

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT			1. CONTRACT ID CODE	PAGE OF PAGES	
2. AMENDMENT/MODIFICATION NO. 0003		3. EFFECTIVE DATE 27-Feb-2002	4. REQUISITION/PURCHASE REQ. NO. W81LJ8-1144-7965		5. PROJECT NO.(If applicable)
6. ISSUED BY USAED, WILMINGTON-(910)251-4116 ATTN: JOHN B. ROBERTS, II 69 DARLINGTON AVE(28403) PO BOX 1890 WILMINGTON NC 28402-1890		CODE K7P0000	7. ADMINISTERED BY (If other than item 6)		CODE
			See Item 6		
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)			X	9A. AMENDMENT OF SOLICITATION NO. DACW54-01-R-0009	
			X	9B. DATED (SEE ITEM 11) 14-Jan-2002	
				10A. MOD. OF CONTRACT/ORDER NO.	
				10B. DATED (SEE ITEM 13)	
CODE		FACILITY CODE			
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS					
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input checked="" type="checkbox"/> is extended, <input type="checkbox"/> is not extended.					
Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning <u>2</u> copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.					
12. ACCOUNTING AND APPROPRIATION DATA (If required)					
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.					
A.THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.					
B.THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).					
C.THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:					
D.OTHER (Specify type of modification and authority)					
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.					
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) Solicitation No. DACW54-01-R-0009, Anchorage Basin and Passing Lane Dredging is amended as follows: a. The Front End of the Solicitation [Page 1 of 146 through Page 146 of 146] is amended in accordance with the attached Summary of Changes. b. The Technical Specifications; Drawings; Appendices; and Attachments are amended in accordance with the attached Technical Documents and Drawings. c. Attached is an updated copy of the Front End of the Solicitation [Page 1 of 149 through Page 149 of 149]. These documents should replace your current Front End of the Solicitation and should be used to submit your proposal. Last Item. No further changes to the solicitation. Enclosures/Attachments as discussed above. <i>Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.</i>					
15A. NAME AND TITLE OF SIGNER (Type or print)			16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)		
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA		16C. DATE SIGNED	
_____ (Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)		28-Feb-2002	

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES

Changes in Solicitation/Contract/Order Form

The required performance has changed from:

SPECIFICATIONS FOR NAVIGATION CHANNEL IMPROVEMENTS INCLUDING DEEPENING AND WIDENING, FROM STATION 39+70 IN THE ANCHORAGE BASIN TO STATION 60+00 LOWER BRUNSWICK CHANNEL, AND FROM STATION 55+00 KEG ISLAND CHANNEL THROUGH REAVES POINT CHANNEL.

THIS PROJECT IS DIVIDED INTO PHASE 1 AND PHASE 2 WORK AND IS RESTRICTED BY ENVIRONMENTAL WINDOWS. THE DESIRED COMPLETION OF PHASE I, AS STATED IN SECTION 02325 OF THE SOLICITATION, IS DECEMBER 31, 2003 AND THE REQUIRED COMPLETION DATE IS JANUARY 31, 2004.

PRE-PROPOSAL CONFERENCE SCHEDULED FOR FEBRUARY 6, 2002. [See 52.0215-4002.]

ESTIMATED COST RANGE OF PROJECT IS BETWEEN \$100,000,000. AND \$250,000,000.
[UNRESTRICTED SOLICITATION]

THIS IS A REQUEST FOR PROPOSAL, SEE SECTIONS 00100 AND 00600 FOR REQUIRED SUBMISSIONS.

IF PROPOSAL IS HANDCARRIED, DELIVER TO CONTRACTING DIVISION, 69 DARLINGTON AVENUE, WILMINGTON, NC 28403, PRIOR TO THE TIME AND DATE SPECIFIED BELOW. PLEASE ALLOW ADDITIONAL TIME FOR SECURITY SCREENING OF PACKAGES AND PERSONNEL.

VERBAL OR WRITTEN REQUESTS FOR INFORMATION MUST BE DIRECTED TO THE PERSON LISTED IN ITEM 9 ABOVE. INQUIRIES AND REQUESTS THAT ARE DIRECTED TO ANY OTHER PERSON MAY NOT BE RELAYED TO THE PROPER PERSON, AND THEREFORE, MAY NOT BE ANSWERED. SEE 52.000-4011, IN SECTION 00100.

To:

SPECIFICATIONS FOR NAVIGATION CHANNEL IMPROVEMENTS INCLUDING DEEPENING AND WIDENING, FROM STATION 39+70 IN THE ANCHORAGE BASIN TO STATION 60+00 LOWER BRUNSWICK CHANNEL, AND FROM STATION 55+00 KEG ISLAND CHANNEL THROUGH REAVES POINT CHANNEL.

THIS PROJECT IS DIVIDED INTO PHASE 1 AND PHASE 2 WORK AND IS RESTRICTED BY ENVIRONMENTAL WINDOWS. THE DESIRED COMPLETION OF PHASE I [AS DESCRIBED IN SECTION 02325 OF THE SOLICITATION] IS DECEMBER 31, 2003 AND THE REQUIRED COMPLETION DATE IS JANUARY 31, 2004.

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VERBAL OR WRITTEN REQUESTS FOR INFORMATION MUST BE DIRECTED TO THE PERSON LISTED IN ITEM 9 ABOVE. INQUIRIES AND REQUESTS THAT ARE DIRECTED TO ANY OTHER PERSON MAY NOT BE RELAYED TO THE PROPER PERSON, AND THEREFORE, MAY NOT BE ANSWERED. SEE 52.000-4011, IN SECTION 00100.

The required response date/time has changed from 14-Mar-2002 15:00 to 28-Mar-2002 15:00

The offeror acceptance period has decreased from 150 by 30 to 120

Changes in Section 00010

CLIN 0001

The CLIN description has changed from Mobilization and Demobilization to MOBILIZATION AND DEMOBILIZATION - UNCLASSIFIED
The CLIN extended description EXCAVATION. has been added.

CLIN 0002

The CLIN description has changed from Unclassified Excavation to MOBILIZATION AND DEMOBILIZATION - MAINTENANCE
The CLIN extended description has changed from (Estimated Quantity) to DREDGING. [Estimated Quantity - Not subject to Clause 52.211-18 "Variation in Estimated Quantity (Apr 1984)" and Clause 52.211-4001 "Variation in Estimated Quantities - Dredging (OCE 1985 Jan).]
The unit of issue has changed from Cubic Yard to Each
The pricing detail quantity has decreased from 11,450,000.00 by 11,449,996.00 to 4.00

CLIN 0003

The CLIN type has changed from priced to informational
The CLIN description has changed from Maintenance Dredging to UNCLASSIFIED EXCAVATION
The CLIN extended description has been deleted.
The unit of issue has been deleted.
The pricing detail quantity has decreased from 3,800.00 by 3,800.00 to 0.00

SUB-CLIN 0003AA was added.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003AA		3,780,000.00	Cubic Yard		

UNCLASSIFIED EXCAVATION
 Sta. 39+70 Anchorage Basin to Sta. 60+00 Lower Brunswick Channel
 [Estimated Quantity]
 FFP - PURCHASE REQUEST NUMBER W81LJ8-1144-7965

NET AMT _____

SUB-CLIN 0003AB was added.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003AB		7,670,000.00	Cubic Yard		

UNCLASSIFIED EXCAVATION
 Sta. 55+00 Keg Island Channel to Sta. 65+31.19 Reaves Point Channel
 [Estimated Quantity]
 FFP - PURCHASE REQUEST NUMBER W81LJ8-1144-7965

NET AMT _____

CLIN 0004

The CLIN description has changed from Performance and Payment Bonds to MAINTENANCE DREDGING

The CLIN extended description [Estimated Quantity] has been added.

The unit of issue has changed from JOB to Hours

The pricing detail quantity has increased from 1.00 by 3,799.00 to 3,800.00

CLIN 0005 was added.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0005	PERFORMANCE AND PAYMENT BONDS FFP	1.00	JOB		

NET AMT _____

CLIN 0006 was added.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0006		53,000.00	Cubic Yard		

OPTIONAL BID ITEM 1
 NORTH CAROLINA STATE PORTS AUTHORITY BERTH AREA
 DEEPENING. This work is to be completed no later than the Contract Date set
 for the completion of Phase 1 Work. Price shall include all work associated
 with this item including: Deepening, Disposal, Mobilization, Demobilization,
 and increased Payment and Performance Bonds.
 [Estimated Quantity]
 [Note: The Government reserves the right to exercise this option within 400
 calendar days following the Notice to Proceed.]
 FFP - PURCHASE REQUEST NUMBER W81LJ8-1144-7965

NET AMT _____

Changes in Section 00010

TOTAL OF BID ITEMS 0001 THROUGH 0006:

\$ _____ . ____

NOTE: The Offeror's Proposal will be incorporated into the awarded contract. When there is a conflict between the Solicitation Documents and the Offeror's Proposal, the more stringent standard/requirement shall apply.

[End]

Wilmington, NC 28402-1890

Street Address:

U. S. Army Corps of Engineers, Wilmington District
Reference DACW54-01-R-0009
Attn: John Roberts, Contracting Division
69 Darlington Avenue
Wilmington, NC 28403
Phone: [910] 251 - 4116

2.c. The Technical Proposal should not make reference to cost or price data so that technical evaluations may be made on the basis of technical merit alone. Failure to comply with this requirement may result in a determination of non-responsiveness and rejection of the offer.

2.d. Any exception taken by an Offeror to any provision of this Request for Proposal or any condition placed upon a proposal may result in a finding of non-responsiveness and rejection of the offer.

2.e. Each Offeror may submit only one proposal.

2.f. The evaluation of proposals will be consistent with "Section 00100, Bidding Schedule/Instruction to Bidders" and FAR 52.215-1.

3. Proposal Format.

3.a. The proposal shall be submitted using the sequence and format provided below.

<u>VOLUME</u>	<u>CONTENTS</u>	<u>NUMBER OF COPIES</u>
I	Technical Proposal	Original + 10 copies
II	Price Proposal	Original + 10 copies

3.b. The proposal shall be submitted in a 3 ring binder. The proposal shall not be permanently bound.

3.c. Pages containing text shall be 8 ½ x 11 inches with at least one-inch margins at the top, bottom, and both sides. Larger format drawings or tables may be added by folding them to fit within the binder.

3.d. In order to reduce proposal size, the Offeror shall confine the proposal to essential matters, sufficient to define the proposal and provide an adequate basis for evaluation.

4. Proposal Content.

4.1. Volume I - Technical Proposal

a. The Technical Proposal submitted in response to this RFP will be evaluated based on the three factors and associated sub-factors listed below. The Technical Proposal should include relevant information about the Offeror, Major Subcontractors and Key

Personnel, on all technical evaluation factors. The three factors (1. Work Plan / Methodology, 2. Resources and Capabilities, and 3. Past Performance) are listed below are in descending order of importance. The most important factor is 1. Work Plan / Methodology, which is further broken down into eight sub-factors: 1.a. Schedule / Order of Work, 1.b. Operational Blasting Plan, 1.c. Accident Prevention Plan (Safety Plan), 1.d. Contractor Quality Control Plan, 1.e. Traffic Control Plan, 1.f. Dredged Material Disposal Plan, 1.g. Environmental Protection Plan, and 1.h. Subcontracting Plan. The first five sub-factors are 1.a. Schedule / Order of Work, 1.b. Operational Blasting Plan, 1.c. Accident Prevention Plan (Safety Plan), 1.d. Contractor Quality Control Plan, and 1.e. Traffic Control Plan, are of equal value. The next three sub-factors are 1.f. Dredged Material Disposal Plan, 1.g. Environmental Protection Plan, and 1.h. Subcontracting Plan, are of equal value and slightly less important than the first five sub-factors. The second factor is 2. Resources and Capabilities, is significantly less important than 1. Work Plan / Methodology. 2. Resources and Capabilities is further broken down into two sub-factors, 2.a. Equipment and 2.b. Personnel and Organization. Each sub-factor is of approximately the same value. The final factor is 3. Past Performance, which is slightly less important than 2. Resources and Capabilities.

- b. The Technical Proposal should be arranged to have required information on evaluation factors displayed in tabbed sections of the 3-ring binder or binders in the following manner:

Tab 1. - Work Plan / Methodology
 Tab 1.A - Schedule / Order of Work (Sub-factor 1.a.)
 Tab 1.B - Operational Blasting Plan (Sub-factor 1.b.)
 Tab 1.C - Accident Prevention Plan [Safety Plan](Sub-factor 1.c.)
 Tab 1.D - Contractor Quality Control Plan (Sub-factor 1.d.)
 Tab 1.E - Traffic Control Plan (Sub-factor 1.e.)
 Tab 1.F - Dredged Material Disposal Plan (Sub-factor 1.f.)
 Tab 1.G - Environmental Protection Plan (Sub-factor 1.g.)
 Tab 1.H - Subcontracting Plan (Sub-Factor 1.h)
 Tab 1.I - Agreement to Protect Proprietary Information
 Tab 2 - Resource and Capabilities
 Tab 2.A - Equipment (Sub-factor 2.a.)
 Tab 2.B - Personnel and Organization (Sub-Factor 2.b)
 Tab 3 - Past Performance Information (Factor 3)

4.2. Volume II - Price Proposal. The price proposal shall be tabbed as below and shall include the following:

Tab 4.A - SF 1442 - Solicitation, Offer and Award

Tab 4.B - Section 00010 - Solicitation Contract Form
 (with line item UNIT PRICE and NET AMT filled in)

Tab 4.C - Section 00600 - Representations & Certification

Tab 4.D - Bid Bond - A bid bond, in the amount of 20% of the proposed price or \$3,000,000, whichever is less, is to be submitted with the proposal.

5. TECHNICAL PROPOSAL - EVALUATION FACTORS.**5.1. Work Plan / Methodology**

5.1.a. Schedule / Order of Work (Sub-factor 1.a.) The Offeror shall submit a brief summary of the Concept of the Contractor's Operations and Technical Approach for the execution of work required. The Offeror shall submit a practicable schedule / progress chart demonstrating how the Offeror plans to complete the work (Phase 1 and Phase 2) within the time specified in the Solicitation. Schedules submitted showing completion dates for phase 1 and 2 work, prior to the time specified will receive higher ratings, for this sub-factor. The schedule shall include the specific resources and equipment to be used for each segment of construction to accomplish the work as indicated in the schedule. The Schedule / Order of Work shall comply with Section 02325, of the Specifications. The offered performance schedule will be incorporated into the contract and will become the required performance period for all contract purposes including assessment of liquidated damages.

5.1.b. Operational Blasting Plan (Sub-factor 1.b.). The Offeror shall submit an operational blasting plan as described in Section 02200, "Blasting", of the RFP.

5.1.c. Accident Prevention Plan [Safety Plan] (Sub-factor 1.c.) The Offeror shall submit an accident prevention plan as described in Section 01100, Supplementary Special Contract Requirements, of the RFP. The Offeror shall provide a listing of all current contracts and a listing of all contracts completed in the past two years with the U.S. Army Corps of Engineers. For each of these contact they shall provide by Contract the Plant involved, Responsible Individual's Name (Project Manager), Quality Control and Safety Professional's name, Accident Rates, Accident Descriptions, Causes, and Corrective Actions. The Offeror shall address the specific actions planned for this contract to preclude similar accidents.

5.1.d. Contractor Quality Control Plan (Sub-factor 1.d.) The Offeror shall submit a quality control plan as described in Section 01451, Contractor Quality Control, of the RFP.

5.1.e. Traffic Control Plan (Sub-factor 1.e.) The Offeror shall submit a traffic control plan as described in Section 02325 "Dredging", of the RFP.

5.1.f. Dredged Material Disposal Plan (Sub-factor 1.f.) The Offeror shall submit a disposal plan as described in Section 02325 "Dredging", of the RFP.

5.1.g. Environmental Protection Plan (Sub-factor 1.g.) The Offeror shall submit an environmental protection plan as described in Section 01354, Environmental Protection for Civil Works, of the RFP. The Environmental Protection Plan shall address the environmental requirements of Section 02200, Blasting; Section 02300, Water Pressure Monitoring during Blasting; and Section 02325, Dredging.

5.1.h. Subcontracting Plan (Sub-Factor 1.h.) All Offerors are required to prepare and submit a sub-contracting plan. The Army's Subcontracting Plan Evaluation Guide (AFARS Appendix DD) at http://acqnet.saalt.army.mil/library/AFAR/AFARS_OCTOBER_2001.pdf provides guidance for preparing an acceptable plan. In addition to the AFARS requirements, the Offeror shall identify all Subcontractors, who will perform work under this contract, by Name and their involvement.

5.1.h.1 The extent of proposed participation of Small Businesses (SBs) and Small Disadvantaged Businesses (SDBs) will be evaluated.

5.1.h.2 The Subcontracting Plan shall provide, targets, expressed as dollars and percentages of total contract value, for Small Business and a total target for SDB participation by the Contractor, including joint venture partners, and teaming arrangements, and a total target for SDB participation by subcontractors.

5.1.h.3 Any Targets listed in the approved subcontracting plan will be incorporated into and will become part of any resulting contract. Contractors with SDB participation targets shall be required to report SDB participation.

5.1.h.4 Offerors shall submit "Past Performance" information (for the past three (3) years) in their compliance with Contract Clause FAR 52.219-8 "Utilization of Small, Small Disadvantaged, and Women-Owned Small Business Concerns" and FAR 52.219-9 "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan" for previous and/or current contracts.

5.2. Resources and Capabilities

5.2.a. Equipment (Sub-factor 2.a.) The Offeror shall submit and discuss the relevant information for each dredge and/or any other major equipment to be used to extract, convey, and dispose of dredged material in the performance of this contract. The equipment shall be identified by intended use: New Work Dredging, or Maintenance Dredging.

For dredges, submit the following information:

- Identification of the dredge;
- Coast Guard Certification, if applicable;
- Daily rock production rate based on Dredge Operation Reports in cubic yards per day. Submit monthly summaries;
- Dredge Operation Reports for rock under comparable operating conditions. Submit monthly summaries;
- Daily non-rock production rate based on Dredge Operation Reports cubic yards per day. Submit monthly summaries;
- Dredge Operation Reports for non-rock under comparable operating conditions;
- Associated booster/pipeline equipment;
- Estimated Pipeline Lengths and Location of booster pumps for this contract;
- Positioning equipment;
- Size of Suction and Discharge Lines;
- Equipment Horsepower Distribution; and

- Existing commitments of this equipment to other projects during the Contract Period of Performance.

For each waterbound accompanying vessel the following information shall be submitted:

- Identification of the vessel;
- Coast Guard Certification, if applicable;
- Hopper or Scow Capacity in cubic yards; and
- Existing commitments of this equipment to other projects scheduled during the Contract Period of Performance.

5.2.b. Personnel and Organization (Sub-Factor 2.b.) The Offeror shall submit an organizational chart (which displays authorities and communication chains) and qualifications, including education and/or experience, of the following personnel to perform this contract:

- Project Manager;
- Superintendent responsible for contract execution [Minimum ten (10) years experience in dredging operations];
- Blasting Specialist [Minimum ten (10) years total experience and five (5) years underwater experience];
- Environmental Manager [Minimum five (5) years experience in environmental work];
- Contractor Quality Control System Manager [Minimum five (5) years experience in quality control];
- Risk/Site Safety and Health Officer [Minimum five (5) years experience in implementing safety and health programs at dredging projects or ten (10) years experience implementing safety and health programs at construction sites]; and
- Traffic Control Manager [Minimum five (5) years experience in traffic control].

5.3. Past Performance Information (Factor 3.) The Offeror shall submit past performance information described in the following paragraphs:

5.3.a. For Past Performance, using the Past Performance Information sheet, located in Section 00100, the Offeror shall provide past performance information about all current projects and projects completed that include dredging contracts similar in nature to the requirements of this proposed project. These contracts may be with government agencies and/or commercial customers. The Offeror shall include for each of these contracts, the plant involved, responsible individual's name (e.g. - project manager, QC, and safety professional), accident rates, accident descriptions, causes and corrective actions. Additionally, the offeror shall address the specific actions planned for this contract to preclude similar accidents. (A separate sheet is required for each contract/subcontract.)

5.3.b. The Offeror shall include its corporate past performance, the past performance of its key employees who will work on this contract, and the past performance of major subcontractors and their key employees who will work on this contract.

5.3.c. The Offeror must describe work that will be performed by major subcontractors and submit relevant past performance information for those subcontractors.

5.3.d. The Offeror is encouraged to provide information on problems encountered, and actions taken to correct the problems.

5.3.e. In conducting the risk assessment, the government may use past performance data provided by the Offeror and data obtained from other sources. While the Government may elect to consider data obtained from other sources, the burden of providing thorough and complete past performance information rests with the Offeror. Additionally, the Government may elect not to contact all contracting parties identified by the Offeror, therefore, it is to the Offeror's advantage to fully explain the relevance of the data provided and to ensure the data is complete, current, and accurate.

5.3.f. If an Offeror or newly formed entity has no relevant past performance, the Offeror will be evaluated on the past performance of its Key Personnel, Subcontractors, and/or Entities in a Joint Venture.

5.3.g. The Offeror shall also send the identified references a letter authorizing them to provide past performance information to the Government. A sample of a "Client Authorization Letter" is located in Section 00100, Clause 52.0215.4305.

5.3.h. The Offeror shall provide copies of the "Contractor Performance Questionnaire", with Part 1 completed, to all of those parties identified on the Offeror's Past Performance Information forms. The parties identified on the Offeror's "Past Performance Information Form" should be asked to return the Questionnaire, not later than the date and time for receipt of proposals, to:

U.S. Army Corps of Engineers, Wilmington District
ATTN: Mr. John Roberts, Contracting Division
(Reference DACW54-01-R-0009)
P.O. Box 1890
Wilmington, NC 28402-1890

6. PRICE PROPOSAL.

Price will not be rated, but will be evaluated to determine realism and reasonableness in relationship to the technical merits of the proposal.

7. PROPOSAL EVALUATION PROCEDURES.

7.a. Each offeror will be checked against the suspended/debarred list. Any offeror who is listed will be eliminated from further consideration.

7.b. The Government will evaluate the offeror's technical proposal for clarity, completeness, thoroughness and reasonableness.

7.c. The evaluation of proposals will be consistent with contract provision FAR 52.215-1 "Instructions to Offerors - Competitive Acquisitions" and the Source Selection - Evaluation Plan for Solicitation DACW54-01-R-0009.

7.d. Award will be made to the offeror whose proposal represents the best value to the Government. See paragraphs 1.a and 1.b above, of this local instruction (52.0215-4305 V).

7.e. Using the Army's Subcontracting Plan Evaluation Guide (AFARS Appendix DD), the Deputy for Small Business will evaluate each offeror's subcontracting plan. Generally, to be acceptable, a plan must be rated 70 points or higher. Regardless of the rating received from this evaluation, the successful offeror, if other than a small business, will be required to submit an acceptable subcontracting plan prior to award. If discussions are required to make the subcontracting plan acceptable, these discussions will not constitute negotiations as defined at FAR 15.306(d).

7.f. The Government will compare the offeror's prices against each other and against the IGE to determine price reasonableness. If any price (either the total price or prices for individual line items) appear unreasonably low, the Government may ask the offeror to review and verify its prices. Any such communications shall be deemed to fall under FAR 15.306(b).

7.g. Verify acceptability of bid bond. If the bond is not acceptable, the proposal may be eliminated from further consideration.

7.h. Offerors are advised that employees of the firm identified below may serve as technical advisors or source selection evaluation team members during the source selection process. They will not participate as voting members of the evaluation team [FAR 7.503(c)(12)]. These individuals will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. These firms are expressly prohibited from completing for the contract.

Gordon F. Revey
REVEY Associates, Inc.
P.O. Box 261219
Highlands Ranch, CO 80163-1219
Physical Address:
8258 S. Jasmine Court
Englewood, CO 80112-3049
Phone: (303) 470 - 0416
Fax: (303) 791 - 0140
Email: grevey@earthlink.net

7.i In accomplishing their duties related to the source selection process, employees of the firms named above may require access to proprietary information contained in proposals. Therefore, pursuant to FAR 9.505-4, the firms must execute an agreement with each offeror wherein they agree to (1) protect the offeror's information from unauthorized use or disclosure for as long as it remains proprietary and (2) refrain from using the information for any purpose other than

that for which it was furnished. To expedite the evaluation process, each offeror must contact the named firms, execute the required agreement with each firm, and submit a copy of each agreement with the offeror's proposal, as Tab 1 - I Agreement to Protect Proprietary Information.

(End of Instruction)

Changes in Section 00700

The following clauses which are incorporated by full text have been added or modified:

52.228-1 BID GUARANTEE (SEP 1996)

- (a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.
- (b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.-
- (c) The amount of the bid guarantee shall be twenty percent [20%] of the bid price or \$3 million, whichever is less.-
- (d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.-
- (e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

Changes in Section 00800

The following clauses which are incorporated by full text have been added or modified:

52.232-5001 CONTINUING CONTRACTS (MAR 1995)--EFARS

(a) This is a continuing contract, as authorized by Section 10 of the River and Harbor Act of September 22, 1922 (33 U.S. Code 621). The payment of some portion of the contract price is dependent upon reservations of funds from future appropriations, and from future contribution to the project having one or more non-federal project sponsors. The responsibilities of the Government are limited by this clause notwithstanding any contrary provision of the "Payments to Contractor" clause or any other clause of this contract.

(b) The sum of \$ 10,700,000.00 will be obligated at the time of contract award and a total of \$ 10,700,000.00 has been reserved for this contract and is available for payments to the contractor during the current fiscal year. We anticipate funding sufficient to allow completion of Phase I work by January 2004, and funding sufficient to allow completion of Phase 2 work by the required contract completion date as determined in contract clause 52.211-10 "Commencement, Prosecution, and Completion of Work (Apr 1984)". It is expected that Congress will make appropriations for future fiscal years from which additional funds together with funds provided by one or more non-federal project sponsors will be reserved for this contract.

(c) Failure to make payments in excess of the amount currently reserved, or that may be reserved from time to time, shall not entitle the contractor to a price adjustment under the terms of this contract except as specifically provided in paragraphs (f) and (i) below. No such failure shall constitute a breach of this contract, except that this provision shall not bar a breach-of-contract action if an amount finally determined to be due as a termination allowance remains unpaid for one year due solely to a failure to reserve sufficient additional funds therefore.

(d) The Government may at any time reserve additional funds for payments under the contract if there are funds available for such purpose. The contracting officer will promptly notify the contractor of any additional funds reserved for the contract by issuing an administrative modification to the contract.

(e) If earnings will be such that funds reserved for the contract will be exhausted before the end of any fiscal year, the contractor shall give written notice to the contracting officer of the estimated date of exhaustion and the amount of additional funds which will be needed to meet payments due or to become due under the contract during that fiscal year. This notice shall be given not less than 45 nor more than 60 days prior to the estimated date of exhaustion.

(f) No payments will be made after exhaustion of funds except to the extent that additional funds are reserved for the contract. The contractor shall be entitled to simple interest on any payment that the contracting officer determines was actually earned under the terms of the contract and would have been made except for exhaustion of funds. Interest shall be

computed from the time such payment would otherwise have been made until actually or constructively made, and shall be at the rate established by the Secretary of the Treasury pursuant to Public Law 92-41, 85 STAT 97, as in effect on the first day of the delay in such payment.

(g) Any suspension, delay, or interruption of work arising from exhaustion or anticipated exhaustion of funds shall not constitute a breach of this contract and shall not entitle the contractor to any price adjustment under the "Suspension of Work" clause or in any other manner under this contract.

(h) An equitable adjustment in performance time shall be made for any increase in the time required for performance of any part of the work arising from exhaustion of funds or the reasonable anticipation of exhaustion of funds.

(i) If, upon the expiration of sixty (60) days after the beginning of the fiscal year following an exhaustion of funds, the Government has failed to reserve sufficient additional funds to cover payments otherwise due, the contractor, by written notice delivered to the contracting officer at any time before such additional funds are reserved, may elect to treat his right to proceed with the work as having been terminated. Such a termination shall be considered a termination for the convenience of the Government.

(j) If at any time it becomes apparent that the funds reserved for any fiscal year are in excess of the funds required to meet all payments due or to become due the contractor because of work performed and to be performed under the contract during the fiscal year, the Government reserves the right, after notice to the contractor, to reduce said reservation by the amount of such excess.

(End of clause)

52.236-4 PHYSICAL DATA (APR 1984)

Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) The indications of physical conditions on the drawings and in the specifications are the result of site investigations by the Corps of Engineers.

(b) Weather Conditions. Temperature and rainfall data for the work area can be obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) Environmental Data Service, Asheville, North Carolina. In common with most Atlantic Coastal localities, the area is subject to the effects of coastal storms and hurricanes which produce high winds, waves, above normal tides and heavy rain. Prevailing winds are from the southwest March through August and from the north-northeast from September through February. The highest wind speeds occur during the peak hurricane season being August through October, however, storms occur most frequently from November through April. It is the Contractor's

responsibility to obtain and analyze available weather data for the project area and determine their potential affect on his operations.

(c) Transportation Facilities. US Highways 17, 74, 76 and 421 and NC Highways 87 and 133 and Interstate 40 serve the general area where the work is to take place.

(d) Location. The project is located within New Hanover and Brunswick Counties in Southeastern North Carolina on the Cape Fear River with the upstream and downstream limits of the work located approximately 0.3 miles and 18.3 miles respectively downstream of the Cape Fear Memorial Bridge, Wilmington, North Carolina.

(e) Utilities. Overhead transmission lines owned by Carolina Power & Light Company cross Lower Brunswick Channel at approximately station 55+00. Vertical clearance of the overhead lines at the channel crossing is approximately 165 feet above mean high water.

Submarine utilities owned by AT&T Inc. and Exxon-Mobil Chemical Company cross the Fourth East Jetty Channel. The AT&T utility is a light guide cable installed by directional bore in approximately 1988. The Exxon Pipeline Corporation utilities consist of one 4 inch and two 6 inch pipelines which were trenched into the river bottom in 1973. One of the lines carries natural gas and the other two are currently not in use. An additional 6 inch pipeline was installed by directional bore in 1993 and currently carries paraxylene. The Contractor shall contact each utility owner prior to commencement of work.

(f) Local Tidal Conditions. Information about local tidal conditions is available through the following internet site:

<http://www.co-ops.nos.noaa.gov/tp4days.html>

(g) Obstruction of Channel. The Government will not undertake to keep the channel free from vessels or other obstructions, except to the extent of such regulations, if any, as may be prescribed by the Secretary of the Army in accordance with provisions of Section 7 of the River and Harbor Act approved 8 August 1917. The Contractor shall schedule and perform the work in such a manner that minimizes delays to shipping. Movement of Contractor's Plant and Equipment shall be required to allow for passage of Large Vessels. If navigation is obstructed due to the Contractor's work activities the Contractor shall immediately notify the Coast Guard so that a notice to mariners can be issued if needed. Upon completion of the work, the Contractor shall promptly remove his plant, including ranges, buoys, piles and other markers placed by him under the contract in navigable waters or on the shore.

(h) Subsurface Investigations.

(1) Drilling logs of borings are provided in Appendix A. Soils laboratory data is provided in Appendix B. Unconfined compressive strengths of rock specimens selected from core borings are provided in Appendix C. All data is provided for information only.

(2) Subsurface conditions indicated on drawings and specifications are the result of site investigations by hydrographic and geophysical methods,

splitspoon, rock core, and wash probe borings. Boring locations are shown on the drawings. Elevations on boring logs are referenced to Mean Lower Low Water (MLLW) or Mean Low Water (MLW). River channel elevations on boring logs may vary from hydrographic soundings on drawings, because there are seasonal changes in channel bottom elevations and local changes attributable to maintenance dredging. Descriptions of the subsurface are representations of the soil and/or rock specimens at the respective locations and elevations of the borings.

(3) Expert technical judgment is required to extrapolate and project subsurface conditions from a particular boring location. The description of geologic and engineering characteristics may change or vary with distance away from the boring.

(4) When viewing subsurface investigation data provided in these specifications, the Contractor shall recognize the limitations inherent in extrapolating and projecting subsurface conditions from a boring location, methods of subsurface investigation, classification systems and evaluation procedures used to describe the subsurface materials. A generalized view of the subsurface condition is obtainable through analyses of the subsurface investigation data. In view of the geomorphological development of the area and civil development of the harbor, conditions not disclosed by borings may be encountered during the work. These conditions may range from and include lenses of well-cemented rock with high unconfined compressive strengths to very low strength or even flowing sediments. Other conditions may include highly organic material or trees and stumps buried in the geologic past, large slabs or boulders of rock from previous blasting, Civil War ordnance, sunken ships, and other miscellaneous discarded items.

(i) Condition of Channel. Controlling low water depths, at the time of the most recent survey, are shown on the drawings referenced in Section 01100 paragraph, CONTRACT DRAWINGS AND SPECIFICATIONS.

(j) Waves. Wave height data in the offshore area near the new Ocean Dredged Material Disposal Site (ODMDS) is available through the following internet site:

<http://chl.wes.army.mil/research/wave/wavesprg/numeric/wgeneration/wisdata.htm>
P

(k) Channel Traffic. Temporary cessation of operations may be necessary for the passage of large ocean-going vessels, large fishing vessels, tugs with barges in tow, and small vessel traffic. Recent records indicate there have been approximately 800 vessel arrivals per year in Wilmington Harbor that use Pilot Assistance. Details of these records are available by contacting Cape Fear Marine, Inc. at (910) 457 – 6909.

(End)

14. DACW54-01-R-0009 - TECHNICAL SPECIFICATIONS AND DRAWINGS is being amended as follows:

VOLUME 1 (SECTION 00010-02325)

a. MAIN TABLE OF CONTENTS: Delete existing Main Table of Contents in its entirety and substitute enclosed revised page.

b. SECTION 01100: Delete existing Page 18 thru Page 20 in their entirety and substitute enclosed revised pages.

c. SECTION 1354: Delete existing Table of Contents and SECTION in their entirety and substitute enclosed revised Table of Contents and SECTION (Page 1 thru Page 16) pages.

d. SECTION 02325:

(1) Delete existing Table of Contents and SECTION (Page 1 thru Page 28) in their entirety and substitute enclosed revised Table of Contents and SECTION (Page 1 thru Page 29).

(2) Delete existing Attachment enclosure 1 "QUANTITY SUMMARY" in its entirety and substitute enclosed revised "QUANTITY SUMMARY."

NOTE:

Text that is added or revised by this amendment is replaced in its entirety and/or underlined and printed in bold and/or stamped appropriately.

The text changes may have necessitated reformatting of subsequent text or pages. If this is the case, those pages have also been issued as amended pages but are not underlined with bold text.

VOLUME 2 (APPENDIX A - BORING LOGS)

e. APPENDIX A: ADD enclosures with Cover Sheets.

VOLUME 3 (APPENDICES B & C)

f. APPENDIX C: ADD enclosures with Cover Sheets.

g. APPENDIX D: ADD enclosures with Cover Sheet.

PROJECT DRAWINGS:

h. DRAWINGS.

Delete Plate Nos. P-2 through P-29 in their entirety and substitute enclosed revised Plate Nos. P-2 through P-29

Encls
As stated

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3	P-3	ANCHORAGE BASIN STA 45+54 - 84+83.64 & BETWEEN CHANNEL	21 February 2002
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SECTION 01354

ENVIRONMENTAL PROTECTION FOR CIVIL WORKS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 261 Identification and Listing of Hazardous Waste

ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 DEFINITIONS

Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents that adversely affect human health or welfare; unfavorably alter ecological balances of plant or animal communities; or degrade the environment from an aesthetic, cultural or historic perspective. Environmental protection is the prevention/control of pollution and habitat disruption that may occur during construction. The control of environmental pollution and damage requires consideration of air, water, land, biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive materials; and other pollutants.

Stewardship of environmental and cultural resources is an important responsibility of the Corps of Engineers and its contractors, and thus is a continual goal. For the purpose of this specification, environmental and cultural resource protection includes preventing (1) release into the environment of significant amounts of pollutants (chemical, physical, or biological substances or agents) having the potential to adversely affect human health or other life forms; (2) addition of excessive quantities of silt and/or sediment to water bodies; (3) unfavorable alteration of ecological relationships; (4) significant adverse impacts on fish and wildlife resources; (5) reduction of aesthetic or recreational values of the environment; (6) creation of major or unpleasant increases in noise levels; and (7) disturbance of significant historical or archaeological objects. The Contractor shall conduct all activities performed under this contract in a manner, which supports these protection goals, including the use of management measures to control solid and liquid waste, noise levels, radioactive materials, siltation and sedimentation, and pollutants in any form. The work covered by this section consists of furnishing all labor, material, and equipment and performing all work required for environmental protection during and/or as a result of construction operations under this contract. Additional instructions related to specific aspects of environmental and cultural resource compliance appear in other provisions of these specifications.

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation;

submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Environmental Protection Plan; GA.

Submit plan detailing Contractor's procedures for environmental protection and pollution control and abatement.

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

The Contractor shall comply with all applicable Federal, State, and local laws and regulations. The Contractor shall provide environmental protective measures and procedures to prevent and control pollution, limit habitat disruption, and correct environmental damage that occur during construction.

Some applicable State regulations are as follows:

a. State of North Carolina Division of Environmental Management, "Classification of Water Quality Standards Applicable to the surface Waters of North Carolina."

b. State of North Carolina Division of Environmental Management, "Rules and Regulations Governing the Control of Air Pollution."

c. North Carolina Sedimentation Control Commission, North Carolina Department of Environment, Health and Natural Resources, Land Quality Section, "Title 15A, Chapter 4 of the North Carolina Administrative Code: Sedimentation Pollution Control Act of 1973 (as amended through 1991)."

d. State Stream Sanitation Committee, North Carolina Department of Water Resources, "Classifications and Water Quality Standards Assigned to the Waters of the Cape Fear River Basin Including the Drainage Areas of the Haw, Deep, and the Cape Fear Rivers."

1.4.1 Permits

This section supplements the Contractor's responsibility under the contract clause PERMITS AND RESPONSIBILITIES to the extent that the Government has already obtained environmental permits for dredging, blasting, and disposal of dredged material. The Government has obtained necessary clearances in accordance with the North Carolina Coastal Management Program and the North Carolina Division of Water Quality.

1.4.2 Environmental Assessment of Contract Deviations

The Contract specifications have been prepared to comply with the special conditions and mitigation measures of an environmental nature, which were established during the planning, and development of this project. The Contractor is advised that deviations from the drawings or specifications (e.g., proposed alternate disposal areas) could result in the requirement for the Government to reanalyze the project from an environmental standpoint. Deviations from the construction methods and procedures indicated by the plans and specifications, which may have an environmental impact, will require an extended review, processing, and approval time by the Government. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.5 ENVIRONMENTAL PROTECTION PLAN

The Contractor shall submit an Environmental Protection Plan as required by SECTION 00100, paragraph 52.0215-4305V. The Government reserves the right to require the Contractor to make changes in the Environmental Protection Plan or operations if the Contracting Officer determines that environmental protection requirements are not being met. The plan shall detail the actions, which the Contractor shall take to comply with all applicable Federal, State, and local laws and regulations concerning environmental protection and pollution control and abatement, as well as the additional specific requirements of this contract. The environmental protection plan shall include, but not be limited to, the following:

1.5.1 List of State and Local Laws and Regulations

The Contractor shall provide as part of the Environmental Protection Plan a list of all State and local environmental laws and regulations that apply to the construction operations under the Contract.

1.5.2 Methods for Protection of Features

The Contractor shall provide a listing of methods to protect resources within authorized work areas needing protection from blasting, dredging, and disposal of dredged material and transit of equipment. Resources include air and water quality, fish and wildlife, historical, archeological and cultural resources, wetlands, and endangered and threatened species.

1.5.3 Procedures to be Implemented

The Contractor shall provide a list of procedures to be implemented, which will provide the required environmental protection and comply with the applicable laws and regulations. The Contractor shall set out the procedures to be followed to correct pollution of the environment due to accident, natural causes or failure to follow the procedures set out in accordance with the environmental protection plan.

1.5.4 Solid Waste Disposal Area

The Contractor shall provide a copy of the permit and license for the solid waste disposal area and a description of its location.

1.5.5 Drawings

The Contractor shall provide drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.

1.5.6 Environmental Monitoring Plan

The Contractor shall provide an environmental monitoring plan for the job site, including land, water, air, and noise monitoring. Special emphasis shall be provided for the monitoring required in paragraph, PROTECTION OF FISH AND WILDLIFE RESOURCES of this section and in SECTION 02300.

1.5.6.1 Blast Area Environmental Monitoring Plan

The Contractor shall provide an environmental monitoring Plan for blast areas. The Plan shall include a drawing showing typical layout for gill nets, channel

nets, observer vessels and aircraft in relation to location of blast area.

1.5.7 Methods for Surface and Ground Water Protection

The Contractor shall provide a list of methods for protecting surface and ground water during construction activities.

1.5.8 Work Area Site Plan

The Contractor shall provide a work area site plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. The plan shall include measures for marking the limits of use areas. This applies to work areas in the Cape Fear River, the Atlantic Ocean, and on land. In selecting work areas on land, the Contractor shall confine the locations of activities, equipment storage, and staging areas to previously cleared areas and non-wetland areas to the maximum extent practicable. Access routes to such work areas shall also avoid wetlands.

1.5.9 Erosion and Sediment Control

The Contractor shall provide a plan for erosion and sediment control measures to be performed at all upland areas to be disturbed. The plan shall show location of all temporary silt fence and other necessary measures. The Contractor shall coordinate all upland area disturbance activities with the North Carolina Department of Environment and Natural Resources (NCDENR) Land Quality Section. For all upland disturbance activities, a sedimentation and erosion control plan shall be submitted to and approved by NCDENR Land Quality Section or the Contractor shall obtain written confirmation from the NCDENR Land Quality Section that a sedimentation and erosion control plan is not required.

1.5.10 Spill Control Plan

The Contractor shall include as part of the environmental protection plan, a Spill Control Plan. The plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by the Emergency Response and Community Right-to-Know Act or regulated under State or local laws or regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

- a. The name of the individual who will be responsible for implementing and supervising the containment and cleanup.
- b. Training requirements for Contractor's personnel and methods of accomplishing the training.
- c. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
- d. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.
- e. The methods and procedures to be used for expeditious contaminant cleanup.
- f. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer in addition to the

legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity spill occurs. The plan shall contain a list of the required reporting channels and telephone numbers.

1.5.11 Recycling and Waste Minimization Plan

The Contractor shall submit a Recycling and Waste Minimization Plan as a part of the Environmental Protection Plan. The plan shall detail the Contractor's plan to reduce the volume of solid waste materials at the source.

1.5.12 Contaminant Prevention Plan

As a part of the Environmental Protection Plan, the Contractor shall prepare a contaminant prevention statement identifying potentially hazardous substances to be used on the job site and intended actions to prevent accidental or intentional introduction of such materials into the air, water, or ground. The Contractor shall detail provisions to be taken to meet Federal, State, and local laws and regulations regarding the storage and handling of these materials.

