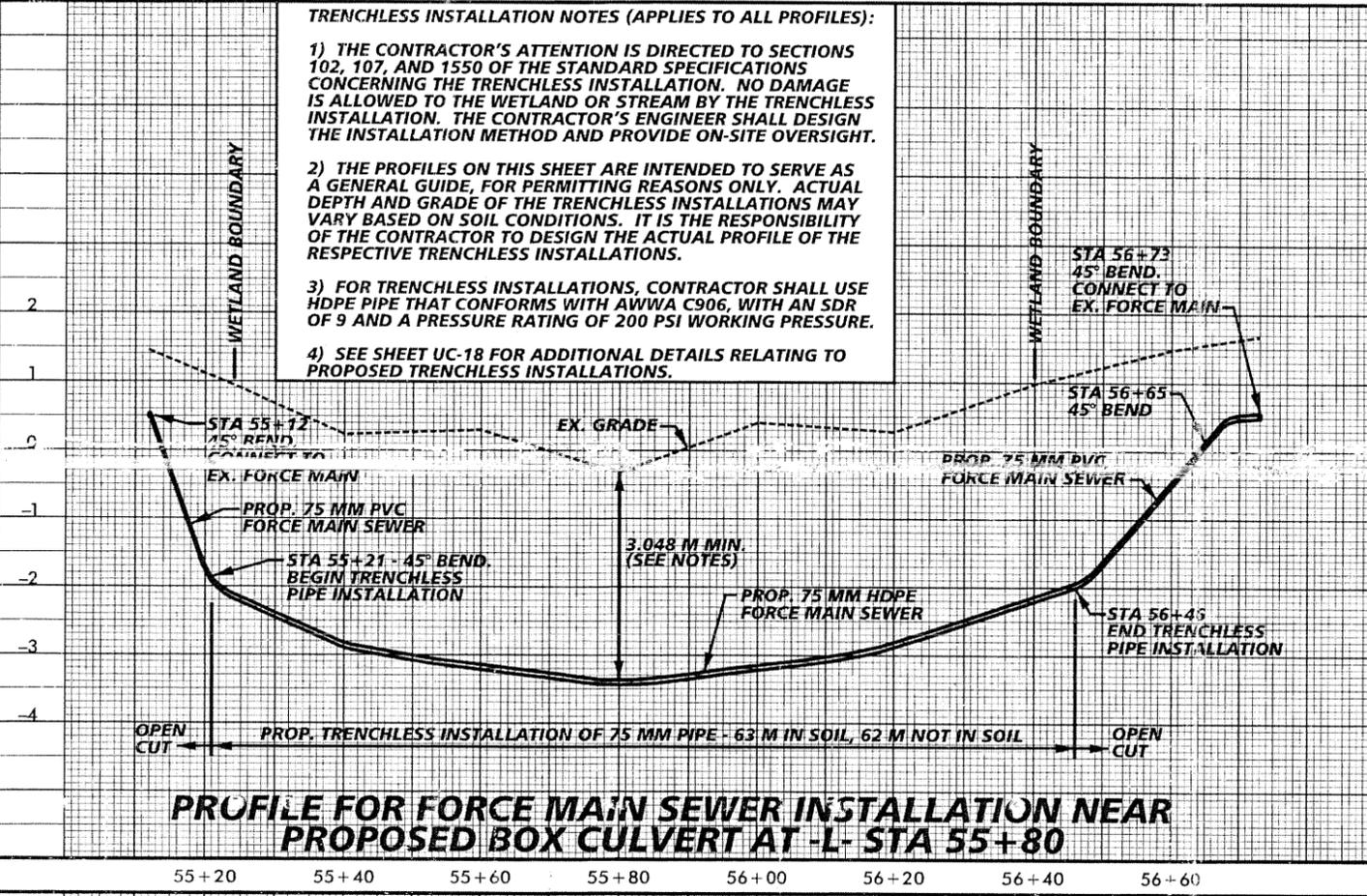
TRENCHLESS INSTALLATION NOTES (APPLIES TO ALL PROFILES):

- 1) THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTIONS 102, 107, AND 1550 OF THE STANDARD SPECIFICATIONS CONCERNING THE TRENCHLESS INSTALLATION. NO DAMAGE IS ALLOWED TO THE WETLAND OR STREAM BY THE TRENCHLESS INSTALLATION. THE CONTRACTOR'S ENGINEER SHALL DESIGN THE INSTALLATION METHOD AND PROVIDE ON-SITE OVERSIGHT.
- 2) THE PROFILES ON THIS SHEET ARE INTENDED TO SERVE AS A GENERAL GUIDE, FOR PERMITTING REASONS ONLY. ACTUAL DEPTH AND GRADE OF THE TRENCHLESS INSTALLATIONS MAY VARY BASED ON SOIL CONDITIONS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DESIGN THE ACTUAL PROFILE OF THE RESPECTIVE TRENCHLESS INSTALLATIONS.
- 3) FOR TRENCHLESS INSTALLATIONS, CONTRACTOR SHALL USE HDPE PIPE THAT CONFORMS WITH AWWA C906, WITH AN SDR OF 9 AND A PRESSURE RATING OF 200 PSI WORKING PRESSURE.
- 4) SEE SHEET UC-18 FOR ADDITIONAL DETAILS RELATING TO PROPOSED TRENCHLESS INSTALLATIONS.

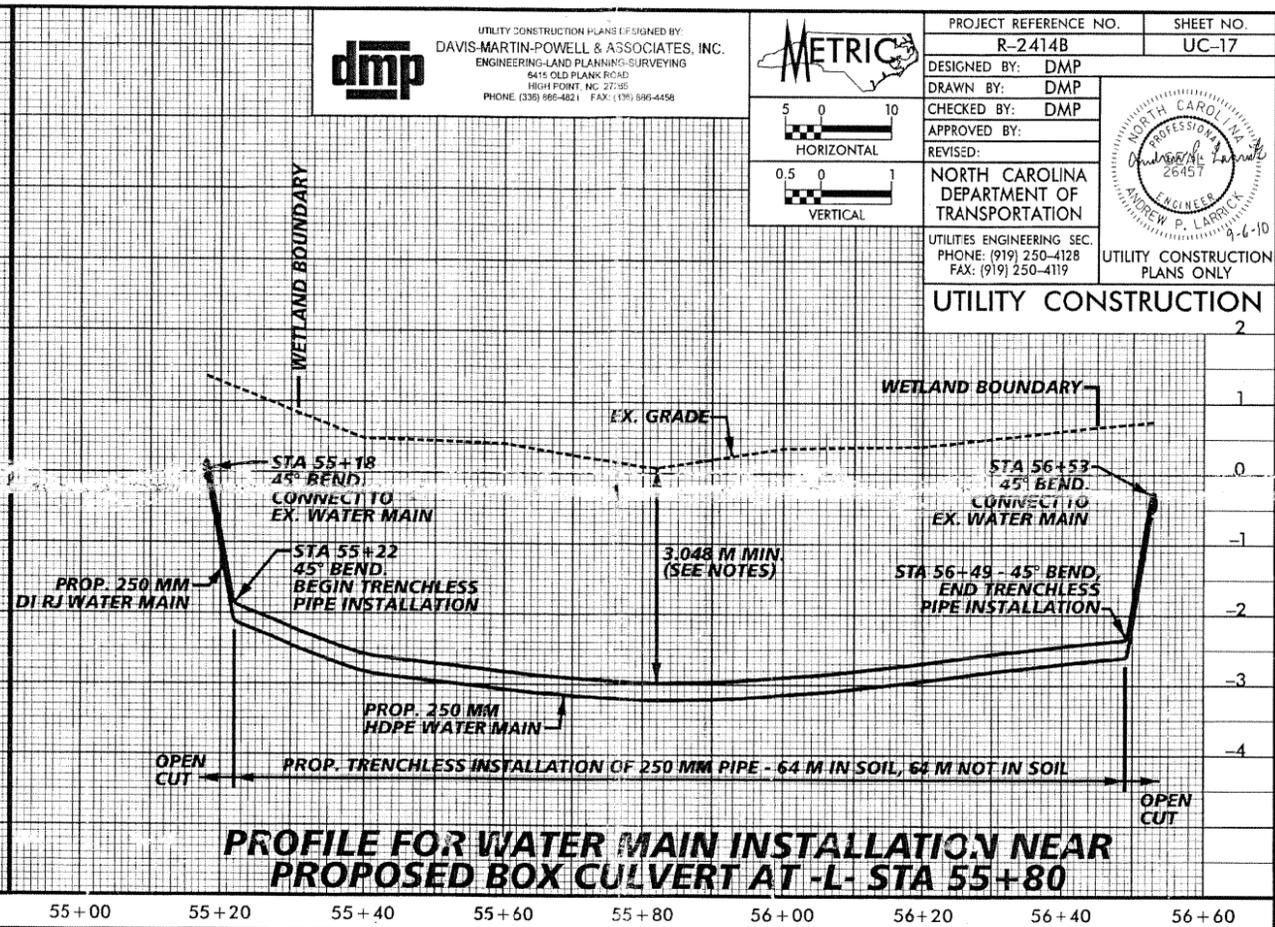
dmp
 UTILITY CONSTRUCTION PLANS DESIGNED BY:
 DAVIS-MARTIN-POWELL & ASSOCIATES, INC.
 ENGINEERING-LAND PLANNING-SURVEYING
 5415 OLD PLANK ROAD
 HIGH POINT, NC 27735
 PHONE: (336) 866-4621 FAX: (336) 896-4458