In addition, this statement shall include as a minimum:

- a. The name of the individual who will be responsible for implementing and supervising the containment and cleanup.
- b. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
- c. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material placement equipment available in case of an unforeseen spill emergency.
- d. The methods and procedures to be used for expeditious contaminant cleanup.
- e. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual must immediately notify the Contracting Officer in addition to the legally required reporting channels, when a reportable quantity spill of oil or hazardous substance occurs.

1.5.13 Environmental Monitoring

The Contractor shall include in the plan the details of environmental monitoring requirements under the laws and regulations and a description of how this monitoring will be accomplished.

1.5.14 Operational Plan To Minimize Turtle Takes

If a mechanical dredge with scow or a hopper dredge is to be used to accomplish the work, the Contractor shall include as part of the Environmental Protection Plan, an Operational Plan to minimize turtle takes.

1.6 QUALITY CONTROL

The Contractor shall establish and maintain quality control for environmental protection of all items set forth herein. The Contractor shall record on daily quality control reports or attachments thereto, any problems in complying with laws, regulations, and corrective actions taken.

1.7 MEASUREMENT AND PAYMENT

All costs for environmental protection measures required by this section shall be considered incidental to and included in the cost for the various items of work as listed in the BIDDING SCHEDULE and described elsewhere in these specifications.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 SPECIAL ENVIRONMENTAL PROTECTION REQUIREMENTS

3.1.1 Tree Protection

No ropes, cables, or guys shall be fastened to or attached to any tree(s) for anchorage unless specifically authorized by the Contracting Officer. Where such special use is permitted, the Contractor shall provide effective protection to prevent damage to the tree and other land and vegetative resources. Unless specifically authorized by the Contracting Officer, no construction equipment or materials shall be placed or used within the drip line of trees shown on the drawings to be saved. No excavation or fill shall be permitted within the drip line of trees.

3.1.2 U.S. Department of Agriculture (USDA) Quarantined Considerations

The Contractor shall thoroughly clean all construction equipment at the prior job site in a manner that ensures all residual soil is removed and that egg deposits from plant pests are not present. The Contractor shall consult with the USDA Plant Protection and Quarantine (USDA - PPQ) jurisdictional office for additional cleaning requirements that may be necessary.

3.1.3 Disposal of Solid Wastes

Solid waste is rubbish, debris, waste materials, garbage, and other discarded solid materials (excluding hazardous waste as defined in following paragraphs). Solid waste shall be placed in containers and disposed on a regular schedule. All handling and disposal shall be conducted in such a way as to prevent spillage and contamination. The Contractor shall transport and dispose of all solid waste in compliance with Federal, State, and local requirements.

3.1.4 Disposal of Contractor Generated Hazardous Wastes

Hazardous wastes are wastes as defined in 40 CFR 261, and as defined by applicable State and local regulations. Hazardous waste generated by construction activities shall be removed from the work area and disposed in compliance with Federal, State, and local requirements. The Contractor shall segregate hazardous waste from other materials and wastes, and shall protect it from the weather by placing it in a safe covered location; precautionary measures against accidental spillage shall be taken.

3.1.5 Fuels and Lubricants

Fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spills and evaporation. Lubricants and waste oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with Federal,

State, and local laws and regulations.

3.2 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Cultural resources including both wooden and metal hulled shipwrecks that are State-owned resources protected under a number of State and Federal laws and regulations may be encountered in the project area. Cultural resources are known to exist within the "sensitive areas" shown on the drawings. Only operations essential for the channel deepening will be allowed within the sensitive areas. The "sensitive areas" shall not be used for equipment staging or storage, or anchorage of ancillary equipment. Cultural resource contact may be evidenced by repeated contact with an obstruction and/or the recovery of wooden planking or framing, brass or copper plating or fittings, chain, old anchors, ship tackle, ballast, old brick, or similar items. In the event that the Contractor makes an unanticipated discovery or contact with a shipwreck or other cultural resource, the Contractor shall suspend dredging operations in the vicinity of contact or discovery, immediately record the location of the contact or discovery, immediately notify the Contracting Officer or designated representative of the discovery or contact, and preserve any recovered cultural material until it can be inspected by the appropriate authorities. After investigation by the Contracting Officer, the Contractor will be instructed on how to proceed.

3.3 PROTECTION OF WATER RESOURCES

The Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. The Contractor shall not pollute groundwater or any body of surface water, including the Atlantic Ocean, estuaries, rivers, streams, creeks, canals, ditches, lakes, or ponds. For the purpose of this specification, pollution includes spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, dumping, or disposing of harmful substances into the environment. Harmful substances, including, but not limited to, fuels, oils, bitumens, calcium chloride, ammonia nitrate, explosive materials and acids shall not be allowed to pollute any waters. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County, and Municipal laws concerning water pollution control. All work under this contract shall be performed in such a manner that objectionable conditions will not be created in any groundwater or surface waters. The Contractor shall take immediate corrective action if it is determined that pollutants have been allowed to enter any groundwater or surface water. Any incidents causing water pollution, even if minor, shall be promptly reported to the Contracting Officer.

It is the responsibility of the Contractor to comply with all Federal and State laws pertaining to dredging and disposal of dredged material. In addition, it is the responsibility of the Contractor to assure that no wetlands are adversely affected by dredging, disposal of dredged material, or associated operations (including land-based support activities) conducted under this contract. Any disposal or leakage of dredged material, even if unintentional, outside the disposal area designated in this contract or not in compliance with placement criteria in this contract, is the responsibility of the Contractor, and is subject to removal by the Contractor at his own expense upon the request of the Contracting Officer. Upon discovery of such misplaced material, the Contractor shall immediately take corrective action to stop the continued misplacement of dredged material, and shall notify the Contracting Officer's Representative for further instructions.

The Contractor is responsible for monitoring all water and wetland areas affected by construction activities. In the event that water quality violations result from the Contractor's operation, the Contractor shall suspend the operation or operations causing the pollution, and such suspension shall not form the basis for a claim against the Federal government. The contractor shall conduct his/her dredging and disposal operations in a manner to minimize turbidity and shall conform to all water quality standards and conditions as prescribed under General Water Quality Certification Number 3105 for the Corps of Engineers Dredging Activities Using Existing Upland Diked Disposal Sites, issued by the North Carolina Division of Environmental Management on February 11, 1997. There are no turbidity requirements associated with disposal at the ODMDS. However during disposal operations at diked disposal facilities, the activity shall be conducted in such a manner as to prevent significant increases in turbidity outside the area of construction or construction related discharge. The effluent shall not exceed or be above ambient background levels or 25 NTUs (whichever is more stringent) in the immediate vicinity of the discharge end of the effluent pipe. The Contractor is responsible for testing to determine the ambient background level prior to disposal activities. In addition, the Contractor will be responsible for visually monitoring the discharge effluents from disposal areas for evidence of higher than normal turbidity levels, such as a turbidity plume or distinct boundaries between released waters and receiving waters, muddy water, or water with a distinguishable amount of solid material. All visual observations shall be noted and reported to the Contracting Officer in conjunction with submissions with regular quality control plans. All distinct discharges shall be reported to the Contracting Officer immediately for further action.

3.3.1 Monitoring of Water Areas Affected by Construction Activities

The Contractor shall monitor all water areas affected by construction activities and take immediate corrective action if it is determined that pollutants have been allowed to enter any groundwater or surface water. Any incidents causing water pollution, even if minor, shall be promptly reported to the Contracting Officer.

3.4 PROTECTION OF FISH AND WILDLIFE RESOURCES

The Contractor shall keep construction activities under surveillance, management and control to minimize interference, disturbance, and damage to fish and wildlife and fish and wildlife habitat.

3.4.1 Endangered Species and Threatened Species

Species Federally listed as endangered or threatened receive a high level of protection under the Endangered Species Act of 1973 (PL 93-205), as amended. The Contractor should be aware that protected species frequently occur in North Carolina waters and work should be planned accordingly. Endangered or threatened species, including whales, sea turtles, manatees, and shortnose sturgeon, may be encountered in the project area during dredging and disposal operations for this project. In addition, all marine mammals, including porpoises, and dolphins, are protected under the Marine Mammal Protection Act of 1972 (PL 92-522), as amended. Therefore, the Contractor shall take such measures as may be required to assure that any activities conducted as a part of this contract do not kill, injure, capture, pursue, harass, or otherwise harm any of these species. Noncompliance with these measures may result in civil penalties under the Endangered Species Act of 1973 or the Marine Mammal Protection Act of 1972.

NOTIFICATION AND REPORTING REQUIREMENTS FOR INCIDENTS INVOLVING PROTECTED

SPECIES - Incidents involving the death or injury of any protected species shall be reported to the Contracting Officer immediately. The Contractor shall prepare and provide to the Contracting Officer written records detailing the incident within 24 hours of its occurrence.

Specific types of equipment and operations pose different types of hazards, so specific protective measures will vary depending upon the type of operation being conducted. Concerns related to each type of operation are as follows:

3.4.2 Blasting

Explosives used for blasting rock may potentially kill or otherwise harm animals for hundreds of feet from a blast. The Contractor shall reduce the potential adverse impacts of blasting by following the instructions provided below.

1. Blasting is restricted to the months of August through January, inclusive.

2. The pre- and post-blast monitoring for shortnose sturgeon shall be conducted under the supervision of a principle biologist that has at least a Master of Science degree in fisheries biology or similar fields approved by the Contracting Officer. In addition, the principle biologist must have at least 3 years of experience in the estuarine/marine environment that includes capturing, tagging and handling shortnose sturgeon. The Wilmington District has obtained the required authorization to capture, tag and handle shortnose sturgeon under the terms of this contract. The principle fisheries biologist will work under this authorization.

The pre- and post-blast monitoring for marine mammals (dolphin and manatee) and sea turtles shall be conducted under the supervision of a principle biologist that has at least a Master of Science degree in marine mammalogy or similar fields approved by the Contracting Officer. In addition, the principle biologist must have at least 3 years of experience in the estuarine/marine environment that includes monitoring marine mammals and must have all appropriate permits for such monitoring.

3. Four (4) 5.5 inch mesh, 100 meter long, 3-4 meters high, sinking gill nets shall be set to surround each blast area as near as feasible. Equally spaced along the float line of each gill net shall be ten (10) lines leading to surface floats. These surface floats will serve to detect if a marine mammal or sea turtle has become entangled in a net. Each float shall have reflective tape, at least 1 inch wide, wrapped completely around the center of each float. For gill net sets, all floats shall be observed at least every five minutes. If entanglement is apparent, the nets shall be immediately retrieved and the animal released if uninjured. If the animal is injured or dead, the principle biologist for marine mammals monitoring shall be immediately contacted, and appropriate action taken. For all cases if a marine mammal or sea turtle is entangled in a net, photographs shall be taken of the animals and appropriate data taken including species, appropriate length, date, time and location.

These nets shall be in place for 3 hours and none of the nets removed any sooner than 30 minutes before the blast. Retrieval of the 4 gill nets within the 30-minute time limit may require multiple boats and crews. No overnight gill net sets are allowed. Nets set in the dark (30 minutes or more before sunrise) prior to any early morning blast (blast can't occur within 2 hours of sunrise), will require monitoring the surface water and net floats with night vision equipment, and using hydrophones to monitor for the presence of dolphin. The Contracting Officer must approve the night vision equipment and hydrophones used to monitor for the presence of dolphin. The nets shall be manned

continuously to prevent obstructing the channel to ship traffic. Each sturgeon removed (shortnose or Atlantic) shall be tagged with a t-bar tag and the sturgeon released in the Brunswick River within 100 meters of the US highway 74/76/17 bridge.

4. Within 10 minutes before each blast, one large mesh (up to 4 inch mesh) channel net shall be set immediately down current of and within 300 feet of the perimeter of the blast array (layout of the blast holes) to capture sturgeon that are injured or killed during blasting. The channel net shall have a minimum head rope length of 100 feet. The channel nets shall be left in place for at least 1 hour after the blast. If blasting occurs near the time of slack tide, the channel net shall be set where it will fish for at least 30 minutes. This may result in the channel net being set a few minutes after the blast instead of within 10 minutes before the blast. The number, length and species of all fish captured shall be recorded. If more than 30 fish of a species is captured, at least a subset of 30 fish of that species may be measured and the total number of that species may be estimated. In addition, indicate if the fish are alive, injured or dead and if the injury or death was obviously caused by the blast (e.g. ruptured body cavity, bulging eyes, etc.).

5. Pre-blast surveys for sea turtles and manatees and other marine mammals shall be conducted one hour before each blast to ensure no turtles or manatees or other marine mammals are within the monitoring area (area within at least 5,000 feet of the perimeter of the blast array). Personnel experienced in marine mammal observation shall conduct the surveys from at least 2 surface vessels and 1 helicopter. The Contractor may submit an alternative proposal for surveys to address situations when weather conditions do not allow for helicopter flights. Surveys shall continue throughout blasting activities to ensure no sea turtles or manatees or other marine mammals are within the monitoring area. If a sea turtle or manatee or other marine mammal is within the monitoring area, blasting shall be delayed until the animal voluntarily departs the monitoring area. For each blast, water pressure shall be monitored at least 5,000 feet from the perimeter of the blast array. For additional water pressure monitoring details, see SECTION: WATER PRESSURE MONITORING DURING BLASTING. If the average peak water pressure exceeds 178 dB re 1Pa for any five consecutive blasts, the monitoring location shall be relocated outward and the monitoring area shall be extended outward from 5,000 feet in 500-foot intervals until the threshold is not exceeded. Post-blast surveys shall be conducted for one half hour after each blast to determine if any sea turtles, manatees, or dolphins are injured.

If a marine mammal or sea turtle is observed in the monitoring area, no gill nets shall be set, and if any nets are already set they shall be retrieved. Nets shall not be reset until the animals voluntarily leave the monitoring area. If the gill nets need to be retrieved during the minimum 3-hour set period due to ship passage or observation of a marine mammal or sea turtle in the monitoring area, the 3-hour minimum set time does not restart for that blast. After animals voluntarily leave the monitoring area, the gill nets must be reset as soon as possible, but for at least one (1) continuous hour prior to retrieval at 30 minutes before a blast. If a marine mammal or sea turtle is in the monitoring area before the gill nets are set, the 3-hour minimum set will not begin until the animals have voluntarily left the monitoring area.

6. Electronic surveillance of each blast area shall take place using boat mounted sonar fish finders, with an LCD display screen. The sonar sweeps shall take place within the last twenty minutes prior to each blast. The sweeps shall cover an area (surveillance zone) extending out 500 feet from all sides of the perimeter of the blast array. Blasting shall be delayed until

schools of fish that may be located leave the surveillance zone.

At least two vessels equipped with fish finders shall be needed. If a school of fish is located, it shall be followed by one vessel until the school leaves the surveillance zone. The other vessel shall continue sweeping. If the second vessel finds a school of fish prior to the same blast event, that vessel shall also follow the school until it leaves the surveillance zone. In the event that both vessels follow a school of fish, the sonar sweep process shall begin again and cover the entire surveillance zone to assure that no schools of fish are in the 500-foot zone.

While these vessels are performing the sonar sweeps, additional personnel in separate boats shall perform the marine mammal and sea turtles watch. Separate vessels and personnel are required because monitoring for schools of fish is performed in an area extending out 500 feet from all sides of the perimeter of the blast array, and monitoring for marine mammals and sea turtles is performed in an area extending out 5,000 feet or more (see subparagraph 5. above) from all sides of the perimeter of the blast array.

7. Two scare charges shall be fired before each blast. A scare charge is a small charge of unconfined explosive detonated immediately prior to a blast for the purpose of scaring aquatic organisms away from the location of an impending blast. The scare charges shall be detonated within 30 feet of the perimeter of the blast array. Non-electric detonators with charge weight of 12 grains (0.78 grams) shall be used for all scare charges. The detonation of the first scare charge shall occur 5 minutes prior to the blast. The second scare charge shall be detonated four (4) minutes prior to the blast. To prevent any air-borne shrapnel from scare charge detonators, weights shall be attached to detonator tubes to ensure they are positioned at least ten feet below the water surface before they are fired.

8. Blast hole stemming and delays shall be required as detailed in Section: BLASTING.

9. Blast water pressure measurements 140 feet from the perimeter of the blast array shall also be required for each blast as detailed in Section: WATER PRESSURE MONITORING DURING BLASTING.

3.4.3 Hopper Dredge

Hopper dredging poses a threat to sea turtles, which are subject to injury or mortality if they are sucked through the dredging system. If 2 sea turtles are taken within 24 hours or 3 turtles are taken in a year, consultation is required with the Contracting Officer to determine compliance with the contract requirements. If 5 turtles are taken in one year, all work by hopper dredge under this contract will be terminated at no cost to the Government and the Contractor shall complete the work remaining for that year with other plant and equipment. No more than 12 turtle takes are allowed for the contract period. The first year begins the date the notice to proceed is issued, and subsequent years start on the anniversary date of the notice to proceed.

The use of hopper dredges is subject to specific requirements. Observer and reporting requirements are discussed below. Other specific requirements for hopper dredges are discussed in Section: DREDGING.

a. Observers. Observers shall be used to monitor take of sea turtles and shortnose sturgeon and aid in avoidance of marine mammals.

(1) Inflow screens shall be used at all times, and observer coverage shall be provided 24 hours a day. Observers shall have necessary permits from the State of North Carolina to capture and handle sea turtles and shortnose sturgeons.

(2) Screens shall be examined for sea turtle and sturgeon parts after each filling of the hopper is complete. Other debris found on the screens during their examination for sea turtle or sturgeon parts shall be disposed of so as not to impede their functioning during the next loading cycle.

(3) The time, date, and condition (fresh or decaying) of all turtle and sturgeon parts recovered shall be recorded. Reach dredged shall also be recorded (channel name and station numbers). Sea turtle or sturgeon parts unidentifiable to species shall be placed in plastic bags, labeled as to the time and date of collection, and frozen for later analysis. Identifiable parts shall be disposed of in such a manner as to not be re-dredged at a later date. Whole specimens of sea turtles or sturgeons shall be frozen and the District Office contacted for directions on disposition of specimens.

(4) When multiple parts are taken, the observer shall determine, to the best of his ability, the number of sea turtles or sturgeons the multiple parts represent. The basis for the decision shall be noted (e.g., two left-front flippers, etc.)

(5) The Contractor shall provide any unidentified sea turtle and sturgeon parts to the North Carolina Wildlife Resources Commission (Mr. Steve Johnson, 252/729-7601) to be identified to species if possible. If positive identification is impossible, specimens shall be recorded as "unidentified sea turtle" or "unidentified sturgeon." After such examination is complete, all parts shall be properly disposed of.

(6) The taking of any sea turtle or sturgeon parts shall be reported to the Contracting Officer immediately. Observer data sheets shall be faxed to the Contracting Officer as soon as possible after the take.

(7) Sea turtles that are still alive when taken and appear to have a chance for recovery shall be transported by the Contractor for treatment as soon as possible. The North Carolina Wildlife Resources Commission (Mr. Steve Johnson 252/729-7601) shall be contacted to determine the appropriate facility to receive the turtle. If the turtle survives and is fit for release, the Contractor shall make arrangements to transport it to the ocean. If permanently handicapped, the Contractor shall seek a suitable aquarium for long-term care. If none can be found, the turtle shall be released to the ocean after providing acceptable documentation of his search efforts to the Contracting Officer.

(8) From 1 December through 31 January one endangered species observer with at-sea large whale identification experience must be present to conduct daytime observations. During this period, one of the sea turtle observers may perform this observation work. Records shall be kept of the date, time, and approximate location of all marine mammal sightings. Care shall be taken not to closely approach any whales or manatees observed during dredging. The observer shall serve as a lookout to alert the vessel pilot of the occurrence of these animals. If any are observed, collisions shall be avoided either through reduced vessel speed, course, alteration, or both. During the evening hours, when there is limited visibility due to fog, or when there are sea states of greater than Beaufort 3, the dredge must slow down to 5 knots or less when transiting between areas if whales have been spotted within 15 nautical miles of the vessel's path within the previous 24 hours.

b. Reporting. Daily observer reports shall be submitted with the daily "Report of Operations-Hopper Dredges." Reports of take of any listed species shall be furnished to the Contracting Officer as soon as possible. All sea turtle sightings and locations (name of channel reach) shall be noted on the daily observer reports.

3.4.4 Pipeline Dredges

Special precautions to protect listed species are not required for pipeline dredges.

3.4.5 Mechanical Dredges

Special precautions to protect listed species are not required for mechanical dredges except as noted in subparagraph Avoidance of Marine Animals, below.

3.4.6 Avoidance of Marine Animals

(1) Records shall be kept of the date, time, and approximate location of all marine mammal sightings. Care shall be taken not to closely approach (within 300 feet) any whales, manatees, or other marine mammals during dredging or transportation of dredged material. The observer shall serve as a lookout to alert the dredge operator and/or vessel pilot of the occurrence of these animals.

(2) If whales or manatees are observed within 300 feet of the area being dredged, all work shall cease until the animals have left the area. If any marine mammals are observed during transit to the new Ocean Dredged Material Disposal Site (ODMDS), collisions shall be avoided either through reduced vessel speed, course, alteration, or both.

(3) Sightings of whales or manatees in the work area shall be reported to the Contracting Officer as soon as possible.

(4) During ocean transit of dredging and disposal equipment from 1 December through 31 March one endangered species observer with at-sea large whale identification experience must be present to conduct daytime observations. Records shall be kept of the date, time, and approximate location of all marine mammal sightings. Care shall be taken not to closely approach any whales or manatees observed during dredging. The observer shall serve as a lookout to alert the vessel pilot of the occurrence of these animals. If any are observed, collisions shall be avoided either through reduced vessel speed, course alteration, or both. During the evening hours, when there is limited visibility due to fog, or when there are sea states of greater than Beaufort 3, the dredge must slow down to 5 knots or less when transiting between areas if whales have been spotted within 15 nautical miles of the vessel's path within the previous 24 hours.

3.5 PROTECTION OF AIR RESOURCES

Special management techniques as set out below shall be implemented to control air pollution by the construction activities. These techniques supplement the requirements of Federal, State, and local laws and regulations; and the safety requirements under this Contract. If any of the following techniques conflict with the requirements of Federal, State, or local laws or regulations, or safety requirements under this contract, then those requirements shall be followed in lieu of the following.

3.5.1 Particulates

Airborne particulates, including dust particles, from construction activities and processing and preparation of materials shall be controlled at all times, including weekends, holidays, and hours when work is not in progress. The Contractor shall maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, disposal sites, borrow areas, and all other work areas free from airborne dust which would cause a hazard or nuisance.

3.6 INSPECTION

If the Contracting Officer notifies the Contractor in writing of any observed noncompliance with contract requirements or Federal, State, or local laws, regulations, or permits, the Contractor shall inform the Contracting Officer of proposed corrective action and take such action to correct the noncompliance. If the Contractor fails to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action is taken. No time extensions shall be granted or costs or damages allowed to the Contractor for any such suspension.

3.7 COMPLIANCE OF SUBCONTRACTORS

Compliance with the provisions of the contract specifications by subcontractors shall be the responsibility of the Contractor.

3.8 MAINTENANCE OF POLLUTION CONTROL FACILITIES

The Contractor shall maintain all constructed pollution control facilities and portable pollution control devices for the duration of the Contract or for the length of time construction activities create the particular pollutant.

3.9 TRAINING OF CONTRACTOR PERSONNEL

Contractor personnel shall be trained in environmental protection and pollution control. The Contractor shall conduct monthly environmental protection/pollution control meetings for all Contractor personnel. The training and meeting agenda shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual, installation and care of facilities, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control. Anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants, shall also be discussed. Other items to be discussed shall include recognition and protection of archaeological sites and artifacts.

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SECTION 02325

DREDGING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

The work consists of furnishing plant, equipment, materials, and labor to perform dredging and associated work as required by these specifications and the drawings for Wilmington Harbor, North Carolina - 96 Act, Anchorage Basin and Passing Lane Dredging, Sta 39+70 Anchorage Basin to Sta 60+00 Lower Brunswick Channel and Sta 55+00 Keg Island Channel through Reaves Point Channel.

The work consists of deepening the existing channels consisting of the following ranges: Anchorage Basin (Sta 39+70 to 84+83.64), Between, Fourth East Jetty, Upper Brunswick, Lower Brunswick (Sta 0+00 to 60+00), Keg Island (Sta 55+00 to 77+26.39), Upper Lilliput, Lower Lilliput, Upper Midnight, Lower Midnight, and Reaves Point.

The work also includes channel and turn wideners. Turn wideners are required at the intersection of the following ranges: Upper Brunswick and Lower Brunswick, Upper Lilliput and Lower Lilliput, and Lower Midnight and Reaves Point. A 100-foot widener is required on the west side of the Fourth East Jetty Channel and on each side of Lower Lilliput Channel. A 200-foot widener is required on the west side of Upper Midnight and Lower Midnight Channels. A widener is also required on the northwest side of the turning area within the Anchorage Basin.

North Carolina State Ports Authority Berth Area Deepening is identified as an optional bid item in the Bid Schedule. See the drawings for further details.

The bottom depth, widths, and lengths to be dredged are shown on the drawings.

The work also includes maintenance dredging as directed by the Contracting Officer of the existing channel from Sta 13+50 Anchorage Basin to the intersection of Reaves Point and Horseshoe Shoal Channels including all channel ranges in between and North Carolina State Ports Authority berth areas to provide the current project depth (either -38' MLLW plus 1 foot of allowable overdepth or -42' MLLW plus 2 feet of allowable overdepth) as directed by the Contracting Officer during the life of the contract.

1.2 WORK COVERED BY CONTRACT PRICE

1.2.1 Unclassified Excavation

The contract price(s) per cubic yard for the "Unclassified Excavation" sub-items includes all costs associated with plant, equipment, materials, and labor required for removal and disposal of all dredged material during deepening of the existing channel and widening of the channel and turns, with the exception of material removed under subparagraph, Maintenance Dredging, below.

1.2.2 Maintenance Dredging

Maintenance dredging under this contract will be limited to those areas in the existing channel not scheduled by the Contractor to be dredged under the unclassified excavation item for any one individual hydraulic pipeline dredging environmental window (1 August - 31 January) and in which the Contracting Officer considers that there exist or are likely to exist shoals that will be an impediment to navigation. The Contractor shall provide a hydraulic cutterhead suction dredge, with 14-20" discharge pipe, capable of dredging an average of 8000-12000 cubic yards per day along with all required pipe, and attendant plant. As directed by the Contracting Officer, maintenance dredging shall be executed to remove shoaling from the existing channel and from the North Carolina State Ports Authority berth areas to maintain 38' MLLW plus 1' of allowable overdepth during Phase 1. After completion and acceptance of phase 1 in total, the Contracting Officer may direct maintenance dredging to -42' MLLW plus 2 feet of allowable overdepth or may perform some or all maintenance dredging in this area by separate contract, at the Government's discretion. The contract price per hour for "Maintenance Dredging" includes all costs associated with plant, equipment, materials, and labor required for removal and disposal of all maintenance dredging material.

1.3 SUBMITTALS

The following shall be submitted to the Contracting Officer in accordance with Section 01330 SUBMITTAL PROCEDURES:

- a. Dredging Plan.
- b. Dredged Material Disposal Plan.
- c. Traffic Control Plan.
- d. Emergency Plan for Obstruction to Navigation.
- e. Ocean disposal verification data.
- f. Debris screen design (required if mechanical dredge is to be used to accomplish the work).
- g. Turtle deflector device design (required if hopper dredge is to be used to accomplish the work).
- h. Inflow basket or screen design (required if hopper dredge is to be used to accomplish the work).

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 NOTICES

- (a) The Contractor shall give the Contracting Officer five (5) days advance written notice before commencing work.

(b) The Contractor shall be responsible for requesting Government before-dredging surveys, in writing five (5) days prior to beginning work in an acceptance section.

(c) The Contractor shall also be responsible for requesting Government after-dredging surveys, in writing, three (3) working days prior to completion of an acceptance section.

3.2 NAVIGATION AIDS

There are aids to navigation within the project boundaries. Some, or all, of such aids to navigation may need to be removed for the accomplishment of the contract work. It is the responsibility of the Contractor to timely determine any need for moving of aids to navigation and to coordinate with the U.S. Coast Guard (USCG) and any other responsible parties to accomplish any needed movement. Any impacts to the work due to the inability of the Contractor to accomplish any needed movement of aids to navigation will not be the responsibility of the U.S. Government or of the Contracting Officer.

3.3 TRAFFIC CONTROL PLAN

The Contractor shall submit a traffic control plan as required by Section 00100, paragraph 52.0215-4305V. The traffic control plan is the Contractor's plan for providing for safe vessel passage through the construction area at all times during the life of this contract. This plan shall include but not be limited to the following:

a. Name, address, resume, responsibility and qualifications of Traffic Control Manager. The Traffic Control Manager shall have a minimum of 5 years experience in traffic control logistics management of a similar nature. This experience shall include developing schedules and coordinating multiple traffic flow to avoid disruptions.

b. sequence of work to minimize delays to vessel traffic. Sequence of work shall include a delineation of specific work areas (acceptance sections) and an order of completion.

c. communication plan to keep the U.S. Coast Guard Marine Safety Office, Cape Fear Pilots Association, shipping companies, N.C. State Port Authority, Corps of Engineers, and other affected parties informed at all times during project construction (provide points of contact and phone numbers).

d. methods for moving plant and equipment from the navigation channel to make way for approaching vessels.

3.4 COMMUNICATIONS

The Contractor shall furnish and maintain a radiotelephone and a cellular phone on the dredge(s) throughout the period of the contract. The plant will not be allowed to begin work until the VHF marine band radio is installed and in good working order and a properly operating cellular phone is on board. The radiotelephone shall be capable of operation from the dredge's main control station and capable of transmitting and receiving on a frequency or frequencies within the 156-162 megahertz band using the classes of emissions designated by the Federal Communications Commission.

3.5 LOCAL OFFICE

The Contractor shall maintain a land based office in the immediate vicinity of the work site. This office shall be equipped with at least one (1) operable telephone and fax machine, which provides both local and long distance service. The number for this equipment shall be provided to the Contracting Officer's Representative during the preconstruction conference, and the telephone shall be monitored and answered by contractor personnel during working hours.

3.6 OVERDEPTH AND SIDE SLOPES

3.6.1 Overdepth

This contract allows overdepth dredging. No payment will be made for any material that is removed from below the allowable overdepth or outside of the indicated side-slopes.

3.6.2 Side-Slopes

Material actually removed within limits approved by the Contracting Officer, leaving final side-slopes no flatter than the side slopes indicated by the typical dredging sections shown on the drawings will be paid for, whether accomplished by dredging the original position or the space below the pay slope plane and allowing up slope materials to fall into the cut.

3.6.3 Excessive Dredging

Material taken from beyond the limits as extended in provision, side-slopes above, will be deducted from the total amount dredged as excessive dredging and will not be credited.

3.7 QUANTITIES

The estimated quantities for each channel reach are included in Attachment 1 of this section. The estimated quantities provided in the attachment are based on conditions existing on the date of the survey shown on the plans.

3.8 MEASUREMENT AND PAYMENT

(a) Unclassified Excavation. The total volume of all unclassified excavation material removed and to be paid for under this contract will be measured by the cubic yards in place, by computing the volume between the bottom surface shown by soundings of a survey before dredging each acceptance section and the bottom surface shown by the soundings of a survey made as soon as practicable after completion of each acceptance section. If blasting is required, there will be no direct payment made for blasting. Material removed as a result of blasting and dredging will be measured and paid for as Unclassified Excavation. The calculations will exclude any volume of material removed from beyond the limits of the side-slopes and/or below the allowable overdepth and will be further reduced by the volume of any misplaced material. All pay quantities shall be determined from before and after dredging surveys conducted by the Government. Payment for Unclassified Excavation shall also include all disposal costs associated with transporting and disposal of material.

(b) Maintenance Dredging. There will be no direct payment made under this contract for quantity of maintenance dredging material removed.

Government surveys will be made of the areas dredged as soon as practicable after completion of dredging to determine if the typical maintenance dredging section has been achieved -38 feet MLLW plus 1 foot of allowable overdepth or -42 feet MLLW plus 2 feet of allowable overdepth as directed by the Contracting Officer). Payment for effective dredging time will be made at the unit price bid per hour for Maintenance Dredging of the bidding schedule. The Contracting Officer will determine effective dredging time based on the time active dredging was underway as contained in the Report of Operations - Pipeline, Dipper or Bucket Dredges or the Report of Operations - Hopper Dredges submitted by the Contractor. Repositioning of the swing anchors and moves directed by the Contracting Officer will not be included in the effective dredging time. There will be no direct payment made for movement of the dredge associated with change of location between work areas. There will be no direct payment made for down time for any reason including, but not limited to maintenance, movement to allow vessel traffic through the channel or delays due to sea and weather conditions. Payment for Maintenance Dredging shall also include all disposal cost associated with transporting and disposal of material.

(c) North Carolina State Ports Authority Berth Area Deepening. Measurement and payment for material removed during deepening of the North Carolina State Ports Authority berth areas will be made consistent with measurement and payment for unclassified excavation.

(d) Mobilization & Demobilization - Maintenance Dredging. Payment for mobilization and demobilization for maintenance dredging will be made for each instance where the dredge for maintenance dredging is mobilized for one hydraulic pipeline dredging period (1 August - 31 January). Each instance will be paid as outlined in Paragraph 252.236-7004, Section 00800, Special Contract Requirements. This includes the full cost of mobilizing and demobilizing all equipment, pipe and attendant plant required to accomplish maintenance dredging.

(e) The drawings referred to in SECTION 01100: SUPPLEMENTARY SPECIAL CONTRACT REQUIREMENTS, paragraph, CONTRACT DRAWINGS AND SPECIFICATIONS, are believed to represent the conditions existing on the dates of survey. The bottom conditions will be determined by before dredging surveys of each acceptance section prior to commencement of dredging and new maps will be furnished to the Contractor. Determination of quantities removed and the deductions made therefrom to determine quantities by in-place measurement to be paid for in the areas specified, after having once been made, will not be reopened, except on evidence of collusion, fraud, or obvious error.

(f) No payment will be made for Unclassified Excavation in an acceptance section until the full depth required under this contract is secured in the whole of such area.

(g) Method of Survey. Hydrographic surveys to determine the volume of material removed under this contract will be accomplished by the Government with the use of a fully automated survey vessel. The RTK system shall be used by the Government and the Contractor for horizontal and vertical positioning corrections and for tide corrections. Horizontal location of survey lines and depth sounding points will be determined by the use of an automated positioning system utilizing either a microwave line-of-sight system or differential global positioning system. Depth soundings will be taken with a 200 kHz/28 kHz depth sounder/digitizer system. The fathometer will be adjusted twice daily using the bar check method to account for variations of the speed of sound in the water at the

survey area. On automated surveys, position and depth data will be collected, stored on magnetic media, and subsequently processed by the Government for map preparation and quantity computations.

(h) Data will be secured by running survey lines parallel to the longitudinal axis of the channel. A sufficient number of lines will be run within the channel to assure good coverage of the bottom. A sufficient number of lines will also be run in the side slope area to account for side slope ratio versus project depth. The after dredging surveys will be performed in the same manner as the before dredging surveys. Weather permitting, before and after dredge surveys will be made during the same tidal stage.

3.9 ACCEPTANCE SURVEYS

As soon as practicable after the completion of the entire work or any acceptance section which, in the opinion of the Contracting Officer will not be subject to damage by further operations under the contract, multibeam surveys will be performed by the government. The purpose of the multibeam surveys will be to determine the presence of material above required project depth and will not be used to determine volume of material dredged for payment purposes. Other methods, depending on density of bottom material, may be required to determine bottom elevations. Should any material above required project depth be encountered by this examination the Contractor will be required to remove same at the contract rate for Unclassified Excavation and/or North Carolina State Ports Authority Berth Area Deepening. When the area is found to be in a satisfactory condition, it will be accepted. If more than two sounding operations by the Government over an area are necessary because of work for the removal of material disclosed by prior soundings, the cost of such subsequent soundings will be charged against the Contractor at the rate of \$5,000.00 per day in which the Government plant is engaged in sounding, is enroute to or from the site, or is held at or near the site for such operations.

3.10 DREDGE POSITIONING SYSTEM

Each dredge shall be equipped with an electronic positioning system, capable of positioning the dredge in the channel with accuracies equal to contract payment surveys (Class 1), as specified in the U.S. Army Corps of Engineers, Engineer Manual, EM 1110-2-1003, Hydrographic Surveying, dated 31 October 1994 and as superseded by EC 1130-2-210 dated 1 October 1998. This positioning system shall be established, operated, and maintained by the Contractor during the entire period of the contract. The positioning system shall be used to precisely locate the dredge and shall be capable of displaying and recording the dredge's location in an acceptable coordinate system which can be related to, or is directly based on, the North Carolina Lambert State Plane Coordinate System. Navigation channel control, and shore station control, if required, will be provided to the Contractor in the same North Carolina Coordinate System prior to the commencement of work. It shall be the responsibility of the Contractor to have the positioning/navigation system reviewed and inspected by the Contracting Officer's Representative prior to the commencement of work.

3.11 HOPPER DREDGE EQUIPMENT

Hopper dredge drag heads shall be equipped with rigid sea turtle deflectors that are rigidly attached. No dredging shall be performed by a hopper dredge without a turtle deflector device that has been approved by the

Contracting Officer.

3.11.1 Deflector Design

a. The leading vee-shaped portion of the deflector shall have an included angle of less than 90 degrees. Internal reinforcement shall be installed in the deflector to prevent structural failure of the device. The leading edge of the deflector shall be designed to have a plowing effect when the drag head is being operated. Appropriate instrumentation or indicator shall be used and kept in proper calibration to insure the critical "approach angle".

b. If adjustable depth deflectors are installed, they shall be rigidly attached to the drag head using either a hinged aft attachment point or an aft trunnion attachment point in association with an adjustable pin front attachment point or cable front attachment point with a stop set to obtain the plowing effect. This arrangement allows fine-tuning the plowing effect for varying depths. After the deflector is properly adjusted there shall be NO openings between the deflector and the drag head that are more than 4" by 4".

INFORMATION ONLY NOTE: The design "approach angle" or the angle of lower drag head pipe relative to the average sediment plane is very important to the proper operation of a deflector. If the lower drag head pipe angle in actual dredging conditions varies tremendously from the design angle of approach used in the development of the deflector, the plowing effect does not occur. Therefore, every effort should be made to insure this design "approach angle" is maintained with the lower drag pipe.

3.11.2 Inflow Basket Design

The Contractor shall install baskets or screening over the hopper inflow(s) with no greater than 4" x 4" openings. The method selected shall depend on the construction of the dredge used and shall be approved by the Contracting Officer prior to commencement of dredging. The screening shall provide 100% screening of the hopper inflow(s). The screens and/or baskets shall remain in place throughout the work.

The Contractor shall install and maintain floodlights suitable for illumination of the baskets or screening to allow the observer to safely monitor the hopper basket(s) during non-daylight hours or other periods of poor visibility. Safe access shall be provided to the inflow baskets or screens to allow the observer to inspect for turtles and sturgeons, or parts thereof, and clean the baskets or screens for the next loading cycle.

The inflow screens shall be maintained in operational condition throughout the period of work.

3.11.3 Hopper Dredge Operation

The Contractor shall operate the hopper dredge to minimize the possibility of taking sea turtles.

When initiating dredging, suction through the drag heads shall be allowed just long enough to prime the pumps, then the drag heads must be placed firmly on the bottom. When lifting the drag heads from the bottom, suction through the drag heads shall be allowed just long enough to clear the lines, and then must cease. Pumping water through the drag heads shall

cease while maneuvering or during travel to/from the disposal area.

INFORMATION ONLY NOTE:

Optimal suction pipe densities and velocities occur when the deflector is operated properly. If the required dredging section includes compacted fine sands or stiff clays, a properly configured arrangement of teeth may enhance dredge efficiency which reduces total dredging hours and "turtle takes". The operation of a drag head with teeth must be monitored for each dredged section to insure that excessive material is not forced into the suction line. When excess high-density material enters the suction line, suction velocities drop to extremely low levels causing conditions for plugging of the suction pipe. Dredge operators should configure and operate their equipment to eliminate all low level suction velocities. Pipe plugging in the past was easily corrected when low suction velocities occurred by raising the drag head off the bottom until the suction velocities increased to an appropriate level. Arrangements of teeth and/or the reconfiguration of teeth should be made during the dredging process to optimize the suction velocities.

Raising the drag head off the bottom to increase suction velocities is not acceptable. The primary adjustment for providing additional mixing water to the suction line should be through water ports. To insure that suction velocities do not drop below appropriate levels, the Contractor's personnel shall monitor production meters throughout the job and adjust primarily the number and opening sizes of water ports. Water port openings on top of the drag head or on raised stand pipes above the drag head shall be screened before they are utilized on the dredging project. If a dredge section includes sand shoals on one end of a tract line and mud sediments on the other end of the tract line, the Contractor shall adjust the equipment to eliminate drag head pick-ups to clear the suction line.

Near the completion of each payment section, the Contractor shall perform sufficient surveys to accurately depict those portions of the acceptance section requiring cleanup. The Contractor shall keep the drag head buried in the sediment at all times. Although the over depth prism is not the required dredging prism, the Contractor shall achieve the required prism by removing material from the allowable over depth prism.

During turning operations the pumps must either be shut off or reduced in speed to the point where no suction velocity or vacuum exists.

The Contractor must comply with all requirements of this specification and the Contractor's accepted Environmental Protection Plan. The contents of this specification and the Contractor's Environmental Protection Plan shall be shared with all applicable crew members of the hopper dredge.

3.12 FENDER TIRES

All fender tires used on Contractor dredging equipment or vessels shall be permanently marked by the Contractor with the company name and equipment plant name. All fender tires shall be securely attached to prevent them from falling overboard.

3.13 DISPOSAL OF DREDGED MATERIAL

The Eagle Island Disposal Area, Disposal Area 8, Disposal Area 10 and the new Wilmington Ocean Dredged Material Disposal Site (ODMDS) are Government furnished disposal areas available to the Contractor.

3.13.1 Eagle Island Disposal Area and Disposal Areas 8 and 10

Disposal areas are available as follows:

Maintenance material only - Eagle Island Cell No. 1
Disposal Area 8
Disposal Area 10

New work excavation - Eagle Island Cell No. 3
(unclassified excavation and
NCSA Berth Area Deepening)

Through the use of separate contracts the Contracting Officer will maintain and increase the capacity of the upland disposal areas as necessary to meet the disposal needs of the contractor as outlined in the Contractor's Dredged Material Disposal Plan. In order to properly manage and operate the Eagle Island Disposal Area, the Contracting Officer may request changes to the Contractor's Dredged Material Disposal Plan with regard to the specific cell to be used. The Contractor shall obtain approval of the pipeline access route and initial discharge point from the Contracting Officer prior to commencement of disposal operations. The Contractor shall provide a total of two people, fully awake and alert, on the disposal areas at all times pumping operations are in progress and, if in the opinion of the Contracting Officer it is necessary, during non-pumping hours. One dozer and operator shall be stationed at the dredging discharge line to ensure that the effluent is controlled in such a manner that high velocity discharge will not impinge on or cause erosion of the dike. The Contractor shall monitor the spillways during disposal operations and adjust the height of the spillway stoplogs to assure proper drainage of the retained water. The two people at the disposal area shall be in constant contact with the lever room of the dredge and shall monitor the discharge and the pipeline for leaks to be certain material is not deposited outside the limits of the disposal area. The breaking of dikes to permit free drainage will not be permitted. The Contractor shall be responsible for maintenance of the Government furnished disposal areas including the dikes and spillway system throughout the life of the contract.

3.13.2 New Wilmington Ocean Dredged Material Disposal Site

Disposal of excavated material in the new Wilmington Ocean Dredged Material Disposal Site (ODMDS) shall be within the designated disposal zone shown on the drawings. Disposal shall be conducted in such a manner that water above the dumped material will have a minimum clearance of 30 feet at mean lower low water (MLLW). In order to maximize ODMDS capacity and minimize mounding of material, the dumps shall be scattered throughout the designated disposal zone and not placed repeatedly at one location. This

shall be accomplished by dividing the disposal zone into quadrants and placing successive dump loads into successive quadrants. The Contracting Officer can direct the placement of material within any portion of the disposal zone.

3.13.3 Dredged Material Disposal Plan

Prior to commencement of dredging and disposal operations, the Contractor shall submit to the Contracting Officer a disposal plan for dredged material. The plan shall include but not be limited to the following:

- a. staging area location(s).
- b. identification of disposal area(s) for dredged material from each channel reach or dredging area.
- c. pipeline route to each disposal area at Eagle Island.
- d. pipeline discharge point location(s) at each disposal area at Eagle Island.
- e. procedure for maximizing capacity of each disposal area at Eagle Island and anticipated volumes for each.
- f. procedures for maximizing the new ODMDS disposal zone capacity and minimizing mounding of material (reference subparagraph New Wilmington Ocean Dredged Material Disposal Site) and anticipated disposal volume.
- g. procedures for recording verification of ocean disposal in the new ODMDS and ensuring minimum clearance is provided (reference paragraph OCEAN DISPOSAL VERIFICATION)
- h. anticipated cycle times and disposal vessel route to and from the new ODMDS (reference paragraph REQUIRED TRANSPORTATION ROUTE).
- i. identification of public or private upland disposal area for disposal of wood and other debris (reference subparagraph Disposal of Wood and Other Debris).

3.14 CONTRACTOR-FURNISHED DISPOSAL AREAS

The Contractor may furnish area(s) for disposal of dredged material for Contracting Officer's approval. If the Contractor-furnished disposal area(s) are approved by the Contracting Officer, the Contractor shall submit the information required by the form entitled "CONTRACTOR-FURNISHED DISPOSAL AREAS", Attachment 6 of SECTION: CONTRACTOR QUALITY CONTROL, including the written permission of the owners of the property involved in obtaining access to the proposed disposal areas, together with the written approval of the following Federal, State, and local fish and wildlife and pollution control agencies for use of the proposed disposal areas:

STATE AGENCIES

Mr. John Morris, Director
Division of Water Resources
NC Department of Environment,
and Natural Resources
Post Office Box 27687
Raleigh, NC 27611

Mr. Robert Stroud
Division of Coastal Management
NC Department of Environment,
and Natural Resources
127 Cardinal Drive Extension
Wilmington, NC 28405

Mr. Doug Huggett
Division of Coastal Management
NC Department of Environment,
and Natural Resources
Post Office Box 27687
Raleigh, NC 27611

FEDERAL AGENCIES

Field Supervisor
US Fish and Wildlife Service
Fish and Wildlife Enhancement
Post Office Box 33726
Raleigh, NC 27636-3726

Area Supervisor
Habitat Conservation Division
National Marine Fisheries Service
Pivers Island
Beaufort, NC 28516

Regional Director
National Marine Fisheries Service
Duval Building
9450 Koger Boulevard
St. Petersburg, FL 33702

Regional Administrator
US Environmental Protection Agency
Region IV - Atlanta Federal Center
61 Forsyth Street
Atlanta, GA 30303-8909

All expenses incurred in connection with furnishing the alternate disposal areas shall be borne by the Contractor and all materials deposited thereon and all operations incidental thereto shall be at the expense and risk of the Contractor.

3.15 SUBMERGED PIPELINES

(a) In the event the Contractor elects to submerge his pipeline, the location of the submerged pipeline shall be marked with signs, buoys, flags, and lights conforming to U.S. Coast Guard regulations and to the complete satisfaction of the Contracting Officer.

(b) At locations where submerged pipeline crosses a navigation channel, the Contractor shall place the pipeline at such a depth that the top of the pipe is below the authorized depth of the channel. The Contractor shall install and maintain red over red lights on both sides of the navigation channel marking the location of the submerged pipeline. At locations supported by trestle, the Contractor shall also install and maintain flashing yellow lights at 10 meter intervals from the red light marking the location of the pipeline to the shoreline. The contractor shall erect and maintain a warning sign at locations where submerged pipeline crosses a recognized navigation channel. The sign shall be 4' by 8' in size and read:

"CAUTION: SUBMERGED PIPELINE CROSSING."

(1) Red over red lights shall be visible all around the horizon, visible for at least 2 miles on a clear dark night and one meter apart in a

vertical line with the lower light at the same height, not less than 1 and not more than 3.5 meters, above the water at the yellow lights.

(2) Flashing yellow lights shall flash at a rate of 50 to 70 times per minute, shall be visible all around the horizon, shall be visible for at least 2 miles on a clear dark night, shall be not less than 1 and not more than 3.5 meters above the water, shall be equally spaced.

(c) When the submerged pipeline runs outside the navigation channel, the Contractor shall mark the pipeline route with buoys with yellow lights at intervals not to exceed 50 meters unless otherwise approved by the Contracting Officer and at abrupt changes in direction. The Contractor shall also erect signs at one (1) mile intervals along routes of submerged pipelines. The signs shall be 4' by 8' and read:

"CAUTION: SUBMERGED PIPELINE."

(d) All lights shall be visible for at least 2 miles on a clear dark night, visible all around the horizon, not less than one (1) and not more than 3.5 meters above the water and equally spaced.

3.16 DEBRIS SCREENING

The Contractor may encounter wood and other debris within the dredging limits. The wooden debris may consist of tree trunks, stumps, roots, and limbs. The size of the wood may vary considerably. All excavated material removed by mechanical dredge (clamshell, dragline, or dipper) or hopper dredge shall be screened for debris prior to disposal in the designated disposal zone of the new Ocean Dredged Material Disposal Site (ODMDS). In areas where the Contractor elects to drill and blast with overburden in-place, subsequent excavation of material (overburden and rock) by mechanical dredge will not require screening prior to disposal in the new ODMDS. Material excavated by pipeline dredge will not require screening prior to disposal.

3.16.1 Mechanical Dredge

If a mechanical dredge is used for excavation, the Contractor shall design and furnish a debris screen with a maximum hole opening size of 15 inches square. The screen shall be designed and constructed for repeated use and maintain structural integrity when subjected to repeated placement of excavated material from the river bottom. The Contractor shall submit a debris screen design along with plans and specifications to the Contracting Officer for approval prior to commencement of dredging. The Contractor shall be required to obtain the Contracting Officer's written approval of the debris screen a minimum of five (5) days prior to commencement of dredging. All costs associated with design, construction, deployment, operation, and maintenance of the debris screen and disposal of debris shall be included in the contract unit price for "Unclassified Excavation."

3.16.2 Hopper Dredge

Inflow baskets or screens over the hopper inflow(s) shall be maintained in operational condition throughout the period of work. Debris shall be cleaned from the baskets or screens and disposed of in accordance with subparagraph, Disposal of Wood and Other Debris, below.

3.16.3 Disposal of Wood and Other Debris

Wood and other debris shall be placed in a separate barge or other conveyance and disposed of in a public or private upland disposal area in accordance with all applicable Federal, State, and local laws and regulations. Bidders are expected to investigate the availability of disposal areas and any restrictions associated with each prior to submitting their bids.

3.17 REQUIRED TRANSPORTATION ROUTE

For surface vessel transportation of dredged material to the new Ocean Dredged Material Disposal Site (ODMDS) disposal zone, the vessel(s) shall travel in the current navigable channel at the time the work is being performed. When using the existing Baldhead Shoal Channel alignment, the vessels shall remain in the buoyed navigation channel until they are seaward of Buoy "2". When using the new Baldhead Shoal Channel alignment, the vessels shall remain in the buoyed channel until they are seaward of the seaward most buoy. These vessels shall return to the site of work by the same route. A vessel bypass corridor to the east of, parallel to, and within 1000 feet of the Baldhead Shoal Channel (existing alignment) may be authorized if needed to avoid recurring navigation conflicts. This corridor extends from Buoys "10" to "2". The Contracting Officer will authorize the use of the bypass corridor as needed.

3.18 SURFACE TRANSPORT OF DREDGED MATERIAL

(a) Transportation of dredged material by barges and scows to the new ODMDS will be allowed for this contract. All disposal vessels shall be equipped with draft and position measuring and recording devices. These instruments shall be kept in good working order. Vessel draft and vessel position data shall be obtained and recorded in accordance with paragraph, OCEAN DISPOSAL VERIFICATION.

(b) All scows shall be kept in good condition and the coamings kept in good repair. All scows shall have their pockets provided with proper doors or appliances to prevent leakage of material. Failure to repair leaks will result in suspension of dredging. If suspension occurs, dredging will not be allowed to resume until the Contractor has promptly repaired the scow to the satisfaction of the Contracting Officer. Overflow of scows to obtain an economic load will be allowed from station 0+00 of Upper Brunswick Channel to the downstream limits of the project at the intersection of Reaves Point and Horseshoe Shoal Channel. No overflow associated with any dredging operations is allowed upstream of station 0+00 of Upper Brunswick Channel. See paragraph, SITE SPECIFIC INFORMATION, for dredging windows for pipeline dredges, hopper dredges, and mechanical dredges. All scows shall be equipped with radio control dump mechanisms.

(c) Two photographs shall be taken of each scow or barge immediately prior to its departure to the disposal site. One photograph shall be taken from the bow and the other from the stern of each scow or barge. The two photographs shall provide documentation of the entire contents of the scow

hopper or barge. All photographs shall be taken with a digital camera using JPEG format and recorded on floppy disk. Digital camera shall be a Sony, Mavica series MVC-FD91 or approved equal. For all photographs, the camera shall be set for "normal" recording mode, 1024 x 768 image size, and fine resolution. The correct time and date shall be imprinted on each photograph. A floppy disk containing a JPEG file for each photograph shall be provided to the Contracting Officer within 24 hours of departure of the scow or barge to the disposal site.

3.19 HAWSER LENGTH

The Contractor shall be required to document the length of cable or hawser released during the tow of each scow or barge to the disposal site. The distance between the scow and the towing vessel shall be noted for each disposal event and made a part of the daily report of operations. A digital compass shall be used to provide an azimuth to the scow.

3.20 OCEAN DISPOSAL VERIFICATION

a. The Contractor shall prepare and operate under an approved ocean disposal verification plan. This plan shall include an automated system that will record the horizontal location and draft condition of the disposal vessel (scow or hopper dredge) from the time dredging ceases and the transit to the disposal area begins until dredging begins again. Vessel positioning as a minimum shall use either a microwave line-of-sight system or differential global positioning. Required digital data to be collected and recorded for each load is as follows:

1. Sequential load number
2. Date
3. Time, vessel position, and draft in one minute intervals for the disposal cycle specified previously, positioning in North Carolina state plane coordinates, draft in feet.
4. Begin and end dump event times and positions

b. This data shall be maintained by the Contractor and provided to the Contracting Officer, in ASCII digital format on a 3.5 inch, 1.44 MB diskette or other format agreed to by the Contracting Officer.

c. To document that dredged material is being appropriately placed within the disposal zone, the Contractor shall provide two navigation records for each dump event. One of these shall be a track plot of the data recorded and the other a numerical data printout of the data requested. The track plot shall show the positions of Buoy "1" and Buoy "2" verifying the Required Transportation Route stated in paragraph, REQUIRED TRANSPORTATION ROUTE, above. The interval of events actually plotted or listed herein may be adjusted for clarity after coordination and agreement by the Contracting Officer. Both of these must indicate the start and stop dump times. These records shall be submitted in a complete, neat, and orderly manner on a weekly basis to the Contracting Officer.

d. The Contractor shall also maintain a manually documented dump event log on the form provided or equipment agreed upon by the Contracting Officer. This log shall contain the following and be submitted, on a daily basis to the Contracting Officer.

1. Sequential load number
2. Scow or disposal number (or name)
3. Date
4. End dump event time and state plane coordinates

e. The Contractor shall maintain an electronic spreadsheet data record of the ocean dumping project information. The spreadsheet shall be prepared in a form readily exportable to Microsoft Excel 5.0 and shall be similar to the sample form provided in Attachment 2. The spreadsheet shall contain the following:

1. Vessel Name
2. Sequential Load Number
3. Date (month/day/year)
4. Start Dump Time (24 hour clock)
5. Start Dump Position (x position NC State Plane Coordinate)
6. Start Dump Position (y position NC State Plane Coordinate)
7. Observed depth at dump location
8. Responsible party on watch
9. Estimated quantity in load (cy)
10. Dredging range or location

f. This spreadsheet shall be updated and submitted weekly in digital (electronic file) format to the Contracting Officer. The dump positions reported in the spreadsheet shall come from the silent inspector (Automated Navigation Recording).

g. The verification plan shall be in operation throughout dredging and disposal operations. The Contractor shall provide an example of the ocean disposal verification submittals prior to the disposal of the first load. If for any reason the verification data devices stop functioning, they shall be repaired or replaced immediately upon return to the work site. No vessel shall leave for the disposal site without the ability to collect and record the ocean disposal verification data specified. Material placed without the specified verification data shall be considered misplaced materials under this contract.

h. Horizontal location shall have an accuracy equal to or better than + or - 10 feet (horizontal repeatability). Vertical data (draft) shall have an accuracy of + or - 1/2 foot. Horizontal and vertical data shall be collected in sets and each data set shall be referenced to local date and time (to the nearest minute) and shall be referenced to the same geographic reference system used for the survey(s) shown in the contract drawings.

3.21 EMERGENCY DUMPS

If a vessel experiences an emergency situation which causes a dumping of material outside of the designated disposal zone, the Contractor shall verbally notify the Contracting Officer no later than the next work day. The Contractor must submit, in writing within two (2) days of the emergency dump, a statement detailing time of dump, location of dump, and reason dump occurred. Material that is misplaced due to an emergency dump situation is subject to removal by the Contractor at his own expense upon the request of the Contracting Officer.

3.22 EMERGENCY PLAN FOR OBSTRUCTION TO NAVIGATION

The Contractor shall submit an Emergency Plan for Obstruction to Navigation prior to commencement of work. The Emergency Plan for Obstruction to Navigation is the Contractor's plan for clearing the channel in the event that safe passage of vessels is compromised due to an obstruction in the channel. Displaced sediment and/or rock, shoaling, or any object in the channel which may be a hazard to navigation will be considered an obstruction to navigation. This plan shall include but not be limited to the following:

a. Procedure for determining the location (both horizontal and vertical) of the obstruction.

b. Procedure for determining the nature of the obstruction (rock or sediment).

c. Procedure for notifying the U.S. Coast Guard Marine Safety Office, Cape Fear Pilots Association, and the Government of an obstruction in the channel.

d. Method of clearing or removing obstructions from the channel.

3.23 MISPLACED MATERIAL

Any material, including material lost through leaks in the pipelines, that is deposited or allowed to flow elsewhere than in places designated or approved by the Contracting Officer will be considered as misplaced material. If, in the opinion of the Contracting Officer, this misplaced material will in any way be a hazard to navigation, to normal activities of the public, or to the environment, the Contractor shall remove such misplaced material and deposit it where directed at the Contractor's expense. Misplaced material includes dredged material deposited outside the specified new Ocean Dredged Material Disposal Site (ODMDS) disposal zone and any dredged material mounded higher than elevation -30 feet MLLW within the ODMDS disposal zone.

3.24 SITE SPECIFIC INFORMATION

3.24.1 Unclassified Excavation

3.24.1.1 Order of Work

The first order of work (phase 1) shall consist of deepening the existing channel from station 39+70 in the Anchorage Basin to station 60+00 in Lower Brunswick Channel and from station 55+00 in Keg Island channel through Reaves Point channel. Phase 1 shall also include constructing the turn widener at the intersection of Upper Brunswick and Lower Brunswick channels and the widener on the northwest side of the turning area within the Anchorage Basin.

and the widener on the northwest side of the turning area within the Anchorage Basin.

The second order of work (phase 2) shall be to construct a 100-foot widener on the west side of the Fourth East Jetty Channel, a 100-foot widener on each side of Lower Lilliput Channel and a 200-foot widener on the west side of Upper Midnight Channel and Lower Midnight Channel. Phase 2 shall also include constructing a turn widener at the intersection of Upper Lilliput and Lower Lilliput Channels and at the intersection of Lower Midnight and Reaves Point Channels.

See paragraph 52.211-10 of SECTION 00800 for construction period for all work and for Phase 1 completion date.

3.24.1.2 Dredging Plan

The Contractor shall submit a dredging plan for accomplishing the unclassified excavation to the Contracting Officer for approval prior to commencement of dredging. The dredging plan shall identify acceptance sections and the order in which the acceptance sections will be deepened to project depth.

3.24.2 North Carolina State Ports Authority Berth Area Deepening

If the optional bid item, North Carolina State Ports Authority Berth Area Deepening, is exercised by the Government, the Contractor shall accomplish the berth area deepening concurrent with the adjacent Phase 1 unclassified excavation work in the Anchorage Basin, Between Channel and Fourth East Jetty Channel. The Contractor's Dredging Plan shall address deepening of the berth areas. In the event the optional bid item is not exercised by the Government, the Dredging Plan shall also present an alternative plan which does not include the berth area work.

3.24.3 Maintenance Dredging

Maintenance dredging shall be accomplished at shoaling locations as directed by the Contracting Officer throughout the life of the contract to provide for the current project depth in the maintenance dredging channel areas as defined in paragraph, DESCRIPTION OF WORK. Maintenance dredging shall be accomplished by separate piece of equipment other than that being used to accomplish the unclassified excavation and North Carolina State Ports Authority berth area deepening. Maintenance dredging volumes for the existing 38-foot project for each year dating back to 1989 are provided on attachment 3. As shown in the table some channel reaches are dredged once a year while others are dredged less frequently. Shoaling patterns may change due to the channel deepening and construction of the channel and turn wideners. The Contracting Officer will identify the areas which require maintenance dredging and provide written notice to the Contractor to proceed to the areas to perform maintenance dredging. Within 30 days of receipt of the written notice, the Contractor shall begin removal of maintenance material from the specified area(s).

3.24.4 Environmental Windows

The dredging window for pipeline dredges performing unclassified excavation, North Carolina State Ports Authority berth area deepening and maintenance dredging is August through January, inclusive. The dredging window for hopper dredges is 16 November to 31 January, inclusive. Dredging with mechanical dredges (clamshell, dragline, and dipper) may be

performed throughout the year. Blasting is restricted to the months of August through January, inclusive.

3.25 GEOTECHNICAL INVESTIGATIONS

3.25.1 Boring Logs

Drilling logs of borings applicable to the subsurface investigation of the project site are provided in Appendix A. See the drawings for boring locations and bathymetry information.

Results of the above mentioned explorations are representative of subsurface conditions at their respective locations and for their respective vertical range of drilled depth. Local variations in the subsurface materials are to be expected.

Materials recovered from soil and rock core borings are available for examination. The materials are located in Wilmington, NC. Arrangements to examine the materials shall be made with Jimmy Hargrove of the Wilmington District office by calling (910) 251-4479.

3.25.2 Top of Rock

On drilling logs the soil and top of rock contact, Top of Rock, was determined by splitspoon refusal, geologic criteria, and rock coring. Splitspoon refusal is that point at which a splitspoon does not penetrate a foot of material with one hundred blows of the 140-pound hammer falling 30-inches. Rock coring below the point identified as Top of Rock confirms or establishes actual top of rock. In non-core borings top of rock may be tentatively identified as Assumed Top of Rock or Probable Top of Rock by fishtail bit refusal or jet probe refusal. Fishtail bit refusal is the point that, while drilling, overburden material resistance to drilling action stresses the drilling equipment, drilling penetration rate decreases, and to continue drilling with the fishtail bit could cause damage to the bit, rods, or drill rig. Jet probe refusal is that point at which the advancement of an opened end string of drill rods being jetted down with water encounters a solid resistance and upon bouncing the end of the rods on the resistant material produces the sound and vibration interpreted by geotechnical technicians or professionals as steel striking indurated material and lacking physical characteristics associated with soils.

3.25.3 Unconfined Compressive Strength

Select intervals of rock specimens from recently drilled core borings were tested for unconfined compressive strength (UCS). Available unconfined compressive strengths of rock specimens from core borings drilled in the project area channels are provided in Appendix C. Specimen selection from rock core specimens was usually based on selecting the most competent looking rock above or below the project design elevation.

3.25.4 Sieve Analyses

Sieve analyses of selected soil samples are provided in Appendix B. Visual classifications based on the sieve data are included on the gradation form.

3.25.5 Geophysical Investigations

Seismic investigations were conducted in the project site. Geophysical

reports which will be available for review at the Wilmington District office upon request are listed below:

1. Geophysical & Subsurface Interpretation For Selected Locations Along Cape Fear River, Wilmington Harbor, North Carolina; February 1995 by C&C Technologies, Inc., Lafayette, Louisiana.

2. Sub-bottom Geophysical Profiling & Mapping of Top of Rock; Cape Fear River, Wilmington Harbor, North Carolina; August 1997 by C&C Technologies, Inc., Lafayette, Louisiana.

3. Final Report Geophysical Investigation, Wilmington Harbor, Cape Fear River, Wilmington, North Carolina; by Ocean Surveys, Inc., Old Saybrook, CT, April 1994.

3.25.6 Previous Blasting

During dredging of the Wilmington Harbor channel to a project depth of -38 feet MLLW, circa 1970, in or in the vicinity of the project area, blasting was required to finish what was started with a rock cutter head dredge. The blasting may have left shattered and broken rock overlying intact rock in the channel. The Contractor shall evaluate the boring logs to judge if this project site has been affected by the blasting. The existence or whereabouts of the documentation of previous blasting is unknown.

3.26 GENERAL GEOLOGY

3.26.1 Physiographic Province

The project area is in the Coastal Plain Physiographic Province (COASTAL PLAIN) of the Eastern United States. The Coastal Plain is comprised of sand, gravel, clay, silt and admixtures of these sediments which may be unconsolidated to various stages of induration and poorly to well cemented carbonate and other sedimentary rock. The Coastal Plain deposition is wedge-shape with the thin edge in the west overlying a portion of the eastern Piedmont Physiographic Province and the thickened edge in the east covered by the Atlantic Ocean. This Coastal Plain deposition overlies crystalline basement rock. In the Cape Fear area the depth to crystalline basement rock is approximately 1,500 feet.

3.26.2 Geomorphology

The historical geologic development of the Cape Fear area includes cycles of erosion and deposition and transgressions and regressions of the antediluvian ocean contemporaneously with the evolution of the Cape Fear River. During the geomorphological development of the area, sediments were deposited and then all or portions of the deposition may have been removed or scoured by transgressions and regressions of the ocean or the meandering developing Cape Fear River. Subsequently, these scoured areas or channels may have been filled in with younger material. Some of this material may have been indurated while other remained soil-like in character. As the Cape Fear River meandered across the area depositing and eroding sediments and rock, it developed and abandoned river channels through geologic time. Various geologic processes produced irregular rock surfaces of the geologic formations underlying the river sediments in the project area. These geologic processes generally produced geologic erosional features where younger rock is surrounded by older rock, outliers, older rock is surrounded by younger rock, inliers, and lithologies having irregular subsurfaces with different geologic formations separated by erosional

surfaces called unconformable contacts (or unconformities). An unconformity is a substantial break in the depositional record where a rock unit is overlain by another that is not next in stratigraphic succession.

3.26.3 Rock Associated with Unconformities

A dolomitic or calcite cemented rock is often associated with unconformities on this project. This rock varies in thickness from a few inches to several feet thick. This rock exhibited some of the highest unconfined compressive strengths observed on this project. See Appendix C.

3.26.4 Areal Geology

The areal distribution of the rock can be unique for individual reaches (or channels) of Wilmington Harbor. A geologic formation encountered in one reach of Wilmington Harbor at some given elevation can vary in character at the same elevation at another reach of Wilmington Harbor. For example, it can be more or less sandy, porous, fossiliferous, or cemented. High UCS rock can be encountered at the same elevation of low UCS rock a short distance away. As another example, the geologic formation will not be encountered at the same elevation throughout Wilmington Harbor. This uniqueness is attributable to the type of rock deposited, the rock surface undergoing compositional development, erosion, or deposition as the ocean regressed and transgressed contemporaneously with the ancient Cape Fear River meandering across the area cutting channels to be buried or removed by later geomorphological development. More information on the Geology of the area may be obtained from a report by Dr. W. Burleigh Harris titled "Evaluation, Analyses, and Delineation of the Geology, Wilmington Harbor, Brunswick and New Hanover Counties, North Carolina", 14 June 2000. This report is provided in Appendix D.

3.27 CHARACTER OF MATERIALS

3.27.1 Soils

The soils encountered in Wilmington Harbor is predominantly alluvium, and may overlie weathered rock having the characteristics of soil. The alluvium generally may be comprised of sand, silt, clay, or admixtures of these with or without varying amounts of organics. Peat, wood, and other organic material may, in places, be encountered in the soils in Wilmington Harbor.

The soil types that are likely to be excavated are described in the boring logs in Appendix A. In places, the standard splitspoon penetrated the material by the weight of the rods and/or weight of the hammer. This low N value soil may contribute to stability problems when it is excavated or disturbed by blasting. Aggressive construction engineering may be required to handle woody or low N value material. Weathered rock encountered in borings was usually field classified as a GW or GP. Its thickness varies, and its composition will vary according to the type of parent rock decomposing. In places (see boring logs) well-cemented rock was underlain by the sediments of the Pee Dee Formation. The Pee Dee Formation sediments in the project site have the characteristics of a soil with some interbedded cemented zones, and in some borings it was splitspooned to the desired termination elevation.

3.27.2 Rock

Rock encountered in the project area may be limy, dolomitic, silty, or sandy carbonate of Tertiary or Cretaceous age. The carbonate rock may be fossiliferous and vary from poorly to well cemented. The thickness of the well cemented rock varies. In the core borings for the subsurface investigation of Wilmington Harbor, generally, geologic formations were observed not to have uniform thickness with distinct observable bedding planes. In places, the rock of the Rocky Point Member of the Peedee Formation may be interbedded with sand.

3.27.3 Geologic Formations

From oldest to youngest the geologic formations consist of the Peedee Formation, Rocky Point Member of the Peedee Formation (hereafter referred to as Rocky Point Member), Castle Hayne Limestone (Unit A) and, Castle Hayne Limestone (Unit B). Rock encountered in borings at specific locations are described in the boring logs in Appendix A. The general description of the geologic formations encountered are from a U.S. Army Corps of Engineers, Report of Investigation, "Identification of Geologic Formations, Wilmington Harbor Channel Widening, New Hanover and Brunswick Counties, North Carolina", by Harris and Laws (1994).

3.27.3.1 Peedee Formation

The Peedee is interbedded mudstone, gray to green-gray or tan to brown very fine to fine calcareous to dolomitic sand, and muddy, calcareous, glauconitic very fine to fine quartz sand. Zones of lithification are random.

3.27.3.2 Rocky Point Member

The Rocky Point Member consists of "calcareous quartz sandstone and sandy molluscan-mold grain stone." Its hardness varies from soft to very hard. In places it contains solution filling of Castle Hayne limestone.

3.27.3.3 Castle Hayne Limestone, Unit A

Unit A unconformably overlies the Rocky Point Member. This Unit A is usually a "well-indurated, cross-bedded, bryozoan limestone."

3.27.3.4 Castle Hayne Limestone, Unit B

Unit B is generally "fossiliferous with some gravel size brachiopods, sand dollars, and pelecypod fossils. Some lenses of medium grained limestone similar in appearance to that found in Unit A occurs but is poorly lithified or unlithified and is not cross-bedded."

3.28 COMPLIANCE WITH APPLICABLE NAVIGATION RULES AND REGULATIONS, MARINE EQUIPMENT

The Contractor shall ascertain that all vessels used in performance of this contract are commanded, equipped, navigated and/or operated in strict compliance with the general regulations of the Department of the Army and of the U.S. Coast Guard, including but not limited to, applicable safety, environmental, and navigational rules and regulations in the Code of Federal Regulations.

Installations (i.e., pipelines, pipeline risers and/or booster stations) as

may be placed by the Contractor on or over the seabed of the work area are obstructions or structures in accordance with Title 33 CFR SUBPART 67.01. Such installations or portions thereof, are subject to applicable regulations set forth in Title 33 CFR, parts 64, 66 and 67. The responsibility for notifying the Commander, Fifth Coast Guard District, per Title 33 CFR SUBPART 67.40 and the responsibility of securing necessary installation approvals therefrom, rests with the Contractor. The further responsibility for maintaining and operating his job site installation and vessels in accordance with applicable laws also rests with the Contractor.

3.29 FLOATING PLANT INSPECTION AND CERTIFICATION

All floating plant regulated by the U.S. Coast Guard (USCG) shall have current inspections and certificates issued by the USCG before being placed in service and a copy shall be posted in a public area on board the vessel. A copy of any USCG Form 835 issued to the vessel in the preceding year shall be onboard the vessel and shall be available to the Contracting Officer upon request.

All dredges and quarter boats not subject to USCG inspection and certification or not having a current American Bureau of Shipping (ABS) classification shall be inspected in the working mode annually by a marine surveyor accredited by the National Association of Marine Surveyors (NAMS) or the Society of Accredited Marine Surveyors (SAMS) and having at least five years experience in commercial marine plant and equipment. All other plant shall be inspected annually by a qualified person. The inspection shall be documented, and a copy of the most recent inspection report shall be posted in a public area on board the vessel and a copy shall be furnished to the Contracting Officer upon request. The inspection shall be appropriate for the intended use of the plant and shall, as a minimum, evaluate structural integrity and compliance with NFPA 302, Fire Protection Standard for Pleasure and Commercial Motor Craft.

3.30 REPORTING REQUIREMENT

The Contractor will be required to prepare daily a "Report of Operations" (Attachment 4 and Attachment 5 of Section 01451) and furnish copies thereof to the Contracting Officer. The contractor shall furnish daily a copy or copies of any Contractor forms or operational reports he routinely requires to be submitted by his field personnel.

3.31 QUALITY CONTROL

The Contractor shall establish and maintain quality control for the dredging and all other operations in connection therewith to assure compliance with contract requirements. The Contractor shall inspect for compliance with contract requirements and record the inspection of all operations including but not limited to the following:

Dredging is confined within the limits shown on the drawings.

The pipeline is periodically inspected for leakage as specified.

All joints of pipe for discharge line are tight and sound.

A copy of these quality control records, as well as the records of corrective action taken will be furnished the Government as directed by the Contraction Officer.

3.32 TIDE DATA

3.32.1 Real Time Kinematic (RTK) GPS

RTK GPS will be used by the Corps of Engineers for determining Real Time water levels (tide corrections) in the Wilmington Harbor Project. If the Contractor desires to obtain these corrections, he is responsible for providing an RTK capable GPS receiver and a radio modem in order to receive carrier-phase corrections from the Corps-owned RTK GPS reference station located at the Oak Island Coast Guard Station. Radio frequencies should be obtained from Mr. Marc Reavis at (910) 251-4489. The Contractor will be instructed as to the proper use of this system by Corps personnel.

3.32.2 Kinematic Tidal Datum

A file listing the separations between the Reference Ellipsoid and the Chart Datum (Mean Lower Low Water) will be provided to the Contractor for entry into the hydrographic survey software. A Tidal Datum Diagram showing the relationship between NAVD 88 and Mean Lower Low Water will be provided upon request.

3.32.3 Non-Operational Reference Station

In the event that the reference station becomes non-operational, the Contractor shall contact Mr. Marc Reavis at the telephone number shown above. The Government will take measures to ensure correction of any problems with the GPS equipment located at the Oak Island Coast Guard Station within 72 hours of notification.

3.33 EAGLE ISLAND DISPOSAL AREA DIKE MONITORING DURING BLASTING AND DREDGING

3.33.1 General

The stability of the Eagle Island Disposal Area Dikes is vital to the success of the project. To maintain the stability of the dikes, the Contractor shall be required to monitor the dike at Cell No. 2 and selected areas of the other two dikes, during all blasting and dredging that takes place in the Anchorage Basin, from station 39+70 to station 84+83.64. In some areas the dikes at the Eagle Island Disposal Area have experienced slope instabilities in the past. Although the dikes have been rebuilt and strengthened, stability monitoring along the dike of Cell No. 2, shall be required from station 45+00 to station 80+00. The areas selected for monitoring are shown on Plate P-28 of the plans. The requirements below are in addition to the requirements for blasting in Section 02200.

3.33.2 Government Furnished Information

The Government will furnish all available information and data, collected by the Government's monitoring A/E, to the Contractor. This information will include survey line locations, survey points with location and elevation, piezometer locations, top of piezometer tube elevation, bottom of piezometer tube elevation, piezometer installation diagram showing the piezometer cross-section, water level elevation in the tube and the point from where the level is measured.

3.33.3 Contractor Experts

As part of the monitoring program the Contractor shall hire a Land Surveyor and a Geotechnical Engineer, both registered in the State of North Carolina. The Land Surveyor shall collect the piezometer and survey data. The Geotechnical Engineer shall have a minimum of five (5) years experience with slope stability analysis and problems that deal with vibrations. The Geotechnical Engineer shall interpret the collected data and present the data to the Government in electronic form.

3.33.4 Minimum Monitoring Requirements

The Government has established some monitoring points which the Contractor shall assume control of, from the Government hired A/E firm, prior to dredging and blasting within the Anchorage Basin limits given above. The Contractor shall find as part of the existing monitoring plan for the Eagle Island Disposal Dikes, the following:

a. A minimum of five survey lines on the dike of Cell No. 2 on the Cape Fear River side. Other survey lines established include five survey lines at Cell No. 1, three survey lines on the Brunswick River side of Cell No. 2, and three survey lines at Cell No. 3. Each line shall have a minimum of three points for monitoring vertical and horizontal movement to within 0.10 feet. The three points shall be the top of the outward slope, the toe of the outward slope, and twenty-five feet from the toe.

b. At the outward toe of each survey line there shall be an open tube piezometer.

In addition to the Government provided instrumentation, the Contractor shall provide a minimum of 5 seismographs, installed and operational, located at the outward toe of the dike. The seismographs shall meet the requirements as specified in Section 02200 of these specifications. The Contractor shall maintain the sensitivity adjustment of all seismographs to avoid continuous non-detect readings. A minimum of two seismographs shall be at the riverside toe of Cell No. 2 from station 45+00 to station 80+00. The other three seismographs shall be located at sites along the dikes shown on the drawings. The Contractor's experts shall evaluate this minimum monitoring plan. If the Contractor recommends that additional instrumentation is needed, he shall submit a plan to the Contracting Officer, but all additional instruments and work shall be at the Contractor's expense. The Contractor shall maintain all survey lines and points and the piezometers for the required monitoring period. The monitoring period is the time to complete the dredging and/or blasting in the designated area plus a 2 month period, which begins immediately after completion of the dredging and/or blasting in the designated area.

3.33.5 Minimum Monitoring Frequency

The Government will establish a monitoring program prior to dredging and/or blasting to allow for collection of baseline data. Once dredging and/or blasting operations begin in the Anchorage Basin, from station 39+70 to station 84+83.64, the Contractor shall collect the data from the survey lines and piezometers a minimum of once a day. During blasting operations, the data shall be collected after every blast. The seismographs shall operate continuously during blasting and/or dredging operations within the designated area. The monitoring data shall be collected for 2 months after dredging and/or blasting operations in the Anchorage Basin, from station

39+70 to station 84+83.64, are complete at the frequency of once a week for two months. The Contractor shall vary the day of the week for data collection, but the data shall be collected a minimum of 5 days and a maximum of 8 days apart. The seismographs do not need to operate during this 2 month period, but should remain in-place and operational if needed.

3.33.6 Data to be Collected

The Contractor shall collect the locations (x & y) of the survey points, the elevation of the survey points, piezometer locations (x & y), the elevation of the top of the piezometer tube, and the depth to water from the top of the piezometer tube, as measured in the tube. The Contractor shall organize the data and show the difference between the latest readings and the previous reading, and the difference between the latest reading and the reading measured just prior to the start of dredging and/or blasting operations. The Contractor shall also show the piezometer readings in plotted form. The Contractor shall take all necessary pictures of Eagle Island Disposal Area Dikes, before, during, and after the blasting/dredging operations as visual documentation, and submit the pictures to the Contracting Officer.

3.33.7 Reporting of Data

The Contractor shall submit all data collected, in plotted form, to the Contracting Officer within 24 hours of being collected. The Geotechnical Engineer shall provide a verbal recommendation after each event before the succeeding blast may occur, and daily before continuing dredging. This requirement may be relaxed after appropriate experience upon recommendation of the Contractor's expert and the approval of the Contracting Officer. The data shall be presented in a logical, readable and understandable manner and attached electronically in text or Excel format to the daily QC report. The Geotechnical Engineer shall review the data daily to determine if a critical threshold value of movement that requires immediate action has been reached. If the readings indicate a dike movement equal to or greater than 0.25 feet per 24 hour period, then work shall cease and the Contracting Officer notified immediately. If cumulative movement over the course of the monitoring period is greater than or equal to 1.0 feet, then work shall cease and the Contracting Officer notified. In both cases, work shall be ceased until the Contractor and the Contracting Officer agree that it may continue, without endangering the stability of the dike(s). If the cumulative 1.0 foot limit is reached, the Geotechnical Engineer and the Contracting Officer will decide on a daily basis whether work shall continue. During the two (2) month period, after dredging and/or blasting has been completed, the Contractor shall submit his report of data collected every two weeks, or after every two readings.

3.33.8 Contractor Responsibility

As stated in other sections of these specifications, the Contractor is responsible for protecting all man-made structures, including the dikes on Eagle Island, from damage. In the event of damage, such as slope failures or anything else which jeopardizes the use of the cells or dikes, as a result of his negligence or improper operations, the Contractor shall be responsible for the repair of the dike(s), at no expense to the Government. At the end of the two month monitoring period, the Contractor shall submit two (2) copies of a monitoring report to the Contracting Officer. The report shall be in electronic form, CD's, and shall contain all data collected, locations of all survey points, piezometers, and seismographs, and any recommendations made during the operation concerning the

monitoring. The Contractor shall submit this report within four (4) weeks of the end of the monitoring period defined above.

3.33.9 Measurement and Payment

No separate measurement for payment will be made for monitoring work required by this paragraph, 3.33. All costs for labor, materials, equipment, tools, supplies, and incidentals necessary to complete the monitoring work required by paragraph 3.33, shall be included in the cost for "Unclassified Excavation - Sta. 39+70 Anchorage Basin to Sta. 60+00 Lower Brunswick Channel" of the BIDDING SCHEDULE.

3.34 SUBMARINE UTILITIES

Submarine utilities owned by AT&T Inc. and ExxonMobil Chemical Company cross the river in the Fourth East Jetty Channel. The AT&T utility is a light guide cable installed by directional bore in approximately 1988. The ExxonMobil Chemical Company utilities consist of one 4-inch and two 6-inch pipelines which were trenched into the river bottom in 1973. An additional 6-inch pipeline was installed for ExxonMobil Chemical Company by directional bore in 1993 and currently carries paraxylene. The Contractor shall contact each utility owner prior to commencement of work.

3.35 RESTRICTED WORK AREA

One of the three ExxonMobil Chemical Company pipelines trenched into the river bottom in 1973 is leased and used by North Carolina Natural Gas Corporation (NCNG) to carry natural gas (the other two pipelines are not in use). Therefore, a restricted work area exists between station 57+80 and station 58+60 in the Fourth East Jetty Channel as indicated on Plate P-4 of the drawings. The drawings include Plate R-1 which is a reference drawing indicating known existing locations of the ExxonMobil Chemical Company pipelines. Special requirements apply to work in the restricted work area. All work in this area shall be coordinated with ExxonMobil Chemical Company and NCNG. Written documentation of this coordination shall be submitted prior to commencement of work.

Point of contact with ExxonMobil Chemical Company is Mr. Greg Ferrone at telephone number 281-870-6817. Mr. Ferrone's address is:

ExxonMobil Chemical Company
13501 Katy Freeway
Houston, Texas 77079-1398

Point of contact with NCNG is Mr. Tim Greenhouse at telephone number 910-350-2200. Mr. Greenhouse's address is:

NCNG
P.O. Box 4489
Wilmington, NC 28406

A minimum of four weeks notice to NCNG is required prior to commencement of work in the restricted work area. NCNG will arrange to shutdown and purge this line prior to dredging activities in the restricted work area.

Work shall proceed continuously in the restricted work area until all dredging is completed across the entire width of the channel including the 100-foot widener and the side slopes prior to commencing work in other

areas. All work in this area shall be completed within two calendar days.

The following special requirements shall apply while working in the restricted work area:

1. There shall be no blasting.
2. No spuds or anchors shall be set within this area.
3. Material removal equipment shall not be placed any lower than elevation -45 feet MLLW.
4. Immediately after completion of work in this area the contractor shall perform a multi-beam clearance survey of the work area in accordance with the requirements in paragraph, NAVIGATION CONTROL DURING DRILLING, LOADING, AND BLASTING OPERATIONS, of Section, BLASTING, and provide three printed copies of the final plot to the Contracting Officer's Representative.