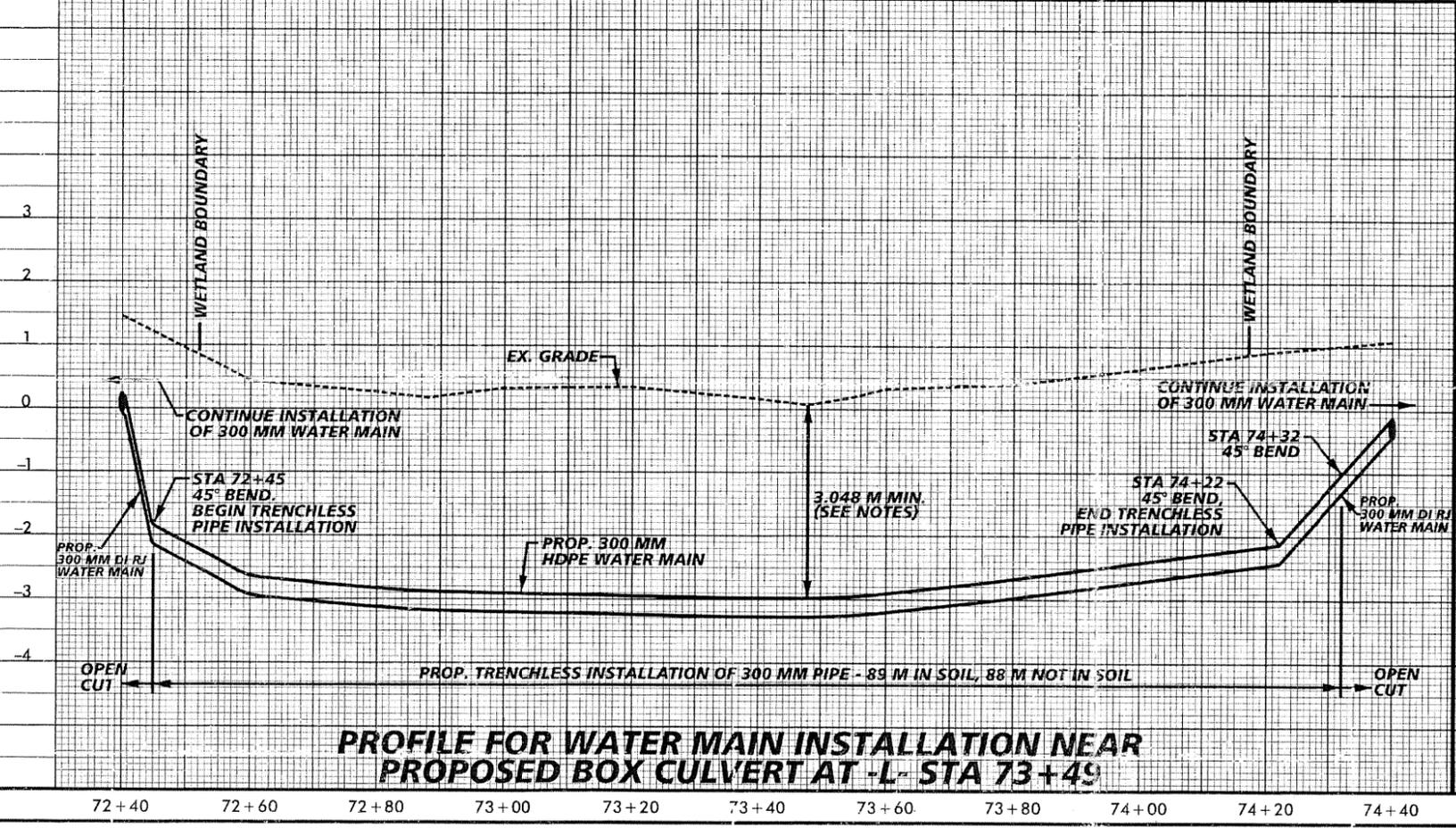
PROJECT REFERENCE NO. R-2414B	SHEET NO. UC-17
DESIGNED BY: DMP	
DRAWN BY: DMP	
CHECKED BY: DMP	
APPROVED BY: [Signature]	
REVISED:	NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
UTILITIES ENGINEERING SEC. PHONE: (919) 250-4128 FAX: (919) 250-4119	UTILITY CONSTRUCTION PLANS ONLY



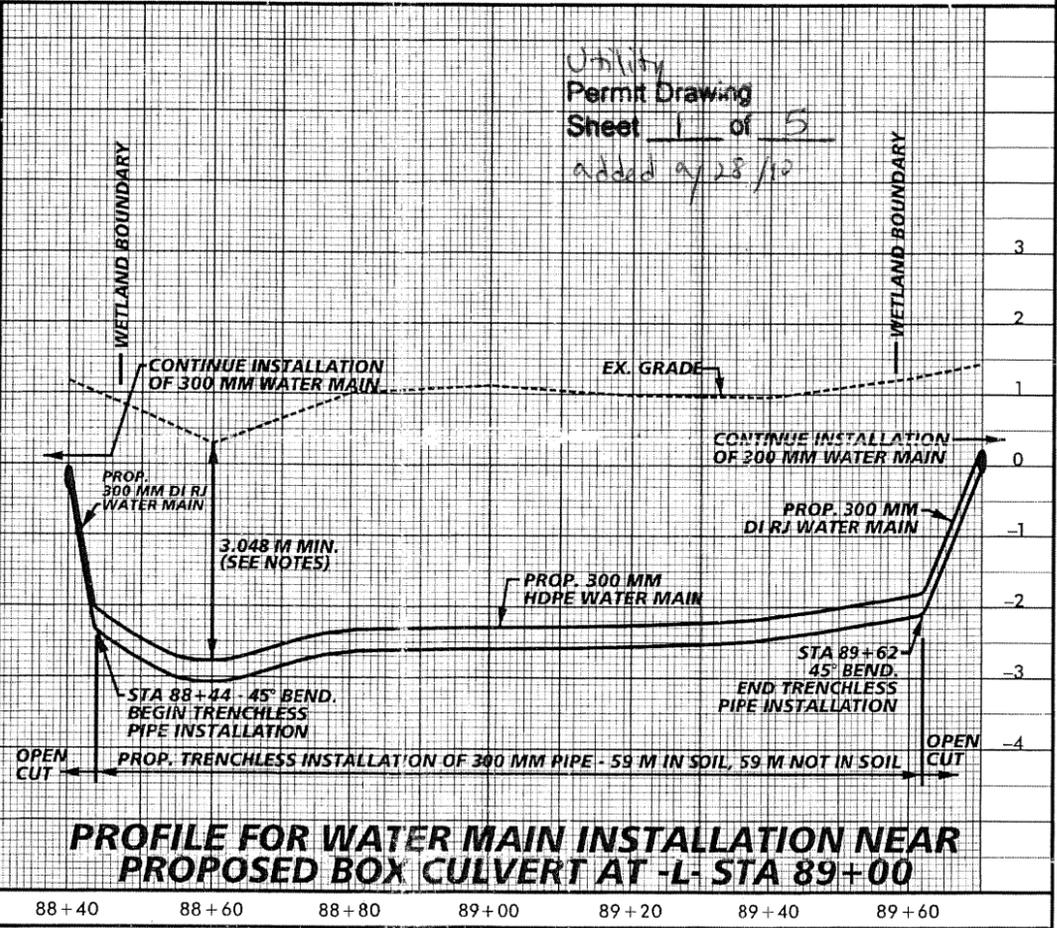
PROFILE FOR FORCE MAIN SEWER INSTALLATION NEAR PROPOSED BOX CULVERT AT -L- STA 55+80