-- End of Section --

Quantities are based on Government surveys				
<u>Channel Reach</u>	<u>Required Depth (FT)</u>	<u>Cubic Yards to Required Depth</u>	<u>2-Foot Allowable Overdepth</u>	<u>Total Cubic Yards</u>
Reaves Point	-42	339,230	224,100	563,330
Lower Midnight	-42	1,231,610	395,810	1,627,420
Upper Midnight	-42	1,637,180	626,070	2,263,250
Lower Lilliput	-42	1,588,730	568,630	2,157,360
Upper Lilliput	-43	537,510	323,220	860,730
Keg Island	-43	123,970	76,660	200,630
Lower Brunswick	-43	474,710	218,610	693,320
Upper Brunswick	-43	366,650	159,700	526,350
Fourth East Jetty	-43	984,880	335,940	1,320,820
Between	-43	126,040	121,070	247,110
Anchorage Basin	-43	632,810	356,870	989,680
NCSPA Berth Areas	-43	31,000	22,000	53,000
	Totals	8,074,320	3,428,680	11,503,000

Appendix A

(Additional Borings)

**THESE BORINGS ARE INCLUDED FOR INFORMATION PURPOSES ONLY.
THEY ARE LOCATED OUTSIDE THE PROJECT LIMITS AND ARE NOT
SHOWN ON THE DRAWINGS.**

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit	
2. LOCATION (Coordinates or Station) E2319629.7 N142030.2 NAD 27		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)	
4. HOLE NO. (As shown on drawing title and file number) UBI-9-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED RIVER 22.3' DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 13.6' (Estimated)		16. DATE HOLE STARTED 9/SEP/89 COMPLETED 9/SEP/89	
8. DEPTH DRILLED INTO ROCK 5.1'		17. ELEVATION TOP OF HOLE 0.0	
9. TOTAL DEPTH OF HOLE 41.0'		18. TOTAL CORE RECOVERY FOR BORING 92.2 %	
		19. SIGNATURE OF INSPECTOR LARRY BENJAMIN	

ELEVATION 0.0	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) = d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Water			
-22.3	20.00		Assumed Top of Overburden @ 22.3'*			Core logged, 21 Sep. 1989, by Tong c. Haw Geologist. *Fathometer reading offset 9' East of borehole. Note: Changed Scale @ 20', 30', & 35.0'.
	30.00		Overburden not classified.			
	35.00					NAD 83 E 2319755.6 N 142051.5
-35.9	36.00		Top of Rock @ 35.9'			
	37.00		Castle Hayne Limestone: Moderately to well cemented in places; poorly cemented in places; predominantly fine grained fossil fragments occasionally glauconitic. 35.9' to 40.6' mostly broken-length of core estimated. 36.2' to 37.4' bryozoan fossil hash; friable; poorly cemented 37.4' to 40.6' occasional gravel size fossil fragments; occasionally well cemented in places.	100%	BOX 1 OF	PULL-1 FROM 35.9' TO 41.0' RUN 5.1' GAIN 0.0' REC 4.7' UL 0.0' LOSS 0.4'
	38.00				1	Pull-1 Cont. Sheet 2
			CONTINUED ON SHEET 2			

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE		Hole No.		
PROJECT		INSTALLATION		SHEET		
WILMINGTON HARBOR TURNS BENDS		WILMINGTON DISTRICT		OF 2 SHEETS		
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-38.0	38.00	FT c	d	e	f	g
			Castle Hayne Limestone: Same as above.		BOX	Pull-1 Continued
	39.00			100%	1	
	40.00				OF	
					1	
						CD 40.6'
-41.0	41.00		40.6' to 41.0' core left in hole.			
			BOTTOM OF HOLE AT 41.00'			

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit		
2. LOCATION (Coordinates or Station) E2317847.6 N144847.4 NAD 27		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW		
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)		
4. HOLE NO. (As shown on drawing title and file number) LB-9-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. RIVER 22.3'		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN 14.6' (Estimated)		16. DATE HOLE STARTED 7/SEP/89 COMPLETED 7/SEP/89		
8. DEPTH DRILLED INTO ROCK 5.0'		17. ELEVATION TOP OF HOLE 0.0		
9. TOTAL DEPTH OF HOLE 41.9'		18. TOTAL CORE RECOVERY FOR BORING 92 %		
19. SIGNATURE OF INSPECTOR LARRY BENJAMIN				

ELEVATION 0.0 a	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Water			Diamond bit 4"X5-1/2 Serial # 80PC1779 Core logged by R.W. Magee, 19 Sep 1989.
-22.3	20.00		Assumed Top of Overburden @ 22.3'*			*Fathometer reading offset 9' East of borehole. Scale changed at 20' and 30'.
	30.00		Overburden not classified.			NAD 83 E 2317927.5 N 144914.7
	31.00					
	32.00					
	33.00					
	34.00					

CONTINUED ON SHEET 2

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

0.0

Hole No.

LB-9-89

PROJECT

WILMINGTON HARBOR TURNS & BENDS

INSTALLATION

WILMINGTON DISTRICT

SHEET

2

OF 2 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-34.0	34.00 FT	c	d	e	f	g
			Overburden not classified.			
	35.00					
	36.00					
-36.9	37.00		Top of Rock @ 36.9' Castle Hayne Limestone: Mod. hard, cream, chalky with glauconite bivalve and echinoids (No bryozoans) glauconite increase at bottom section. Core broken, length est.			PULL-1 36.9' TO 41.9' RUN 5.0' GAIN 0.0' REC 4.6' UL 0.0' LOSS 0.4'
-38.0	38.00		Castle Hayne Limestone: New Hanover Member.		BOX	
	39.00		Limestone, hard, cream conglomeratic with lithic frags. glauconite and phosphatic upper 9' clasts are lithic frags. replaced with glauconite lower 1.3' clasts smaller, more rounded, phosphatic rock well cemented. With leached appearance lower 0.9' Algal? Bryozonian. clumps.	100%	1	
	40.00				OF	
-40.3	41.00		Pee Dee Formation, Limey sandstone, hard fine grained, gray, vertical solution vugs phosphatic clasts.		1	
						CD 41.5'
-41.9	41.90		Core left in Hole.			
			BOTTOM OF HOLE AT 41.90'			

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit	
2. LOCATION (Coordinates or Station) E2320072.0 N141586.8 NAD 27		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)	
4. HOLE NO. (As shown on drawing title and file number) LBI-1-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. RIVER 29.2'		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 4.8' (Estimated)		16. DATE HOLE STARTED 9/SEP/89 COMPLETED 9/SEP/89	
8. DEPTH DRILLED INTO ROCK 7.7'		17. ELEVATION TOP OF HOLE 0.0	
9. TOTAL DEPTH OF HOLE 41.7'		18. TOTAL CORE RECOVERY FOR BORING 80.5 %	
		19. SIGNATURE OF INSPECTOR LARRY BENJAMIN	

ELEVATION 0.0 d	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) - d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Water			Logged by R.W. Magee 09/20/89
	20.00					*Fathometer reading offset 9' East of borehole. NAD 83 E 2320151.9 N 141654.1
-29.2	30.00		Assumed Top of Overburden @ 29.2'*			NOTE: Changed scale @ 20', 30' and 35.0'.
			Overburden not classified.			
-34.0	35.00		Top of Rock @ 34.0'			
		CORE LOSS	Castle Hayne Limestone: Hard, white chalky, core broken with poor recovery. Core length and discription estimated.		BOX 1	PULL-1 FROM 34.0' TO 39.2' RUN 5.2' GAIN 0.0' REC 3.7' UL 1.5' LOSS 1.5'
	36.00		Castle Hayne Limestone: Hard, well cemented cream; coral, bivalve foram biomicruride numerous solution cavities coral molds-Calcite crystal fill in molds cavities lined with flower like structures.	71%	OF 1	
	37.00					
	38.00					
			CONTINUED ON SHEET 2			Pull-1 Cont. Sheet 2

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

0.0

Hole No. LBI-1-89

PROJECT

WILMINGTON HARBOR TURNS & BENDS

INSTALLATION

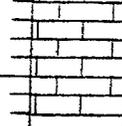
WILMINGTON DISTRICT

SHEET 2 OF 2 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-38.20	38.00 FT	c	d	e	f	g
			Castle Hayne Limestone: Same as above.	71%	BOX	PULL-1 Continued
	39.00				1	CD 39.2'
	40.00		Castle Hayne Limestone: Hard, well cemented, gray, molluscs, glauconite grains, solution along bedding plane; calcite crystals (brown) on solution cavities.	100%	OF	PULL-2 FROM 39.2' TO 41.7' RUN 2.5' GAIN 0.0' REC 2.5' UL 0.0' LOSS 0.0'
	41.00					
-41.7	41.70		BOTTOM OF HOLE AT 41.70'		1	CD 41.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit	
2. LOCATION (Coordinates or Station) E2320551.7 N140991.5		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)	
4. HOLE NO. (As shown on drawing title and file number) LBI-4-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. RIVER 29.5'		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 7.6' (Estimated)		16. DATE HOLE STARTED 9/SEP/89 COMPLETED 9/SEP/89	
8. DEPTH DRILLED INTO ROCK 5.0'		17. ELEVATION TOP OF HOLE 0.0	
9. TOTAL DEPTH OF HOLE 42.1'		18. TOTAL CORE RECOVERY FOR BORING 32 %	
		19. SIGNATURE OF INSPECTOR LARRY BENJAMIN	

ELEVATION 0.0 a	DEPTH 0 ft	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Water			Logged by R.W. Magee 09/21/89. Fathometer reading offset 9' West of borehole. NOTE: Changed scale @ 20', 30' and 35.0'.
	20.00					
	30.00		Assumed Top of Overburden @ 29.5'*			
			Overburden not classified.			
	35.00					
	36.00					
	37.00		Top of Rock @ 37.1'			
-29.5 -29.0 MLLW			Castle Hayne Limestone: Poor recovery, white chalky, soft, with fossils. Some bryozoan shell hash sponge, echinoid, bivalve fragments, pecten. Discriptions & core length est	32%	BOX 1 OF 1	PULL-1 FROM 5.0' TO 42.1' RUN 5.0' GAIN 0.0' REC 1.6' UL 1.1' LOSS 3.4'
-37.1 -36.6 MLLW						PULL-1 Cont. Sheet 2
-37.5 MLLW	38.00					
			CONTINUED ON SHEET 2			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-38.0	38.00 FT	c	d	e	f	g
-37.5 MLLW			Castle Hayne Limestone: Same as above.		BOX 1	PULL-1 Continued.
	39.00	CORE LOSS	Unaccountable loss 38.7' to 39.8'.	32%	OF 1	CD 39.8'
	40.00 41.00		39.8' to 42.1' core left in hole.			Soft drilling with no water return at the last 1.2'.
-42.1 -41.6 MLLW	42.00 42.10		BOTTOM OF HOLE AT 42.10'			

Sheet 2 of 2
LBI-4-89

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit		
2. LOCATION (Coordinates or Station) E2319117.6 N142495.3		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW		
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)		
4. HOLE NO. (As shown on drawing title and file number) UBI-6-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. RIVER 15.4'		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN 22.6' (Estimated)		16. DATE HOLE STARTED 8/SEP/89 COMPLETED 8/SEP/89		
8. DEPTH DRILLED INTO ROCK 3.0'		17. ELEVATION TOP OF HOLE 0.0 / 0.5 MLLW		
9. TOTAL DEPTH OF HOLE 41.0'		18. TOTAL CORE RECOVERY FOR BORING 100 %		
		19. SIGNATURE OF INSPECTOR LARRY BENJAMIN		

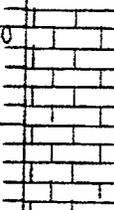
ELEVATION 0.0 g	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.5 MLLW			WATER			Core logged by Tong C. Haw, Geologist. 21 Sep 89. *Fathometer reading offset 9' West of borehole. NOTE: Changed Scale At 20', 30' and 35'.
-15.4 -14.9 MLLW	20.00		Assumed Top of Overburden @ 15.4'*			
			Overburden not classified.			
	30.00					
	35.00					
	36.00					
	37.00					
-38.0 -37.5 MLLW	38.00		Top of Rock @ 38.0'			
			CONTINUED ON SHEET 2			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-	38.00	FT	c	d	e	f
-37.5 MLLW			Castle Hayne Limestone. Well cemented, predominantly fine to medium grained fossil fragments; glauconite in places; occasional vug.		BOX	PULL-1 38.0' TO 41.0' RUN 3.0' GAIN 0.0' REC 3.0' UL 0.0' LOSS 0.0'
-39.5 -39.0 MLLW	39.00		New Hanover Member; phosphatic conglomerate.	100%	1	
-40.0 -39.5 MLLW	40.00		Pee Dee: Well cemented; arenaceous limestone; fine grained.		OF	
-41.0 -40.5 MLLW	41.00		BOTTOM OF HOLE AT 41.00'		1	CD 41.0'

Sheet 2 of 2
UBI-6-89

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit		
2. LOCATION (Coordinates or Station) E2319944.4 N142571.0		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW		
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)		
4. HOLE NO. (As shown on drawing title and file number) UBI-17-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. RIVER 29.1'		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN 6.9' (Estimated)		16. DATE HOLE	STARTED 8/SEP/89	COMPLETED 8/SEP/89
8. DEPTH DRILLED INTO ROCK 5.0'		17. ELEVATION TOP OF HOLE 0.0 / 0.5 MLLW		
9. TOTAL DEPTH OF HOLE 41.0'		18. TOTAL CORE RECOVERY FOR BORING 50 %		
		19. SIGNATURE OF INSPECTOR LARRY BENJAMIN		

ELEVATION 0.0	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.5 MLLW			Water			Diamond bit 4X5-1/2" Serial # 80PC1779 Logged by R.W. Magee 20 Sep. 89. *Fathometer reading offset 9' East of borehole.
	20.00					
-29.1 -28.6 MLLW	30.00		Assumed Top of Overburden @ 29.1' *			
	35.00		Overburden not classified.			
-36.0 -35.5 MLLW	36.00		Top of Rock @ 36.0'			
	37.00		Castle Hayne Limestone. White, chalky soft, poorly cemented, bryozoan shell hash glauconitic sponge, bivalve molds, echinoid bryozoan and bivalve fragments common; some clasts bryozoanic, mollusc, micrite (Bio micrudite).	.50%	BOX 1 OF 1	PULL-1 36.0' TO 41.0' RUN 5.0' GAIN 0.0' REC 2.5' UL 2.5' LOSS 2.5' NOTE: Changed scale at 20', 30' and 35'.
-37.5 MLLW	38.00	CORE LOSS				
			CONTINUED ON SHEET 2			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-38.0 -37.5 MLLW	38.00 39.00 40.00 41.00	FT c CORE LOSS 	d Castle Hayne Limestone, same as above. Water return from 37.0' to 39.5'. Unaccountable loss 37.4' to 39.9'. White, chalky, limestone same as above.	50%	BOX 1 OF 1	PULL-1 Continued CD 41.0'
-41.0 -40.5 MLLW	41.00		BOTTOM OF HOLE AT 41.00			

Sheet 2 of 2
UBI-17-89

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR TURNS & BENDS		10. SIZE AND TYPE OF BIT 4X5-1/2" Diamond Core bit	
2. LOCATION (Coordinates or Station) E2320172.6 N142424.6		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Local Mean Low Water, LMLW	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314 (Truck mounted)	
4. HOLE NO. (As shown on drawing title and file number) UBI-18-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER HERMAN SCOTT		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. RIVER 26.4'		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 8.4' (Estimated)		16. DATE HOLE	STARTED 8/SEP/89 COMPLETED 8/SEP/89
8. DEPTH DRILLED INTO ROCK 5.2		17. ELEVATION TOP OF HOLE 0.0 / 0.5 MLLW	
9. TOTAL DEPTH OF HOLE 40.0'		18. TOTAL CORE RECOVERY FOR BORING 34.6 %	
		19. SIGNATURE OF INSPECTOR LARRY BENJAMIN	

ELEVATION 0.0 e	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.5 MLLW			Water			Core logged by Tong C. Haw, Geologist, 21 Sep 89. *Fathometer reading offset 9' West of borehole. NOTE: Changed Scale at 20', 30' and 35'.
-26.4	20.00		Assumed Top of Overburden @ 26.4'*			
-25.9 MLLW	30.00		Overburden not classified.			
-34.8	35.00		Top of Rock @ 34.8'			PULL-1 34.8' TO 40.0' RUN 5.2' GAIN 0.0' REC 1.8' UL 3.4' LOSS 3.4'
-34.3 MLLW	36.00		Castle Hayne Limestone. White to light gray; occasional coarse fossil fragments predominantly medium grained fossil fragments; moderately cemented; very broken core. 34.5' to 35.8' very broken; length of core estimated 35.8' to 38.3' soft drilling; probable 2.5' unaccountable loss ground up and washed away or filled cavity.	35%	BOX 1 OF 1	
-37.5 MLLW	38.00	CORE LOSS				Pull-1 Cont. Sheet 2

CONTINUED ON SHEET 2

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING			10. SIZE AND TYPE OF BIT 1-3/8" I.D. Splitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) Big Island Ch. LAT. 34° 8' 21.03" LONG. 77° 56' 52.79"			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Fishtail & Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT			12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH94-1 (B1-2)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN :DISTURBED :UNDISTURBED 2 : 0	
5. NAME OF DRILLER David Justiss			14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 40.3' (WATER 36.8')			16. DATE HOLE :STARTED :COMPLETED :17 JUN 94 :17 JUN 94	
8. DEPTH DRILLED INTO ROCK 10.1'			17. ELEVATION TOP OF HOLE 0.0 MLLW 43.5 MLLW	
9. TOTAL DEPTH OF HOLE 50.4'			18. TOTAL CORE RECOVERY FOR BORING 72.3 %	
19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.				

+0.5
MLLW

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0		0.0' to 36.8' Water			BORING LOCATION NC Coord. N. 143265 NAD 27 E. 2318272 Approx. Station & Offset 3+20 217' Right of Centerline NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Jul 94. NOTE: <u>CHANGED SCALE</u> @ 36.0' & 40.0' Set 6" dia. casing to 36.8'
	36					
	36.8		<u>BOTTOM OF HARBOR @ 36.8'</u>			
	36.8		GM, Light gray, fine to coarse, silty limestone gravel, trace of fine quartz sand		1	BLOWS PER FOOT Begin drilling with FLORIGEL drilling mud 34 Re-set casing to 39.3' 7 Bounced rods @ 40.3' (splitspoon refusal). 27
	38					
	40		<u>TOP OF ROCK @ 40.3'</u>		2	
	40.3		CASTLE HAYNE LS, UNIT A Limestone: Light greenish-gray, fossiliferous, slightly glauconitic, moderately to highly weathered, fine grained, hard, highly pitted and vuggy, small to large vugs.		BOX	PULL 1: 40.3' to 45.2' RUN 4.9' UL 0.6' REC 4.3' LOSS 0.6' Hyd. press: 75 psi Drill water return: 0% Drilling time: 58 min. RQD = 18.4%
	41					
	42		40.8' to 42.0' Iron stains, some small to large sand filled vugs, hard to very hard.		1	Tape checked to 44.6' "Probable fall-in obscured corrected depth," T. Haw, Jul 94.
	42		42.0' to 44.3' Gray, sandy, fine grained, quartz sand, some fossils, hard to very hard.	88	OF	
	43		40.6', 40.8', 41.1', 41.4', 41.6', 42.0', 42.7', 42.9', & 43.6' Low angle, open joint		1	
	43		40.3' to 40.6', 41.6' to 42.0', 42.7' to 42.9', 43.6' to 44.1', Fragmented.			
	44		42.0' to 42.9' Nearly vertical, open joint			
	44		CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 3/4" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES
			NOTE: Soils field classified in accordance with the Unified Soil Classification System.			

-36.3
MLLW

-39.8
MLLW

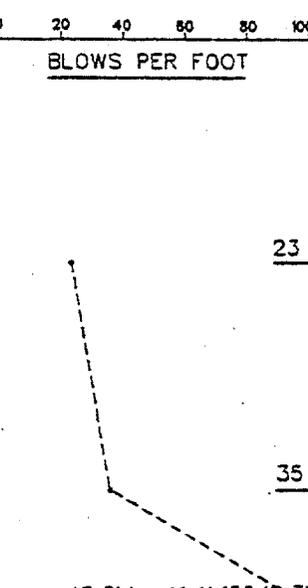
-43.5
MLLW

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE 0.0 MLLW		Hole No. WH94-1		
PROJECT WILMINGTON HARBOR CHANNEL WIDENING			INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS	
ELEVATION MLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-44.0	44.0		PEEDEE FM, ROCKY POINT MBR Limestone: Gray, sandy, fine grained, quartz sand, some fos- sils, hard to very hard.			Pull 1 cont. from above
	45	CORE LOSS	44.6' to 45.2' Unaccountable core loss		BOX	
	46		SM, Gray, fine, silty sand, some fine to coarse, limestone gravel, slightly calcareous		1	PULL 2: 45.2' to 50.4' RUN 5.2' UL 3.2' REC 2.0' LOSS 3.2'
	46		45.8' to 46.2' Limestone as above		OF	Hyd. press: 100 psi Drill water return: 0% Drilling time: 16 min. RQD = 0%
	47		SM, Gray, fine, silty sand, some fine to coarse, limestone gravel, slightly calcareous		1	
	47		47.2' to 50.4' Unaccountable core loss	39		
	48	CORE LOSS				
	49					
	50					
-50.4	50.4		BOTTOM OF HOLE @ 50.4'			Tape checked to 50.1' "Probable fall-in obscured corrected depth," T. How, Jul 94.

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Splitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) Big Island Ch. LAT. 34° 8' 16.92" LONG. 77° 56' 46.92"		11. DATUM FOR ELEVATION SHOWN (BM or WSU) Fishtail & Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH94-3 (BI-3)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN :DISTURBED 7 :UNDISTURBED 0	
5. NAME OF DRILLER David Justiss		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 40.5' (WATER 27.0')		16. DATE HOLE :STARTED :COMPLETED :19 JUN 94 :19 JUN 94	
8. DEPTH DRILLED INTO ROCK 9.8'		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 50.3'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
		19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0.0	0		0.0' to 27.0' Water			BORING LOCATION NC Coord. N. 142854 NAD 27 E. 2318771 Approx. Station & Offset 9+69 244' Right of Centerline NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Jul 94. NOTE: CHANGED SCALE @ 27.0'
-27.0	27.0		<u>BOTTOM OF HARBOR @ 27.0'</u>			
	27.0		27.0' to 30.0' Wood		1	BLOWS PER FOOT Set 6" casing to 29.0' Begin drilling with FLORIGEL drilling mud. WH 27.0' to 28.5' Splitspoon driven by Weight of Hammer (WH) without recovery. 5 Redrove to 28.5' then cont'd drive to 30.0' and recovered soft wood. 30.0' to 33.7' Splitspoon driven by Weight of hammer.. WH 7 3 14
	29					
	31		SC, Dark grayish-brown, fine to medium, clayey quartz sand, trace of wood		2	
	33					
	35		SM, Grayish-brown, fine to medium, silty sand		3	
	37		SP, Gray, fine to medium, poorly graded, quartz sand		4	
	37		SM, Light gray to white, fine to medium, silty sand mostly shell fragments, some quartz, calcareous		5	
	39		Medium to coarse, sand-size shell fragments, (cont.)		6 cont.	
			CONTINUED ON SHEET 2 NOTE: Soils field classified in accordance with the Unified Soil Classification System.			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 1/4" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Splitspoon, S-1/2"	
2. LOCATION (Coordinates or Station) Big Island Ch. LAT. 34° 8' 21.02" LONG. 77° 56' 42.79"		11. DATUM FOR ELEVATION SHOWN (TBM or WSW) Fishtail & Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) : WH94-4 (B1-4)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN :DISTURBED :UNDISTURBED : 4 : 0	
5. NAME OF DRILLER David Justiss		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 41.4' (WATER 37.6')		16. DATE HOLE :STARTED :COMPLETED : 20 JUN 94 : 20 JUN 94	
8. DEPTH DRILLED INTO ROCK 7.7'		17. ELEVATION TOP OF HOLE 0.0 MLLW.	
9. TOTAL DEPTH OF HOLE 49.1'		18. TOTAL CORE RECOVERY FOR BORING 100 %	
19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0		0.0' to 37.6' Water			BORING LOCATION NC Coord. N. 143272 NAD 27 E. 2319113 Approx. Station & Offset 9+88 298' Left of Centerline NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Jul 94. NOTE: CHANGED SCALE @ 37.0' Set 6" dia. casing to 38.3' Used FLORIGEL drilling mud.
-37.6	37.6		<u>BOTTOM OF HARBOR @ 37.6'</u>			
	38		SM, Very dark gray to gray, fine to medium, silty sand, trace of wood.		1	<u>BLOWS PER FOOT</u> 
	39		GM, Light gray to white, fine to coarse, silty gravel, some fine to medium, quartz sand and shell fragments, calcareous.		2	
	40		SM, Light gray to white, medium to coarse, limestone gravel, some fine to coarse, sand size shell fragments, calcareous		3	
	41		GM, Light gray to white, fine to coarse, limestone gravel, some fine to coarse, sand-size, shell fragments, calcareous.		4	
-41.4	41.4		<u>TOP OF ROCK @ 41.4'</u>			40.6' to 41.4' 100/0.5'
-42.2	42.2		CASTLE HAYNE LS, UNIT A Limestone: Mottled, light gray to gray, fossiliferous, numerous intersecting healed joints with green to black glauconite. 41.4' to 41.6' Some iron stains, weathered, moderately hard to hard. 41.6' to 42.2' Slightly weathered, very hard.	100	BOX 1 OF 2 42.2' Sent to SADL 42.3'	PULL 1: 41.4' to 42.2' RUN 0.8' UL 0.0' REC 0.8' LOSS 0.0' Hyd. press: 120 psi Drill water return: 0% Drilling time: 43 min. RQD = 100% Tape checked to 42.1' Probable fallin.
	43		CONTINUED ON SHEET 2 NOTE: Soils field classified in accordance with the Unified Soil Classification System.			<u>BLOWS/FOOT:</u> NUMBER REQUIRED TO DRIVE 1 1/4" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE 0.0 MLLW		Hole No. WH94-4		
PROJECT WILMINGTON HARBOR CHANNEL WIDENING			INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS	
ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	43		PEEDEE FM, ROCKY POINT MBR cont'd from 42.3' above			Pull 2 cont. from above: PULL 2: 42.2' to 45.2' RUN 3.0' UL 0.0' REC 3.0' LOSS 0.0'
	44		Limestone: Gray and light gray, sandy, fine to medium, sand, some fossils, slightly to moderately weathered, pitted, and vuggy, some small to large cemented sand filled vugs, glauconitic, very hard.	100	BOX	Hyd. press: 120 psi Drill water return: 100% Drilling time: 97 min. RQD = 86.7% Tape checked to 44.8'
	45		43.0', 43.5', 44.1', 44.7', and 45.0' Low angle, open joints. 44.1' to 44.5' and 45.0' to 45.2' Fragmented.		1	"Probable fall-in obscured corrected depth," T. Haw, Jul 94.
	46		45.2' to 46.9' Mottled, gray and light gray, fossiliferous, some fine to medium, quartz sand, moderately weathered, hard to very hard, moderately to highly pitted and vuggy, small to large cemented and noncemented sand filled vugs, some glauconitic minerals.		OF 2	PULL 3: 45.2' to 49.1' RUN 3.9' UL 0.0' REC 3.9' LOSS 0.0'
	47		46.9' to 47.6' Fragmented with thick, gray, fine to medium, silty sand seams.	100		Hyd. press: 80 psi Drill water return: 100% Drilling time: 26 min. RQD = 38.5%
	48		SM, Gray, fine to medium, silty sand, some limestone			
	49				48.6'	
-49.1	49.1				BOX 2	Tape checked to 49.1'
			BOTTOM OF HOLE @ 49.1'			

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING			10. SIZE AND TYPE OF BIT 1-3/8" I.D. Spitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) Big Island Ch. LAT. 34° 8' 17.08" LONG. 77° 56' 37.55"			11. DATUM FOR ELEVATION SHOWN (TBM or NSD) Fishtail & Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT			12. MANUFACTURER'S DESIGNATION OF DRILL Failing 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) : WH94-5 (BI-6)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : 3 : 0 DISTURBED : UNDISTURBED	
5. NAME OF DRILLER David Justiss			14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 44.4' (WATER 40.4')			16. DATE HOLE : STARTED : COMPLETED : 21 JUN 94 : 21 JUN 94	
8. DEPTH DRILLED INTO ROCK 5.8'			17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 50.2'			18. TOTAL CORE RECOVERY FOR BORING 100 %	
			19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0.0	0		0.0' to 40.4' Water			BORING LOCATION NC Coord. N. 142879 NAD 27 E. 2319558 Approx. Station & Offset 15+81 254' Left of Centerline NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Jul 94. NOTE: <u>CHANGED SCALE</u> @ 40.0' & 44.0'
-40.4	40.4		BOTTOM OF HARBOR @ 40.4'			
	40.4		SP, Gray to dark gray, medium to coarse, poorly graded sand		1	BLOWS PER FOOT Set 6" dia. casing to 42.7' Used FLORIGEL drilling mud. 2 Bounced rods @ 44.4' (spitspoon refusal) 98 43.9' to 44.4' 82/0.5'
	42		trace of silt		2	
	44		GM, Light gray to white, fine to coarse, silty limestone gravel, some fine to coarse, quartz sand and shell fragments, calcareous		3	
-44.4	44.4		TOP OF ROCK @ 44.4'			
	45		PEEDEE FM, ROCKY POINT MBR Limestone: Light gray to gray, sandy, fine to medium, sand, some small to large and green to black glauconitic minerals, some fossils and cemented sand filled vugs, slightly to moderately weathered, very hard, slightly pitted, moderately vuggy, small to large vugs, some iron stains, moderately to highly jointed, some green and black healed joints.	100	BOX OF	PULL 1: 44.4' to 47.7' RUN 3.3' UL 0.0' REC 3.3' LOSS 0.0' Hyd. press: 120 psi Drill water return: 0% Drilling time: 124 min. RQD = 60.6% Tape checked to 47.5' "Probable fall-in obscured corrected depth," T. Haw, Jul 94. PULL 2: 47.7' to 50.2' RUN 2.5' UL 0.0' REC 2.5' LOSS 0.0' Hyd. press: 100 psi Drill water return: 0% Drilling time: 15 min.
	46		44.8', 45.0', 45.1', 45.6' & 46.9' Low angle, open joint		1	
	47		46.9' to 47.7' Fragmented, numerous low to high angle, intersecting, healed joints with glauconitic coating.			
	48		CONTINUED ON SHEET 2 NOTE: Soils field classified in accordance with the Unified Soil Classification System.			BLOWS/FOOT. NUMBER REQUIRED TO DRIVE 1 1/4" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 0.0 MLLW Hole No. WH94-5

PROJECT WILMINGTON HARBOR CHANNEL WIDENING INSTALLATION WILMINGTON DISTRICT SHEET 2 OF 2 SHEETS

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	48		PEEDEE FM, ROCKY POINT MBR cont'd from above Limestone cont'd from above		BOX	Pull 2 cont. from above RQD = 0%
	49		47.7' to 50.2' Moderately hard to hard, fragmented, light gray, sandy clay seams.	100	1	Tape checked to 44.0' "Probable fall-in obscured corrected depth," T. Haw, Jul 94.
	50				OF	
-50.2	50.2		BOTTOM OF HOLE @ 50.2'			

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Splitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) Lower Big Island Ch. LAT. 34° 7' 33.38" LONG 77° 56' 10.99"		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH94-7 (LBI-3)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN :DISTURBED :UNDISTURBED 2 : 0	
5. NAME OF DRILLER David Justiss		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 39.1' (WATER 34.6')		16. DATE HOLE :STARTED :COMPLETED 23 JUN 94 23 JUN 94	
8. DEPTH DRILLED INTO ROCK 8.9'		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 48.0'		18. TOTAL CORE RECOVERY FOR BORING 56.2 %	
		19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0.0	0		0.0' to 34.6' Water			<p>BORING LOCATION NC Coord. N. 138485 NAD 27 E. 2321838 Approx. Station & Offset 38+72 339' Right of Centerline</p> <p>NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Jul 94.</p> <p>NOTE: CHANGED SCALE @ 34.0' & 38.0'</p>
-34.6	34.6		<u>BOTTOM OF HARBOR @ 34.6'</u>			
	34.6		SM, Very dark gray to gray, medium to coarse, silty sand.		1	<p><u>BLOWS PER FOOT</u></p> <p>37.6' TO 39.1' Very poor recovery, splitspoon 3</p> <p>broke on drive to 39.1' and may have travelled on an angle through</p> <p>15</p>
	36		Some wood.			
	38		GP, Light gray, coarse, poorly graded, sand some wood.		2	<p>fragmented limestone. 38.6' Above fragmented rock begins.</p> <p>39.1' Fishtail refusal.</p> <p>36</p>
	39.1		<u>TOP OF ROCK @ 39.1'</u>			
-39.1	39.1		CASTLE HAYNE LS, UNIT A, Limestone: Light gray to tannish-gray, fossiliferous, slightly weathered, very hard, moderately pitted, moderately to highly vuggy with small to large vugs, some fine to medium, sand-size, black, glauconite grains, moderately to highly jointed.		39.3'	<p>PULL 1: 39.1' to 43.0' RUN 3.9' UL 0.6' REC 3.3' LOSS 0.6'</p> <p>Hyd. press: 100 psi Drill water return: 30% Drilling time: 20 min. RQD = 56.4%</p> <p>41.5' to 43.0' Highly porous, pitted and vuggy, hard, highly to intensely jointed. 41.5' to 42.0' Fragmented and poorly cemented. 42.0', 42.1', 42.4', 42.5', & 43.0' Low angle, open joint. Pull 1 cont.</p>
	40		39.2', 40.1', 40.6', and 41.2' Low angle, open joint.		40.2'	
	41	CORE LOSS	40.6' to 41.2' Unaccountable core loss, black, fat clay at joints.	85	BOX 1	
	42		41.5' to 42.0' Some wood. 41.2' to 41.5' Light gray. 41.2' to 41.5' High angle, open joint.		OF 1	
	42		<u>CONTINUED ON SHEET 2</u>			<p><u>BLOWS/FOOT:</u> NUMBER REQUIRED TO DRIVE 1 1/2" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES</p>

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE 0.0 MLLW		Hole No. WH94-7		
PROJECT WILMINGTON HARBOR CHANNEL WIDENING			INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS	
ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	42		CASTLE HAYNE LS, UNIT A cont'd from above Limestone cont'd as above.	85		Pull 1 cont. from above
	43		Tannish-light gray to gray, fossiliferous, highly weathered, badly broken with some black, fat clay, some medium to coarse, quartz sand, black glauconite minerals and iron stains.		BOX 1	PULL 2: 43.0' to 48.0' RUN 5.0' UL 3.3' REC 1.7' LOSS 3.3'
	44		SP, Tannish-gray, fine to med- ium, poorly graded sand.		OF 1	Hyd. press: 100 psi Drill water return: 0% Drilling time: 5 min. RQD = 0%
	45		Limestone: Light gray to white, fossilifer- ous, highly weathered, mod- erately hard, highly pitted and vuggy with small to large vugs, fragmented with greenish-gray, fine to medium, sand-size, green and black glauconite grains.	34		
	46	CORE LOSS	44.7' to 48.0' Unaccountable core loss.			
	47					Tape checked to 47.4' "Probable fall-in obscured corrected depth," T. Haw, Jul 94.
-48.0	48.0		BOTTOM OF HOLE @ 48.0'			

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Spitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) Lower Big Island Ch. LAT. 34° 7' 37.59" LONG. 77° 56' 12.69"		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Fishtail & Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH94-8 (LBI-2)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED : 2 : UNDISTURBED : 0	
5. NAME OF DRILLER David Justiss		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 37.0' (WATER 34.0')		16. DATE HOLE : STARTED : 24 JUN 94 : COMPLETED : 24 JUN 94	
8. DEPTH DRILLED INTO ROCK 14.4'		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 51.4'		18. TOTAL CORE RECOVERY FOR BORING 89.9 %	
		19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0		0.0' to 34.0' Water.			<p>BORING LOCATION NC Coord. N. 138909 NAD 27 E. 2321690 Approx. Station & Offset 34-31 261' Right of Centerline</p> <p>NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Jul 94. NOTE: CHANGED SCALE @ 34.0'</p>
-34.0	34.0		<u>BOTTOM OF HARBOR @ 34.0'</u>			
	35		SM, Gray, fine to medium, silty, quartz sand and shell fragments, trace of fine limestone gravel, slightly calcareous.		1	<p><u>BLOWS PER FOOT</u></p> <p>Set 6" dia. casing to 35.8'. Used FLORIGEL drilling mud. 34.0' to 35.5' Loss drill water return. Re-set casing to 36.2'.</p>
	36		GM, Light gray to white, fine to medium, glauconite minerals, moderately weathered, hard, moderately to highly pitted and vuggy, small to large vugs.		2	<p>37.0' 50 blows with the hammer and bounced rods off the bottom of hole. Began coring @ 37.0'.</p>
-37.0	37.0		<u>TOP OF ROCK @ 37.0'</u>			33
	38		CASTLE HAYNE LS. UNIT B, Limestone: White, fossiliferous, some fine to medium, glauconite minerals, moderately weathered, hard, moderately to highly pitted and vuggy, small to large vugs.		BOX	<p>PULL 1: 37.0' to 41.7' RUN 4.7' UL 1.9' REC 2.8' LOSS 1.9'</p> <p>Hyd. press: 100 psi Drill water return: 0% Drilling time: 30 min. RQD - 30.9%</p>
	39		37.4', 37.3', 38.1', 38.4', and 38.9' Low angle, open joint.	67	1	
	39		37.4' to 37.7' and 38.9' to 39.8' Fragmented.		OF	
	40		39.8' to 41.7' Unaccountable core loss.		2	
	40	LOSS				
			CONTINUED ON SHEET 2 NOTE: Soils field classified in accordance with the Unified Soil Classification System.			<p><u>BLOWS/FOOT:</u> NUMBER REQUIRED TO DRIVE 1 1/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES</p>

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)	
	40	CORE LOSS	Core loss cont. from above	67	BOX	Pull 1 cont. from above Tape checked to 40.2' "Probable fall-in obscured corrected depth," T. Haw, Jul 94.	
	41						
	42	CASTLE HAYNE LS, UNIT B, cont'd. Light gray to white, fossiliferous, highly weathered, soft, fragmented with some loose, fine to coarse, silty sand-size shell fragments, friable, some green and black glauconite minerals.		100	1	PULL 2: 41.7' to 43.9' RUN 2.2' UL 0.0' REC 2.2' LOSS 0.0'	
	43				2	Hyd. press: 100 psi Drill water return: 100% Drilling time: 23 min. RQD = 0% Tape checked to 43.2' "Probable fall-in obscured corrected depth," T. Haw, Jul 94.	
	44						
-44.1	44.1	CASTLE HAYNE FM, UNIT A Limestone: Light gray to gray, slightly weathered, very hard, slightly pitted and vuggy, small vugs, some green and black glauconite minerals, slightly jointed.		100	45.4'	PULL 3: 43.9' to 48.9' RUN 5.0' UL 0.0' REC 5.0' LOSS 0.0'	
	46				Sent to SADL	Hyd. press: 100 psi Drill water return: 100% Drilling time: 44 min. RQD = 100%	
	48		45.5' and 46.4' hammer break.			BOX	NOTE: CHANGED SCALE @ 44.0' & 48.0' Tape checked to 48.1' "Probable fall-in obscured corrected depth," T. Haw, Jul 94.
	49		47.1' to 51.4' Highly porous, pitted and vuggy, small to large vugs, slightly to moderately weathered, hard to very hard.			2	
	50	47.7', 50.0', and 51.2' Low angle, open joint.		100	OF	PULL 4: 48.9' to 51.4' RUN 2.5' UL 0.0' REC 2.5' LOSS 0.0'	
	51				2	Hyd. press: 100 psi Drill water return: 100% Drilling time: 24 min. RQD = 0%	
-51.4	51.4		51.0' to 51.2' Core broken while removing from bit.			Tape checked to 51.4'	
			BOTTOM OF HOLE @ 51.4'				

Appendix A

(Additional Borings)

THESE BORINGS ARE LOCATED WITHIN THE PROJECT LIMITS.

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR			10. SIZE AND TYPE OF BIT 1 3/8" ID SPLITSPOON	
2. LOCATION (Coordinates or Station) N 162135 E 2315133 (NAD 27)			11. DATUM FOR ELEVATION SHOWN (TBM or MLLW) MLW	
3. DRILLING AGENCY MOBILE DISTRICT			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 87-WH-23			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 19	
5. NAME OF DRILLER L. LUCAS			14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A			16. DATE HOLE STARTED 8/JUN/87	
8. DEPTH DRILLED INTO ROCK N/A			17. ELEVATION TOP OF HOLE 0.0 / +0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.0' W/Water			18. TOTAL CORE RECOVERY FOR BORING N/A	
			19. SIGNATURE OF INSPECTOR BENJAMIN & ZIELONKA, GEOLOGIST	

MLLW
+0.6

-15.8

-27.4
MLLW

ELEVATION 0.0	DEPTH 0 FT	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Water.			BLOWS/FOOT
	10.00					NOTE: Scale changed @ 10.0', 20.0', 24.0' AND 42.0'.
	15.00					NOTE: 6" casing advance 1.5' after each drive.
-16.5			MH inorganic silts, elastic with wood, grey.		1	
-18.0			Decayed wood.		2	
-19.5	20.00		MH inorganic silts, elastic with wood, grey.		3	
	24.00				4	
	25.00		Light grey, silty clay, stiff, trace of wood.		5	
-26.0			No wood.		6	
-28.0	28.00				7	
					8	
			CONTINUED ON SHEET 2 SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM	BLOWS PER FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES		

MLLW
-27.4

ELEVATION -28.0 a	DEPTH 28.00 FT b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)				
						20	40	50	80 100	
			MH silty clay, light grey, stiff.		8				BLOWS/FOOT	3
	30.00				9					2
	32.00				10					3
	34.00		Inorganic silts, with wood and fine sand.		11					3
	36.00		No wood.		12					6
-36.0	36.00		SP/SH grey fine to medium poorly graded silty sand, trace of wood, and clay.		13					4
	38.00		With wood no clay.		14					18
-39.0	39.00		SP Grey coarse poorly graded sand.		15					11
	40.00		With wood, trace of clay.		16					36
	42.00		No clay or wood.		17					15
	44.00		Trace of wood.		18					15
-45.0	45.00				19					18
			BOTTOM OF HOLE AT 45.00							

-44.4
MLLW

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT		SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR			10. SIZE AND TYPE OF BIT 1 3/8" ID SPLITSPOON		
2. LOCATION (Coordinates or Station) N 160887 E 231508 (NAD 27)			11. DATUM FOR ELEVATION SHOWN (TBM or ASL) MLW		
3. DRILLING AGENCY MOBILE DISTRICT			12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500		
4. HOLE NO. (As shown on drawing title and file number) 87-WH-24			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 18
					UNDISTURBED 0
5. NAME OF DRILLER L. LUCAS			14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A			16. DATE HOLE STARTED 9/JUN/87		
8. DEPTH DRILLED INTO ROCK N/A			COMPLETED 9/JUN/87		
9. TOTAL DEPTH OF HOLE 42.8' W/Water			17. ELEVATION TOP OF HOLE 0.0 / 40.0 MLLW		
			18. TOTAL CORE RECOVERY FOR BORING N/A		
			19. SIGNATURE OF INSPECTOR BENJAMIN S. ZIELONKA, GEOLOGIST		

MLLW
+ 0.0

-15.2

-28.4
MLLW

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0 FT	c	Water.			
						BLOWS/FOOT
	10.00					NOTE: Scale changed @ 10.0' and 25.0'. NOTE: 6" Casing advance 1.5' after each drive.
-15.8						
-18.8						
-20.3	20.00		SP/SM Poorly graded silty sand fine to medium, grey.		1	7
					2	11
			SC Clayey sand, fine to medium grey.		3	WB
			WH Inorganic, elastic silts, grey, with fine to medium grain sizes. trace of sand.		4	2
-23.3					5	5
-24.8	25.00		SP/SM Poorly graded silty sand, fine to medium, grey.		6	4
			SC Clayey sand, fine to medium, grey.		7	12
					8	19
-27.8			SP/SM Poorly graded silty sand, medium to coarse, grey.		9	14
-29.0	29.00		CONTINUED ON SHEET 2 SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			BLOWS PER FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

MLLW
-28.5

ELEVATION a	DEPTH 29.00 FT b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)				
						g	h	i	j	k
			SP/SM Poorly graded silty sand, medium to coarse, grey.		9			BLOWS/FOOT		14
-30.8	31.00		SP Poorly graded sand, coarse, grey.		10					17
-32.3	33.00		SC Clayey sand, fine to medium, grey.		11					27
	35.00				12					3
	37.00		MH Inorganic silts, elastic, trace of sand, grey.		13					10
-36.8	39.00		With sand.		14					8
	41.00				15					7
-39.8	42.80		SC Clayey sand, fine to medium, grey.		16					16
					17					25
-42.8			BOTTOM OF HOLE AT 42.80		18					24

- 42.8
MLLW

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR		10. SIZE AND TYPE OF BIT 1 3/8" ID SPLITSPOON		
2. LOCATION (Coordinates or Station) N 156146 E 2314769		11. DATUM FOR ELEVATION SHOWN (TBM or ASL) MLW		
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 87-WH-27		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		UNOBTAINED
5. NAME OF DRILLER L. LUCAS		14. TOTAL NUMBER CORE BOXES		0
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		N/A
7. THICKNESS OF OVERBURDEN N/A		16. DATE HOLE		STARTED 10/JUN/87 COMPLETED 10/JUN/87
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE		0.0 <i>+0.6 MLLW</i>
9. TOTAL DEPTH OF HOLE 43.2' W/Water		18. TOTAL CORE RECOVERY FOR BORING		N/A %
		19. SIGNATURE OF INSPECTOR BENJAMIN & ZIELONKA, GEOLOGIST		

MLLW
+0.6

-14.1

-28.4
MLLW

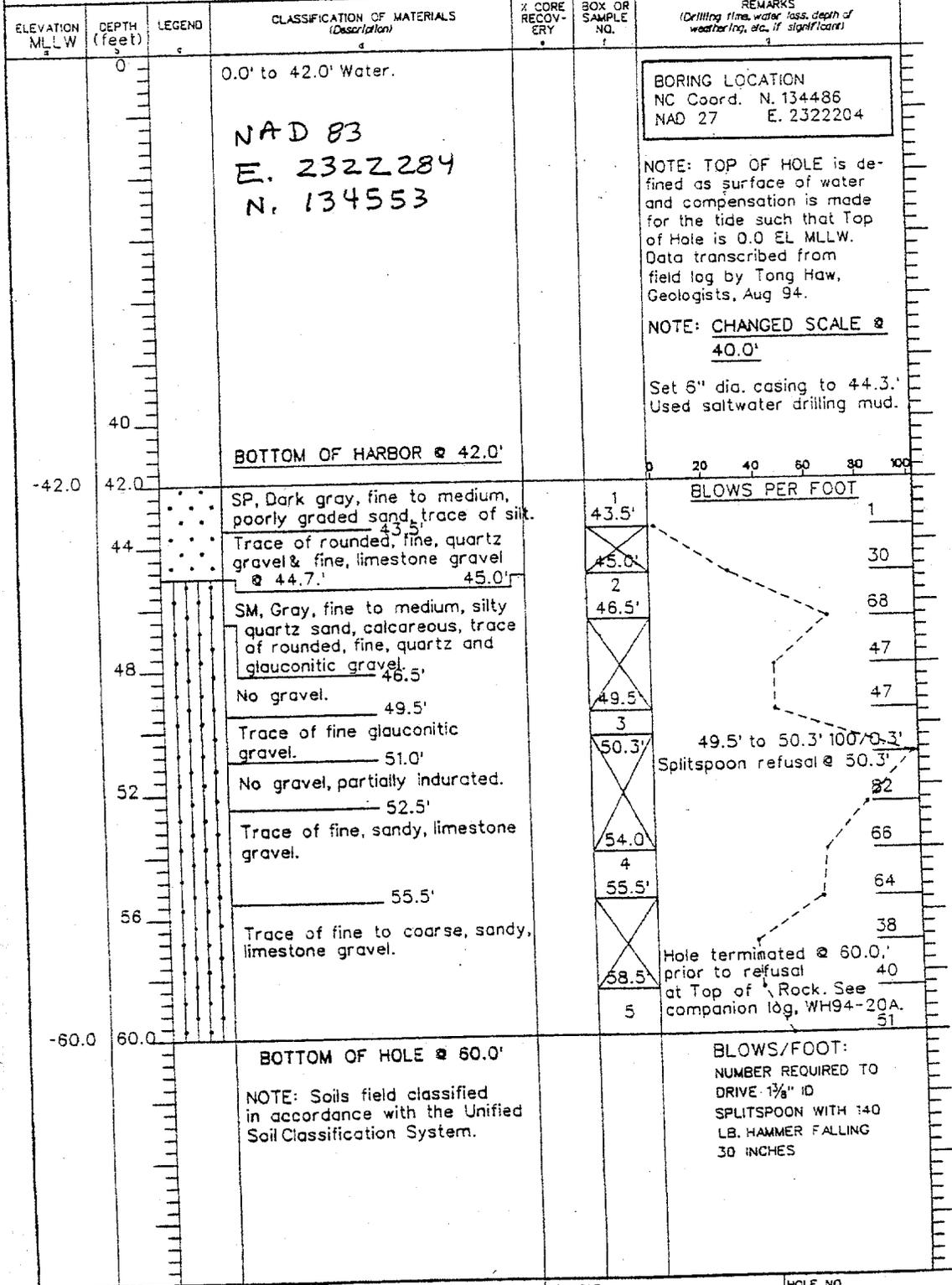
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0 FT	c	d	e	f	g
			Water.			BLOWS/FOOT NOTE: Scale changed at 10.0' and 25.0'. NOTE: 6" Casing advance 1.5' after each drive.
	10.00					
	14.7					
	15.00		SP Poorly graded sand, coarse, tan.		1	5
	18.5		SC Clayey sand, fine to medium, grey.		2	20
	19.5		SP Poorly graded sand, coarse, tan.		3	5
	20.00		With traces of clay layer. No clay layers.		4	13
					5	22
					6	13
	25.00		With wood.		7	8
	26.7		MH Inorganic silts, elastic, grey, soft.		8	24
	28.2		SP Poorly graded sand, coarse, grey, trace of clay.		9	WB
	29.0				10	9
			CONTINUED ON SHEET 2 SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM	BLOWS PER FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES		

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE 0.0		Hole No. 87-WH-27		
PROJECT WILMINGTON HARBOR			INSTALLATION WILMINGTON DISTRICT			
			SHEET 2 OF 2 SHEETS			
ELEVATION -29.0 a	DEPTH 29.00 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. ERY e	BOX OR SAMPLE NO. f	REMARKS
						(Drilling time, water loss, depth of weathering, etc., if significant)
						20 40 g 60 80 100
			SP Poorly graded sand, coarse, grey, trace of clay.		10	BLOWS/FOOT 9
-29.5			SC Clayey sand, fine to medium grey.		11	24
-31.1	31.00		SP Poorly graded sand, coarse, tan.		12	28
	33.00		Trace of clay.		13	21
	35.00		No clay.		14	43
	37.00				15	37
	39.00				16	34
	41.00				17	33
	43.00				18	51
-43.2	43.20		BOTTOM OF HOLE AT 43.20		19	66

MLLW
-28.4

-42.6
MLLW

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR COMPREHENSIVE STUDY		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Splitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) LAT. 34° 5' 53.79" LONG. 77° 56' 7.15" Keg Island		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) Mean Lower Low Water 4" x 5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH94-20		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : 5 : 0	
5. NAME OF DRILLER C. ROBBINS		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 60.0' (WATER 42.0')		16. DATE HOLE : STARTED 26 JUL 94 : COMPLETED 26 JUL 94	
8. DEPTH DRILLED INTO ROCK 0.0'		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 60.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	



DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR COMPREHENSIVE STUDY		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Spitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) LAT. 34° 6' 53.86" LONG. 77° 56' 7.17" (Keg Island)		11. DATUM FOR ELEVATION SHOWN (TBM or USL) Fishtail & Mean Lower Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH94-20A		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN :DISTURBED 4 :UNDISTURBED 0	
5. NAME OF DRILLER C. ROBBINS		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 69.4' (WATER 42.8')		16. DATE HOLE :STARTED :COMPLETED 27 JUL 94 27 JUL 94	
8. DEPTH DRILLED INTO ROCK 13.6'		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 83.0'		18. TOTAL CORE RECOVERY FOR BORING 79.4 %	
		19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
	0		0.0' to 42.8' Water.			BORING LOCATION NC Coord. N. 134493 NAD 27 E. 2322202 NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Aug 94. NOTE: CHANGED SCALE 40.0' AND 72.0' Set 6" dia. casing to 45.0'. Used saltwater drilling mud.
	42.8		NAD 83 E. 2322282 N. 134560			
	42.8		BOTTOM OF HARBOR 42.8'			BLOWS PER FOOT Began spitspoon sampling at 60.0'. 63 33 90 30 40 65.7' to 68.7' 100/0.7' 69.0' to 69.4' 100/0.0'
	60		42.8' to 60.0' Washed with 5-7/8" roller rock bit. Soil not sampled or classified, see companion log, WH94-20.		60.0'	
	64		SM, Gray, fine, silty, quartz sand, calcareous, trace of fine to coarse, sandy, limestone gravel and clay.		61.5'	
	68		Some fine to coarse, sandy limestone gravel.		63.0'	
	68		Some clay, trace of coarse, limestone gravel.		64.5'	
	68		Trace of fine to coarse, sandy, limestone gravel.		67.5'	
	68		Some fine to coarse, sandy limestone gravel.		68.7'	
	69.4		TOP OF ROCK 69.4'		69.4'	
	72		PEEDEE FM Limestone - Gray, sandy, fine grained, moderately to highly weathered, hard.			PULL 1: 69.4' to 73.5' RUN 4.1' UL 2.6' REC 1.5' LOSS 2.6' Hyd. press: 100 psi Drill water return: 100% Drilling time: 18 min. RQD - 0%
	72	CORE LOSS	69.4' to 70.9' Very fragmented. Core loss probably throughout run at sand layers between fragmented rock.	37	1	
	73		70.9' to 73.5' Accumulative unaccountable core loss.		OF	
	74		Moderately pitted and vuggy, small to large vugs.		2	Pull 2 cont'd on next page
	74		73.8' and 73.9' Low angle, open joints.			
			CONTINUED ON SHEET 2 NOTE: Soils field classified in accordance with the Unified Soil Classification System.			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 1/2" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

~~MLLW~~
-0.5

~~42.3~~
MLLW

~~68.9~~
MLLW

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE 0.0 MLLW		Hole No. WH94-20A		
PROJECT WILMINGTON HARBOR COMP. STUDY			INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS	
ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVER- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	74		PEEDEE FM, cont'd from above. Limestone - Gray, sandy, fine grained, moderately to highly weathered, hard, moderately pitted and vuggy, small to large vugs. 74.3, 74.5, 74.6, & 74.8' Low angle, open joints.			Pull 2 cont'd from above PULL 2: 77.8' to 83.0' RUN 4.3' UL 0.2' REC 4.1' LOSS 0.2'
	75		SM, Dark gray, fine, silty sand, some clay and sandy limestone fragments.	95	BOX 1	Hyd. press: 150 psi Drill water return: 80% Drilling time: 17 min. ROD - 24.4%
	76				OF 2	
	77					Tape checked to 77.6' "Probable fall-in obscured corrected depth," T. Haw, Aug 94.
	78	LOSS	Limestone - Same as 73.5' - 74.1, but moderately weathered. 77.2' & 77.6' Low angle, open joint 77.6' to 77.8' Unaccountable core loss.			PULL 3: 77.8' to 83.0' RUN 5.2' UL 0.0' REC 5.2' LOSS 0.0'
	79		Gray, sandy, fine grained, mod- erately to highly weathered, hard, moderately pitted and vuggy, small to large vugs, fragmented. SC, Dark gray, fine, clayey sand, some limestone fragments.		79.7'	Hyd. press: 150 psi Drill water return: 100% Drilling time: 16 min. ROD - 7.7%
	80		Limestone same as 77.8' to 78.8' but fine to medium grained and not fragmented. 89.5' to 80.7' High angle, open joint.	100		
	81		80.8' Low angle, open joint. SC, Same as 78.8' to 80.5'		BOX 2	
	82				OF 2	
	83.0		Limestone - Same as 80.5' to 80.8, but dark gray, moderately hard to hard, highly weathered. 82.2, 82.7, & 82.8' Low angle open joint			Tape checked to 83.0'
			BOTTOM OF HOLE @ 83.0'			

~~-82.5~~
MLLW

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR COMPREHENSIVE STUDY		10. SIZE AND TYPE OF BIT 1-3/8" I.D. Solitspoon, 5-1/2"	
2. LOCATION (Coordinates or Station) LAT. 34° 9' 40.54" LONG. 77° 57' 44.29"		11. DATUM FOR ELEVATION SHOWN (TBM or VSL) Fishtail & Mean Low Water 4"x5-1/2" Core bit	
3. DRILLING AGENCY SAVANNAH DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and file number) WH93-56		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED : 3 UNDISTURBED : 0	
5. NAME OF DRILLER David Justiss		14. TOTAL NUMBER CORE BOXES 2	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 45.7' (Water 32.5')		16. DATE HOLE STARTED : 01 SEP 93 COMPLETED : 01 SEP 93	
8. DEPTH DRILLED INTO ROCK 13.2'		17. ELEVATION TOP OF HOLE 0.0 MLW TO 0.6 MLLW	
9. TOTAL DEPTH OF HOLE 58.9'		18. TOTAL CORE RECOVERY FOR BORING 100	
19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.			

ELEVATION MLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
	0		0.0' to 32.5' Water NAD 83 E. 2314026 N. 151387 NOTE: POST PEEDEE AGE SEDIMENTS ARE UNDIFFERENTIATED BOTTOM OF RIVER @ 32.5'			BORING LOCATION NC Coord. N. 151320.3 NAD 27 E. 2313946.5 (Upper/Lower Brunswick) NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLW. Data transcribed from field log by Tong Haw, Geologists, Mar 94. NOTE: CHANGED SCALE @ 32.0' and 44.0'
	32.5		CH, Dark gray, fat clay		1	BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES 32.5' to 43.5' and 43.5' to 45.0' Splitspoon driven by Weight of Rods (WR).
	45		SC, Olive-gray, fine clayey sand, partially indurated, calcareous TOP OF ROCK @ 45.7'		3	45.7' Fishtail refusal
	45.7		PEEDEE FORMATION - Locally, lenses of molluscan-mold limestone in upper beds which may be interbedded with greenish-gray to olive-black sand, clayey sand, and/or clay 45.8' to 46.7' & 46.9' to 48.8'	100	BOX 1 OF 2	Pull 1 cont. on next page 45.7' to 45.8' and 46.7' to 46.9' Limestone - Fine to medium grained, slightly weathered, fragmented
	47		SC, cont. on next page			
			CONTINUED ON SHEET 2 NOTE: Soils field classified in accordance with the Unified Soil Classification System.			

+0.6 MLLW

-31.9 MLLW

-45.1 MLLW

-46.4 MLLW

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE		Hole No. WH93-56		
PROJECT WILMINGTON HARBOR COMP. STUDY		INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS		
ELEVATION MLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVER- ED	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-46.4 MLLW	47		PEEDEE FORMATION cont. SC, continued from above - olive-gray, fine, clayey sand, calcareous			Pull 1 cont. from above PULL 1: 45.7' to 50.3' RUN 5.2' UL 0.0' REC 5.2' LOSS 0.0' Hyd. press: 90 psi Drill water return: 100% Drilling time: 49 min. RQD = 0%
	48			100	1	
	49				OF	
	50				2	Tape checked to 50.7' "Probable fall-in obscured corrected depth," T. Haw, Feb 94.
	51					
	52					
	53		Limestone - Gray, sandy, fine to medium grained, slightly weathered, hard 52.0' to 53.1' High angle, open joint		52.7'	PULL 2: 50.9' to 56.1' RUN 5.2' UL 0.0' REC 5.2' LOSS 0.0' Hyd. press: 90 psi Drill water return: 100% Drilling time: 27 min. RQD = 21.2%
	54		SC, Same as 49.4' to 52.7'	100		
	55		Limestone - Same as 52.7' to 53.1' 54.8' and 55.3' Low angle, open joint		2	
	56		SC, Same as 49.4' to 52.7'		OF	
	57				2	
	58			100		PULL 3: 56.1' to 58.9' RUN 2.8' UL 0.0' REC 2.8' LOSS 0.0' Hyd. press: 90 psi Drill water return: 100% Drilling time: 3 min. RQD = 0%
	58.9		BOTTOM OF HOLE @ 58.9'			Tape checked to 58.4' "Probable fall-in obscured corrected depth," T. Haw, Feb 94.

-58.3
MLLW

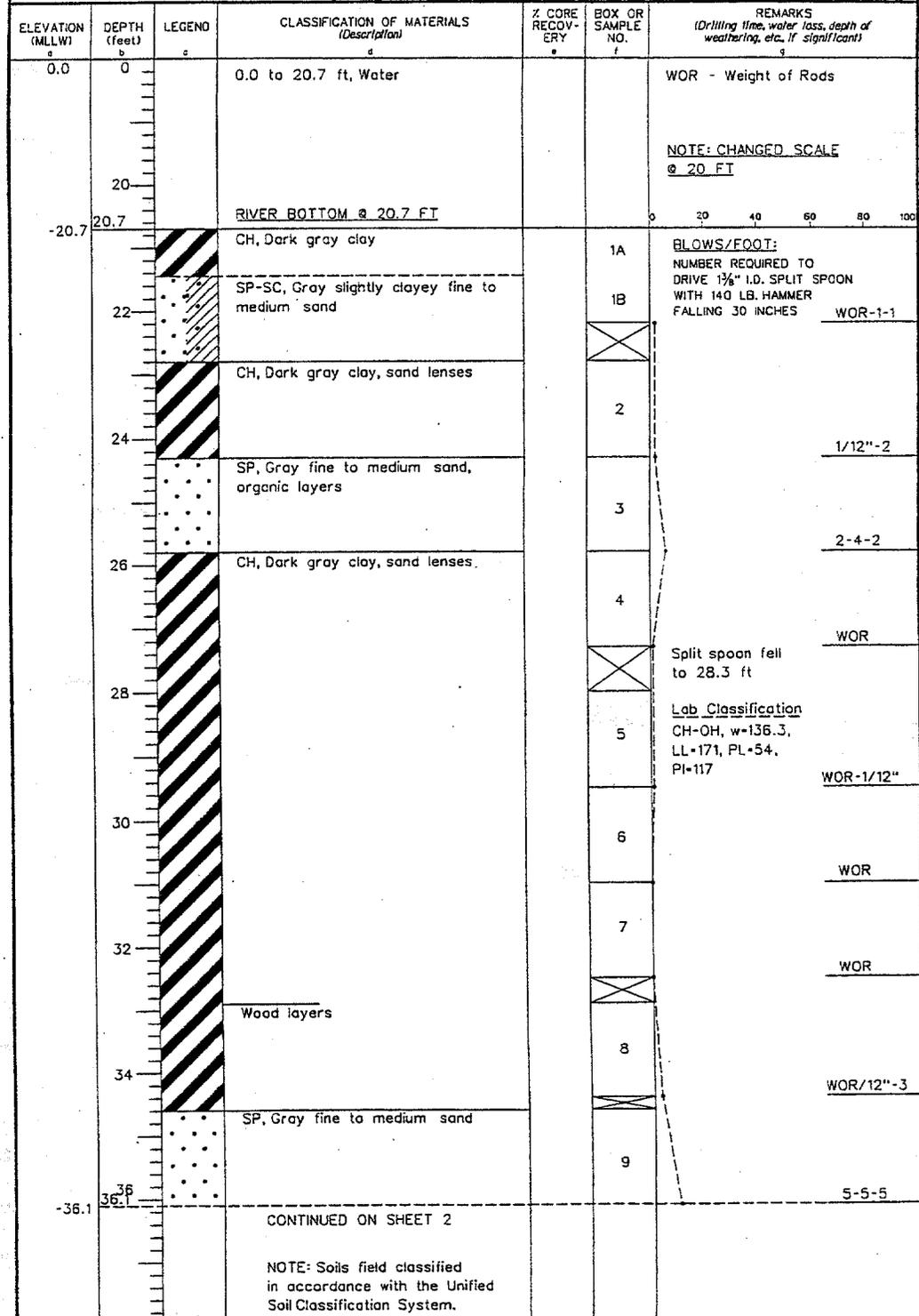
DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR CHANNEL WIDENING			10. SIZE AND TYPE OF BIT 5-1/2" dia. Fishtail	
2. LOCATION (Coordinates or Station) Lower Midnight Ch. LAT. 33° 59' 15.56" LONG. 77° 56' 53.15"			11. DATUM FOR ELEVATION SHOWN (TBM or MSU) Mean Lower Low Water	
3. DRILLING AGENCY SAVANNAH DISTRICT			12. MANUFACTURER'S DESIGNATION OF DRILL Fairing 314 (CESAS - "EXPLORER")	
4. HOLE NO. (As shown on drawing title and title number) : WH94P-LM5 (LM-5)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED : UNDISTURBED : 0 : 0	
5. NAME OF DRILLER DAVID JUSTISS			14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 60.0' (WATER 21.0')			16. DATE HOLE : STARTED : COMPLETED : 17 JUL 94 : 17 JUL 94	
8. DEPTH DRILLED INTO ROCK 0.0'			17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 60.0'			18. TOTAL CORE RECOVERY FOR BORING N/A %	
			19. SIGNATURE OF INSPECTOR JIM ARTHUR, P.G.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0		0.0' to 21.0' Water.			BORING LOCATION NC Coord. N. 88122 NAD 27 E. 2318826 Approx. Station & Offset 87+85 393' Right of Centerline NOTE: TOP OF HOLE is defined as surface of water and compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Tong Haw, Geologists, Aug 94. NOTE: <u>CHANGED SCALE @ 20.0'</u>
-21.0	21.0		<u>BOTTOM OF HARBOR @ 21.0'</u>			
	21.0		21.0' to 48.0' Probably gray, fat clay.			NAD 83
	30					N 88188 E 2318906
	40		48.0' to 54.0' Probably medium to coarse sand and trace of wood.			
	50		54.0' to 60.0' Hard.			60.0' Hydraulic pressure, 200 psi and drill water return 100%.
	60.0		<u>PROBABLE TOP OF ROCK @ 60.0'</u>			Fishtail refusal @ 60.0'
-60.0	60.0		<u>BOTTOM OF HOLE @ 60.0'</u>			

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR COMPREHENSIVE STUDY			10. SIZE AND TYPE OF BIT 3 7/8" Side-Discharge Drag Bit	
2. LOCATION (Coordinates or Station) N164027, E2315276 (NAD 83)			11. DATUM FOR ELEVATION SHOWN MLLW	
3. DRILLING AGENCY S&ME, INC. (Raleigh, NC)			12. MANUFACTURER'S DESIGNATION OF DRILL ARDCO C-1000 (Barge Mounted)	
4. HOLE NO. (As shown on drawing title and file number) WHP98-23			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: N/A UNDISTURBED: N/A	
5. NAME OF DRILLER BILLY RACKLEY			14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 52.8ft (Water 35.0ft)			16. DATE HOLE STARTED: 16 APR 98 COMPLETED: 16 APR 98	
8. DEPTH DRILLED INTO ROCK N/A			17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 52.8ft			18. TOTAL CORE RECOVERY FOR BORING N/A %	
			19. SIGNATURE OF INSPECTOR BRYAN MOELLER (ZAPATA ENGINEERING)	

ELEVATION (MLLW) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0.0	0		0.0 ft to 35.0 ft, Water			Washed probe with 3 7/8" side-discharge drag bit and water
	10					
	20					
	30					NOTE: CHANGED SCALE @ 30 FT
	35		RIVER BOTTOM @ 35.0 ft			
-35.0	35.0		Probably silt			Classification of material based on drill cuttings and drilling resistance
	40		Probably silt with limestone fragments and trace of clay			Set initial casing to 39.3 ft No return Advanced casing to 44.0 ft
	45		Probably fine sand with limestone fragments			Harder/denser @ 44.1 ft and 46.8 ft Softer/looser @ 46.2 ft
	50					
-52.8	52.8		BOTTOM OF HOLE @ 52.8 ft			Hole terminated at predetermined depth

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT WILMINGTON HARBOR COMPREHENSIVE STUDY		10. SIZE AND TYPE OF BIT 2 7/8" Side-Discharge Drag Bit	
2. LOCATION (Coordinates or Station) N116467, E2322626 (NAD 83)		11. DATUM FOR ELEVATION SHOWN MLLW	
3. DRILLING AGENCY S&ME, Inc. (Raleigh, NC)		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 (Barge Mounted)	
4. HOLE NO. (As shown on drawing title and file number) WH98-97		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 15 UNDISTURBED 0	
5. NAME OF DRILLER MIKE MOSELY		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 4.6ft (Water 20.7ft)		16. DATE HOLE STARTED 27 MAY 98 COMPLETED 27 MAY 98	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.6ft		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR GINA LONG (ZAPATA ENGINEERING)			



DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE 0.0 MLLW		Hole No. WH98-97		
PROJECT WILMINGTON HARBOR COMP. STUDY			INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS	
ELEVATION (MLLW) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g 20 40 60 80 100
-36.1	36.1	•••••	SP, continued as above		10	BLOWS/FOOT 6-6-7
	38	○ ○ ○ ○ ○	SW, Fine to coarse sand		11	4-3-6
	40	○ ○ ○ ○ ○			12	Lab Classification SP 3-4-6
	42	•••••	SP, Fine to medium quartz sand		13	4-6-8
	44	○ ○ ○ ○ ○	SW, Fine to coarse sand, trace fine gravel		14	5-7-7
-44.6	44.6		BOTTOM OF HOLE @ 44.6 FT			Hole terminated at predetermined depth

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR COMPREHENSIVE STUDY		10. SIZE AND TYPE OF BIT 2 7/8" Side-Discharge Drag Bit	
2. LOCATION (Coordinates or Station) N114275, E2321540 (NAD 83)		11. DATUM FOR ELEVATION SHOWN MLLW	
3. DRILLING AGENCY S&ME, Inc. (Raleigh, NC)		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 (Barge Mounted)	
4. HOLE NO. (As shown on drawing title and file number) WH98-99		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED : UNDISTURBED 5 : 0	
5. NAME OF DRILLER MIKE MOSELEY		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN 40.1ft (Water 32.3ft)		16. DATE HOLE : STARTED : COMPLETED 29 MAY 98 : 29 MAY 98	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 40.1ft		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR GINA LONG (ZAPATA ENGINEERING)	

ELEVATION (MLLW) a	DEPTH (feet) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0		0.0 to 40.5 ft, Water			WOR - Weight of Rods
						NOTE: CHANGED SCALE @ 32 FT
-32.3	32.3		RIVER BOTTOM @ 32.3 FT			
			No recovery - Cuttings are wood and clay			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/4" I.D. SPLIT SPOON WITH 140 LB. HAMMER FALLING 30 INCHES WOR
	34		MH-OH, Brown gray clayey silt and fibrous organics		2A	
					2B	1/18"
	36		CH, Light gray silty clay with wood fragments, trace fine sand		3	WOR
			Slightly sandy		4	
	38					WOR
			SP-SM, light gray slightly silty fine sand, trace organics		5	
	40					WOR-1-1
-40.1	40.1		BOTTOM OF HOLE @ 40.1 FT NOTE: Soils field classified in accordance with the Unified Soil Classification System.			Hole terminated because drill rig not equipped for undisturbed sampling. See WH98-99A.

Appendix A

WHP-02-1 to WHP-02-76

FOURTH EAST JETTY CHANNEL WASH PROBES IN VICINITY OF EXXONMOBIL CHEMICAL COMPANY PIPELINES

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315063 N. 158654 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>BM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-1		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (34.3' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.1'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 34.3' Water			NOTE: Time Begin Washprobe 0854 hrs.
-34.3	34.3		RIVER BOTTOM @ 34.3'			
	36		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	38					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	40					
	42					
-43.1	43.1		BOTTOM OF HOLE @ 43.1'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.1'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314943 N. 158675 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-2		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (33.1' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.2'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 33.1' Water			NOTE: Time Begin Washprobe 0905 hrs.
-33.1	33.1		RIVER BOTTOM @ 33.1'			
	35		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	37					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	39					
	41					
-42.2	42.2		BOTTOM OF HOLE @ 42.2'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.2'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315058 N. 158610 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>(BM or MSL)</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-3		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (34.1' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 42.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.		

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 34.1' Water			NOTE: Time Begin Washprobe 0912 hrs.
-34.1	34.1		RIVER BOTTOM @ 34.1'			
	36		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin. Civil Engr. Tech.
	38					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	40					
	42					
-42.9	42.9		BOTTOM OF HOLE @ 42.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.9'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315055 N. 158557 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>NBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-4		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (33.0' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 43.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.				

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 33.0' Water			NOTE: Time Begin Washprobe 0918 hrs.
-33.0	33		RIVER BOTTOM @ 33.0'			
	35		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	37					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	39					
	41					
-43.0	43		BOTTOM OF HOLE @ 43.0'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.0'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315060 N. 158505 (NAD 83)		11. DATUM FOR ELEVATION SHOW (BM or MSL) MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (as shown on drawing title and file number) WHP-02-5		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (34.9' of Water)		16. DATE HOLE STARTED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 48.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 34.9' Water			NOTE: Time Begin Washprobe 0926 hrs.
-34.9	34.9		RIVER BOTTOM @ 34.9'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-48.7	48.7		BOTTOM OF HOLE @ 48.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 48.7'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315049 N. 158524 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-6		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (36.0' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 45.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.		

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 36.0' Water			NOTE: Time Begin Washprobe 0929 hrs.
-36.0	36.0		RIVER BOTTOM @ 36.0'			
	38		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
	44					
-45.4	45.4		BOTTOM OF HOLE @ 45.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315030 N. 158479 (NAD 83)		11. DATUM FOR ELEVATION SHOWN M or MSU MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-7		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (35.9' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 39.5'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVER- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 35.9' Water			NOTE: Time Begin Washprobe 0932 hrs.
	35					
	35.9		RIVER BOTTOM @ 35.9'			
-35.9	36		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is defined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	37					
	38					
	39					
-39.5	39.5		BOTTOM OF HOLE @ 39.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 39.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314984 N. 158488 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>WTBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-8		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (34.7' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 49.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 34.7' Water			NOTE: Time Begin Washprobe 0953 hrs.
-34.7	34.7		RIVER BOTTOM @ 34.7'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-49.7	49.7		BOTTOM OF HOLE @ 49.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 49.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314966 N. 158504 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>(BM or MSL)</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-9		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (34.7' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 49.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 34.7' Water			NOTE: Time Begin Washprobe 0955 hrs.
-34.7	34.7		RIVER BOTTOM @ 34.7'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-49.9	49.9		BOTTOM OF HOLE @ 49.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 49.9'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314948 N. 158538 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (as shown on drawing title and file number) WHP-02-10		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (35.7' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 46.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 35.7' Water			NOTE: Time Begin Washprobe 1002 hrs.
-35.7	35.7		RIVER BOTTOM @ 35.7'			NOTE: Scale Changed at 41.0'
	37		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	39					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
	45					
-46.6	46.6		BOTTOM OF HOLE @ 46.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 46.6'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2314940 N. 158613 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-11		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (32.6' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 42.5'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.		

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 32.6' Water			NOTE: Time Begin Washprobe 1015 hrs.
-32.6	32.6		RIVER BOTTOM @ 32.6'			
	34		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	36					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	38					
	40					
	42					
-42.5	42.5		BOTTOM OF HOLE @ 42.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314935 N. 158564 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-12		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (32.6' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if signif/cont) g
0	0		0.0' to 32.6' Water			NOTE: Time Begin Washprobe 1022 hrs.
-32.6	32.6		RIVER BOTTOM @ 32.6'			
	34		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	36					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	38					
	40					
	42					
-42.6	42.6		BOTTOM OF HOLE @ 42.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.6'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2314932 N. 158523 (NAD 83)		11. DATUM FOR ELEVATION SHOWN ^{BM} or ^{MSL} MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-13		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (32.5' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 49.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.		

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0	0		0.0' to 32.5' Water			NOTE: Time Begin Washprobe 1031 hrs.
	32					
-32.5	32.5		RIVER BOTTOM @ 32.5'			
	37		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	47					
-49.4	49.4		BOTTOM OF HOLE @ 49.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 49.4'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315184 N. 158756 (NAD 83)		11. DATUM FOR ELEVATION SHOWING <i>BM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-14		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (42.5' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 44.2'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.				

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 42.5' Water			NOTE: Time Begin Washprobe 1100 hrs.
	41					
	42					
-42.5	42.5		RIVER BOTTOM @ 42.5'			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	44					
-44.2	44.2		BOTTOM OF HOLE @ 44.2'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.2'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315305 N. 158740 (NAD 83)		11. DATUM FOR ELEVATION SHOW/TBM or NSL MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-15		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (37.5' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.2'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 37.5' Water			NOTE: Time Begin Washprobe 1107 hrs.
-37.5	37.5		RIVER BOTTOM @ 37.5'			
	38		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
	42					
-42.2	42.2		BOTTOM OF HOLE @ 42.2'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.2'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315191 N. 158652 (NAD 83)		11. DATUM FOR ELEVATION SHOWING or MSL MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-16		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (42.6' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 44.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.				

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 42.6' Water			NOTE: Time Begin Washprobe 1119 hrs.
-42.6	42.6		RIVER BOTTOM @ 42.6'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-44.9	44.9		BOTTOM OF HOLE @ 44.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.9'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315304 N. 158646 (NAD 83)		11. DATUM FOR ELEVATION SHOW(BM or MSU) MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-17		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.6' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 46.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 42.6' Water			NOTE: Time Begin Washprobe 1126 hrs.
-42.6	42.6		RIVER BOTTOM @ 42.6'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TDP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-46.4	46.4		BOTTOM OF HOLE @ 46.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 46.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315310 N. 158605 (NAD 83)		11. DATUM FOR ELEVATION SHOWNTSM or MSU MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) : WHP-02-18		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.6' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 46.5'		18. TOTAL CORE RECOVERY FOR BORING N/A	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 42.6' Water			NOTE: Time Begin Washprobe 1135 hrs.
-42.6	42.6		RIVER BOTTOM @ 42.6'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	45					
	46					
-46.5	46.5		BOTTOM OF HOLE @ 46.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 46.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315189 N. 158605 (NAD 83)		11. DATUM FOR ELEVATION SHOWNTBM or MSU MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-19		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.7' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 42.7' Water			NOTE: Time Begin Washprobe 1140 hrs.
	42					
-42.7	42.7		RIVER BOTTOM @ 42.7'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin. Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	45					
-45.7	45.7		BOTTOM OF HOLE @ 45.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315295 N. 158541 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTM</i> or <i>MSJ</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-20		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.0' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.5'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 42.0' Water			NOTE: Time Begin Washprobe 1219 hrs.
-42.0	42.0		RIVER BOTTOM @ 42.0'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	45					
-45.5	45.5		BOTTOM OF HOLE @ 45.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315187 N. 158549 (NAD 83)		11. DATUM FOR ELEVATION SHOWNTBM or MSU MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-21		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.1' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 42.1' Water			NOTE: Time Begin Washprobe 1227 hrs.
-42.1	42.1		RIVER BOTTOM @ 42.1'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	45					
-45.6	45.6		BOTTOM OF HOLE @ 45.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315188 N. 158501 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MSL</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-22		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : 0 , UNDISTURBED : 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (43.2' of Water)		16. DATE HOLE STARTED 1/15/02 , COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 47.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 43.2' Water			NOTE: Time Begin Washprobe 1236 hrs.
-43.2	43.2		RIVER BOTTOM @ 43.2'			
	44		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	45					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	46					
	47					
-47.9	47.9		BOTTOM OF HOLE @ 47.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 47.9'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)			10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315314 N. 158488 (NAD 83)			11. DATUM FOR ELEVATION SHOW <i>WFBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT			12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-23			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)			14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.3' of Water)			16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A			17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.5'			18. TOTAL CORE RECOVERY FOR BORING N/A	
			19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 42.3' Water			NOTE: Time Begin Washprobe 1241 hrs.
-42.3	42.3		RIVER BOTTOM @ 42.3'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-45.5	45.5		BOTTOM OF HOLE @ 45.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.5'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315446 N. 158477 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>MBM</i> or <i>MSU</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-24		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (37.6' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 43.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.				

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0	0		0.0' to 37.6' Water			NOTE: Time Begin Washprobe 1303 hrs.
-37.6	37.6		RIVER BOTTOM @ 37.6'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.6	43.6		BOTTOM OF HOLE @ 43.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315442 N. 158526 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>BM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-25		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.8' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 41.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 38.8' Water			NOTE: Time Begin Washprobe 1317 hrs.
-38.8	38.8		RIVER BOTTOM @ 38.8'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-41.7	41.7		BOTTOM OF HOLE @ 41.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 41.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315431 N. 158576 (NAD 83)		11. DATUM FOR ELEVATION SHOW/BM or MSL MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-26		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.0' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 41.0' Water			NOTE: Time Begin Washprobe 1335 hrs.
-41.0	41.0		RIVER BOTTOM @ 41.0'			
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-42.8	42.8		BOTTOM OF HOLE @ 42.8'			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315436 N. 158630 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>BM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-27		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.2' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.2'		18. TOTAL CORE RECOVERY FOR BORING N/A	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 41.2' Water			NOTE: Time Begin Washprobe 1346 hrs.
-41.2	41.2		RIVER BOTTOM @ 41.2'			
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	43					Jetted 4-inch diameter opened and steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-44.2	44.2		BOTTOM OF HOLE @ 44.2'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.2'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315437 N. 158736 (NAD 83)		11. DATUM FOR ELEVATION SHOWING or MSL MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-28		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.4' of Water)		16. DATE HOLE STARTED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.1'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 41.4' Water			NOTE: Time Begin Washprobe 1400 hrs.
	40					
	41					NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-41.4	41.4		RIVER BOTTOM @ 41.4'			
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			
-42.1	42.1		BOTTOM OF HOLE @ 42.1'			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.1'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314933 N. 158169 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>WBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-29		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (33.0' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.0'		18. TOTAL CORE RECOVERY FOR BORING N/A	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lockey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 33.0' Water			NOTE: Time Begin Washprobe 1445 hrs.
-33.0	33.0		RIVER BOTTOM @ 33.0'			
	35		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	37					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	39					
	41					
-42.0	42.0		BOTTOM OF HOLE @ 42.0'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.0'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315065 N. 158162 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSU</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and Title number) WHP-02-30		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.2' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lockey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 38.2' Water			NOTE: Time Begin Washprobe 1458 hrs.
-38.2	38.2		RIVER BOTTOM @ 38.2'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-44.4	44.4		BOTTOM OF HOLE @ 44.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315052 N. 158268 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-31		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (36.4' of Water)		16. DATE HOLE STARTED: 1/15/02 COMPLETED: 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 36.4' Water			NOTE: Time Begin Washprobe 1515 hrs.
-36.4	36.4		RIVER BOTTOM @ 36.4'			
	38		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
-43.6	43.6		BOTTOM OF HOLE @ 43.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314930 N. 158248 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>BM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-32		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (35.6' of Water)		16. DATE HOLE 'STARTED' 1/15/02 'COMPLETED' 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 35.6' Water			NOTE: Time Begin Washprobe 1535 hrs.
-35.6	35.6		RIVER BOTTOM @ 35.6'			
	37		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	39					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
-42.4	42.4		BOTTOM OF HOLE @ 42.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314941 N. 158324 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>(BM or MSL)</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-33		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (28.2' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.2'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 28.2' Water			NOTE: Time Begin Washprobe 1622 hrs.
-28.2	28.2		RIVER BOTTOM @ 28.2'			
	33		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	38					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-42.2	42.2		BOTTOM OF HOLE @ 42.2'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.2'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315067 N. 158309 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSU</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-34		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (39.4' of Water)		16. DATE HOLE 'STARTED 1/15/02 'COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.4' Water			NOTE: Time Begin Washprobe 1638 hrs.
-39.4	39.4		RIVER BOTTOM @ 39.4'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
	43					
-43.4	43.4		BOTTOM OF HOLE @ 43.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315185 N. 158154 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-35		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (40.5' of Water)		16. DATE HOLE 'STARTED' 1/15/02 'COMPLETED' 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lockey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 40.5' Water			NOTE: Time Begin Washprobe 1650 hrs.
	40					
-40.5	40.5		RIVER BOTTOM @ 40.5'			
	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened and steel pipe using water paired with a 1-inch diameter opened and steel pipe using air to refusal or predetermined depth
	43					
	44					
-45.0	45.0		BOTTOM OF HOLE @ 45.0'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.0'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315309 N. 158116 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>FBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-36		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (40.7' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 42.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.				

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 40.7' Water			NOTE: Time Begin Washprobe 1713 hrs.
	40					
	40.7		RIVER BOTTOM @ 40.7'			
	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42.9		BOTTOM OF HOLE @ 42.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.9'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315182 N. 158238 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>WTBW</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-37		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.7' of Water)		16. DATE HOLE 'STARTED 1/15/02 'COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.5'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ.Engr.Tech.& Ben Lackey P.E.			