PROFILE FOR WATER MAIN INSTALLATION NEAR PROPOSED BOX CULVERT AT -L- STA 55+80



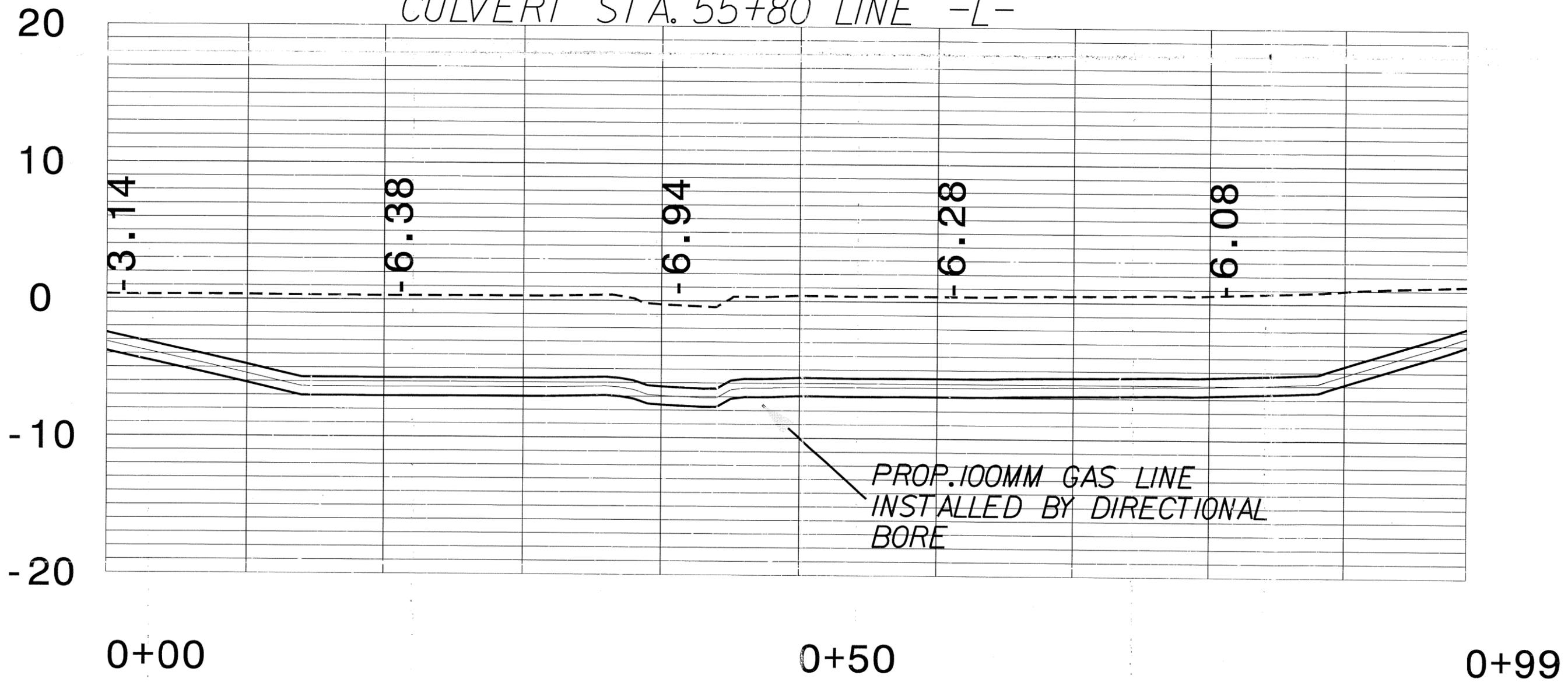
PROFILE FOR WATER MAIN INSTALLATION NEAR PROPOSED BOX CULVERT AT -L- STA 73+49



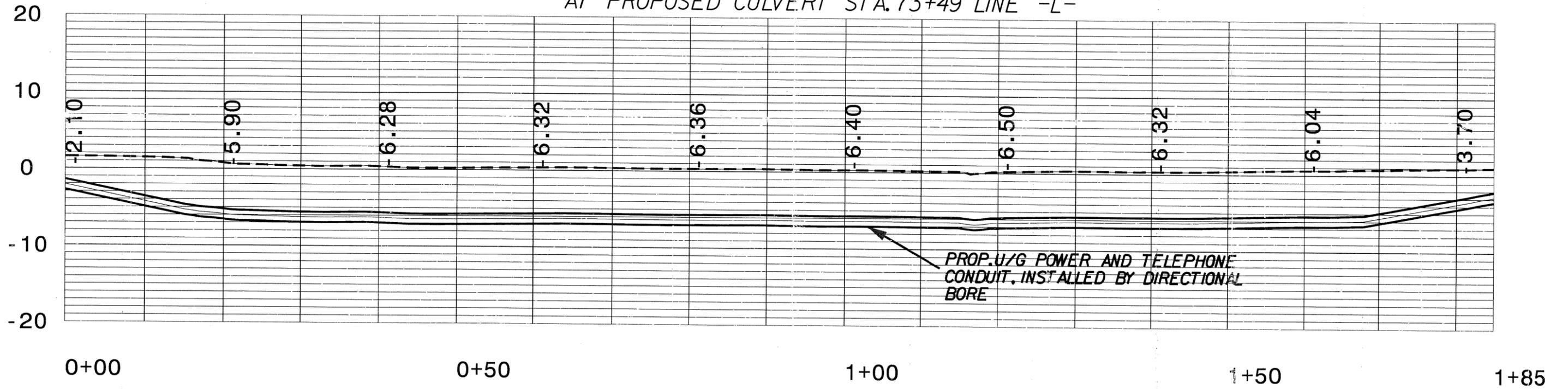
PROFILE FOR WATER MAIN INSTALLATION NEAR PROPOSED BOX CULVERT AT -L- STA 89+00

Utility
 Permit Drawing
 Sheet 1 of 5
 added 9/28/10

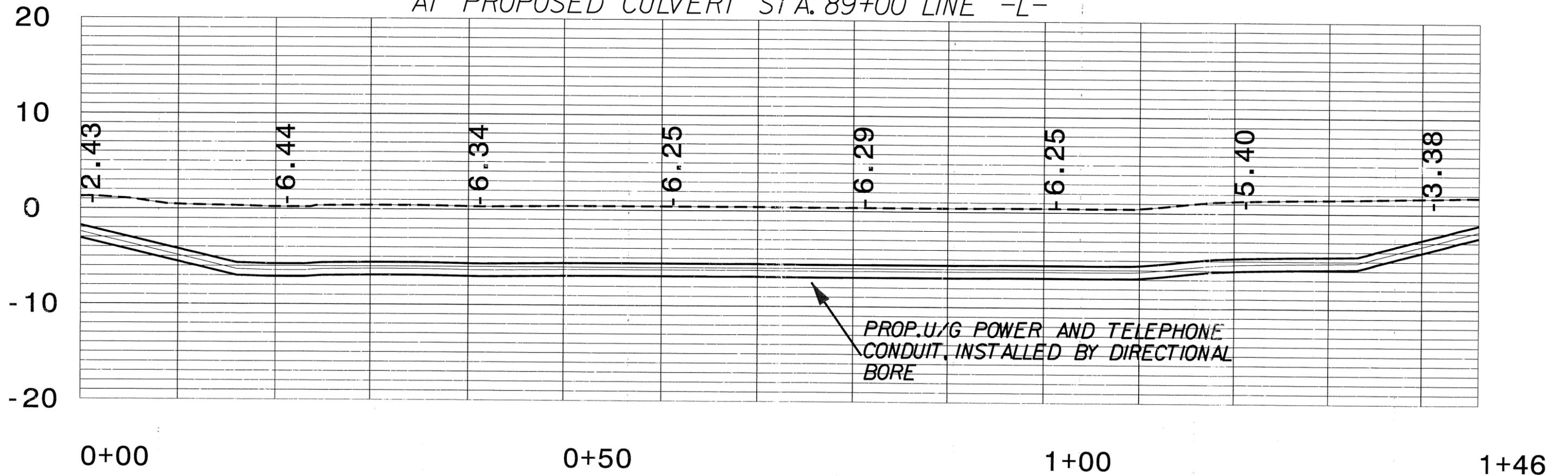
GAS LINE RELOCATION AT PROPOSED
CULVERT STA. 55+80 LINE -L-



POWER AND TELEPHONE LINE RELOCATIONS
 AT PROPOSED CULVERT STA. 73+49 LINE -L-



POWER AND TELEPHONE LINE RELOCATIONS
AT PROPOSED CULVERT STA. 89+00 LINE -L-



Utility
Permit Drawing
Sheet 5 of 5

added 9/28/10



GEOTECHNICAL ENGINEER

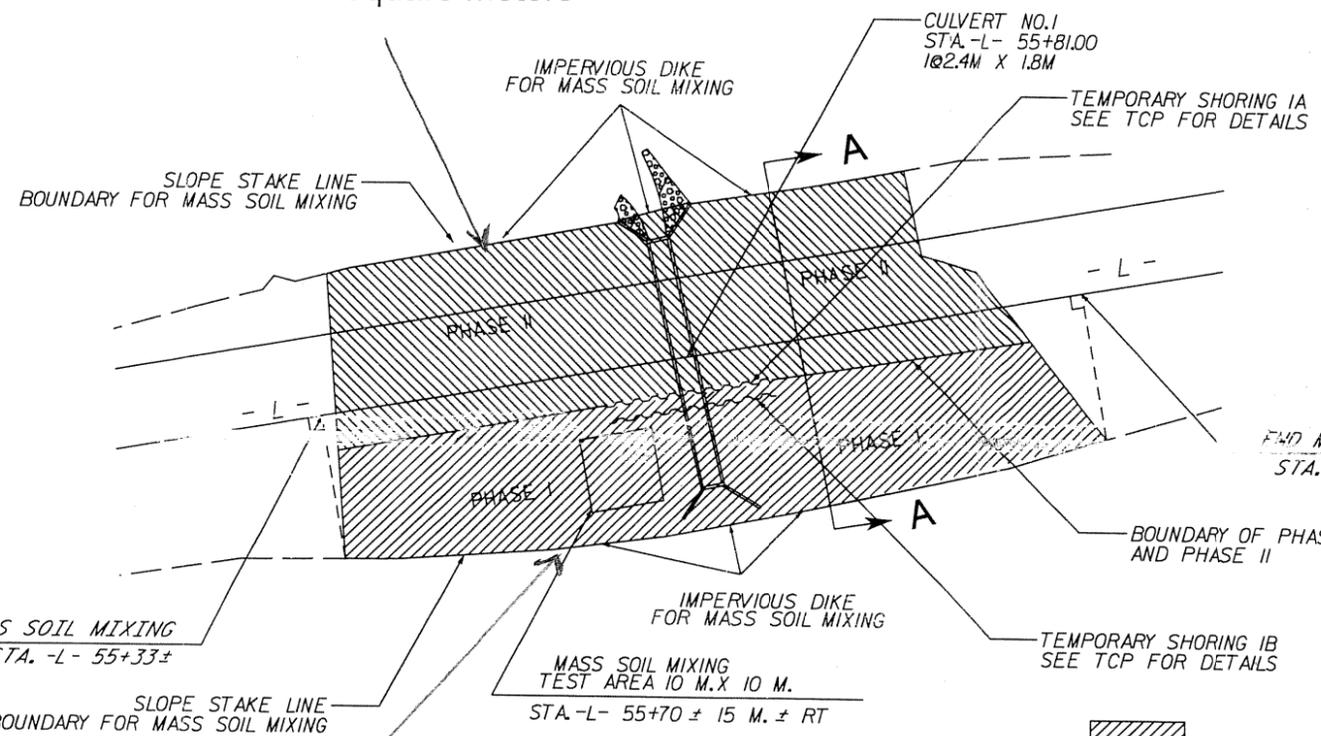
ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 32171 JINYOUNG PARK