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 41.7' Water			NOTE: Time Begin Washprobe 1721 hrs.
-41.7	41.7		RIVER BOTTOM @ 41.7'			
-42	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-45.5	45.5		BOTTOM OF HOLE @ 45.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315308 N. 158294 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>RTM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-38		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (39.7' of Water)		16. DATE HOLE STARTED 1/15/02 COMPLETED 1/15/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.3'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Tech. & Ben Lackey P.E.	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.7' Water			NOTE: Time Begin Washprobe 1728 hrs.
	39					
	39.7		RIVER BOTTOM @ 39.7'			
-39.7	39.7		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
	42					
	43					
-43.3	43.3		BOTTOM OF HOLE @ 43.3'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.3'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315429 N. 158129 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-39		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (25.7' of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 40.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician				

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 25.7' Water			NOTE: Time Begin Washprobe 0804 hrs.
-25.7	25.7		RIVER BOTTOM @ 25.7'			
	30		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	35					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-40.7	40.7		BOTTOM OF HOLE @ 40.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 40.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315429 N. 158229 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>NBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-40		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (40.3' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 40.3' Water			NOTE: Time Begin Washprobe 0826 hrs.
	39					
	40					
-40.3	40.3		RIVER BOTTOM @ 40.3'			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
-42.4	42.4		BOTTOM OF HOLE @ 42.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315434 N. 158047 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-41		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (N/A of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 29.1'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		NO RIVER BOTTOM RECORDED			NOTE: Time Begin Washprobe 0854 hrs.
	25		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	26					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	27					
	28					
-29.1	29.1		BOTTOM OF HOLE @ 29.1'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 29.1'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315423 N. 157932 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>NBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-42		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (N/A of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 28.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		NO RIVER BOTTOM RECORDED			NOTE: Time Begin Washprobe 0902 hrs.
	25		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	26					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	27					
	28					
-28.7	28.7		BOTTOM OF HOLE @ 28.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 28.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315313 N. 157942 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-43		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (39.6' of Water)		16. DATE HOLE 'STARTED' 1/16/02 'COMPLETED' 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.6' Water			NOTE: Time Begin Washprobe 0905 hrs.
	39					
-39.6	39.6		RIVER BOTTOM @ 39.6'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
	42					
-42.6	42.6		BOTTOM OF HOLE @ 42.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.6'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315315 N. 157942 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) : WHP-02-44		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (39.5' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 42.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.5' Water			NOTE: Time Begin Washprobe 0912 hrs.
	39					
-39.5	39.5		RIVER BOTTOM @ 39.5'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Lorry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
-42.7	42.7		BOTTOM OF HOLE @ 42.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315197 N. 158064 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-45		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (40.3' of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 40.3' Water			NOTE: Time Begin Washprobe 0930 hrs.
-40.3	40.3		RIVER BOTTOM @ 40.3'			
	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.8	43.8		BOTTOM OF HOLE @ 43.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315193 N. 157954 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-46		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (40.2' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.2'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 40.2' Water			NOTE: Time Begin Washprobe 0939 hrs.
-40.2	40.2		RIVER BOTTOM @ 40.2'			
	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.2	43.2		BOTTOM OF HOLE @ 43.2'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.2'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314932 N. 157971 (NAD 83)		11. DATUM FOR ELEVATION SHOW/FM or MSU MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-47		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (35.1' of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 35.1' Water			NOTE: Time Begin Washprobe 1000 hrs.
-35.1	35.1		RIVER BOTTOM @ 35.1'			
	37		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin. Civil Engr. Tech.
	39					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
-42.8	42.8		BOTTOM OF HOLE @ 42.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.8'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2314934 N. 158055 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>FBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-48		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (33.9' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 42.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 33.9' Water			NOTE: Time Begin Washprobe 1019 hrs.
	33					
-33.9	33.9		RIVER BOTTOM @ 33.9'			
	35		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	37					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	39					
	41					
-42.6	42.6		BOTTOM OF HOLE @ 42.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315042 N. 158059 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-49		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.8' of Water)		16. DATE HOLE 'STARTED: 1/16/02 'COMPLETED: 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.5'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 38.8' Water			NOTE: Time Begin Washprobe 1037 hrs.
-38.8	38.8		RIVER BOTTOM @ 38.8'			
-40	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-42	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-44.5	44.5		BOTTOM OF HOLE @ 44.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315065 N. 157956 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-50		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (39.8' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.3'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.8' Water			NOTE: Time Begin Washprobe 1046 hrs.
-39.8	39.8		RIVER BOTTOM @ 39.8'			
-41	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin. Civil Engr. Tech.
-45.3	45.3		BOTTOM OF HOLE @ 45.3'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.3'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2314934 N. 157727 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>MBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) : WHP-02-51		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (29.9' of Water)		15. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 42.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (feet)	LEGEND e	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 29.9' Water			NOTE: Time Begin Washprobe 1231 hrs.
-29.9	29.9		RIVER BOTTOM @ 29.9'			
	34		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-42.9	42.9		BOTTOM OF HOLE @ 42.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.9'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314930 N. 157466 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>WBM or MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) : WHP-02-52		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED : 0 UNDISTURBED : 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.0' of Water)		16. DATE HOLE 'STARTED : 1/16/02 'COMPLETED : 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 38.0' Water			NOTE: Time Begin Washprobe 1244 hrs.
-38.0	38.0		RIVER BOTTOM @ 38.0'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.8	43.8		BOTTOM OF HOLE @ 43.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315055 N. 157491 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTM</i> or <i>MSU</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-53		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.0' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 38.0' Water			NOTE: Time Begin Washprobe 1248 hrs.
-38.0	38.0		RIVER BOTTOM @ 38.0'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech. Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
-43.7	43.7		BOTTOM OF HOLE @ 43.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315061 N. 157713 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-54		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.1' of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.9'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 38.1' Water			NOTE: Time Begin Washprobe 1256 hrs.
-38.1	38.1		RIVER BOTTOM @ 38.1'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.9	43.9		BOTTOM OF HOLE @ 43.9'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.9'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315058 N. 156960 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>BM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-55		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (37.2' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0	0		0.0' to 37.2' Water			NOTE: Time Begin Washprobe 1304 hrs.
-37.2	37.2		RIVER BOTTOM @ 37.2'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.4	43.4		BOTTOM OF HOLE @ 43.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314931 N. 156973 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>(BM or MSL)</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-56		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (37.2' of Water)		16. DATE HOLE 'STARTED: 1/16/02 'COMPLETED: 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 37.2' Water			NOTE: Time Begin Washprobe 1307 hrs.
-37.2	37.2		RIVER BOTTOM @ 37.2'			
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.4	43.4		BOTTOM OF HOLE @ 43.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.4'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315061 N. 156457 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>MBM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-57		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (39.3' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 43.3'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.3' Water			NOTE: Time Begin Washprobe 1315 hrs.
-39.3	39.3		RIVER BOTTOM @ 39.3'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
	43					
-43.3	43.3		BOTTOM OF HOLE @ 43.3'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.3'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314941 N. 156469 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FWM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-58		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (39.6' of Water)		16. DATE HOLE STARTED: 1/16/02 COMPLETED: 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.6' Water			NOTE: Time Begin Washprobe 1334 hrs.
	39					
	39.6		RIVER BOTTOM @ 39.6'			
-39.6	39.6		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
	42					
-42.4	42.4		BOTTOM OF HOLE @ 42.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314932 N. 155975 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>MSL</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and title number) WHP-02-59		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (40.8' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 40.8' Water			NOTE: Time Begin Washprobe 1351 hrs.
-40.8	40.8		RIVER BOTTOM @ 40.8'			
	41		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	43					
-43.8	43.8		BOTTOM OF HOLE @ 43.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315064 N. 155966 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>NBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-60		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (38.9' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician			

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
0	0		0.0' to 38.9' Water			NOTE: Time Begin Washprobe 1400 hrs.
-38.9	38.9		RIVER BOTTOM @ 38.9'			
-40	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-43.6	43.6		BOTTOM OF HOLE @ 43.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2314932 N. 155466 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>(MSL or MLLW)</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) : WHP-02-61		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES	UNDISTURBED 0
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	N/A
7. THICKNESS OF OVERBURDEN N/A (41.1' of Water)		16. DATE HOLE 'STARTED 1/16/02	'COMPLETED 1/16/02
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.1'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 41.1' Water			NOTE: Time Begin Washprobe 1411 hrs.
-41.1	41.1		RIVER BOTTOM @ 41.1'			
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	43					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	44					
-45.1	45.1		BOTTOM OF HOLE @ 45.1'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.1'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315062 N. 155463 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>MBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-62		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (42.1' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		0.0' to 42.1' Water			NOTE: Time Begin Washprobe 1414 hrs.
-42.1	42.1		RIVER BOTTOM @ 42.1'			
	43		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-44.8	44.8		BOTTOM OF HOLE @ 44.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315430 N. 158829 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>BM or MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) : WHP-02-63		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.6' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 41.6' Water			NOTE: Time Begin Washprobe 1451 hrs.
	41					
-41.6	41.6		RIVER BOTTOM @ 41.6'			
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	43					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	44					
-44.8	44.8		BOTTOM OF HOLE @ 44.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315427 N. 158957 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>WTM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-64		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (N/A of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.8'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		NO RIVER BOTTOM RECORDED			NOTE: Time Begin Washprobe 1458 hrs.
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					
	42					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	43					
-43.8	43.8		BOTTOM OF HOLE @ 43.8'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.8'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315435 N. 159174 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>RTM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-65		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.9' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if signf (cont) g
0	0		0.0' to 41.9' Water			NOTE: Time Begin Washprobe 1506 hrs. NOTE: TOP OF HOLE is de- fined as surface of water, compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-41.9	41.9		RIVER BOTTOM @ 41.9'			
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	43					
-43.6	43.6		BOTTOM OF HOLE @ 43.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315432 N. 159427 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>MSL</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-66		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (N/A of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.4'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0					NOTE: Time Begin Washprobe 1512 hrs.
	39		NO RIVER BOTTOM RECORDED			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-42.4	42.4		BOTTOM OF HOLE @ 42.4'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.4'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315428 N. 159936 (NAD 83)		11. DATUM FOR ELEVATION SHOWING or MSL MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-67		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.2' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if signif/cant) g
0	0		0.0' to 41.2' Water			NOTE: Time Begin Washprobe 1531 hrs.
	39					NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					
	41		RIVER BOTTOM @ 41.2'			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-41.2	41.2		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			
-42.0	42.0		BOTTOM OF HOLE @ 42.0'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.0'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315432 N. 160431 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>BM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-68		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (43.4' of Water)		16. DATE HOLE 'STARTED 1/16/02 'COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 44.6'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 43.4' Water			NOTE: Time Begin Washprobe 1545 hrs.
	41					NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42					
	43					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
-43.4	43.4		RIVER BOTTOM @ 43.4'			
	44		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			
-44.6	44.6		BOTTOM OF HOLE @ 44.6'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 44.6'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315425 N. 160923 (NAD 83)		11. DATUM FOR ELEVATION SHOWING or MSL MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and File Number) WHP-02-69		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (43.5' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 45.5'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 43.5' Water			NOTE: Time Begin Washprobe 1600 hrs.
-43.5	43.5		RIVER BOTTOM @ 43.5'			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-45.5	45.5		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
			BOTTOM OF HOLE @ 45.5'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 45.5'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315433 N. 161432 (NAD 83)		11. DATUM FOR ELEVATION SHOW (FBM or MSL) MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-70		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (43.7' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 46.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 43.7' Water			NOTE: Time Begin Washprobe 1613 hrs.
-43.7	43.7		RIVER BOTTOM @ 43.7'			
-44	44		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-46.7	46.7		BOTTOM OF HOLE @ 46.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 46.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315441 N. 162431 (NAD 83)		11. DATUM FOR ELEVATION SHOWING <i>BM</i> or <i>MSD</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-71		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (48.0' of Water)		16. DATE HOLE STARTED: 1/16/02 COMPLETED: 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 52.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 48.0' Water			NOTE: Time Begin Washprobe 1639 hrs.
-48.0	48.0		RIVER BOTTOM @ 48.0'			
	49		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is defined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	50					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	51					
-52.0	52.0		BOTTOM OF HOLE @ 52.0'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 52.0'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315185 N. 161451 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>ITEM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-72		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (43.2' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 46.2'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
0	0		0.0' to 43.2' Water			NOTE: Time Begin Washprobe 1657 hrs.
-43.2	43.2		RIVER BOTTOM @ 43.2' JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
-46.2	46.2		BOTTOM OF HOLE @ 46.2'			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
						HOLE TERMINATED AT WASH PROBE REFUSAL @ 46.2'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315183 N. 160948 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>BM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-73		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (39.3' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 43.7'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 39.3' Water			NOTE: Time Begin Washprobe 1707 hrs.
-39.3	39.3		RIVER BOTTOM @ 39.3'			
	40		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is defined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	41					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	42					
	43					
-43.7	43.7		BOTTOM OF HOLE @ 43.7'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.7'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315189 N. 160447 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-74		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (41.3' of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 43.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		0.0' to 41.3' Water			NOTE: Time Begin Washprobe 1714 hrs.
	40					
	41					
-41.3	41.3		RIVER BOTTOM @ 41.3'			NOTE: TOP OF HOLE is defined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	43.0					
-43.0	43.0		BOTTOM OF HOLE @ 43.0'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 43.0'

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE	
2. LOCATION (Coordinates or Station) NC Coord. E. 2315190 N. 159949 (NAD 83)		11. DATUM FOR ELEVATION SHOW <i>FBM</i> or <i>MSL</i> MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)	
4. HOLE NO. (As shown on drawing title and file number) WHP-02-75		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF OVERBURDEN N/A (N/A of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02	
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW	
9. TOTAL DEPTH OF HOLE 42.1'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician	

ELEVATION MLLW	DEPTH (feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		NO RIVER BOTTOM RECORDED			NOTE: Time Begin Washprobe 1720 hrs.
	39		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	40					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	41					
	42					
-42.1	42.1		BOTTOM OF HOLE @ 42.1'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 42.1'

DRILLING LOG		DIVISION SOUTH ATLANTIC	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT WILMINGTON HARBOR (FOURTH EAST JETTY)		10. SIZE AND TYPE OF BIT 4" STEEL PIPE & 1" AIR LINE		
2. LOCATION (Coordinates or Station) NC Coord. E. 2315173 N. 159451 (NAD 83)		11. DATUM FOR ELEVATION SHOWN <i>BM</i> or <i>MSL</i> MLLW		
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL WASH PROBE & AIR LINE (CESAW-SNELL)		
4. HOLE NO. (As shown on drawing title and file number) WHP-02-76		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0		
5. NAME OF DRILLER JERRY FULCHER (Crane Operator)		14. TOTAL NUMBER CORE BOXES N/A		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER N/A		
7. THICKNESS OF OVERBURDEN N/A (N/A of Water)		16. DATE HOLE STARTED 1/16/02 COMPLETED 1/16/02		
8. DEPTH DRILLED INTO ROCK N/A		17. ELEVATION TOP OF HOLE 0.0 MLLW		
9. TOTAL DEPTH OF HOLE 48.1'		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR Diane Greene Civ. Engr. Technician		

ELEVATION MLLW	DEPTH (Feet)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVER- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0	0		NO RIVER BOTTOM RECORDED			NOTE: Time Begin Washprobe 1730 hrs.
	42		JETTED- NO SAMPLES OR CLASSIFICATION OF SOILS			NOTE: TOP OF HOLE is de- fined as surface of water. compensation is made for the tide such that Top of Hole is 0.0 EL MLLW. Data transcribed from field log by Larry Benjamin, Civil Engr. Tech.
	44					Jetted 4-inch diameter opened end steel pipe using water paired with a 1-inch diameter opened end steel pipe using air to refusal or predetermined depth
	46					
	48					
-48.1	48.1		BOTTOM OF HOLE @ 48.1'			HOLE TERMINATED AT WASH PROBE REFUSAL @ 48.1'

Appendix A

Pre 1964 Probes

The following probes are shown on the plans as a #(abbreviated location), for example 2(AB). These probes were drilled prior to 1964 and have no boring logs. The information below was shown on a set of plans for Wilmington Harbor, October 1965. The validity and accuracy of the information below is suspect because of channel changes since 1964 and technical developments in locating boreholes and depths.

<u>HOLE #</u>	<u>DEPTH TO PROBE REFUSAL ft. (DATUM-mlw)</u>
2(AB)	42.5
3(AB)	40.9
7(AB)	40.2
10(AB)	42.1
11(AB)	39.8
21(AB)	39.5
22(AB)	40.2
24(AB)	38.6
25(AB)	37.4
29(AB)	42.3
30(AB)	37.6
36(AB)	38.6
37(AB)	36.6
41(AB)	38.7
42(AB)	39.2
49(AB)	41.5
52(AB)	35.9
53(AB)	38.2
54(AB)	42.1
58(AB)	44.0
59(AB)	40.3
60(AB)	45.8
62(AB)	43.7
64(AB)	42.4
65(AB)	44.4
66(AB)	41.7
68(AB)	43.0
71(AB)	42.4
76(AB)	42.2
80(AB)	49.4
82(AB)	46.8
84(AB)	44.3
85(AB)	46.5
89(AB)	44.4
100(FEJ)	43.9
101(FEJ)	45.6
107(FEJ)	41.8

<u>HOLE #</u>	<u>DEPTH TO PROBE REFUSAL ft. (DATUM - mlw)</u>
108(FEJ)	42.6
109(FEJ)	43.8
112(FEJ)	42.8
120(FEJ)	45.4
134(FEJ)	44.5
139(FEJ)	43.3
141(FEJ)	44.1
142(FEJ)	43.5
153(UB)	42.0
154(UB)	46.2
155(UB)	37.0
157(UB)	34.6
160(LB)	44.9
162(LB)	44.1
165(LB)	47.1
255B(UL)	41.0

- NOTES:** 1. These probes were advanced by pumping water through a $\frac{3}{4}$ inch or 1 inch standard pipe using jet pressure varying from 45 to 125 psi.
2. There are no boring logs for these probes. This information came from plans for the contract for Wilmington Harbor, October 1965.

APPENDIX C

COMPRESSIVE STRENGTH OF DRILLED ROCK CORES

- 1. Rock samples were cored in the laboratory.**
- 2. Large samples of rock were obtained from the ladder of the dredge "Texas."**
- 3. In February 2002, the "Texas" performed dredging , for others in an area adjacent to this Corps Project, but within the side slope of the Fourth East Jetty Channel.**
- 4. The approximate area where rock was encountered is shown on Plate P-4.**
- 5. The Contractor shall be equipped to deal with this type of condition that may exist in the side slopes in other areas.**
- 6. Additional information on the area geology is provided in Appendix D. Refer to report:**

**Evaluation, Analyses, and Delineation of the Geology,
Wilmington Harbor, Brunswick and New Hanover
Counties, North Carolina, by Dr. W. Burleigh Harris,
14 June 2000.**

APPENDIX C

Additional Rock Unconfined Compressive Strengths

**TABLE 1 TAKEN FROM GEOTECHNICAL APPENDIX
OF
"FINAL FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT ON
IMPROVEMENT OF NAVIGATION, CAPE FEAR – NORTHEAST CAPE FEAR RIVERS
COMPRESSIVE STUDY, WILMINGTON, NORTH CAROLINA, VOLUME II, JUNE
1996-US ARMY CORPS OF ENGINEERS, WILMINGTON DISTRICT**

**LEGEND FOR ABBREVIATIONS AND SYMBOLS USED IN
TABLE 1. GEOTECHNICAL DATA SUMMARY OF SELECTED CORE BORINGS**

ABBREVIATIONS USED FOR GEOLOGIC ROCK UNITS:

PD Peedee Formation
RP Rocky Point Member (of Peedee Formation)
OS Olive Sand
T Ls Turritellid Limestone
CH Castle Hayne, Units A and B undifferentiated
CH,A Castle Hayne, Unit A
CH,B Castle Hayne, Unit B
TR Trent Formation (?)
Wac Waccamaw Formation (?)

OTHER ABBREVIATIONS AND SYMBOLS

NC COORD.

NORTHING - North Carolina Lambert Coordinate System, with Easting omitted.

ROCK UNIT

ENCOUNT. - Geologic rock unit encountered in core boring.

TOR - Top of Rock, depth (corresponds to elevation) of rock encountered in core boring.

BOH - Bottom of Hole, depth of boring where terminated.

UNIT WT.

(pcf) - Unit weight of rock lab specimen in pounds per cubic foot.

UCS

(psi) - Unconfined compressive strength of rock specimen in pounds per square inch.

%

REC - Percent recovery for boring.

%

RQD - 1. Percent Rock Quality Designation from the first pull in the boring log when Top of Rock is encountered below about elevation -50, or
2. Average percent RQD of pulls about -50 elevation and higher.

LEGEND FOR ABBREVIATIONS AND SYMBOLS USED IN TABLE 1.
GEOTECHNICAL DATA SUMMARY OF SELECTED CORE BORINGS
(Continued)

* Data not applicable, not observed, or unknown.

" Same as above.

(IM2551) Boring Number, Lab identification number of tested specimen. Information compiled from historical data prescribed as peripheral information.

NOTES:

1. Information designated as (IM####) is questionable because it was performed on a rock retrieved from a dredge disposal area. The disposal area is unknown and the validity of the channel reach where the rock came from is questionable. No boring logs exist for these samples.
2. In Upper Midnight Channel Hole 6 is questionable. No boring log, lab data, nor location can be found. This data may or may not be valid.
3. Bore holes WH93-# and WH94-# show rock strengths. Laboratory backup data for these boreholes is not available.

TABLE 1. GEOTECHNICAL DATA SUMMARY OF SELECTED CORE BORINGS

RIVER CHANNEL OR BASIN	HOLE NUMBER	NC COORD. NORTHING	ROCK UNIT ENCOUNT.	TOR	BOH	ROCK UNIT TESTED	SPECIMEN DEPTH (FEET)	UNIT WT. (pcf)	UCS (psi)	% REC	% RQD
ANCHORAGE BASIN (CONTINUED)	WH93-11	173565	PD	43.1	55.2	PD	43.9 to 44.7	117.4	301	100	73.9
	"	"	PD	43.1	55.2	PD	45.7 to 46.4	114.5	324	"	"
NOT IN CONTRACT	WH93-12	172616	PD	41.6	55.2	PD	42.0 to 42.9	108.6	"	100	81
	"	"	PD	41.6	55.2	PD	42.9 to 43.6	114.7	600	"	"
	WH93-13	172467	PD	42.6	55	PD	43.9 to 45.4	112.9	819	80.6	92.5
	"	"	PD	42.6	55	PD	45.4 to 46.6	115.4	406	"	"
INCLUDED IN CONTRACT	WH93-14	172013	PD	44.5	55.2	PD	47.0 to 48.1	111.4	560	100	66.7
	"	"	PD	44.5	55.2	PD	48.7 to 49.6	113.2	*	"	"
	WH93-15	171497	PD(?)	41.7	69.4	*	*	*	*	100	49.5
	WH93-16	171085	PD	41.3	55.5	PD	41.8 to 43.5	114.4	680	96.5	89.6
	"	"	PD	41.3	55.5	PD	43.5 to 44.7	108.8	503	"	"
	"	"	PD	41.3	55.5	PD	45.1 to 46.0	109.6	827	"	"
	"	"	PD	41.3	55.5	PD	46.3 to 47.8	107	407	"	"
	"	"	PD	41.3	55.5	PD	48.6 to 49.6	116	556	"	"
	WH93-38	170775	PD	36.5	51.5	PD	36.5 to 37.6	112.6	427	86.7	80.4
	"	"	PD	36.5	51.5	PD	37.6 to 38.8	107.3	522	"	"
WH93-17	170767	PD	42.4	57.1	PD	48.4 to 49.2	115.3	589	75.5	26	
WH93-18	170562	PD	41	59.3	PD	42.3 to 43.4	111.3	410	100	86.6	
"	"	PD	41	59.3	PD	44.1 to 45.6	114.5	735	"	"	
WH93-39	"	PD	36.4	52.6	PD	36.7 to 38.8	117.4	1015	74.1	46.3	
WH93-37	170103	PD	38.7	57.5	PD	38.7 to 39.9	110.5	369	100	91.1	
WH93-20	169766	PD	40.3	57.7	PD	41.0 to 42.1	115.1	541	94.8	80.9	
WH93-19	169754	PD	41.2	58.3	PD	42.5 to 43.2	131.5	368	100	83.3	
"	"	PD	41.2	58.3	PD	46.0 to 46.8	150	*	"	"	
WH93-21	168498	PD	37.8	58.7	PD	*	*	*	100	28.3	
WH93-22	168953	PD	44.3	58.4	PD	*	*	*	90.1	3.8	
WH93-23	168925	PD	50.8	57.6	PD	*	*	*	100	12.5	
WH93-24	168731	PD	49.2	59	PD	*	*	*	90.1	18.2	
WH93-26	168731	PD	41.8	58.2	PD	*	*	*	83.1	0	
WH93-25	168870	PD	38.1	58.9	PD	*	*	*	94.7	6.6	
WH93-27	168870	PD	45.1	58.7	PD	*	*	*	74	0	
WH93-28	168534	PD	43.5	58.5	PD	*	*	*	100	0	
WH93-29	168443	PD	48.9	58.3	PD	*	*	*	76.6	10.3	
WH93-30	168217	PD	43.8	58	PD	*	*	*	85.3	0	
WH93-31	168053	PD	44.4	59.2	PD	*	*	*	92.6	48.7	

TABLE 1. GEOTECHNICAL DATA SUMMARY OF SELECTED CORE BORINGS

RIVER CHANNEL OR BASIN	HOLE NUMBER	NC COORD. NORTHING	ROCK UNIT ENCOUNTER.	TOR	BOH	ROCK UNIT TESTED	SPECIMEN DEPTH (FEET)	UNIT WT. (pcf)	UCS (psi)	% REC	% RQD
ANCHORAGE BASIN (CONTINUED)	WH93-32	168065	PD	39.7	58.9	PD	41.1 to 42.3	113.1	691	100	27.7
	WH93-33	167929	PD	41.7	56	PD	43.3 to 44.5	113.4	558	64.3	32.6
	WH93-34	167526	PD	44.2	60	*	*	*	*	60.4	0
	WH93-35	167261	PD	44.8	59.9	*	*	*	*	78.1	0
	WH93-36	167117	PD	42.8	57.4	*	*	*	*	66.4	36.4
BETWEEN CHANNEL (OR ANCHORAGE BASIN APPROACH CHANNEL)	WH93-40	166423	PD	42.4	58.3	PD	43.0 to 44.0	112.4	776	88	91.3
	WH93-41	165671	PD	43.7	56.8	*	*	*	*	100	32.1
	WH93-42	164517	PD	46	58.1	*	*	*	*	50.4	32.1
	WH93-43	163659	PD	55.3	57.6	*	*	*	*	65.5	0
	87-WH-22	163632	PD(?)	45.5	46	*	*	*	*	*	*
FOURTH EAST JETTY	87-WH-23	162135	*	*	45	*	*	*	*	*	*
	87-WH-24	160887	*	*	42.8	*	*	*	*	*	*
	WH93-52	160570	PD	51.9	72.4	*	*	*	*	82.9	28.6
	WH93-44	159454	PD	48.2	59.9	PD	*	*	*	100	34.3
	87-WH-25	159141	*	*	43.3	*	*	*	*	*	*
	WH93-45	158883	PD	43.2	58.6	PD	46.2 to 46.7	157.8	4835	100	16
	WH93-46	158723	PD	46.6	51.4	*	*	*	*	100	10.4
	WH93-47	158488	PD	43.5	57.5	*	*	*	*	100	18.3
	WH93-48	158068	PD	46.7	58.4	PD	46.7 to 47.3	157.7	4924	100	36.5
	87-WH-26	157643	*	*	42.5	*	*	*	*	*	*
UPPER BRUNSWICK	WH93-49	157337	PD	45.1	59	*	*	*	*	100	4.1
	WH93-50	156771	PD	47.9	57.9	*	*	*	*	100	0
	87-WH-27	156146	*	*	43.2	*	*	*	*	*	*
	WH93-51	155769	PD	44.9	51.4	*	*	*	*	53.8	0
	WH93-53	153288	PD	52.7	59	*	*	*	*	100	11.4
LOWER BRUNSWICK (ROCK BLASTING, 1970, from Sta. 53+00 to 87+00)	WH93-54	152333	PD	44.3	58.4	*	*	*	*	100	11.7
	WH93-55	151501	PD	48.6	58.2	*	*	*	*	72.9	?
	WH93-56	151320	PD	45.7	58.9	*	*	*	*	100	0
	WH93-57	151247	PD	46.3	58.2	*	*	*	*	84.9	7
	LB-1-89	150802	PD	35.8	40.8	*	*	*	*	90	*
ROCK BLASTING, 1970, from Sta. 53+00 to 87+00	WH93-58	150418	PD	47.9	58.1	PD	48.1 to 48.8	158.1	4346	90	26.9
	WH93-59	148677	PD	47	58.8	*	*	*	*	100	22
	WH94-19	148006	PD	69.4	70.5	*	*	*	*	100	22.9
	WH93-60	147191	PD	53.2	58.3	*	*	*	*	100	33.3
	WH9361	144982	*	*	48.1	*	*	*	*	*	*

TABLE 1. GEOTECHNICAL DATA SUMMARY OF SELECTED CORE BORINGS

RIVER CHANNEL OR BASIN	HOLE NUMBER	NC COORD. NORTHING	ROCK UNIT ENCOUNT.	TOR	BOH	ROCK UNIT TESTED	SPECIMEN DEPTH (FEET)	UNIT WT. (pcf)	UCS (psi)	% REC	% RQD
ANCHORAGE BASIN (CONTINUED)	WH94-23	116311	*	59.9	59.9	*	*	*	*	*	*
	WH94-12	115600	*	60	60	*	*	*	*	*	*
	WH94-13	113043	*	59.2	59.2	*	*	*	*	*	*
	WH93-69	112432	RP(?)	52.7	58.5	*	*	*	*	81	100
	WH94-14A	110474	*	64.6	64.6	*	*	*	*	*	*
	WH94-14	110471	*	*	35	*	*	*	*	*	*
	WH93-72	108807	*	57.8	57.8	*	*	*	*	*	*
	WH94-15	107471	*	60.6	60.6	*	*	*	*	*	*
	WH93-73	105069	RP(?)	54.4	60.6	*	*	*	*	100	0
	WH94-16	102481	*	61.9	61.9	*	*	*	*	*	*
UPPER MIDNIGHT	WH94-17	100503	*	60.6	60.6	*	*	*	*	*	*
	6	*	*	*	*	*	39.4 to 40.0	147.9	3280	*	*
	6	*	*	*	*	*	39.0 to 39.4	145.4	3540	*	*
	WH94-18	98480	*	64.6	64.6	*	*	*	*	*	*
	WH93-70	95873	*	*	58.1	*	*	*	*	*	*
	WH94-LM1	94221	*	64.1	64.1	*	*	*	*	*	*
	WH94P-LM2	92717	*	62.4	62.4	*	*	*	*	*	*
	WH94-LM3	91298	*	59.8	59.8	*	*	*	*	*	*
	WH91-71	90884	*	*	58.3	*	*	*	*	*	*
	WH94-LM4	89038	*	62.3	62.3	*	*	*	*	*	*
LOWER MIDNIGHT	WH94-LM5	88122	*	60	60	*	*	*	*	*	*
	WH93-74	84860	*	*	57.8	*	*	*	*	*	*
	WH93-75	79192	*	*	57.8	*	*	*	*	*	*
	WH93-24	78100	*	60.7	60.7	*	*	*	*	*	*
	WH94-25	70834	RP/PD	48	53.2	*	*	*	*	100	52.5
	WH94-26	64584	CH,B	56.7	60.3	*	*	*	*	100	80.6
	WH94-27	61032	CH,B	47	52.6	*	*	*	*	100	43
	WH94-28	58974	CH,B	47.7	61.8	*	*	*	*	93.6	67.4
	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
BATTERY ISLAND SOUTHPORT	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
BALDHEAD-CASWELL SMITH ISLAND	*	*	*	*	*	*	*	*	*	*	*
	*	*	*	*	*	*	*	*	*	*	*
BALDHEAD SHOAL	BS92-12	36806	Wac:CH,B	42.1	79.5	T Ls	52.0 to 52.9	154.8	6190	89	95.6
			T Ls:OS	42.1	79.5	T Ls	52.0 to 52.9	146	2870		

1* This boring may be a typo. It is believed to be WH94P-LM5 for which the boring log is included in Appendix A.

APPENDIX C

ROCK COMPRESSIVE STRENGTHS

WH98-# HOLES DRILLED BY ZAPATA ENGINEERING



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS
 PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2938-95**

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING / WILMINGTON HARBOR
 LAW PROJECT NUMBER: 30771-8-2976
 DATE: AUGUST 10, 1998

CORE ID	DEPTH	LAB ID	DATE CUT	METHOD OF CUTTING	DATE TESTED	TIME TO FAILURE (min:sec)	MOISTURE CONDITION AT TEST	LAB AIR TEMP (°C)	DIAMETER (in)	LENGTH (in)	L/D	CROSS-SECTIONAL AREA (in ²)	MAXIMUM LOAD (lbs)	COMPRESSIVE STRENGTH (psi)
WH98-23	47.7-48.2	1	7/6/98	DRY	07/30/98	2:36	LAB AIR-DRY	22.5	2.05	4.75	2.32	3.30	1015	308
WH98-23	49.1-49.4	2	7/6/98	DRY	07/30/98	4:28	LAB AIR-DRY	23.0	2.05	4.37	2.13	3.30	905	274
WH98-27	46.3-46.6	3	7/6/98	DRY	07/30/98	11:10	LAB AIR-DRY	22.5	2.05	4.19	2.04	3.30	4215	1277
WH98-27	47.8-48.1	4	7/6/98	DRY	07/30/98	4:15	LAB AIR-DRY	22.5	2.05	4.51	2.20	3.30	2760	836
WH98-25	42.0-42.5	5	7/6/98	DRY	07/30/98	11:15	LAB AIR-DRY	23.0	2.05	4.87	2.38	3.30	2930	888
WH98-25	46.0-46.3	6	7/6/98	DRY	07/30/98	1:38	LAB AIR-DRY	23.0	2.04	4.84	2.37	3.27	940	287
WH98-30	48.2-48.7	7	7/6/98	DRY	07/30/98	2:02	LAB AIR-DRY	23.0	2.04	4.49	2.20	3.27	840	257
WH98-64	40.6-41.3	8	7/9/98	WET	08/04/98	3:50	LAB AIR-DRY	22.5	2.05	4.78	2.33	3.30	40500	12273
WH98-35	43.3-44.2 (TOP)	9	7/6/98	DRY	07/30/98	13:45	LAB AIR-DRY	23.0	2.04	5.06	2.48	3.27	4150	1269
WH98-35	43.3-44.2 (BOT)	10	7/6/98	DRY	07/30/98	3:51	LAB AIR-DRY	23.0	2.04	4.83	2.37	3.27	3500	1070
WH98-34	44.8-45.2	11	7/6/98	DRY	07/30/98	5:38	LAB AIR-DRY	23.0	2.04	4.37	2.14	3.27	4005	1225
WH98-34	46.6-47.0	12	7/14/98	DRY	07/30/98	3:23	LAB AIR-DRY	23.5	2.05	4.77	2.33	3.30	2590	785
WH98-87A	45.0-45.5	13	7/14/98	WET	08/04/98	2:43	LAB AIR-DRY	22.5	2.04	3.45	1.69	3.27	5500	1682
WH98-49	49.6-50.5 (TOP)	14	7/6/98	DRY	07/30/98	2:20	LAB AIR-DRY	22.5	2.02	4.69	2.32	3.20	1020	319
WH98-49	49.6-50.5 (BOT)	15	7/6/98	DRY	07/30/98	3:55	LAB AIR-DRY	22.5	2.01	4.87	2.42	3.17	1055	333
WH98-76	46.2-46.7	16	7/9/98	WET	08/07/98	2:13	LAB AIR-DRY	22.5	2.05	4.19	2.04	3.30	15600	4727
WH98-76	47.6-48.1	17	7/9/98	WET	08/09/98	2:08	LAB AIR-DRY	22.0	2.06	4.97	2.41	3.33	7850	2357
WH98-76	49.0-49.3	18	7/9/98	WET	08/09/98	5:27	LAB AIR-DRY	22.0	2.05	4.07	1.99	3.30	10500	3182
WH98-71	41.8-42.4	19	7/9/98	WET	08/07/98	5:05	LAB AIR-DRY	22.5	2.05	4.43	2.16	3.30	*	NOT DETERMINED
WH98-71	43.2-43.7	20	7/9/98	WET	08/07/98	3:02	LAB AIR-DRY	22.5	2.04	4.79	2.35	3.27	13650	4174

REMARKS: *NOT RECORDED AT TIME OF TEST.

John Dwyer

REVIEWED BY:



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS
 PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2938-95**

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING / WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: AUGUST 10, 1998

CORE ID	DEPTH	LAB ID	DATE CUT	METHOD OF CUTTING	DATE TESTED	TIME TO FAILURE (min:sec)	MOISTURE CONDITION AT TEST	LAB AIR TEMP (°C)	DIAMETER (in)	LENGTH (in)	L/D	CROSS-SECTIONAL AREA (in ²)	MAXIMUM LOAD (lbs)	COMPRESSIVE STRENGTH (psi)
WH98-71	44.9-45.4	21	7/9/98	WET	08/04/98	6:00	LAB AIR-DRY	23.0	2.06	4.87	2.36	3.33	24850	7462
WH98-66A	43.9-44.3	22	7/9/98	WET	08/04/98	1:56	LAB AIR-DRY	23.0	2.05	4.04	1.97	3.30	9400	2848
WH98-66A	46.0-46.5	23	7/9/98	WET	08/04/98	6:10	LAB AIR-DRY	23.0	2.05	4.55	2.22	3.30	29150	8833
WH98-67	41.1-41.5	24	7/9/98	WET	08/09/98	5:45	LAB AIR-DRY	22.0	2.05	4.40	2.15	3.30	16150	4894
WH98-67	42.8-43.2	25	7/14/98	WET	08/04/98	3:10	LAB AIR-DRY	23.0	2.05	4.24	2.07	3.30	7400	2242
WH98-67	44.1-44.6	26	7/6/98	DRY	07/30/98	9:29	LAB AIR-DRY	23.5	2.05	4.16	2.03	3.30	3310	1003
WH98-67	45.9-46.4	27	7/6/98	DRY	07/31/98	11:58	LAB AIR-DRY	23.5	2.04	4.39	2.15	3.27	5495	1680
WH98-77A	43.0-43.4	28	7/9/98	WET	08/04/98	6:49	LAB AIR-DRY	23.0	2.05	4.93	2.40	3.30	18500	5606
WH98-77A	46.7-47.2	29	7/9/98	WET	08/04/98	5:35	LAB AIR-DRY	23.0	2.05	4.84	2.36	3.30	22650	6864
WH98-77A	47.6-48.0	30	7/6/98	DRY	07/31/98	5:22	LAB AIR-DRY	22.0	2.05	4.53	2.21	3.30	2455	744
WH98-69A	45.7-46.1	31	7/9/98	WET	08/04/98	5:38	LAB AIR-DRY	23.0	2.05	4.00	1.95	3.30	23000	6970
WH98-69A	46.5-47.0	32	7/15/98	WET	08/05/98	3:33	LAB AIR-DRY	23.0	2.04	3.14	1.54	3.27	5600	1713
WH98-68A	44.2-44.6	33	7/9/98	WET	08/05/98	2:49	LAB AIR-DRY	23.0	2.05	4.52	2.20	3.30	4250	1288
WH98-68A	45.6-45.9	34	7/9/98	WET	08/05/98	7:44	LAB AIR-DRY	23.0	2.05	3.81	1.86	3.30	29200	8848
WH98-65A	40.9-41.4	35	7/9/98	WET	08/05/98	4:01	LAB AIR-DRY	23.0	2.05	4.23	2.06	3.30	8850	2682
WH98-65A	44.0-44.4	36	7/14/98	WET	08/05/98	7:13	LAB AIR-DRY	23.0	2.02	3.84	1.90	3.20	4255	1330
WH98-65A	44.9-45.2	37	7/14/98	WET	08/05/98	3:20	LAB AIR-DRY	23.0	2.03	3.51	1.73	3.24	9700	2994
WH98-56	41.0-41.6	38	7/14/98	WET	08/05/98	2:44	LAB AIR-DRY	23.0	2.04	4.29	2.10	3.27	9700	2966
WH98-56	42.5-43.1	39	7/14/98	WET	08/05/98	3:55	LAB AIR-DRY	23.0	2.04	4.66	2.28	3.27	9000	2752
WH98-73	43.4-43.9	40	7/9/98	WET	08/05/98	5:46	LAB AIR-DRY	23.0	2.05	4.89	2.39	3.30	18800	5697

REMARKS:



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WH98-73	45.0-45.4	41	7/6/98	DRY	07/31/98	1:58	LAB AIR-DRY	23.0	2.04	4.26	2.09	3.27	1150	352
WH98-70	33.5-34.0	42	7/9/98	WET	08/05/98	6:00	LAB AIR-DRY	23.0	2.05	4.18	2.04	3.30	18550	5621
WH98-70	36.7-37.2	43	7/14/98	WET	08/05/98	3:30	LAB AIR-DRY	23.0	2.05	4.24	2.07	3.30	12000	3636
WH98-70	37.6-37.9	44	7/14/98	WET	08/05/98	4:37	LAB AIR-DRY	23.0	2.06	4.99	2.42	3.33	13850	4159
WH98-70	40.0-40.3	45	7/6/98	DRY	07/31/98	3:30	LAB AIR-DRY	23.0	2.05	3.57	1.74	3.30	1520	461
WH98-70	41.8-42.1	46	7/9/98	WET	08/05/98	3:04	LAB AIR-DRY	23.0	2.05	3.91	1.91	3.30	6100	1848
WH98-75	44.0-44.5	47	7/14/98	WET	08/05/98	3:29	LAB AIR-DRY	*	2.05	5.02	2.45	3.30	15700	4758
WH98-75	45.4-45.7	48	7/6/98	DRY	07/31/98	4:00	LAB AIR-DRY	23.0	2.05	4.20	2.05	3.30	6100	1848
WH98-75	47.4-47.7	49	7/6/98	DRY	07/31/98	2:34	LAB AIR-DRY	23.0	2.05	4.46	2.18	3.30	800	242
WH98-75	48.6-49.1	50	7/6/98	DRY	07/31/98	6:12	LAB AIR-DRY	23.0	2.04	4.91	2.41	3.27	2820	862
WH98-81A	53.4-53.9	51	7/9/98	WET	08/09/98	3:43	LAB AIR-DRY	22.0	2.05	4.26	2.08	3.30	16150	4894
WH98-81	45.5-46.0	52	7/6/98	DRY	07/31/98	9:28	LAB AIR-DRY	23.0	2.04	4.41	2.16	3.27	4525	1384
WH98-81	48.7-49.0	53	7/9/98	WET	08/05/98	2:31	LAB AIR-DRY	23.0	2.05	4.01	1.96	3.30	10800	3273
WH98-81	50.0-50.5	54	7/9/98	WET	08/05/98	5:05	LAB AIR-DRY	23.0	2.05	4.89	2.39	3.30	33550	10167
WH98-81B	60.2-60.6	55	7/6/98	DRY	07/31/98	5:15	LAB AIR-DRY	23.0	2.05	3.59	1.75	3.30	8500	2576
WH98-121	48.9-49.2	56	7/9/98	WET	08/05/98	2:56	LAB AIR-DRY	23.0	2.05	4.41	2.15	3.30	8700	2636
WH98-72	44.2-44.5	57	7/9/98	WET	08/05/98	2:54	LAB AIR-DRY	23.0	2.05	4.14	2.02	3.30	13400	4061
WH98-72	45.5-46.0	58	7/9/98	WET	08/07/98	3:10	LAB AIR-DRY	22.5	2.04	4.96	2.43	3.27	21300	6514
WH98-57	42.9-43.4	59	7/9/98	WET	08/05/98	6:02	LAB AIR-DRY	23.0	2.04	4.17	2.04	3.27	18950	5795
WH98-57	45.5-45.8	60	7/9/98	WET	08/07/98	*	LAB AIR-DRY	22.5	2.05	5.02	2.45	3.30	42300	12818

REMARKS: *NOT RECORDED AT TIME OF BREAK.