SIGNATURE DATE SIGNATURE DATE

Geotechnical Drawings Sheet 1 of 3

0.006 acre/ 24 square meters



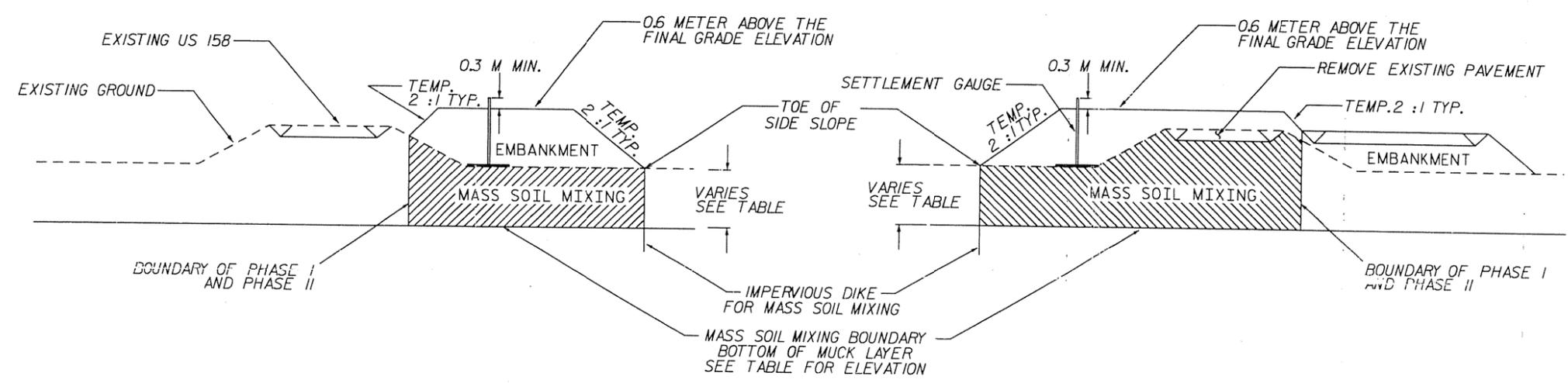
- PHASE I MASS SOIL MIXING
- PHASE II MASS SOIL MIXING

0.008 acre/ 31.5 square meters MASS SOIL MIXING NO.1 PLAN VIEW Not To Scale

MASS SOIL MIXING BOTTOM ELEVATIONS

STATION	ELEVATION* (PHASE I)	ELEVATION* (PHASE II)
-L- 55+33.00	-5.5 M	-5.5 M
-L- 55+40.00	-5.5 M	-5.5 M
-L- 55+60.00	-5.5 M	-5.5 M
-L- 55+80.00	-5.5 M	-5.5 M
-L- 56+00.00	-6.0 M	-7.5 M
-L- 56+20.00	-4.5 M	-3.0 M
-L- 56+34.00	-4.5 M	-

*USE A LINEAR INTERPOLATION OF THE ELEVATION BETWEEN THE STATIONS



TRAFFIC PHASE I A-A CROSS SECTION TYP. Not To Scale

TRAFFIC PHASE II A-A CROSS SECTION TYP. Not To Scale

DRAFT

GEOTECHNICAL ENGINEERING UNIT

EASTERN REGIONAL OFFICE

WESTERN REGIONAL OFFICE

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RALEIGH

REVISIONS					SHEET NO.
NO.	BY	DATE	NO.	BY	DATE
1			3		
2			4		

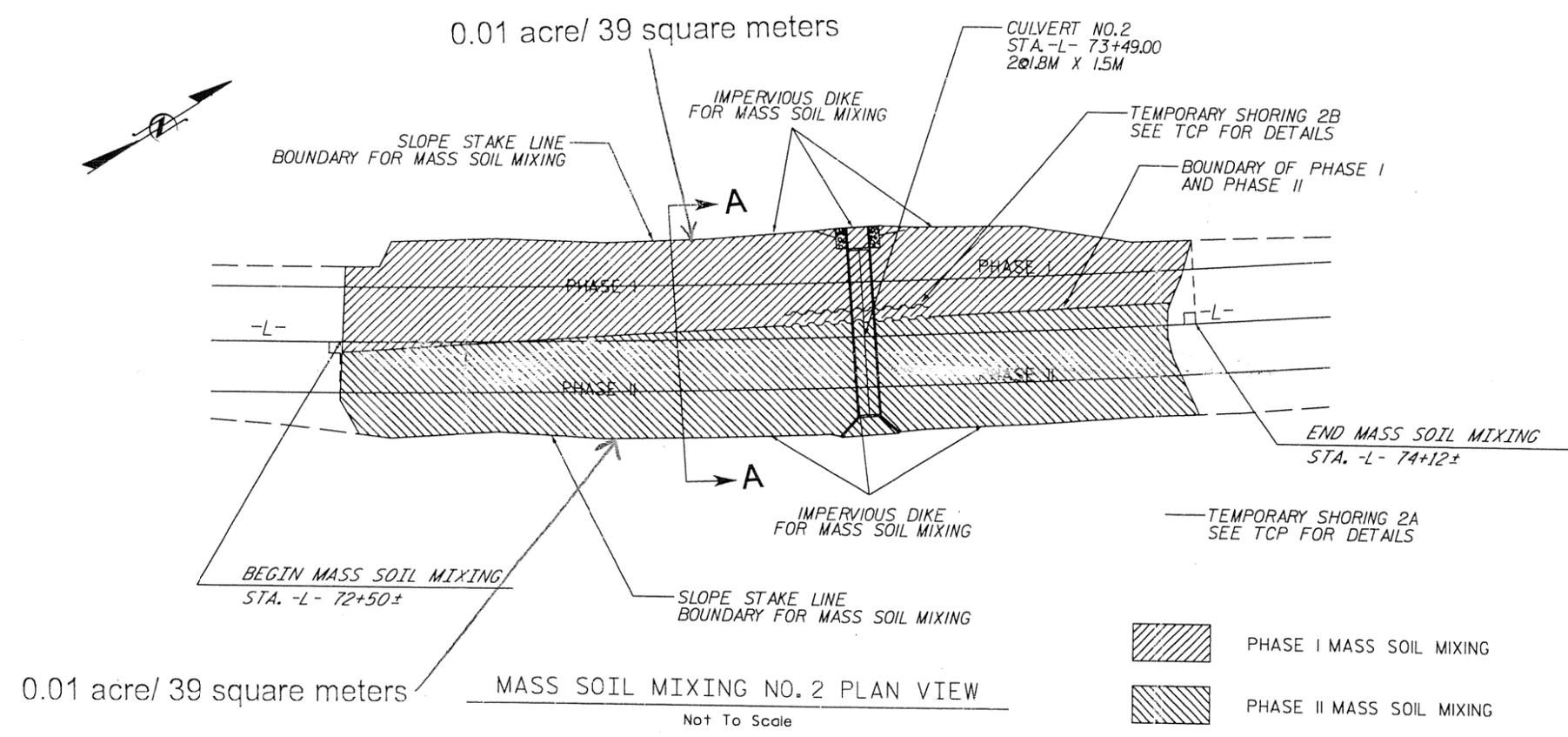


GEOTECHNICAL ENGINEER
ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 32171
JINYOUNG PARK

SIGNATURE DATE SIGNATURE DATE

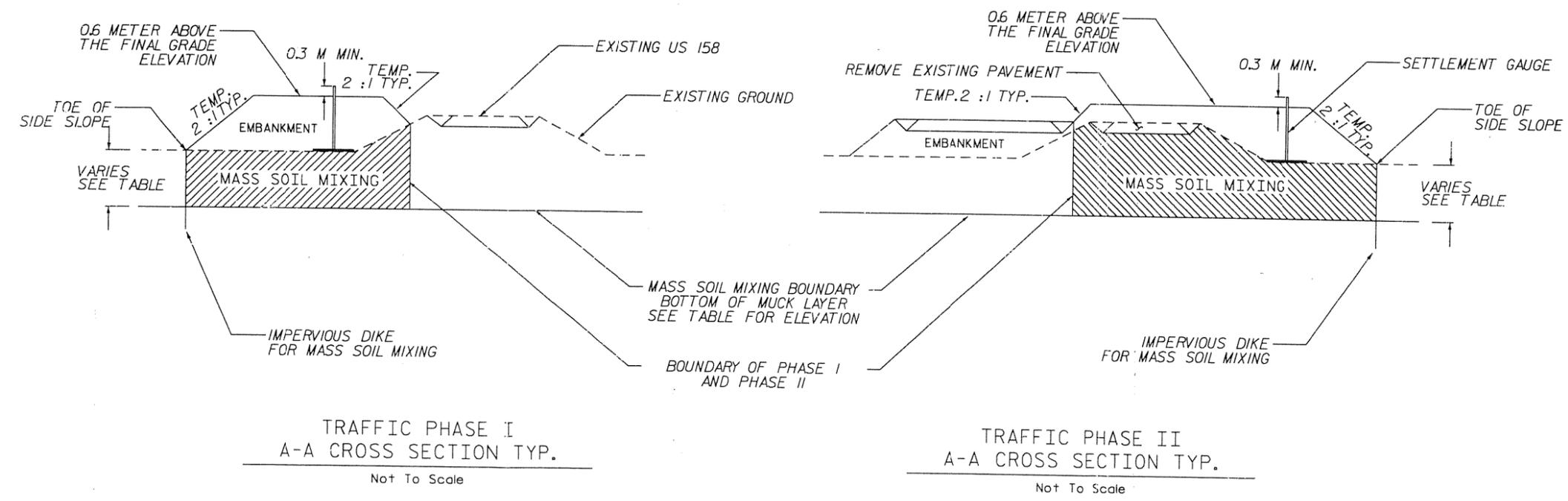
Geotechnical Drawings Sheet 2 of 3



MASS SOIL MIXING BOTTOM ELEVATIONS

STATION	ELEVATION* (PHASE I)	ELEVATION* (PHASE II)
-L- 72+50.00	-1.5 M	-1.0 M
-L- 72+60.00	-1.5 M	-1.0 M
-L- 72+80.00	-2.5 M	-1.5 M
-L- 73+00.00	-4.0 M	-3.0 M
-L- 73+20.00	-5.0 M	-5.0 M
-L- 73+40.00	-5.0 M	-4.0 M
-L- 73+60.00	-3.0 M	-4.0 M
-L- 73+80.00	-1.0 M	-1.0 M
-L- 74+00.00	-1.0 M	-1.0 M
-L- 74+12.00	-1.0 M	-1.0 M

*USE A LINEAR INTERPOLATION OF THE ELEVATION BETWEEN THE STATIONS



DRAFT

GEOTECHNICAL ENGINEERING UNIT

EASTERN REGIONAL OFFICE
 WESTERN REGIONAL OFFICE

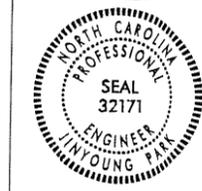
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			TOTAL SHEETS
2			4			

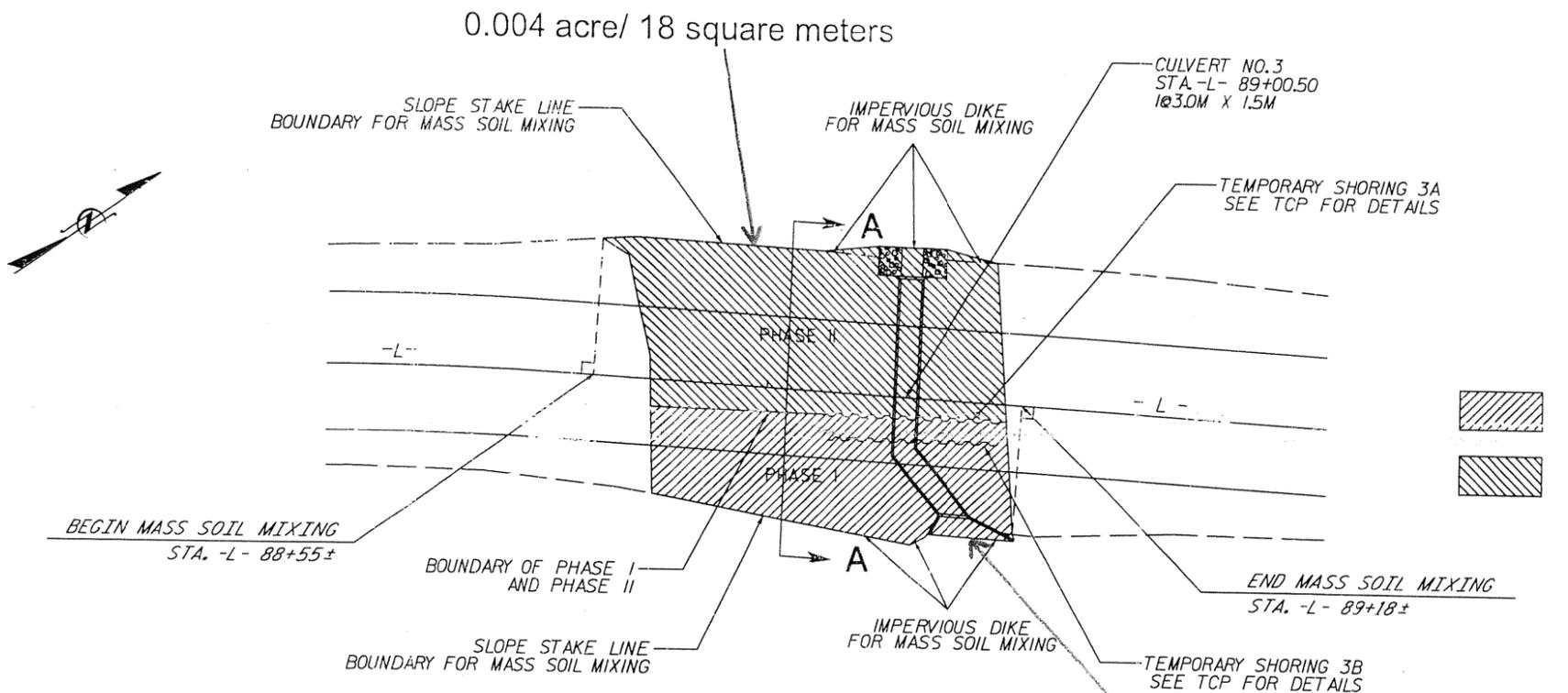


GEOTECHNICAL ENGINEER

ENGINEER



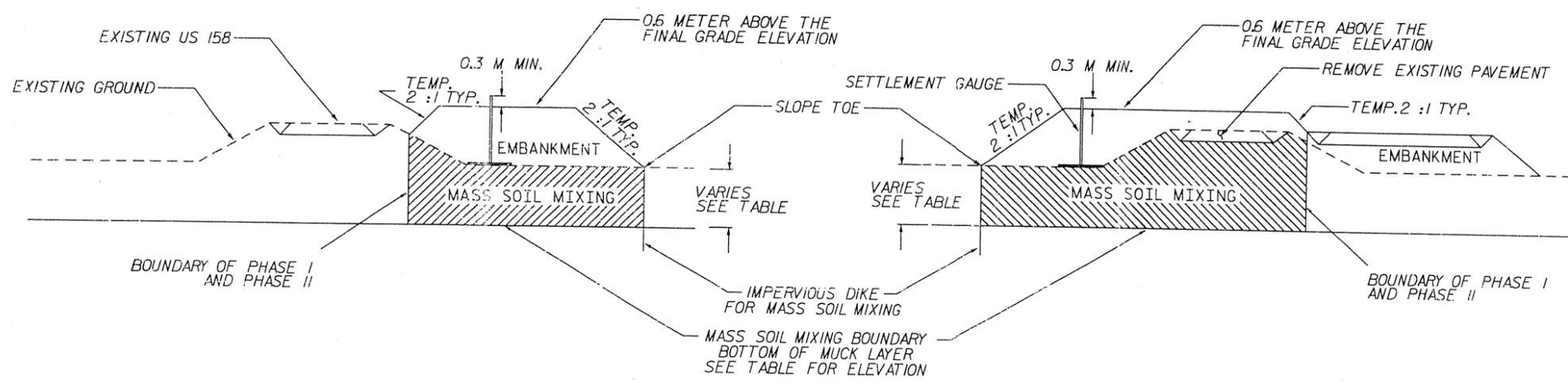
SIGNATURE DATE SIGNATURE DATE



MASS SOIL MIXING BOTTOM ELEVATIONS

STATION	ELEVATION* (PHASE I)	ELEVATION* (PHASE II)
-L- 88+55.00	-	-1.0 M
-L- 88+80.00	-1.5 M	-1.5 M
-L- 89+00.00	-2.5 M	-2.5 M
-L- 89+18.00	1.0 M	-

*USE A LINEAR INTERPOLATION OF THE ELEVATION BETWEEN THE STATIONS



DRAFT

GEOTECHNICAL ENGINEERING UNIT

EASTERN REGIONAL OFFICE
 WESTERN REGIONAL OFFICE

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PREPARED BY: J. PARK	DATE: 08/2010
REVIEWED BY: K. J. KIM	DATE: 08/2010

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	TOTAL SHEETS
1			3			
2			4			

MASS SOIL MIXING

1.0 GENERAL

The work covered by this provision consists of furnishing all equipment, labor, and materials, and performing all operations required for installing and testing mass soil mixing as specified herein and shown on the contract plans. The term “Mass Soil Mixing” used in this provision is intended as a generic term and refers to a mechanical method of blending in-situ soil with a reagent binder or grout using a mixing tool. The binder or grout is injected and in-situ soils are mixed to achieve a design strength. The purpose of the Soil Mixing program specified herein is to improve the strength and deformation characteristics of the soft organic soils within the limits indicated on the project drawings to assure the stability and performance of the roadway embankment constructed over the treated soil mass. The Contractor shall hire a specialty subcontractor who meets the requirements of the subcontractor qualifications in Section 2.0 below. The Contractor shall perform all work described in this provision in accordance with this provision and the NCDOT Standard Specifications for Road and Structures unless otherwise directed by the Engineer.

2.0 SUBCONTRACTOR QUALIFICATIONS

The mass soil mixing subcontractor shall have a minimum of five continuous years of documented experience in soil mixing and shall provide at least one project manager, site superintendent, and operator with a minimum of three years of documented experience in soil mixing within the last five years. Both the site superintendent and the operator shall be available for this project on a full-time basis.