[Signature]

REVIEWED BY:



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS
 PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2938-95**

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING / WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: AUGUST 10, 1998

CORE ID	DEPTH	LAB ID	DATE CUT	METHOD OF CUTTING	DATE TESTED	TIME TO FAILURE (min:sec)	MOISTURE CONDITION AT TEST	LAB AIR TEMP (°C)	DIAMETER (in)	LENGTH (in)	L/D	CROSS-SECTIONAL AREA (in ²)	MAXIMUM LOAD (lbs)	COMPRESSIVE STRENGTH (psi)
WH98-58	40.3-40.7	61	7/9/98	WET	08/05/98	4:53	LAB AIR-DRY	23.0	2.05	4.44	2.17	3.30	22050	6662
WH98-58	40.8-41.3	62	7/9/98	WET	08/05/98	2:32	LAB AIR-DRY	23.0	2.05	4.06	1.98	3.30	10800	3273
WH98-60	39.3-39.7	63	7/9/98	WET	08/05/98	3:10	LAB AIR-DRY	23.0	2.04	4.51	2.21	3.27	6800	2080
WH98-60	40.3-40.9	64	7/14/98	WET	08/05/98	4:40	LAB AIR-DRY	23.0	2.05	4.64	2.26	3.30	29050	8803
WH98-60	42.0-42.5	65	7/9/98	WET	08/01/98	9:26	LAB AIR-DRY	22.0	2.04	4.37	2.14	3.27	3665	1121
WH98-60	44.5-44.8	66	7/9/98	WET	08/09/98	16:36	LAB AIR-DRY	22.0	2.06	4.10	1.99	3.33	40100	12042
WH98-62A	41.1-41.6	67	7/9/98	WET	08/05/98	4:50	LAB AIR-DRY	23.0	2.05	5.07	2.47	3.30	17400	5273
WH98-62A	44.0-44.3	68	7/9/98	WET	08/05/98	3:12	LAB AIR-DRY	23.0	2.04	4.32	2.12	3.27	7150	2187
WH98-62A	44.3-44.8	69	7/9/98	WET	08/05/98	5:38	LAB AIR-DRY	23.0	2.05	4.98	2.43	3.30	13300	4030
WH98-62A	46.2-46.6	70	7/9/98	WET	08/05/98	2:02	LAB AIR-DRY	23.0	2.05	4.32	2.11	3.30	4200	1273
WH98-22	44.1-44.5	71	7/6/98	DRY	08/01/98	4:55	LAB AIR-DRY	22.0	2.04	5.01	2.46	3.27	2545	778
WH98-22	47.0-47.4	72	7/6/98	DRY	08/01/98	2:14	LAB AIR-DRY	22.0	2.04	4.51	2.21	3.27	1220	373
WH98-20	43.7-44.1	73	7/6/98	DRY	08/01/98	3:30	LAB AIR-DRY	22.0	2.05	4.37	2.13	3.30	2650	803
WH98-20	44.6-45.1	74	7/6/98	DRY	08/01/98	5:03	LAB AIR-DRY	22.0	2.05	4.99	2.43	3.30	1160	352
WH98-16	48.2-48.7	75	7/6/98	DRY	08/01/98	4:30	LAB AIR-DRY	22.0	2.05	5.00	2.44	3.30	1215	368
WH98-18	45.2-45.7	76	7/9/98	WET	08/01/98	10:53	LAB AIR-DRY	22.0	2.05	4.70	2.29	3.30	4500	1364
WH98-18	46.5-46.9	77	7/6/98	DRY	08/01/98	1:43	LAB AIR-DRY	23.0	2.01	4.84	2.41	3.17	235	74
WH98-19	46.6-47.1	78	7/6/98	DRY	08/01/98	5:08	LAB AIR-DRY	23.0	2.04	4.65	2.28	3.27	1885	576
WH98-19	47.7-48.2	79	7/6/98	DRY	08/01/98	7:50	LAB AIR-DRY	23.0	2.05	5.10	2.49	3.30	2160	655
WH98-128	43.9-44.5	80	7/6/98	DRY	08/01/98	6:08	LAB AIR-DRY	23.0	2.05	5.05	2.46	3.30	3840	1164

REMARKS:

John Daily

REVIEWED BY:



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2938-95**

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING / WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: AUGUST 10, 1998

CORE ID	DEPTH	LAB ID	DATE CUT	METHOD OF CUTTING	DATE TESTED	TIME TO FAILURE (min:sec)	MOISTURE CONDITION AT TEST	LAB AIR TEMP (°C)	DIAMETER (in)	LENGTH (in)	L/D	CROSS-SECTIONAL AREA (in ²)	MAXIMUM LOAD (lbs)	COMPRESSIVE STRENGTH (psi)
WH98-83	46.6-47.1	81	7/6/98	DRY	08/01/98	5:00	LAB AIR-DRY	23.0	2.05	5.04	2.46	3.30	9550	2894
WH98-126	48.6-49.0	82	7/6/98	DRY	08/01/98	3:30	LAB AIR-DRY	23.0	2.04	4.53	2.22	3.27	2200	673
WH98-78	44.9-45.4	83	7/6/98	DRY	08/01/98	2:40	LAB AIR-DRY	23.5	2.05	4.98	2.43	3.30	6650	2015
WH98-78	47.8-48.1	84	7/9/98	WET	08/05/98	2:15	LAB AIR-DRY	23.0	2.05	4.03	1.97	3.30	18250	5530
WH98-127	40.8-41.2	85	7/14/98	WET	08/05/98	2:10	LAB AIR-DRY	23.0	2.05	4.72	2.30	3.30	13050	3955
WH98-127	42.0-42.4	86	7/9/98	WET	08/09/98	9:47	LAB AIR-DRY	22.0	2.05	4.63	2.26	3.30	11000	3333
WH98-127	43.6-44.2	87	7/9/98	WET	08/05/98	4:40	LAB AIR-DRY	23.0	2.05	4.45	2.17	3.30	20000	6061
WH98-65A	43.0-43.4	88	7/9/98	WET	08/05/98	2:08	LAB AIR-DRY	23.0	2.05	4.18	2.04	3.30	12500	3788

REMARKS:

[Handwritten Signature]

REVIEWED BY:



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-23 47.7-48.2 (LAB ID. NO. 1)

METHOD OF CUTTING: DRY

DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH (in):	4.75	---	---
LENGTH-TO-DIAMETER RATIO:	2.32	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

EST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.062	0.070	0.072
MAXIMUM:	0.103	0.098	0.104

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.041	≤ 0.020	NO
Δ_{120} :	0.028		NO
Δ_{240} :	0.032	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-23 49.1-49.4 (LAB ID NO. 2)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	----	----
MEASUREMENT #2:	2.05	----	----
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.37	----	----
LENGTH-TO-DIAMETER RATIO:	2.13	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

EST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.054	0.076	0.067
MAXIMUM:	0.110	0.111	0.110

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.056	≤ 0.020	NO
Δ_{120} :	0.035		NO
Δ_{240} :	0.043	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Daily



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-27 46.3-46.6 (LAB ID NO. 3)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	----	----
MEASUREMENT #2:	2.05	----	----
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.19	----	----
LENGTH-TO-DIAMETER RATIO:	2.04	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.705	0.707	0.710
MAXIMUM:	0.735	0.734	0.733

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.030	≤ 0.020	NO
Δ_{120} :	0.027		NO
Δ_{240} :	0.023		NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Scully



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-27 47.8-48.7 (LAB ID NO. 4)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.51	---	---
LENGTH-TO-DIAMETER RATIO:	2.20	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.715	0.718	0.708
MAXIMUM:	0.731	0.730	0.733

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.016	≤ 0.020	YES
Δ_{120} :	0.012		YES
Δ_{240} :	0.025	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Scully



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-25 42.0-42.5 (LAB ID NO. 5)

METHOD OF CUTTING: DRY

DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH (in):	4.87	---	---
LENGTH-TO-DIAMETER RATIO:	2.38	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.715	0.706	0.716
MAXIMUM:	0.735	0.729	0.730

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.020	≤ 0.020	YES
Δ_{120} :	0.023	↓	NO
Δ_{240} :	0.014	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: *John Dailly*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-25 46.0-46.3 (LAB ID NO. 6)

METHOD OF CUTTING: DRY

DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	----	----
MEASUREMENT #2:	2.04	----	----
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH (in):	4.84	----	----
LENGTH-TO-DIAMETER RATIO:	2.37	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

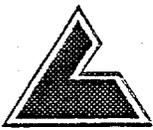
	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.708	0.697	0.709
MAXIMUM:	0.724	0.724	0.732

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.016	≤ 0.020	YES
Δ_{120} :	0.027		NO
Δ_{240} :	0.023	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-30 48.2-48.7 (LAB ID NO. 7)

METHOD OF CUTTING: DRY

DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.03	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):	4.49	---	---
LENGTH-TO-DIAMETER RATIO:	2.20	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.706	0.697	0.710
MAXIMUM:	0.728	0.723	0.748

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.022	≤ 0.020	NO
Δ_{120} :	0.026		NO
Δ_{240} :	0.038	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY:

John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-35 43.3-44.2 TOP (LAB ID NO. 9)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):	5.06	---	---
LENGTH-TO-DIAMETER RATIO:	2.48	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.698	0.690	0.700
MAXIMUM:	0.728	0.733	0.736

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.030	≤ 0.020	NO
Δ_{120} :	0.043		NO
Δ_{240} :	0.036	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Sully



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
 RALEIGH, NORTH CAROLINA

REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
 AND SHAPE TOLERANCES

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
 LAW PROJECT NUMBER: 30771-8-2976
 DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-35 43.3-44.2 BOTTOM (LAB ID NO. 10)
 METHOD OF CUTTING: DRY
 DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):	4.83	---	---
LENGTH-TO-DIAMETER RATIO:	2.37	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.704	0.708	0.703
MAXIMUM:	0.727	0.732	0.729

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.023	≤ 0.020	NO
Δ_{120} :	0.024		NO
Δ_{240} :	0.026	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY:

John Dudley



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-34 44.8-45.2 (LAB ID NO. 11)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	----	---
MEASUREMENT #2:	2.04	----	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH (in):	4.37	---	---
LENGTH-TO-DIAMETER RATIO:	2.14	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.714	0.708	0.718
MAXIMUM:	0.733	0.730	0.735

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.019	≤ 0.020	YES
Δ_{120} :	0.022		NO
Δ_{240} :	0.017	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-34 46.6-47.0 (LAB ID NO. 12)
METHOD OF CUTTING: DRY
DATE CUT: 07/14/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):		REQUIREMENTS	CONFORMANCE
LENGTH-TO-DIAMETER RATIO:	2.33	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

EST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.715	0.728	0.711
MAXIMUM:	0.725	0.740	0.740

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.010	$\leq 0.020^*$	YES
Δ_{120} :	0.012		YES
Δ_{240} :	0.029	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-49 49.6-50.5 TOP (LAB.ID NO. 14)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.03	---	---
MEASUREMENT #2:	2.01	---	---
AVERAGED DIAMETER:	2.02	> 1.88	YES
SPECIMEN LENGTH (in):		REQUIREMENTS	CONFORMANCE
LENGTH-TO-DIAMETER RATIO:	2.32	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.708	0.703	0.709
MAXIMUM:	0.732	0.729	0.743

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.024	≤ 0.020	NO
Δ_{120} :	0.026		NO
Δ_{240} :	0.034	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Sully



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-49 49.6-50.5 BOTTOM (LAB ID NO. 15)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.01	---	---
MEASUREMENT #2:	2.01	---	---
AVERAGED DIAMETER:	2.01	> 1.88	YES
SPECIMEN LENGTH: (in):		REQUIREMENTS	CONFORMANCE
LENGTH-TO-DIAMETER RATIO:	2.42	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	$\Delta_{.0}$ READINGS	$\Delta_{.120}$ READINGS	$\Delta_{.240}$ READINGS
MINIMUM:	0.713	0.714	0.726
MAXIMUM:	0.727	0.724	0.744

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
$\Delta_{.0}$:	0.014	≤ 0.020	YES
$\Delta_{.120}$:	0.010		YES
$\Delta_{.240}$:	0.018	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Nalley



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
 RALEIGH, NORTH CAROLINA

REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
 AND SHAPE TOLERANCES

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
 LAW PROJECT NUMBER: 30771-8-2976
 DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-56 41.0-41.6 (LAB ID NO. 38)
 METHOD OF CUTTING: WET
 DATE CUT: 07/14/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):	4.29	---	---
LENGTH-TO-DIAMETER RATIO:	2.10	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	ND	ND	ND
MAXIMUM:	ND	ND	ND

VISUALLY INSPECTED WITH FEELER GAUGE; NON-CONFORMING

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	ND	≤ 0.020	NO
Δ_{120} :	ND		NO
Δ_{240} :	ND		NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.
 ND=NOT DETERMINED.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-56 42.5-43.1 (LAB ID NO. 39)
METHOD OF CUTTING: WET
DATE CUT: 07/14/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH (in):	4.66	---	---
LENGTH-TO-DIAMETER RATIO:	2.28	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	ND	ND	ND
MAXIMUM:	ND	ND	ND

VISUALLY INSPECTED WITH FEELER GAUGE; NON-CONFORMING

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	ND	≤ 0.020	NO
Δ_{120} :	ND		NO
Δ_{240} :	ND	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.
ND=NOT DETERMINED.

REVIEWED BY: John Dally



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: AUGUST 6, 1998

SAMPLE IDENTIFICATION: WH98-81A 53.4-53.9 (LAB ID NO. 51)
METHOD OF CUTTING: WET
DATE CUT: 07/09/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.26	---	---
LENGTH-TO-DIAMETER-RATIO:	2.08	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.022	0.026	0.021
MAXIMUM:	0.036	0.036	0.035

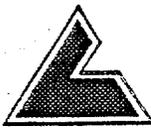
TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.014	≤ 0.020	YES
Δ_{120} :	0.010		YES
Δ_{240} :	0.014		YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY:

John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-57 42.9-43.4 (LAB ID NO. 59)
METHOD OF CUTTING: WET
DATE CUT: 07/09/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH (in):		REQUIREMENTS	CONFORMANCE
LENGTH-TO-DIAMETER RATIO:	2.04	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	ND	ND	ND
MAXIMUM:	ND	ND	ND

VISUALLY INSPECTED WITH FEELER GAUGE; NON-CONFORMING

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	ND	≤ 0.020	NO
Δ_{120} :	ND		NO
Δ_{240} :	ND	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.
ND=NOT DETERMINED.

REVIEWED BY: *John Daulton*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-57 45.5-45.8 (LAB ID NO. 60)
METHOD OF CUTTING: WET
DATE CUT: 07/09/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH (in):	5.02	---	---
LENGTH-TO-DIAMETER RATIO:	2.45	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	ND	ND	ND
MAXIMUM:	ND	ND	ND

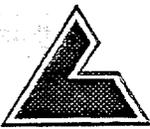
VISUALLY INSPECTED WITH FEELER GAUGE; NON-CONFORMING

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	ND	≤ 0.020	NO
Δ_{120} :	ND		NO
Δ_{240} :	ND	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.
ND=NOT DETERMINED.

REVIEWED BY: *John D. Kelly*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-22 44.1-44.5 (LAB ID NO. 71)

METHOD OF CUTTING: DRY

DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):		REQUIREMENTS	CONFORMANCE
LENGTH-TO-DIAMETER RATIO:	2.46	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.726	0.725	0.725
MAXIMUM:	0.735	0.743	0.743

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.009	≤ 0.020	YES
Δ_{120} :	0.018		YES
Δ_{240} :	0.018	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-22 47.0-47.4 (LAB ID.NO. 72)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):	4.51	---	---
LENGTH-TO-DIAMETER RATIO:	2.21	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

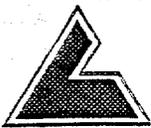
	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.728	0.725	0.727
MAXIMUM:	0.745	0.742	0.765

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.017	≤ 0.020	YES
Δ_{120} :	0.017		YES
Δ_{240} :	0.038	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: *John Drilly*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-20 43.7-44.1 (LAB ID NO. 73)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.37	---	---
LENGTH-TO-DIAMETER RATIO:	2.13	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

EST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.722	0.724	0.725
MAXIMUM:	0.740	0.740	0.740

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.018	≤ 0.020	YES
Δ_{120} :	0.016	↓	YES
Δ_{240} :	0.015	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Drilly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-20 44.6-45.1 (LAB ID NO. 74)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.99	---	---
LENGTH-TO-DIAMETER RATIO:	2.43	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.730	0.728	0.735
MAXIMUM:	0.744	0.760	0.750

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.014	≤ 0.020	YES
Δ_{120} :	0.032		NO
Δ_{240} :	0.015	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-16 48.2-48.7 (LAB ID NO. 75)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH (in):	5.00	---	---
LENGTH-TO-DIAMETER RATIO:	2.44	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

EST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.710	0.710	0.714
MAXIMUM:	0.738	0.732	0.737

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.028	≤ 0.020	NO
Δ_{120} :	0.022		NO
Δ_{240} :	0.023	▼	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: *John Dailly*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-18 45.2-45.7 (LAB ID NO. 76)
METHOD OF CUTTING: WET
DATE CUT: 07/09/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	4.70	---	---
LENGTH-TO-DIAMETER RATIO:	2.29	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	ND	ND	ND
MAXIMUM:	ND	ND	ND

VISUALLY INSPECTED WITH FEELER GAUGE; NON-CONFORMING

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	ND	≤ 0.020	NO
Δ_{120} :	ND	↓	NO
Δ_{240} :	ND	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.
ND=NOT DETERMINED.

REVIEWED BY: *John Dailly*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-18 46.5-46.9 (LAB ID NO. 77)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.00	---	---
MEASUREMENT #2:	2.02	---	---
AVERAGED DIAMETER:	2.01	> 1.88	YES
SPECIMEN LENGTH (in):	4.84	---	---
LENGTH-TO-DIAMETER RATIO:	2.41	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

EST DATA:

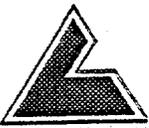
	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.745	0.750	0.753
MAXIMUM:	0.803	0.798	0.811

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.058	≤ 0.020	NO
Δ_{120} :	0.048		NO
Δ_{240} :	0.058	↓	NO

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Dailly



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-19 46.6-47.1 (LAB ID NO. 78)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.04	---	---
MEASUREMENT #2:	2.04	---	---
AVERAGED DIAMETER:	2.04	> 1.88	YES
SPECIMEN LENGTH: (in):	4.65	---	---
LENGTH-TO-DIAMETER RATIO:	2.28	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.730	0.725	0.720
MAXIMUM:	0.770	0.760	0.740

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.040	≤ 0.020	NO
Δ_{120} :	0.035	↓	NO
Δ_{240} :	0.020	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: *John Daily*



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR

LAW PROJECT NUMBER: 30771-8-2976

DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-19 47.7-48.2 (LAB ID NO. 79)

METHOD OF CUTTING: DRY

DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH: (in):	5.10	---	---
LENGTH-TO-DIAMETER RATIO:	2.49	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.724	0.724	0.725
MAXIMUM:	0.740	0.738	0.737

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.016	≤ 0.020	YES
Δ_{120} :	0.014	↓	YES
Δ_{240} :	0.012	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John P. Bailey



LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
RALEIGH, NORTH CAROLINA

**REPORT OF DETERMINATION OF ROCK CORE DIMENSIONAL
AND SHAPE TOLERANCES**

Performed in General Accordance with ASTM D 4543 - 85 (Reapproved 1991)

PROJECT NAME: ZAPATA ENGINEERING LABORATORY TESTING - WILMINGTON HARBOR
LAW PROJECT NUMBER: 30771-8-2976
DATE: JULY 27, 1998

SAMPLE IDENTIFICATION: WH98-83 46.6-47.1 (LAB ID NO. 81)
METHOD OF CUTTING: DRY
DATE CUT: 07/06/98

DIMENSIONAL AND SHAPE TOLERANCES:

SPECIMEN DIAMETER (in):		REQUIREMENTS	CONFORMANCE
MEASUREMENT #1:	2.05	---	---
MEASUREMENT #2:	2.05	---	---
AVERAGED DIAMETER:	2.05	> 1.88	YES
SPECIMEN LENGTH (in):	5.04	---	---
LENGTH-TO-DIAMETER RATIO:	2.46	2.0 - 2.5	YES

DEVIATION FROM STRAIGHTNESS:

TEST DATA:

	Δ_0 READINGS	Δ_{120} READINGS	Δ_{240} READINGS
MINIMUM:	0.720	0.714	0.720
MAXIMUM:	0.730	0.732	0.737

TEST RESULTS:

	DIFFERENCES (in)	REQUIREMENTS	CONFORMANCE
Δ_0 :	0.010	≤ 0.020	YES
Δ_{120} :	0.018		YES
Δ_{240} :	0.017	↓	YES

REMARKS: CRITERIA CONFORMANCES ARE BEST EFFORT PREPARATIONS.

REVIEWED BY: John Sully

FLATNESS TOLERANCE:

TEST DATA:

	END 1, DIAMETER 1 ZERO = 0.0802		END 1, DIAMETER 2 ZERO = 0.1568		END 2, DIAMETER 1 ZERO = 0.1379		END 2, DIAMETER 2 ZERO = 0.1223	
	READINGS	DEVIATION	READINGS	DEVIATION	READINGS	DEVIATION	READINGS	DEVIATION
-0.8750	0.0841	0.0039	0.1516	-0.0052	CAVITY	---	0.1403	0.0180
-0.7500	0.0839	0.0037	0.1528	-0.0040	CAVITY	---	0.1383	0.0160
-0.6250	0.0837	0.0035	0.1536	-0.0032	0.1401	0.0022	0.1356	0.0133
-0.5000	0.0828	0.0026	0.1544	-0.0024	0.1399	0.0020	0.1327	0.0104
-0.3750	0.0825	0.0023	0.1552	-0.0016	0.1395	0.0016	0.1288	0.0065
-0.2500	0.0814	0.0012	0.1558	-0.0010	0.1392	0.0013	0.1265	0.0042
-0.1250	0.0810	0.0008	0.1563	-0.0005	0.1387	0.0008	0.1248	0.0025
0.0000	0.0802	0.0000	0.1568	0.0000	0.1379	0.0000	0.1223	0.0000
0.1250	0.0793	-0.0009	0.1572	0.0004	0.1374	-0.0005	0.1192	-0.0031
0.2500	0.0786	-0.0016	0.1574	0.0006	0.1367	-0.0012	0.1159	-0.0064
0.3750	0.0777	-0.0025	0.1575	0.0007	0.1360	-0.0019	0.1135	-0.0088
0.5000	0.0767	-0.0035	0.1576	0.0008	0.1356	-0.0023	0.1105	-0.0118
0.6250	0.0760	-0.0042	0.1577	0.0009	0.1348	-0.0031	0.1081	-0.0142
0.7500	0.0750	-0.0052	CAVITY	---	0.1339	-0.0040	0.1056	-0.0167
0.8750	CAVITY	---	CAVITY	---	0.1336	-0.0043	0.1011	-0.0212

TEST RESULTS:

- Δ_1 DIFFERENCE BETWEEN MAXIMUM & MINIMUM READINGS FOR DIAMETER 1, END 1 = 0.0091
- Δ_2 DIFFERENCE BETWEEN MAXIMUM & MINIMUM READINGS FOR DIAMETER 2, END 1 = 0.0061
- Δ_1' DIFFERENCE BETWEEN MAXIMUM & MINIMUM READINGS FOR DIAMETER 1, END 2 = 0.0065
- Δ_2' DIFFERENCE BETWEEN MAXIMUM & MINIMUM READINGS FOR DIAMETER 2, END 2 = 0.0392
- Δ_{max} LARGEST DIFFERENCE OF FOUR DETERMINATIONS = 0.0392

The perpendicularity tolerance will be considered to have been met when:

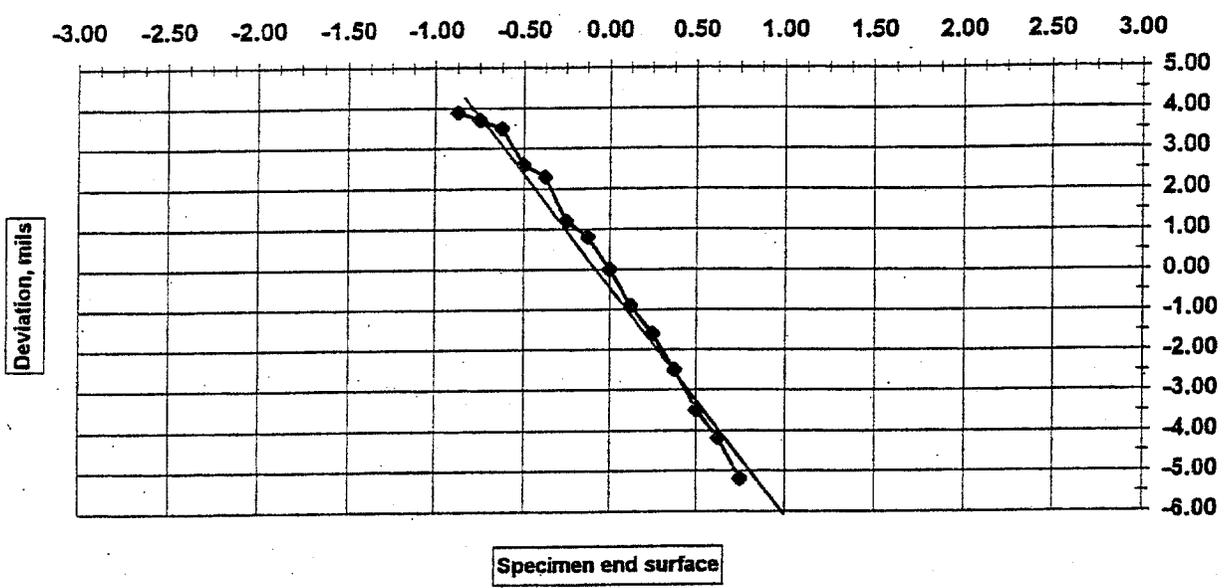
$$\frac{\Delta_I}{d} \text{ and } \frac{\Delta_{I'}}{d} \leq \frac{1}{230} = 0.0043$$

where:

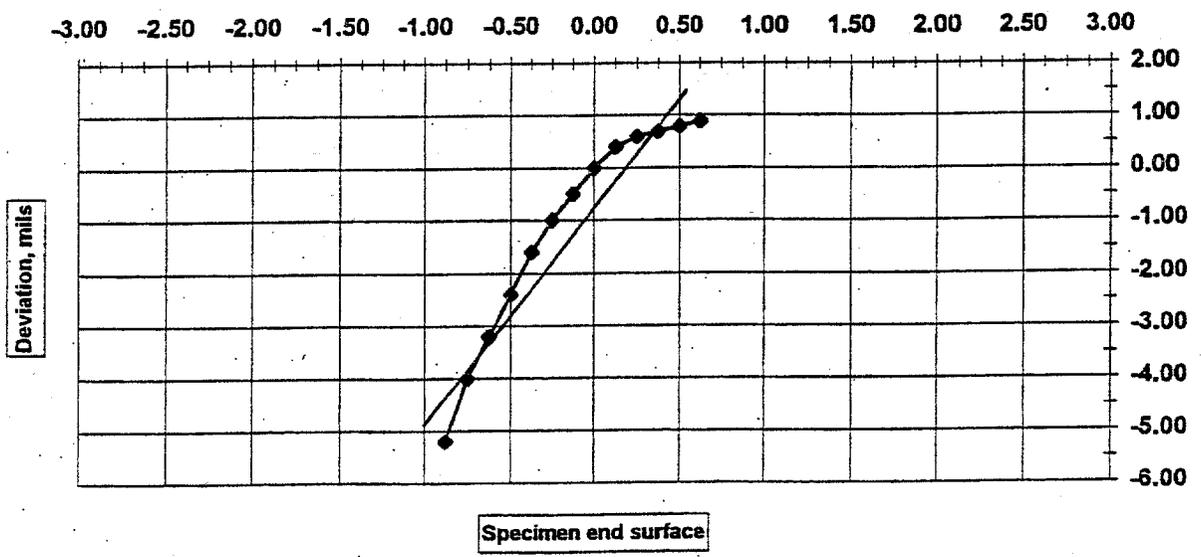
- $I = 1 \text{ or } 2$, and
- $d = \text{diameter}$.

RESULTS OF TESTING FOR PERPENDICULARITY TOLERANCE:	REQUIREMENTS	CONFORMANCE
DIAMETER 1, END 1: 0.0091 / 2.05 = 0.0044	≤ 0.0043	NO
DIAMETER 2, END 1: 0.0061 / 2.05 = 0.0030	≤ 0.0043	YES
DIAMETER 1, END 2: 0.0065 / 2.05 = 0.0032	≤ 0.0043	YES
DIAMETER 2, END 2: 0.0392 / 2.05 = 0.0191	≤ 0.0043	NO

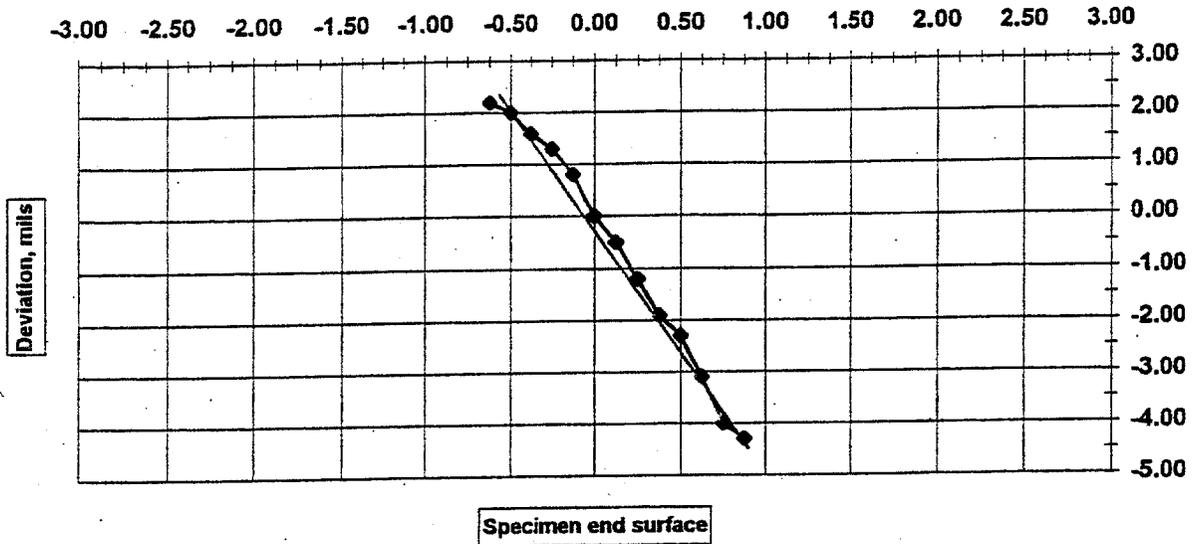
END 1, DIAMETER 1



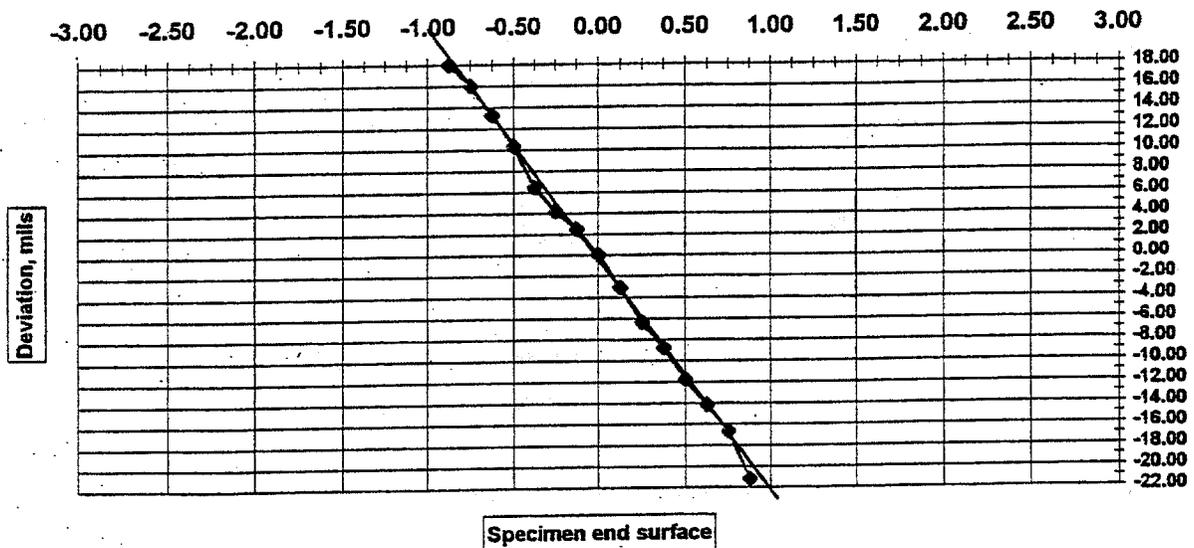
END 1, DIAMETER 2



END 2, DIAMETER 1



END 2, DIAMETER 2



Appendix D

EVALUATION, ANALYSES, AND DELINEATION OF THE GEOLOGY,
WILMINGTON HARBOR, BRUNSWICK AND NEW HANOVER COUNTIES,
NORTH CAROLINA

**EVALUATION, ANALYSES AND DELINEATION OF THE
GEOLOGY, WILMINGTON HARBOR,
BRUNSWICK AND NEW HANOVER COUNTIES,
NORTH CAROLINA**

**Report for the Department of Army
Wilmington District
Corps of Engineers**

Contract Number DACW54-00-P-3179

**W. Burleigh Harris
N.C. Professional Geologist #460**

Date: 14 June 2000

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SUMMARY

The Cape Fear River Channel between Wilmington and Southport is located on the approximate axis of the Cape Fear arch, a NW-SE trending geologic high that extends from the fall-line to the coast. Along its extent, the channel is located in sediments and rocks ranging in age Cretaceous to Oligocene. The following bullets highlight the important points of this paper.

- No active faulting is identified in the area.
- The distribution of Cretaceous, Paleogene and Neogene units in the Cape Fear River is controlled by the underlying geologic structure (Cape Fear arch), the hardness and lithification of the units, and erosion by the Cape Fear River.
- Upper part of Fourth East Jetty and the Anchorage Basin - The Rocky Point Member of the Peedee Formation underlies this area. It varies from loose and friable sandy limestone in the lower part to well-lithified sandy limestone in the upper part. In this area, the top of the Rocky Point Member is generally above – 43’ MLLW, or within the dredging prism. In addition, the thickness of the Rocky Point exceeds the distance between the TOR and the permitted channel depth (-50 MLLW).
- Lower Brunswick Channel to the upper part of the Fourth East Jetty - The Peedee Formation underlies this area and is mainly unconsolidated dark gray to green very fine to fine muddy sand. In this area, TOR stays below the dredging prism or is greater than –44’ MLLW generally remaining between –45’ and –50’ MLLW. In a few areas, TOR drops below –50’ MLLW. Areas where rock is high are irregular karstic surfaces reflecting differential weathering and erosion.
- Upper Lilliput, Keg Island, Big Island - The Rocky Point Member of the Peedee Formation and/or Units A and B of the Castle Hayne Limestone underlie this area; both are generally well-lithified, thickly bedded and very resistant. This results in TOR rising to less than –43’ MLLW in several different places in this part of the channel.
- Lower Lilliput through Battery Island - The Bald Head Shoals Formation, Castle Hayne Limestone or the River Bend Formation underlie this area with TOR generally greater than –50’ MLLW. However, in Snow Marsh Channel, the Bald Head Shoals Formation and the Castle Hayne Limestone form a high rising as high as –45’ MLLW, but staying below the dredging prism. In addition, in Battery Island Channel and Lower Swash Channel, the Castle Hayne Limestone rises to –46’ MLLW, but still stays below the dredging prism.
- Rock occurring in the Wilmington Harbor is generally limestone that is variable in hardness. The top of rock is often irregular, “pinnacle like” resulting from Cape Fear River erosion and dissolution.
- The Peedee aquifer occurs in the Anchorage Basin to the northern part of the Fourth East Jetty Channel. Deepening the channel to –43’ (-44’) MLLW in this

area will remove the upper part of the Peedee aquifer, increase its exposed surface area and enhance its discharge relationship into the river. However, the impact will be minimal as the Peedee aquifer only occurs for a short distance west of the Cape Fear River (about ½ mile) in this area.

- Between Upper Big Island and Keg Island Channel, the Castle Hayne aquifer and the Peedee aquifer occur. The lack of a mappable confining unit between them in this area results in a single aquifer system. As both aquifers have potentiometric surfaces above river elevation, any fresh water in the units will discharge into the Cape Fear River upon deepening.
- Channel deepening in other parts of the river will have no impact on the secondary aquifers in southeastern North Carolina.

INTRODUCTION

The Atlantic Coastal Plain Province is an eastward dipping (20-25'/mile) and thickening wedge of Mesozoic-Cenozoic sediments and sedimentary rocks that become progressively younger oceanward. The western boundary of the Coastal Plain is the fall-line which separates Paleozoic age igneous and metamorphic rocks to the west from younger sediments and sedimentary rocks that unconformably overlie a southeast dipping pre-Cretaceous basement. The province consists of a series of basins including from north to south the Salisbury Embayment, the Albemarle Embayment and the Southeast Georgia Embayment, and intervening highs including the Normandy arch in New Jersey, the Norfolk arch in Virginia, the Cape Fear arch in North Carolina, and the Yamacraw High in South Carolina. The Cape Fear arch whose axis trends northwest-southeast and lies north of the South Carolina-North Carolina State line is the principal structural feature of the Southeastern Atlantic Coastal Plain (Figure 1). To the north of the arch axis and south of the Norfolk arch lies the Albemarle Embayment which represents the major depocenter in North Carolina for Mesozoic-Cenozoic sediments. Coastal Plain sediments in North Carolina reach their maximum onshore thickness of almost 3050 m in the Albemarle Embayment near Cape Hatteras on the outer banks.

The basement extends from outcrop west of the fall-line beneath the coastal plain to a depth of about 3050 m at Cape Hatteras. Lawrence and Hoffman (1993) used basement cores and cuttings from 124 bore holes, magnetic and Bouguer gravity maps to construct an interpretative geologic map of the basement beneath the coastal plain. Based on lithologic characteristics and tectonic features of the basement rocks, they recognized five major regions beneath the coastal plain, the Carolina terrane to the west, the Spring

Hope terrane to the east, the Roanoke Rapids terrane to the northeast, the Charleston terrane to the south and the Hatteras belt in the extreme east. Each terrane is delimited by an inferred basement fault, except for the Hatteras belt.

A northwest-southeast trending feature occurring between the axis of the Cape Fear arch and the major depocenter of the Albemarle Embayment is represented by the Neuse hinge (Harris and Laws, 1997). The area south of the hinge is referred to as the Onslow block and the area north of the hinge the Albemarle block. Riggs and others (1985) designated the area generally represented by the northern part of Onslow block the Mid-Carolina Platform High. On the Albemarle block, Mesozoic and Cenozoic sediments and rocks generally trend north to south, whereas on the Onslow block, their strike becomes more northeast-southwest as units wrap around the nose of the Cape Fear arch. Because of the discordant relationship between the onshore strike of Cenozoic strata and the northeast-southwest orientation of the Onslow Bay shoreline, sediments and rocks exposed onshore continue offshore into Onslow and Long Bays.

This report presents background information on the stratigraphy and structural geology of the southeastern part of the North Carolina Coastal Plain. Bore hole stratigraphy from previous reports by Zullo and Harris (1992, 1993), Harris and Laws (1994) and Harris (1998, a-k) are integrated for the Cape Fear River and Bald Head Shoals Channel. In addition, aquifers and confining units along the Cape Fear River are discussed.

REGIONAL AND LOCAL GEOLOGIC STRUCTURES

Albemarle block

The area between the White Oak and Neuse Rivers and the Norfolk arch (Virginia) used in the sense of Gibson (1983) and Ward and Strickland (1985) is referred to as the Albemarle block. The Albemarle block is a crustal entity that has behaved in concert or independently of adjacent crustal structures. At various times throughout the Mesozoic and Cenozoic the Albemarle block has been elevated or subsided relative to adjacent blocks; currently, the Albemarle block is down relative to adjacent blocks. The Albemarle block more or less corresponds to the Albemarle Embayment and is separated into updip and downdip parts. When reference to stratigraphic units in this report is made to exposures in the Kinston area this is the updip part of the Albemarle block. When reference is made in this report to the subsurface geology in the Pamlico Sound or Outer Banks area this is the downdip part of the Albemarle block. The Albemarle block corresponds to the northern part of the Spring Hope terrane, most of the Roanoke Rapids terrane and Hatteras belt of Lawrence and Hoffman (1993). Tectonic features associated with the basement area of the Albemarle block include the Roanoke Island-Goldsboro fault, the Hollister fault and an unnamed fault that splays southwest from the Roanoke Island-Goldsboro fault, ending at the Neuse hinge and corresponding to the Graingers wrench zone.

Hollister Fault – The Hollister fault is a major dextral strike-slip fault zone that trends north-south through Hollister (Halifax County) and continues southward on a line west of Rocky Mount, Wilson and Goldsboro to be truncated by the inferred Pender fault of

Lawrence and Hoffman (1993). Up to 15 miles of dextral movement has been suggested for the Hollister fault.

Roanoke Island-Goldsboro Fault – The east northeast to west southwest trending Roanoke Island-Goldsboro fault has been suggested because of truncated magnetic anomalies in the Roanoke Rapids terrane. This fault, totally concealed by the Coastal Plain, is interpreted to extend from just north of Oregon Inlet (Dare County) to the southwest beneath Roanoke Island, Greenville, Farmville and Goldsboro where it turns more south and joins the Hollister fault. The Roanoke Island-Goldsboro is interpreted to also have dextral movement.

Graingers Wrench Zone – In the Kinston area, Brown et al. (1977) identified a wrench zone (Graingers wrench zone) east of Kinston based on analysis of stratigraphic and structural data from cores and outcrops that corresponds to the unnamed basement fault of Lawrence and Hoffman (1993). They interpreted its geologic history based on a previously published regional model that dealt with Cretaceous-Cenozoic rocks of the Atlantic Coastal Plain (Brown et al., 1972). Later Brown et al. (1977) attributed the variation in distribution and thickness of the Beaufort Formation (now group) in this area to a series of northeast trending, en echelon, left lateral strike-slip faults. In their interpretation, horizontal movement along these features formed a series of northeastward plunging horsts and grabens. They suggested these structures developed initially in the Paleocene and Eocene, with most deformation in the post-Eocene. McLaurin and Harris (in press) reinterpreted the direction of movement on the wrench zone through detailed stratigraphic analysis.