3.0 SUBMITTALS

3.1 Before beginning of mass soil mixing construction, the Contractor shall submit the following for approval by the Engineer. Within 15 days of the receipt of the submittal, the Engineer will notify the Contractor of approval or rejection of the subcontractor’s qualification.

- A. Detailed documentation to prove that the subcontractor meets the qualification requirements stated in Section 2.0.
- B. List of soil mixing projects the subcontractor has performed with contact information of the project owners.
- C. List of soil mixing projects the project manager has performed with contact information of the project owners.
- D. List of soil mixing projects the site superintendent has performed with contact information of the project owners.
- E. List of soil mixing projects the operator has performed with contact information of the project owners.
- F. Resumes of the project manager, site superintendent, and operator
- G. Certifications and training records of the operator of soil mixing

3.2 After the Engineer's approval of the mass soil mixing subcontractor, but no less than 30 days before beginning of mass soil mixing construction, the Contractor shall submit the following for approval by the Engineer. Within 30 days of the receipt of the submittal, the Engineer will notify the Contractor of approval or rejection of the submittals. The Contractor shall not perform any soil mixing work until all of the items listed below have been approved by the Engineer.

- A. List and sizes of proposed equipment, tools, binder or grout delivery system including mixing tool used to mix the in-situ soil and binder or grout.
- B. Soil mix design including sources and type of binder material with proportions. Also, proposed binder or grout mixture, mixing rates, flow rates, air injection pressure and volume flow rates, auger/mixing tools rotational speed, auger down pressure, and auger penetration and withdrawal rates.
- C. Mass soil mixing construction sequence and step-by step description of work procedures outlining means and methods to achieve the specified criteria detailed in this Special Provision.
- D. Mass soil mixing construction schedule.
- E. Design plans and supporting engineering analysis and calculations of temporary embankment and slope stabilization to assure stability of both the existing and widened roadway embankments during the mass soil mixing work.
- F. Material suppliers' certifications of quality.
- G. Contractor's Quality Assurance-Quality Control (QA/QC) Plan, including, but not limited to:
 - a. Details and procedures of all testing and sampling
 - b. Measures to be implemented each day during Soil Mixing to monitor, modify, record, and control binder or grout ratios and quantities, mixing time, and other related aspects of the Soil Mixing process
- F. Sample log to be used to report daily production records of mass soil mixing. The log shall contain at least the following information:
 - a. project name
 - b. date, start and finish time, and duration of mixing operation
 - c. machine number
 - d. type of mixing tool
 - e. location of the treated area in terms of station number and offset from -L-
 - f. surface area, depth, and volume of the treatment
 - g. quantity of binder material and injection ratio
 - h. installation air pressure
 - i. rate of insertion and withdrawal of mixing tool
 - j. description of obstructions or interruptions of mass soil mixing operation
 - k. weather

4.0 PRECONSTRUCTION MEETING

After approval of the submittals in Section 3.0, but before starting any mass soil mixing work including the test section, the Contractor shall have a preconstruction meeting to discuss the

details of materials, equipment, construction, inspection, and testing for the mass soil mixing. Schedule this meeting with the representatives of the Department's Resident Engineer, Construction Unit, and Geotechnical Engineering Unit, and the Contractor and the mass soil mixing subcontractor including the project manager, site superintendent, and operator. Notify them of the meeting schedule a minimum of seven days in advance of the meeting.

5.0. SOIL MIXING EQUIPMENT AND STORAGE TANKS FOR BINDER OR GROUT MATERIALS

A. Soil Mixing Equipment

Use self-contained soil mixing rigs for soil mixing. The minimum equipment requirements are:

- a. One or more pressure tanks rated to safely contain an air pressure 8 bar.
- b. Base equipment capable of firmly supporting the mixing tool throughout the installation process.
- c. Torque and rotational speed suitable for thorough mixing.
- d. Specially designed mixing tools with the capacity to construct the required geometries and dimensions as shown in the plan

The soil mixing equipment shall have real-time computer control system to permit accurate and continuous monitoring, recording, and control of the following: binder and water proportioning, grout mix, water-cement ratio, mixing tool depths, binder or grout injection pressures and quantities, auger rotational speeds, auger down pressure, auger advancement and withdrawal rates, and other operations required for mass soil mixing.

The soil mixing equipment shall be of sufficient size, capacity, and torque to perform the required mass soil mixing operations. The equipment shall be capable of advancing through the soft untreated ground or previously installed and cured mass soil mixing area as necessary to complete the work.

Soil mixing equipment must allow the use of compressed air or grout during mixing. Mixing tools must be capable of injecting binder or grout through the mixing tool. Rotate and orient mixing tools sufficiently to break up the in situ soils and disperse and blend with injected binder or grout to form the soil/binder mixture. Continuous auger flights are not allowed. Mixing tools shall be rotated sufficiently fast and be oriented to thoroughly break up the in situ soils and disperse and blend with injected cement/grout to form a homogenous mixture. Mixture rotation speed during mixing shall be chosen by the Soil Mixing Contractor and should not vary by more than 10% at any time.

B. Storage Tanks for Binder Materials or Grout Mixing Plant

Store and deliver binder materials to the mixing points in closed pressure tanks suitable to be used as pressure vessels, for all pressures required including those to be used to load and unload the materials. Provide storage tanks or silos for adequate storage space for

continuous production. The bulk storage equipment includes all pumps, scales, mixers, valves, gauges, and regulating devices required to measure and mix binder.

The grout mixing plant shall include the necessary equipment including a high shear mixer capable of producing a colloidal suspension of cement and additives in water and pumps, valves, hoses, supply lines, and all other equipment as required to adequately supply grout to the mixing tool. Positive displacement grout pumps shall be used to transfer the grout to the mixing auger. The grout pump shall be capable of pumping to the required distance and elevations to provide an adequate supply of grout to the mixing tool. The plant shall be equipped to accept dry or liquid additives in measured amounts. Storage tanks shall be provided (as needed) to store and allow for an adequate supply of batches or continuously mixed grout to the soil mixing machine. Grout shall be agitated until fully mixed and recirculated in the storage tanks to maintain a homogeneous mix and prevent flash set. Grout meters or calibrated tanks shall be provided to measure injection volumes.

6.0 MATERIALS

A. Reagent Binder

Use a binder material consisting of cement and slag. The percentage of slag shall not exceed 50% of the binder material by weight. The binder shall be delivered in a powder form. Protect the binder material from damage by moisture while in transit to and in storage at the job site.

1. Cement:

Use Type I or II Portland Cement in accordance with Section 1024 of the Standard Specifications for Roads and Structures. No other types of cement will be allowed. All cement shall be homogeneous in composition and properties, and shall be manufactured using the same method at one plant by the same manufacturer. Material which has become caked due to moisture absorption shall not be used. Bags of cement shall be stacked no more than ten bags high to avoid compaction. Cement containing lumps or foreign material that may be deleterious to the mass soil mixing operation shall not be used. Tricalcium aluminate content shall not exceed 7%.

2. Slag

Use ground granulated blast furnace slag. Other types of slag or fly ash may be allowed upon approval of the Engineer.

3. Additives

All additives shall be included in the mix design submittal for the Engineer's review and approval. No admixtures shall be used without the Engineer's approval.

B. Grout

Grout shall be a stable homogeneous mixture of cement, slag, and water. The percentage of slag shall not exceed 50% of the binder material by weight. The Contractor shall not change grout composition unless conditions encountered so require, in which case the Contractor shall submit the change in writing with substantiating reasons for the Engineer's review and

approval. The requirements of cement, slag, additives, and water for grout are the same as the reagent binder material above.

C. Water

Water used in mass soil mixing shall be clean and potable, of neutral pH, and free from sewage, oil, acid, alkali, salts, organic materials, and other deleterious contamination. If the Contractor obtains water from sources other than public drinking water supply, then the Contractor shall provide water quality test data to prove that the water meets this requirement.

7.0 FIELD TEST SECTION

The Contractor shall construct a mass soil mixing test section before beginning a full-scale production work. The test section construction is to verify that the Contractor is capable of performing the mass soil mixing work in accordance with this provision and other contract requirements. In addition, the test section construction is to verify that the Contractor's proposed construction method, procedures, and equipment will produce the mass soil mixing meeting the acceptance criteria specified in this provision. The test section shall be constructed at a location designated in the plan unless otherwise directed by the Engineer. The size of the test section shall be 9 to 10 meter in width and 9 to 10 meter in length unless otherwise approved by the Engineer. The Contractor shall use the same materials, equipment, and construction method and procedures for test section construction as he proposes for production mass soil mixing in this project. The quality control and quality assurance (QC/QA) measures specified in this provision shall also be implemented in the test section construction. The sampling and testing requirements for the test section are as follows:

- 1) Unconfined Compressive Testing of Wet Samples: one sample at every two meter depth of the treated soil mass at two different locations selected by the Engineer
- 2) Cone Penetration Test (CPT): two CPT tests at locations selected by the Engineer down to a depth of two meters below the bottom of the mass soil mixing
- 3) Coring and Unconfined Compressive Testing: a continuous coring down to the bottom of the mass soil mixing at two different locations selected by the Engineer

The Engineer will determine acceptance or rejection of the test section based on the acceptance criteria specified in this provision. If the test section is accepted by the Engineer, it will become part of the production mass soil mixing and will be paid for accordingly. The Contractor may continue the mass soil mixing operation upon the Engineer's acceptance of the test section. If the test section fails to meet the acceptance criteria, the Contractor shall cease all soil mixing operations and submit a revised soil mix design, a list of revised equipment and tools, and/or revised construction methods and procedures including the applicable items in Section 3.2 for the Engineer's review and approval. The Engineer will notify the Contractor of approval or rejection of the submittals within 10 days of the receipt of the submittals. After the Engineer's approval of the revised submittals, the Contractor shall construct a new test section at a location designated by the Engineer following the same requirements applied in the previous test section construction. If the second test section fails to meet the acceptance criteria, the Contractor shall either replace all key personnel of the mass soil mixing subcontractor including the project manager, site superintendent, and operator, or change the

mass soil mixing subcontractor. In either case, the Contractor shall resubmit all of the items listed in Section 3.0 for the Engineer's review and approval. The Engineer will notify the Contractor of approval or rejection of the submittals within 15 days of the receipt of the submittals. This process shall repeat until the test section is accepted by the Engineer.

8.0 CONSTRUCTION METHODS

- 8.1 The Contractor shall furnish all labor, equipment, and materials necessary to conduct all mass soil mixing operations. The Contractor shall use same procedures, materials, and construction methods and equipment used in the test section construction throughout the production mass soil mixing work. Variations may be proposed with the condition that the Contractor demonstrates by constructing a new test section as required in Section 7.0 that the revised procedures, materials, or construction methods or equipment will provide mass soil mixing that meets all of the acceptance criteria. The Contractor shall continuously monitor the soil mixing operation, and if necessary, shall propose modification to any aspects of the work, such as water/cement ratio, to achieve compliance with contract requirements and acceptance criteria, all subject to the Engineer's review and approval. If at any time, the Contractor's equipment, methods, or materials do not produce a satisfactory mass soil mixing, the Contractor shall stop the soil mixing operation and submit for the Engineer's review and approval a plan of action to produce mass soil mixing that meets the acceptance criteria described in this provision.
- 8.2 Relative to the overall site requirements and preparatory work prior to mass soil mixing work, the Contractor shall perform all survey layouts and utility clearances associated with the mass soil mixing operation and coordination will all local, state, and federal agencies having jurisdiction, and all utility companies having facilities that could be impacted by the mass soil mixing construction. Also, The Contractor shall perform clearing and grubbing prior to soil mixing operation in accordance with Section 200 of the NCDOT Standard Specifications for Roads and Structures.
- 8.3 The Contractor shall design, construct, and maintain stable working surfaces for all mass soil mixing operations. The Contractor shall provide timber crane mats of sufficient width and length to form a stable working platform for the mixing equipment and other support equipment.
- 8.4 The Contractor shall design, construct, and maintain temporary embankment and slope stabilization measures during the entire mass soil mixing operation to assure stability of both the existing and widened roadway embankments. The subcontractor of mass soil mixing shall design the temporary embankment and slope stabilization and submit the design plans and supporting engineering analysis and calculations as specified in Section 3.0 of this provision.
- 8.5 The Contractor shall mobilize and maintain a sufficient number of personnel and equipment to meet the schedule completion dates and other milestones. The Contractor shall coordinate all mass soil mixing operations with all other aspects of the work in the contract, including the installation of impervious dikes for the culvert construction.

- 8.6 The Contractor shall design a mass soil mixing sequence layout to achieve the plan area coverage as designated on the contract plans, to the required elevations and limits. The total depth of penetration shall be measured and recorded. Pre-measured marks on the mixing tool may be used to determine the depth of mixing. The Contractor shall perform the mass soil mixing operation in such a manner to produce a homogeneous mass of mixed soils meeting all of the acceptance criteria specified in this provision.
- 8.7 At all times during and at completion of mass soil mixing operations, the site shall be maintained clear of all debris. Any spoil material shall be piped or channeled to holding ponds or other retention structures within the work area. The Contractor shall take all necessary precautions and implement measures to prevent any materials from the mass soil mixing operation from entering storm drain structures, drainage courses, other utility lines, or from leaving the site via surface runoff. The Contractor shall prevent any materials from migrating to any water body. In the event any materials enter storm drain structures, drainage courses, or other utilities, including, but not limited to, surface water bodies beyond the limits of the mass soil mixing operations, the Contractor shall collect and remove all of these materials, and perform all other required/necessary remediation that may be directed by the Engineer or responsible environmental agency, at no additional cost or schedule impact to the Department. The Contractor shall conduct all mass soil mixing operations to conform to the in-water construction moratorium, sedimentation and turbidity control requirements, and all other regulatory requirements of federal, state, and local agencies having jurisdiction over the work.
- 8.7 The Soil Mixing tool shall penetrate the ground as the binder powder or grout is injected into the soil from a nozzle located on the mixing tool. The tool is rotated at a high speed while it is moved back and forth through a known volume of soil until the designed weight of binder or injection rate of grout has been added. The binder take (or injection rate) per cubic meter of soil shall be adjusted upwards if minimum strength parameters can not be obtained. Pumps will be used to transfer the binder from the pressure vessel to the Soil Mixing rig. The pressure vessel will be equipped with a load cell which indicates the weight of the binder in the vessel. Inject a known weight of binder into a known volume of soil to achieve the required binder concentration. Inject binder or grout by air pressure as the mixing tool advances through the soil. The number of passes necessary for either mixing or reagent injection must be submitted for review and acceptance before proceeding with production mixing.
- 8.8 Alert the Engineer immediately if the installation process is interrupted due to obstructions or a dense layer above the planned mixing elevation. Obstructions shall be penetrated with approved methods of either removing the obstructions or loosening them, including any dense soil layers, sufficiently to allow Soil Mixing unless otherwise directed by the Engineer.
- 8.9 The operator shall monitor and adjust as necessary during soil mixing the feeding of material, the injection air pressure, and the rates of rotation. All metering equipment shall be calibrated at the beginning of the project and as frequently as recommended by

the metering equipment manufacturer. Submit the calibration results to the Engineer. Keep the injection of binder within 10 percent of the target unit weight per volume.

- 8.10 Within 24 hours of completion of the mass soil mixing operation, place a separation fabric on the entire surface of freshly mixed soil area and cover it with 0.6 m thickness of the common borrow material for embankment construction meeting the NCDOT Standard Specifications for Road and Structures. Wait until the mixed soil mass achieves the required design strength specified in the acceptance criteria herein. The Contractor shall not place any other fill materials over the mass soil mixing area until the mixed soil mass has attained the required strength. After the mixed soil mass has attained the required strength, the cover material shall be compacted to the required density specified in the NCDOT Standard Specifications. Do not place vibratory rollers on the mixed soil mass until strength requirements have been achieved.
- 8.11 Use a mix design to produce the completed and cured mixed soil mass that meets the acceptance criteria specified in Section 11.0 in this provision. However, do not produce too stiff mixed soil mass that will make timber pile penetration and sheet pile installation practically impossible.

9.0 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

- 9.1 The Contractor shall implement a Quality Assurance and Quality Control (QA/QC) program to confirm the mass soil mixing work satisfies the specified performance requirements and acceptance criteria. The QA-QC program shall be implemented as part of the mass soil mixing work, at no additional cost to the Department.
- 9.2 The Contractor shall undertake general Quality Control for construction of homogeneous mixed soil mass, which shall include, at a minimum, real time (computer) monitoring and graphical recording of the following soil mixing parameters continuously throughout the depth of each operation:
- a. Drilling and mixing depth
 - b. Mixing tool penetration and withdrawal rates
 - c. Mixing tool rotation speeds
 - d. Binder or grout injection rate of each auger
 - e. Amperage resistance to penetration.
- 9.3 The Contractor shall obtain, form, preserve, cure, and transport the core samples, including all sample labeling and documentation in the format accepted by the Engineer.
- 9.4 QC Daily Reports shall be submitted for each work shift, within two hours of the end of each work shift. Each QC Daily Report shall document progress of the mass soil mixing

construction, present the results of QC parameter monitoring, and present the results of the strength testing of wet-grab samples and continuity of core samples.

9.5 The QC Daily Report shall, at a minimum, include the following results of the QC parameters monitored for each mass soil mixing operation:

- a. Identification of Area of Work, by way of geographic orientation and stations/offsets
- b. Rig number and names of the Superintendent and the Operator
- c. Date and time (start and finish) of each operation
- d. Mass soil mixing treated surface area, top and bottom elevations, and volume.
- e. Binder or grout injection pressure, rate and volume
- f. Date, time, plan location, and elevation and other details of all mass soil mix wet grab samples and any other samples taken during the work shift, and the names of persons responsible for obtaining the wet samples
- g. Description of obstructions, interruptions, or other difficulties experienced during installation and how they were resolved, and notes of observations of any unusual behavior of any equipment during the mass soil mixing operation
- h. Graphical results derived from real time (computer) monitoring for each rig operation at each 0.3 meter of penetration and withdrawal, and for every minute of mixing tool rotation without vertical motion:
 1. Shaft rotation speed and revolution number at each 0.3 meter of penetration.
 2. Penetration and withdrawal rates in meter per minute vs. depth.
 3. Quantity of binder or grout injection of each rig operation at every 0.3 meter vertical interval for insertion, mixing, and withdrawal.

10.0 TESTING REQUIREMENTS

The Contractor shall hire a geotechnical firm to conduct the following testing to verify that the mass soil mixing product meets the acceptance criteria specified in Section 11.0 of this provision. Use a geotechnical firm prequalified by the Contractual Services Unit of the Department for each type of testing. The Engineer reserves the right to request additional testing at no additional cost to the Department if the test was performed improperly or the test results are inconclusive or unreliable. In addition, the Contractor shall assist the Department's

personnel to perform its own testing to assure the mass soil mixing product meets the design requirements.

10.1 Unconfined Compressive Testing of Wet Samples

The Contractor shall hire a geotechnical firm meeting the prequalification requirements for both drilling for geotechnical investigations (work code 3050) and laboratory and technician certification to collect wet samples for unconfined compressive testing. After completion of the mass soil mixing of every 200 square meters of surface area, collect a minimum of one sample at every two meter depth of the treated soil mass as directed by the Engineer. Prepare the test specimens and perform the compressive strength tests in accordance with the ASTM D 1633.

10.2 Cone Penetration Test (CPT)

The Contractor shall hire a geotechnical firm meeting the prequalification requirements for both geotechnical engineering services of roadway foundation investigation and design and drilling for geotechnical investigations (work code 3050) to conduct cone penetration tests as specified herein. Conduct a minimum of one CPT per 100 square meter of mass soil mixing area a minimum of seven days after completion of the mass soil mixing work at a location designated by the Engineer. The CPT shall be performed down to a depth of two meters below the bottom of the mass soil mixing.

10.3 Coring and Unconfined Compressive Testing

The Contractor shall hire a geotechnical firm meeting the prequalification requirements for both drilling for geotechnical investigations (work code 3050) and laboratory and technician certification to perform coring of the treated soil mass and unconfined compressive strength testing of the coring samples. Perform a minimum of one coring per 200 square meter of mass soil mixing area a minimum of seven days after completion of the mass soil mixing work at a location designated by the Engineer in the presence of the Engineer or his/her designee. The coring shall be performed continuously down to the bottom of the mass soil mixing in a manner to achieve the maximum recovery possible.

Coring shall generally comply with the requirements of ASTM D2113, except that the core barrel shall produce core samples of either PQ or 101 mm diameter, in runs of 1.52 meters. The coring shall be done only with triple-tube core barrel with split inner barrel, using wire-line equipment. Core bit shall have fine diamonds, be stepped, and have face flush or outward water discharge. The Contractor shall fill each core hole with neat cement grout (w/c = 1:1) at the completion of coring in that hole, using tremie grout methods.

Core sample storage and transportation shall comply with ASTM D5079, except that as a moisture loss prevention measure, the Contractor shall promptly (within 30 minutes of removal of core from the core barrel) completely wrap each soil-cement core specimen in two layers of 4-mil-thick clear plastic, and tape the open sides and ends shut to prevent moisture loss. If the Engineer or the Contractor must make further examination of a core specimen, then such examination shall be done in the controlled environment room with 100% controlled humidity

conditions with the specimen exposed for as brief a time as possible, but not for more than 45 minutes.

Contractor Documentation of core shall include a detailed field log with sketch and description of the treated soil column, that illustrates each crack and variation of the composition of the core sample, to a scale of 25 mm to 150 mm of core length and full-scale across the diameter. Provide the completed field logs to the Engineer and make the entire core sample available for inspection immediately at the end of the coring of each core hole. The Contractor shall preserve and retain the core throughout the time of the coring at each coring location. At the completion of each core hole, the Engineer will make a visual inspection of the core, measure the recovery ratio of the core, and select portions to be tested for unconfined compression strength. Prepare a test specimen for unconfined compressive testing for every two meter length of the core and perform the compressive strength tests in accordance with ASTM D2166. In addition, the Engineer may select core samples to be tested in the Engineer's laboratory for unconfined compressive strength. The Contractor shall wrap each specimen in two layers of 4 mil plastic and tape to prevent loss of moisture, and label each specimen with the soil mixing location, depth, and date. The Contractor shall transport the specimens in a padded wooden box, which provides padding between each specimen, to the testing laboratory within 12 hours of the Engineer's review. The Contractor shall retain all remaining core not selected for testing in a heated and humidified storage room where minimum 95% humidity and 21 degree C shall be continuously provided throughout the remainder of the project time.

11.0 ACCEPTANCE CRITERIA

The completed mass soil mixing shall meet all of the following requirements for an element to be considered acceptable and compliant. If any item listed below is not met, the affected area as determined by the Engineer shall be considered as defective and shall be subject to a remedial work. No work shall be performed in the defective area until the Engineer approves the remedial measures proposed by the Contractor.

- 11.1 The limits of the mass soil mixing in both horizontal and vertical dimensions shall be as shown in the contract plans or as directed by the Engineer.
- 11.2 All construction records including the QA/QC records have been submitted to the Engineer and demonstrate that the mass soil mixing operation was done in conformance with all of the requirements specified in this provision and produces a homogeneously mixed soil mass.
- 11.3 The results of the unconfined compressive testing of wet samples as specified in Section 10.1 show an average and a minimum unconfined compressive strength not less than 165 KPa and 83 KPa at seven days, respectively.
- 11.4 The Cone Penetration Test (CPT) as specified in Section 10.2 demonstrates a homogeneous and thorough treatment of the mass soil mixing throughout the entire depth of penetration. In addition, the CPT results show a minimum average corrected cone resistance (q_t) of 1,100 KPa within any one (1) meter interval of the mass soil mixing

depth. The cone resistance (q_c) shall be corrected to q_t to account for pore water effects in accordance with ASTM D5778.

- 11.5 The coring performed as specified in Section 10.3 shows a homogeneous profile of the treated soil mass with a minimum recovery ratio of 50% for any two (2) meter segment of the core. In addition, the results of the unconfined compressive testing of core samples as specified in Section 10.3 show an average and a minimum unconfined compressive strength not less than 165 KPa and 83 KPa at seven days, respectively.
- 11.6 Any additional test conducted by the Engineer confirms that the mass soil mixing product meets the acceptance criteria stated above.

12.0 REMEDIAL WORK

The Contractor shall submit a plan of remedial work for the mass soil mixing area determined by the Engineer as defective based on the acceptance criteria in Section 12.0. The Engineer will review the submittal and approve or reject it within seven days from the date the submittal is received. All remedial work shall be performed in accordance with this provision including the acceptance criteria unless otherwise approved by the Engineer. The Contractor shall perform all remedial work at his own expense. No additional compensation or time extension will be made for any remedial work.

13.0 MEASUREMENT AND PAYMENT

The quantity of mass soil mixing to be paid for shall be the quantity of the completely treated and accepted soil mass in cubic meters. Measurement shall be made from the limits of mass soil mixing shown on the plans or from the revised limits as directed by the Engineer. No separate measurement for payment will be made of any remedial work. No separate measurement for payment will be made of the temporary embankment and slope stabilization since this work is considered as incidental to the mass soil mixing.

The quantity of mass soil mixing measured as specified above will be paid for at the contract unit price per cubic meter of "Mass Soil Mixing". The unit bid price for this pay item shall include the cost of furnishing all equipment, labor, and materials, temporary embankment and slope stabilization, mobilization, testing, QA/QC, remedial work, and incidentals necessary to complete the required work. Temporary shoring for maintenance of traffic, impervious dike for mass soil mixing, nonwoven fabric for soil separation, settlement monitoring, embankment fill, and surcharge placement and removal will be measured and paid for separately.

Pay Items:

Mass Soil Mixing Cubic Meter

IMPERVIOUS DIKE FOR MASS SOIL MIXING**DESCRIPTION**

The work covered by this provision consists of furnishing all equipment, labor, and materials for installing, maintaining, and removing impervious dike for mass soil mixing as specified herein, as shown on the contract plans, and as directed by the Engineer. The impervious dike shall provide a complete barrier along the limits of mass soil mixing and contain all materials including, but not limited to, reagent binder, grout, water, and mixed soil, within the limits of mass soil mixing during mixing operation and curing of the mixed soil. Also, it shall not permit seepage of water into the mass soil mixing site during mixing operation and curing of the mixed soil. The impervious dike for mass soil mixing shall extend at a minimum to the bottom of the mass soil mixing. The impervious dike for mass soil mixing shall be a steel sheet pile with an ample strength to withstand the pressures imposed by the surrounding soils and water, unless other types of impervious dike for mass soil mixing that meet the requirements specified herein are proposed by the Contractor and approved by the Engineer. Submit a proposed design of impervious dike for mass soil mixing, either a sheet pile or other types, a minimum of seven (7) days prior to beginning of the impervious dike construction for the Engineer's review and approval.

MATERIALS

Steel sheet piles shall meet the requirements of ASTM A328. Provide Type 7 Contractor's Certifications in accordance with Article 106-3 of the *Standard Specifications* for all materials used for construction of impervious dike for mass soil mixing. Load, transport, unload and store all materials such that they are kept clean and free of damage.

CONSTRUCTION

Install sheet piles in accordance with the applicable parts of Section 452 of the *Standard Specifications*. Install and interlock sheet piling as shown on the plans with a tolerance of 40mm per meter from vertical. Perform welding in accordance with Article 1072-20 of the *Standard Specifications*. The Contractor shall maintain the impervious dike until it is no longer needed. Remove the impervious dike in a manner that does not damage or disturb the mass soil mixing treated soils, roadway embankment, culvert, or surrounding areas.

MEASUREMENT AND PAYMENT

The quantity of Impervious Dike for Mass Soil Mixing to be paid for shall be the actual number of linear meters of impervious dike constructed and measured in place from end to end of installation that has been completed and accepted.

The quantity of Impervious Dike for Mass Soil Mixing measured as specified above will be paid for at the contract unit price per linear meter of Impervious Dike for Mass Soil Mixing. Such

price and payment shall be considered as full compensation for furnishing all labor, tools, equipment, materials and all incidentals necessary to install, maintain, and remove the impervious dike and complete the work as described in this provision.

Payment will be made under:

Pay Item
Impervious Dike for Mass Soil Mixing

Pay Unit
Linear Meter