The Graingers wrench zone is a northeast-southwest trending feature that terminates to the south at the Neuse hinge and continues northeastward toward the Virginia state-line for about 160 miles. McLaurin and Harris (in press) show that the zone consists of an echelon northeast-southwest trending faults and east to west trending faults. They suggest that the northeast-southwest trending system is more recently active and overprints a Paleocene east-west fault trend, and that the system experienced episodic activity during the Mesozoic and Cenozoic.

Neuse Hinge

Ferenczi (1959) postulated a fault along the Neuse River and termed it the Cape Lookout-Neuse River fault zone. Baum et al. (1978) also recognized the same feature but shortened the name to the Neuse fault; subsequently, Harris et al. (1979) changed the trend of the Neuse fault. Baum et al. (1978) and Harris et al. (1979) mapped the Neuse fault parallel to the Cape Fear River between about Smithfield, Johnston County, to Bogue Inlet at the mouth of the White Oak River, Onslow-Carteret County line. Harris et al. (1979) suggested that the Neuse fault had a sense of relative movement with the north side down and that movement had occurred periodically from Lower Cretaceous through the Quaternary. Harris and Laws (1997) referred to the Neuse fault informally as the Neuse hinge and identified it as a transition zone between the Onslow and Albemarle blocks. Consequently, as currently recognized, the Neuse hinge of Harris and Laws (1997) or the Cape Look-Neuse River fault Zone of Ferenczi (1959), the Neuse of fault of Harris et al. (1979) or the New Bern arch of Gibson (1983), is a northwest-southeast trending structure that occurs from the fall-line to the terminus of the Whiteoak River.

Although past movement about the structure may have been differential, the north side is currently down relative to the south side.

Onslow Block

The area between the Neuse hinge and the axis of the Cape Fear arch (approximately the North Carolina – South Carolina state-line) is referred to as the Onslow block. The Onslow block is a crustal entity that has behaved in concert or independently of adjacent crustal structures. At various times throughout the Mesozoic and Cenozoic the Onslow block has been elevated or subsided relative to adjacent blocks; currently, the Onslow block is elevated relative to adjacent blocks. All Mesozoic and Cenozoic units on the Onslow block strike northeast southwest and dip to the southeast at less than 1°.

Pender Fault – Lawrence and Hoffman (1993) identified an east-west trending basement fault on the Onslow block and termed it the Pender fault. They mapped the fault from about the Pender/Onslow County line's intersection with the Atlantic Ocean on the east west across Pender and Bladen Counties to the South Carolina line just north of Fair Buff. Evidence for the fault's presence consisted of magnetic anomaly trends and basement rocks of different terrains. Lawrence and Hoffman (1993) gave no evidence for post-rift movement on the fault and suggested dextral movement.

Carolina Fault – LeGrand (1955) and Ferenczi (1959) postulated a fault zone trending northeast-southwest, parallel to the coast, that could be traced from the vicinity of Kinston, Lenoir County, south to the approximate confluence of the Cape Fear and Black Rivers. Baum et al. (1978) named the feature the Carolina fault and traced it from the

confluence of the Cape Fear and Black Rivers north to the Neuse fault. Harris et al. (1979) suggested that the fault passed through Cove City, Craven County.

Cape Fear Arch

The Cape Fear arch of southeastern North Carolina is the principal structural feature in the Atlantic Coastal Plain. It is interpreted as a southeast plunging basement high extending from the Fall Line near Fayetteville along the Cape Fear River to about Cape Fear, North Carolina. Its axial trace marks the main area of Cretaceous outcrops in North Carolina; however, the Cretaceous is exposed in the northern coastal plain on the Albemarle block updip along major river valleys. The Cape Fear arch was originally recognized as a positive feature by Dall and Harris (1892); however, Stephenson (1923) is usually given credit for first delineating the structure. Although recognized by many other workers (MacCarthy, 1936; Mansfield, 1937; Richards, 1945; Straley and Richards, 1950; Baum et al., 1977), Harris et al. (1979) suggested that the Cape Fear arch represented a basement fault that has experienced episodic, differential movement from the Lower Cretaceous through the Quaternary. They located the fault trace approximately northeast of the line separating the Peedee drainage basin of South Carolina from the Cape Fear drainage basin of North Carolina. The area marked by the axis of the Cape Fear arch has also been termed the Carolina Platform by Hine and Riggs (1986). They suggested that it was a broad region of shallow continental crust between the Southeast Georgia and Salisbury Embayments and that the platform was a major structural feature that controlled Cenozoic deposition.

The Cape Fear arch controls the distribution of Cretaceous, Paleogene and Neogene units in southeastern North Carolina. As the arch plunges to the southeast,

geologic units that crop out onshore north of the arch axis continue offshore into Onslow and Long Bays, and then wrap back on shore in South Carolina. The Cape Fear River generally follows the arch axis.

East Coast Fault System

Marple and Talwani (2000) identified the presence of a north-northeast trending buried fault system almost 1000 miles long in the Coastal Plain of the Carolinas and Virginia. They recognized three en echelon segments, each with dextral movement, one segment in South Carolina extending from west of Charleston northeastward to the North Carolina state line, a second part in North Carolina extending from the state line northeastward to about the Fall Line at the Neuse River, and a third extending from this same area, but located east, northeastward to about the James River in Virginia. They suggested that each of these segments had experienced late Quaternary deformation. The second fault segment is interpreted to cross the Onslow block from about Lumberton to west of Fayetteville and Dunn.

GEOMORPHOLOGY

Regional

The area from a little south of the Neuse River, North Carolina north to Cape Cod, Massachusetts, is termed the Embayed Section of the Coastal Plain Province. The main attribute of this section is fairly recent submergence. In North Carolina, this submergence is well documented by the low-lying Albemarle Embayment. As this area lies north of the project area, it is not discussed.

The area south of the Embayed Section is referred to as the Sea Island Section of the Coastal Plain Province. Characteristics of this section include less submergence than

the area to the north, a chain of barrier islands, and a sizeable non-terraced zone inland which is dissected enough to make the inner coastal plain hilly. Shallow depressions commonly referred to as the Carolina Bays are also common. The project area (Cape Fear River and Bald Head Shoals Channel) lies within the Sea Island Section of the Coastal Plain and separates the area north from the area south on the Onslow block.

North of the Cape Fear River – The area north of the Cape Fear River is a structural and geomorphic entity bounded to the southwest by the Cape Fear arch and to the north by the Neuse hinge. This area is characterized by a dearth of large scale relict shoreline features or Pliocene and Pleistocene marine units. In addition, drainage development and direction of flow differ markedly from those seen in adjacent Coastal Plain sections. Throughout the area most streams are deflected to the south, resulting in deflected-tributary asymmetry White (1966). The Cape Fear River valley is asymmetric with most tributaries of the river located on the north side, consequently, tributary length and surface slopes are lower than tributary length and surface slopes south of the Cape Fear River. Although White (1966) suggested that the primal cause of asymmetrical drainage in the Atlantic Coastal Plain was the southward drift of beach sand, basement blocks bounded by northwest-southeast trending hinge zones or faults may partition the Coastal Plain into a series of half grabens with dip slip mainly on the north side. Thus, areas located northeast of block boundaries would reflect southwestward dip slopes of units whereas the areas located immediately southwest of block boundaries would reflect north-facing escarpments, with the axis separating dip directions located further south.

South of the Cape Fear River – The area located south of the Cape Fear River is structural and geomorphic entity bounded by the Cape Fear arch axis north and the

northwest-southeast fault zone that bounds the Peninsular Arch of Florida. Adjacent to the Cape Fear River tributaries that are located on the south side are significantly shorter than those located on the north side and have a greater slope.

Terraces

River and wave cut terraces occur on the north side of the Cape Fear River and along the Intracoastal Waterway of the Onslow block. Five river terraces with successively older terraces located farther away from the river are identified within the Cape Fear River valley, all lying northeast of the river (Soller, 1988). River terraces can be correlated to marine strandline deposits and scarps on the Onslow block north of the Cape Fear River and to marine deposits on the Onslow block south of the Cape Fear. The five terraces recognized by Soller (1988) along the north side of the Cape Fear River valley were from youngest to oldest the Wando, the Socastee, the Penholoway, the Waccamaw and the Bear Bluff. Each of these terraces are correlated to marine deposits south of the Cape Fear River. The Bear Bluff terrace is correlated to the upper Pliocene Bear Bluff Formation, the Waccamaw terrace to the lower Pleistocene Waccamaw Formation, the Socastee terrace to the middle Pleistocene Socastee Formation and the Wando terrace to the upper Pleistocene Wando Formation of Owens (1989).

Several scarps and associated terraces (plains) are recognized on the Onslow block between Cape Fear and Cape Lookout. Zullo and Harris (1979) recognized three scarps that formed the seaward borders of tilted plains in the area: the Hanover scarp, the Bogue-Suffolk scarp, and the Alligator Bay scarp. The Hanover scarp originated at an interpreted cape in central New Hanover County north of the Cape Fear River. To the south, Zullo and Harris (1979) suggested that the scarp paralleled the north side of the

Cape Fear River for several kilometers eventually becoming the Surry scarp about 125 miles inland of the coastal margin. Although Flint (1940) recognized the Surry scarp inland on the Onslow block, Zullo and Harris (1979) traced the Hanover scarp northeastward to just south of the New River where it turned abruptly to the north eventually merging inland along the Neuse hinge with the Surry scarp. Soller and Mills (1991) followed the identification and location of the Surry scarp as mapped by Flint (1940), and did not recognize the Hanover scarp. The plain delimited on the Onslow block by the Orangeburg scarp and the Hanover-Surry scarp is identified as the Duplin Plain (Zullo and Harris, 1979). Sediments of Duplin age represent the youngest marine formation underlying the area. Zullo and Harris (1979) indicated that Duplin Plain was at an elevation of more than 40' in central New Hanover County and over a distance of about 100 miles gradually increased to about 70' on the west side of the New River.

The Bogue-Suffolk scarp is located seaward of the Hanover scarp and essentially delimits the modern mainland coast on the Onslow block. Mixon and Pilkey (1976) mapped the Bogue scarp north of the New River, and indicated that in central Carteret County, it abruptly turned north and became part of elements associated with the Suffolk scarp. The plain delimited by the Hanover scarp and the Bogue-Suffolk scarp is called the Waccamaw/Canepatch Plain (Zullo and Harris, 1979) and ranges in elevation from about 25' in central New Hanover County to over 35' just north of the New River.

Waccamaw and James City Formation sediments represent the youngest marine sediments underlying the plain. Zullo and Harris (1979) also proposed the Alligator Bay scarp for a linear feature that occurred seaward of the Bogue scarp between Spicer and Alligator Bays, Onslow County. The plain bounded by Bogue scarp and the Alligator

Bay scarp rose from sea level 19 miles south of New River to about 15' at New River and was designated the Socastee Plain. North of New River Inlet, the Alligator Bay scarp may merge with the Bogue scarp, forming the western limit of the Core Creek Sand.

GEOLOGIC FORMATIONS

Cretaceous through Holocene sediments occur along the Cape Fear arch in southeastern North Carolina. Stratigraphic units recognized and their age is shown in Figure 2.

Cretaceous

Peedee Formation

The Peedee Formation was first described by Stephenson (1912) as dark green to gray, finely micaceous, and more or less glauconitic, calcareous argillaceous sand with impure limestone layers to 3' in thickness. These impure limestone layers commonly are comprised of high concentrations of mollusks and calcite cement. The Peedee Formation disconformably overlies the Black Creek Group (Donoho Creek Formation) and disconformably underlies Cenozoic sediments. The top of the unit contains two members, the Rocky Point and the Island Creek. The Peedee Formation occurs in every coastal county of North Carolina.

The predominant lithology of the Peedee Formation is dark gray to green, argillaceous, calcareous very fine to fine quartz sand. In southern Brunswick County, however, the Peedee Formation is a moderately indurated, medium light gray to olive gray very fine to fine sandy foraminiferal wackestone to sandy wackestone (Harris et al. (1986). Downdip, the contact between the underlying Peedee Formation and the overlying Rocky Point Member appears to be gradational.

The Peedee Formation has been considered to be Campanian to Maastrichtian in age, and is assigned to the *Exogyra costata* zone. Recent work, however, by D. Prowell, J. Self-Trail and R. Christopher in South Carolina suggests that the Peedee Formation is only Maastrichtian with the lower boundary with the underlying Black Creek Group the Campanian-Maastrichtian boundary. Two distinct lithologies recognized in the Peedee Formation have been formally named, the Rocky Point Member and the Island Creek Member.

Rocky Point Member - The Rocky Point Member of the Peedee Formation was informally proposed by Swift and Heron (1969) and later designated a formal stratigraphic unit by Wheeler and Curran (1974) with the Superior Stone Quarry (later bought by Martin Marietta) in northern New Hanover County designated the holostratotype. The Rocky Point Member disconformably overlies the sediments of the typical Peedee Formation and disconformably underlies either the Island Creek Member of the Peedee, Beaufort Group sediments or the Eocene Castle Hayne Limestone. The Rocky Point Member of the Peedee is recognized in eastern Brunswick, New Hanover, eastern Pender and southwestern Onslow Counties. In extreme southern Brunswick County (Bald Head Island area) it has an estimated maximum thickness over 90'.

Harris (1978) subdivided and mapped the distribution of the Rocky Point Member in southeastern North Carolina. He recognized three vertically superposed lithofacies, lower quartz sand, alternating sandy pelecypod-mold grainstone and quartz sand, and upper sandy pelecypod-mold grainstone in the type locality, but had difficulty recognizing these lithofacies in the subsurface. Harris (1978), however, mapped coarse sandy pelecypod-mold grainstone updip in eastern Brunswick County, most of New

Hanover County and southern Pender County, with fine sandy pelecypod-mold grainstone in eastern Brunswick County, southern New Hanover County and northern Pender and southern Onslow Counties.

The lowermost Rocky Point Member lithofacies consists of interbedded quartz sand and calcareous quartz sand ranging to 10' in thickness. Quartz comprises greater than 95% of the terrigenous fraction with potassium feldspar and plagioclase second in abundance. Although the terrigenous fraction ranges from fine silt to coarse sand size, it averages fine sand size. A few fossil fragments occur in this lithofacies; however, they are not abundant. This lithofacies grades upward into a coarse sandy, pelecypod-mold grainstone which is the principal lithofacies of the Rocky Point Member. It ranges up to 45' in thickness in Brunswick County, but in most areas it averages less than 15'.

Coarse sandy, pelecypod-mold grainstone grades downdip into fine sandy, pelecypod-mold grainstone. The only main difference between this lithofacies and the previous is the size of the allochemical fossils fragments. In southern Brunswick County this lithofacies is over 80' in thickness. Non-carbonate framework constituents consist of greater than 95% quartz in all three lithofacies.

Sandy, pelecypod-mold grainstone occurs directly below the Cretaceous-Tertiary boundary in most of Brunswick County, western New Hanover and Pender Counties. In other areas, it is overlain by the Island Creek Member of the Peedee Formation. Where the top of the Rocky Point forms the Cretaceous-Tertiary boundary, it usually displays microkarst with solution features extending several meters into the top of the unit. In addition, phosphate and glauconite mineralization commonly coat the disconformity.

Allochemical components comprise about 20% of this litho facies and in order of abundance are fossil, peloid, glauconite, phosphate and intraclasts.

The most common fossils in the Rocky Point Member are pelecypods of the genera being *Cardium*, *Crassatellites*, *Cucullaea*, *Anomia*, *Inoceramus*, and the oyster *Flemingostrea subspatulata* which is diagnostic of a Maastrichtian age. In southern Brunswick County diagnostic planktic foraminifers that occur in the lower part of the Rocky Point include *Heterohelix globulosa*, *H. striata*, *Guembelitra cretacea*, *Globigerinelloides prairiehillensis*, *Rugoglobigerina rugosa* and several species of *Globotruncana*. Benthic forms include *Cibicides harperi*, *C. stephensoni*, and *Anomalinides pseudopapillosa* (H.A. Curran, 1974, personal communication).

Island Creek Member - The Island Creek Member of the Pee Dee Formation was defined by Dockal et al. (1998) for a dolomitic argillaceous quartz wacke that disconformably overlies the Rocky Point Member of the Pee Dee Formation in the vicinity of Castle Hayne, NC. Hypostratotypes of the member are identified in the LEA-1A-79 core hole located on the south side of N.C. Highway 210, just west of its intersection with U.S. Highway 17 in Pender County, and along the east bank of the Northeast Cape Fear River at Hilton Park in New Hanover County (Dockal et al., 1998). Paleocene or Eocene strata disconformably overlie the Island Creek. The Island Creek Member is recognized in New Hanover and eastern Pender Counties and may occur in east central Brunswick County along the Cape Fear River (Dockal et al., 1998).

The Island Creek Member is predominantly an olive gray, well sorted, very fine to fine grained, poorly indurated, bioturbated, argillaceous, dolomitic quartz wacke.

Dolomite euhedra make up between 1% to over 50% by volume of the unit with crystals ranging from 0.01 mm to 0.11 mm in size. The primary detrital component is quartz.

The Island Creek contains a characteristic late Maastrichtian calcareous nanofossil assemblage, which includes *Micula decussata*, *Microhabdulus undosus*, *M. decoratus*, *Lithraphidites quadratus*, *Arkhangelskiella cymbiformis*, *Cribrosphaeralla ehrenbergi*, *Prediscosphaera cretacea* and abundant *Thoracosphaera* spp. This assemblage correlates to Cretaceous nanofossil zones CC25-26.

Paleocene

Beaufort Group

The Beaufort Group consists of four formations; the Danian Jericho Run and Yaupon Beach Formations and the Thanetian Moseley Creek and Bald Head Shoals Formations. The Yaupon Beach and Bald Head Shoals Formations are recognized on the Onslow block only in Long Bay. The Jericho Run and Moseley Creek Formations are only recognized near Kinston on the inner part of the Albemarle block (Harris and Laws, 1994) and are thus not discussed in this report.

Yaupon Beach Formation – The Yaupon Beach Formation was designated by Harris and Laws (1994) for siliciclastic sediments that occurred in core holes located along Bald Head Shoals channel in Long Bay. U.S. Army Corps of Engineers core hole BS95-05 between –62.5’ and –78.3’ (MLLW) was designated the holostratotype, core holes BS92-12 and BS92-21 hypostratotypes (Table 2). Although the contact with the underlying Peedee Formation has not been observed, it is assumed to be disconformable. The Bald Head Shoals Formation disconformably overlies the Yaupon Beach Formation. The

Yaupon Beach Formation has only been recognized in core holes along the Bald Head Shoals channel in Long Bay.

The Yaupon Beach Formation consists of olive green to gray, glauconitic, very fine to fine-grained argillaceous bioturbated quartz sand. Lithified intervals, generally less than a foot in thickness, may occur in the unit and generally have higher concentrations of mollusks, preserved as molds, and calcite cement. Insoluble residue analysis indicates that soluble material comprises slightly less than 5% and the insoluble material is dominated by fine to very fine quartz sand (average 84.12%) with silt and clay-sized material forming the remainder of the insoluble fraction. Smear slides indicate that the soluble fraction is mainly composed of foraminifers, calcareous nannofossils and ostracods.

A moderately well preserved, low-diversity nannofossil assemblage that includes species with first appearances in the Danian, species that persist across the Cretaceous/Tertiary boundary and redeposited Cretaceous species are present in the Yaupon Beach Formation. Lower Danian taxa include *Cruciplacolithus primus*, *C. tenuis*, *Ericsonia cava*, *Biscutum* spp. and *Neochiastozygus* sp. Cretaceous survivor species include *Placozygus sigmoides*, *Markalium inversus* and *Cyclogelosphaerella reinhardtii*. Redeposited Cretaceous taxa include *Arkangelskiella cymbiformis*, *Crirosphaerella danias*, *Prediscosphaera spinosa*, *P. cretacea*, *Microrhabdulus decoratus* and *Micula decussata*. In the absence of *Cruciplacolithus danicus*, this assemblage suggests correlation of the Yaupon Beach Formation to the lower Danian *Cruciplacolithus tenuis* Zone (NP2, CP1b).

Bald Head Shoals Formation – The Bald Head Shoals Formation disconformably overlies the Yaupon Beach Formation and disconformably underlies the Eocene Castle Hayne Limestone. The unit is present along the entire length of the Bald Head Shoals ship channel in Long Bay, but it is best developed and thickest in the northern most area. It is also identified in two core holes (WH94-25, WH98-121) located along the Cape Fear River in Snow Marsh Channel. U.S. Army Corps and Engineers core hole BS92-12 in Bald Head Shoals between the depths –73.7’ to –51.1’ (MLLW) was designated the holostratotype and BS92-21 a hypostratotype by Harris and Laws (1994).

The Bald Head Shoals Formation is a moderately to well indurated, medium to dark gray sandy, molluscan-mold mudstone, wackestone to packstone; packstone is the most abundant lithology. The siliciclastic framework of the Bald Head Shoals Formation consists almost exclusively of subangular to subrounded quartz with minor plagioclase, potassium feldspar, muscovite and various heavy minerals. Primary framework constituents are gastropod molds, pelecypods, and bryozoans. Non-framework components are micrite and neomorphic calcite spar.

Weight percent insoluble residue varies from a low of about 25% to higher than 50%; sand is the major component averaging almost 85% of the total residue. Percent sand of the insoluble and the amount of medium and coarse sand in the increase upward in the unit.

The Bald Head Shoals Formation is considered to Thanetian in age based on the presence of an undescribed species of turritellid gastropod that is most similar to *Turritella mingoensis*, but is distinct from it, which is Paleocene in age. Three mollusks that occur in the Bald Head Shoals Formation, the gastropod *Mesalia biplicata* and the

pelecypods *Barbatia (Cucullaearca) cuculloides* and *Acanthocardia (Schedocardia) tuomeyi* are found in Paleocene Thanetian age units in the Gulf Coast. Microfossils are sparse, poorly preserved and generally recrystallized; however, the occurrence of the benthic species *Cibicides neelyi*, *Eponides lotus*, *Anomalinoidea umboniferus*, and *Cibidina* sp. suggest an age from middle Paleocene to middle Eocene. On basis of these data, the Bald Head Shoals Formation is interpreted to be late Paleocene, Thanetian in age.

Eocene

Castle Hayne Formation

The Castle Hayne Limestone occurs throughout eastern North Carolina between the Cape Fear and Neuse Rivers. Miller (1912) named the unit for exposures in the vicinity of Castle Hayne, New Hanover County, but a type section was not designated. Baum et al. (1978) designated the Martin-Marietta quarry, 3 miles northeast of Castle Hayne, the lectostratotype and recognized three lithologic units: lower phosphate pebble conglomerate (fossiliferous packstone), a middle bryozoan grainstone and an upper bryozoan-sponge packstone. Zullo and Harris (1987) subsequently identified five depositional sequences in the Castle Hayne Limestone, each separated by phosphatized and glauconitized disconformable surfaces. As these depositional sequences did not conform to previously defined lithostratigraphic units, they designated the sequences from oldest to youngest, 0 through 4. Sequence 0 was only recognized in an outlier in Duplin County and is a sandy, bryozoan limestone. Although the unit has not provided age diagnostic fossils, it is presumed to be Eocene based on lithologic similarity to overlying units that have provided age diagnostic indicators. Sequence 1 is widespread

throughout southeastern North Carolina varying in thickness from a few inches to over 10'. This sequence consists sandy phosphate pebble conglomerate, sandy calcarenite, dense sandy molluscan packstone, sandy cross-bedded bryozoan grainstone and bryozoan-molluscan packstone. These latter two lithologies are the common rock types in sequence 1. Sequence 1 contains age diagnostic echinoids *Protoscutella mississippiensis rosehillensis* Kier, *Cubitostrea lisbonensis?* and nannofossils (Worsley and Laws, 1986) that suggest a middle, middle Eocene (Lutetian) age for the unit. Sequence 2 of the Castle Hayne Limestone has a similar distribution to sequence 1, but is more continuous and usually thicker. Sequence 2 is disconformable on sequence 1 of the Castle Hayne, older Paleocene units, or the Cretaceous Peedee Formation, and the disconformity is usually solutioned, phosphatized and glauconitized. Sequence 2 varies in thickness from about 3' to near 40' and consists of lithologies similar to those in sequence 1. As in sequence 1, sequence 2 also contains a large percentage of quartz sand. Age diagnostic megafossils in sequence 2 include *Protoscutella conradi*, *Cubitostrea sellaeformis* and the upper range of *Chlamys clarkeana*. Worsley and Laws (1986) identified a calcareous nannofossil flora and fauna representative of zone NP 16, or upper middle Eocene (Bartonian). Sequence 3 of the Castle Hayne Limestone is the most complete Eocene depositional sequence exposed in the North Carolina Coastal Plain. This sequence is widespread north of the axis of the Cape Fear arch in New Hanover, Pender, Onslow, Jones and southwestern Craven Counties. Sequence 3 is disconformable on sediments of sequences 1 and 2, but updip may overlies Paleocene or Cretaceous sediments. Lithologic units in sequence 3 are phosphate pebble bearing grainstone, bryozoan grainstone, molluscan-bryozoan grainstone, and bryozoan-sponge

packstone-wackestone. Units attributed to sequence 3 differ from sequences 1 and 2 in their lower content of quartz sand and greater overall thickness. Sequence 4 of the Castle Hayne Limestone has a restricted distribution and is only known from deposits in northern New Hanover County and Craven County. In northern New Hanover County sequence 4 deposits consist of about 12' of fossiliferous packstone, sponge-bearing wackestone, bryozoan packstone and bryozoan-molluscan grainstone disconformably overlying a bored, solutioned phosphate-glaucinite-coated upper surface of sequence 3. Sequence 4 in Craven County consists of the New Bern Formation, which consists of about 20' of fine to coarse sandy, pelecypod-mold grainstone. This lithology does not occur south of Craven County. Sequence 4 of the Castle Hayne Limestone contains the age diagnostic echinoid *Periarchus lyelli* and the pectinid *Chlamys deshayesii dennisoni*.

Unit A – Unit A of the Castle Hayne Limestone is informally used to distinguish the lower part of the unit and is comprised of sequences 0, 1 and 2. These sequences are grouped into this rubric because of the general absence of age diagnostic megafossils and microfossils preserved in the core holes. In addition, the varying lithologies that occur in sequences 0-2 are not age specific.

Unit B – Unit B of the Castle Hayne Limestone is informally used to distinguish the upper part of the unit and is comprised of sequences 3 and 4. Lithologies similar to those in Unit A and the general absence of age-diagnostic fossils in cores make it difficult to distinguish Unit A from Unit B. Often, the absence of quartz sand is the only distinguishing parameter.

Oligocene

River Bend (Trent) Formation

The Oligocene River Bend (Trent) Formation represents the oldest Oligocene unit exposed in North Carolina. Brown et al. (1972) first recognized Oligocene rocks in the North Carolina Coastal Plain and mapped their distribution from the northern part of Dare County (Albemarle block) to Brunswick County (Onslow block). They assigned the rocks to the Gulf Coast Vicksburgian (Rupelian) and Chickasawhayian (Chattian) stages but did not name them. Baum et al. (1978) and Ward et al. (1978) proposed a single Oligocene unit. Baum et al. (1978) resurrected the name Trent Formation from previous work and suggested the unit was middle Oligocene in age based on global cycles of eustasy. Ward et al. (1978) proposed the name River Bend Formation and suggested that it was late Oligocene in age. The unit proposed by Ward et al. (1978) included the same rocks Baum et al. (1978) used for the Trent Formation and also overlying rocks that Baum et al. (1978) called the Belgrade Formation. Zullo and Harris (1987) retained the name Trent Formation and on the basis of sequence stratigraphic concepts, mollusks and barnacles but redefined its age to lower Oligocene (Rupelian).

The River Bend Formation is confined mainly to area between the Neuse and Trent Rivers, but is recognized on the Onslow block in Onslow County and the eastern part of Pender County, in cores located off of Kure Beach in Onslow Bay, in a small outlier mapped in Brunswick County near Supply and in three cores along the Cape Fear River. Lower Oligocene sediments are also recognized in shallow cores from Long Bay. The unit consists of three lithologies on the southern Albemarle block, sandy echinoid grainstone, sandy, pelecypod-mold packstone and barnacle, pelecypod-mold grainstone.

South into Onslow County on the Onslow block, the Trent consists of sandy, foraminiferal silt and silty clay. In cores located off Kure Beach foraminiferal silt and silty clay are also recognized, but a dolosilt has been identified by Marcy (1997). This dolosilt has also been recognized in three cores from the lower part of the Cape Fear River. Along the Trent River in northern Onslow County lower Oligocene sediments obtain a thickness of about 25'; in central Onslow County they are almost 100' thick. Although the base has not penetrated in cores off Kure Beach, the unit is at least 10' thick. Along the Cape Fear River, only several feet occur in cores; however, the base of the unit has not been penetrated in the two southernmost cores.

The lower part of the River Bend Formation is assigned an early Oligocene Rupelian age based on the occurrence of the barnacle *Lophobalanus kellumi*, the pectinid *Chlamys trentensis*, mollusks of early Rupelian age (Rossback and Carter, 1991), foraminifers indicative of the *Globergerins ampliapertura* Zone (P19/20) (Zarra, 1989), and calcareous nannofossils indicative of zones NP21-22 (Worlsey and Turco, 1979).

Belgrade/Silverdale Formations

The youngest Oligocene sediments recognized in North Carolina are referred to the Belgrade/Silverdale Formations (upper River Bend Formation and Belgrade Formation of Ward et al., 1978) and informally the *Crassostrea* channel deposits. The Belgrade/Silverdale Formations only occur south of the Neuse hinge in Onslow County, but they occur offshore in Onslow Bay bore holes. Harris et al. (2000) mapped the distribution of Oligocene units on the onshore Onslow block of southeastern North Carolina, and Snyder et al. (1991) showed their distribution in Onslow Bay. Aquitanian *Crassostrea* channel deposits (latest Oligocene) are only found within a few miles north

or south of the Whiteoak River, both onshore and offshore in Onslow Bay. The Belgrade Formation consists of about 25' of sandy, pelecypod-mold packstone with minor interbeds of quartz sand. The Silverdale Formation consists of about 10' of mollusk-rich quartz sand which is occasionally lithified and moldic. It occurs downdip (eastward) of the Belgrade Formation and is considered to be equivalent in age. Calcareous nannofossils (Laws and Worsley, 1986; Laws, 1992; Parker and Laws, 1991), planktonic Foraminifera (Zarra, 1989), and megafauna indicate that the Belgrade/Silverdale Formations span planktonic foraminiferal zones P21 and P22 (Zullo and Harris, 1987). The Belgrade and Silverdale Formations were suggested to represent four depositional sequences ranging from Chattian to Aquitanian age (Zullo and Harris, 1987). Harris et al. (2000) correlated the onshore Oligocene to the offshore section in Onslow Bay through the use of Sr isotopes.

Pliocene/Pleistocene (Undifferentiated)

Duplin Formation

Pliocene units in North Carolina are referred to as the Duplin/Yorktown Formations and the Bear Bluff/Chowan River Formations. The Yorktown Formation is usually used for lower and lower upper Pliocene sediments that occur north of the Neuse hinge on the Albemarle block (Ward et al., 1991). The Duplin Formation is used for age equivalent sediments that occur south of the Neuse hinge on the Onslow block. The Chowan River is also used for latest Pliocene sediments that occur on the Albemarle block and the Bear Bluff for age equivalent sediments on the Onslow block.

The Duplin Formation consists of sand, sandy and silty clay, and very shelly sand commonly overlying a basal phosphate pebble conglomerate. Although north of the

Neuse hinge the Yorktown Formation (=Duplin Formation) is a continuous unit that has been separated into members, south of the Neuse hinge the Duplin Formation has not been subdivided. The Duplin Formation is also only preserved in outliers; two of these are recognized near the Cape Fear River, one in New Hanover County, the other in Brunswick County.

Bear Bluff Formation

The Chowan River is only used in North Carolina north of the Neuse hinge; south of the Neuse hinge the Bear Bluff Formation of DuBar et al. (1974) is used. The Chowan River and Bear Bluff Formations are considered to be upper Pliocene in age. The Bear Bluff Formation is known mainly from the area south of the Cape Fear River. It consists of calcareous sandstone, sandy limestone, subarkosic sand, and calcareous silt and has maximum thickness that exceeds 100' (DuBar et al., 1974).

Waccamaw Formation

The Waccamaw Formation is used for lower Pleistocene sediments that occur on the southern parts of the Onslow block. The Waccamaw Formation occurs over most of the area south of the Cape Fear River, particularly in low areas developed on older units, and north of the Cape Fear River in small pits and dredge spoils just west of the Intracoastal Waterway. It has also been identified in Burnt Mill Creek, New Hanover County, and probably occurs at other lower elevation locations that are associated with the margins of the Onslow block. Offshore, it has been identified in Onslow Bay (Riggs et al., 1993) and Long Bay by Meisburger (1979). The Waccamaw Formation consists of sandy shell beds and shelly carbonate with sand. The sand is usually clean, fine-grained and contains whole, well preserved shells. In some cases, local areas in the carbonate are

cemented with some shells preserved as molds; burrow structures commonly are cemented. Common fossils in the Waccamaw include pelecypods, gastropods, bryozoans, barnacles and echinoid spines. Waccamaw sediments have been mapped to over 30' in thickness (Owens, 1989), but usually average about 20'.

Holocene

Surficial Deposits

Throughout southeastern North Carolina unfossiliferous sand overlies older fossiliferous units. The surficial unit is generally a light gray to yellow, medium to fine-grained sand with trace quantities of clay, pebble and peat. In some case, dark organic rich sand occurs. These deposits are variable in thickness but usually are less than a few feet and represent various ages.

GEOLOGY OF THE RIVER CHANNEL

Anchorage Basin, Wilmington Harbor (Figures 3-7)

The Wilmington Harbor area is cut into the Rocky Point Member of the Peedee Formation (Figures 3-7). The Rocky Point has a strike that is approximately parallel to the axis of the river channel and thickens to the east-southeast. The maximum observed thickness is 20.9' in core hole WH93-21 (Figure 4); however, it is interpreted to range up to 30'. The lower boundary with the underlying typical Peedee Formation is a lithofacies boundary and is illustrated on Figures 3 through 7 by a lightening bolt line. This contact crosses the channel at the southern margin of Figure 5 and the northern margin of Figure 6 and is indicated by the change in the elevation of the TOR on the along channel profile on Figure 7. The upper boundary of the Rocky Point is a sharp unconformity overlain in this area by Holocene sand, silt or clay.

The Rocky Point consists of two main lithologies in the Wilmington Harbor area, upper sandy, pelecypod-mold grainstone and lower interbedded calcite cemented quartz sand and grainstone. Induration and hardness is better at the top of the formation where sandy, pelecypod-mold grainstone is most common. The base of the Rocky Point contains calcite cemented quartz and grainstone, but gives way to unconsolidated sands of the underlying Peedee Formation. The thickness of the Rocky Point in the Wilmington Harbor exceeds the distance between the TOR in the Anchorage Basin and the top of the Rocky Point. Consequently, deepening the channel to -50.0 MLLW in this area will be into the upper part of the Rocky Point Member. Therefore, well-lithified sandy, pelecypod-mold grainstone will mainly be encountered, although there are thin interbedded zones of poorly cemented molluscan quartz sand in the well-cemented grainstone.

Anchorage Basin to Lower Brunswick Channel (Figure 6, Figure 8)

South of the Wilmington Harbor area (Figure 6), the river channel is developed in the Peedee Formation. This relationship continues until the southern part of Figure 8 where the Rocky Point Member crosses back to the west side of the channel. The Peedee Formation consists mainly of unconsolidated dark gray to green very fine to fine muddy sand with minor, thin consolidated layers of calcite cemented quartz sand. These layers are usually no thicker than 2'. TOR along the channel in the area of the Peedee Formation subcrop varies between -45 to over -50 feet MLLW and reflects the generally unconsolidated nature of the Peedee sand. High areas along the channel are scattered and are reflected by low TOR elevations. These areas probably reflect the thin consolidated calcareous quartz sands in the Peedee Formation.

Lower Brunswick Channel to Keg Island Channel (Figures 8-19)

In the area represented by Figures 8-11, the Rocky Point reemerges to subcrop along the river channel. In this area, the strike varies as this occurrence of the Rocky Point is along the updip edge of the unit. The Rocky Point in this area has a maximum observed thickness of 11.1'+ in WH98-2. Generally, however, the unit is interpreted to have a thickness less than 10 feet in this area and to represent the lower part of the unit. The boundary with the Peedee Formation represents a lithofacies change between the typical Peedee and the Rocky Point (Figures 8-11). Consequently, less sandy, molluscan-mold grainstone occurs and more unconsolidated calcareous quartz sand occurs in this part of the river channel.

The Castle Hayne Limestone is also developed in this approximate area (Figures 13-19), and both units A and B are recognized. Along this part of the Cape Fear River channel, the Castle Hayne strikes generally to the northeast and thickens to the southeast. The maximum observed thickness of the Castle Hayne is 14.3'+ (WH94-6) and 14.4'+ (WH94-8), but generally the unit is less. The lithology of the Castle Hayne Limestone varies from dense, well lithified wackestone/packstone to soft friable cross-bedded grainstone. In this area, Unit A has a maximum measured thickness of 14.3'+ in WH94-6 whereas Unit B has a maximum measured thickness to 7.6' in WH98-128. The thin nature of the Castle Hayne Limestone in this part of the channel is reflected by the highly irregular updip limit of the unit (Figures 13-19).

Keg Island to Upper Lilliput Channel (Figures 16, 20)

The area represented by Figures 16 and 20 exposes the typical Peedee Formation along the river channel. In this area, depth to the TOR is generally greater –50' MLLW

until the southern end of Figure 20 where TOR suddenly rises to -43' or less (Zapata Plate B-17). This sudden change in TOR reflects the updip limit of the Castle Hayne Limestone crossing the river. From here south, the Castle Hayne Limestone generally underlies the Cape Fear River channel, gradually occurring deeper in the subsurface until rising into the riverbed at Battery Island Channel (Figure 28).

Upper Lilliput through Reaves Point Channel (Figures 20-23)

The Castle Hayne Limestone is recognized in several cores in the lower part of Upper Lilliput Channel (WH98-86, WH98-87A, WH98-88A) and the upper part of the Lower Lilliput Channel (WH93-68, WH94-9, WH94-10); however, none of the cores penetrate the base of the unit. It is only in this area that the Castle Hayne rises to a point above -50 MLLW as south along the upper part of Lower Lilliput Channel, TOR drops below -50 MLLW. In this area Castle Hayne Limestone Units A and B are recognized with a maximum measured thickness of 9.4'+ (WH93-68). Castle Hayne Limestone in the Upper Lilliput area is typical of the lithologies described in other areas of the channel.

In the upper part of Lower Lilliput Channel the Oligocene River Bend Formation occurs (WH94-10) on top of the Castle Hayne Limestone. This unit consists of 0.6' of phosphatic and glauconitic, sandy dolosilt. It is tan to brown in color and similar to a dolosilt recognized in cores off Kure Beach in Onslow Bay that is Oligocene in age. This dolosilt is also recognized south along the Cape Fear River channel in two other cores (WH93-69 and WH93-73). Harris (1998a) previously identified this material as the Island Creek Member of the Peedee Formation because of similarities of the unit to sediments along the Northeast Cape Fear River in Wilmington. This unit has a thickness greater than 6.2' in WH93-73 as the total depth of this hole remained in the River Bend

Formation. Along the river channel in this area, TOR stays well below –50 MLLW.

Although no cores were taken from Upper Midnight to Snow Marsh Channel, the area is probably underlain by the Oligocene River Bend Formation.

Snow Marsh Channel to Battery Island Channel (Figures 24-31)

The Castle Hayne Limestone mainly underlies this area of the river channel; however, the Bald Head Shoals Formation occurs at the surface in core hole WH94-25 (Figure 24). In addition, the Bald Head Shoals Formation is also identified below the Castle Hayne Limestone in WH98-121 (Figure 25). This lithology was previously identified by Harris (1998a, 1998b) as the Rocky Point Member of the Peedee Formation; however, re-inspection of these two cores indicates that it is the Bald Head Shoals Formation that previously had been recognized only in Bald Head Shoals Channel (Harris and Laws, 1994). No core holes in Snow Marsh Channel to Battery Island Channel penetrate the base of the Castle Hayne Limestone. TOR profiles in the central part of Snow Marsh Channel indicate that the TOR is between –46 and –49 MLLW, or 2-3' above –50 MLLW. This area reflects an isolated high of the Bald Head Shoals Formation (Figures 24-25). TOR profiles in the lower part of the Lower Swash Channel and Battery Island Channel are also elevated above –50 MLLW and rise to about –46 MLLW. This elevated area reflects Units A and B of the Castle Hayne Limestone.

GEOLOGY OF BALD HEAD SHOALS CHANNEL REALIGNMENT

The proposed realignment of Bald Head Shoals channel is located east of the current channel position. It begins approximately at the northern terminus of the channel in Long Bay and extends along an azimuth to the south. Channel position occurs progressively further east traveling south. The proposed realignment places the channel

along the approximate contact of the Eocene Castle Hayne Limestone and the Oligocene River Bend Formation (Fig.1). Eleven bore holes (Table 2) were examined in this study from the proposed realignment; interpreted lithologic logs for each hole is located in the Appendix.

In all cores, Unit B of the Castle Hayne Limestone was encountered. The observed minimum thickness was 2.0' (BHS-99AA) and the maximum thickness was 8.5' (BHS99-X); however, no bore hole penetrated the base of the unit. Castle Hayne lithology and hardness vary in the cores, from dense well-lithified packstone (BHS99-AA and BHS99-GG) to a soft, friable grainstone (BHS99-U, base). Generally, the degree of induration is greater at the top of the bore holes diminishing with depth. Porosity development including the type and percentage in Unit B of the Castle Hayne Limestone, varies with lithology. Unit B grainstones generally have high percentages of interparticle porosity, except where secondary infilling and calcite cementation are present. In most cases, these materials are most common in grainstones that occur at the top of the bore holes. Castle Hayne Limestone packstone and wackestone usually have little or no interparticle porosity with secondary moldic porosity being common (BHS99-CC, BHS99-Y). The occurrence of molds follows fossil shell (allochems) composition. Where allochems had an original composition of aragonite, molds develop upon burial and diagenesis. Original shell structure is preserved where original shell composition was calcite. Porosity, therefore, in Unit B of the Castle Hayne Limestone generally follows lithology, but most often has been reduced near unconformities. A well developed network of fractures was observed in the Castle Hayne Limestone in BHS99-AA that may control solution porosity and sediment infilling in the unit. In bore holes

where rock was not encountered, the Oligocene River Bend Formation is interpreted to underlie the area. Cores off Kure Beach in Onslow Bay, indicate a soft, fossiliferous calcareous mud which probably also underlies this area of Long Bay. Figure 32 illustrates the distribution of selected geologic units along the Cape Fear River and Bald Head Shoals.

GROUNDWATER

Primary aquifers in the southeastern North Carolina Coastal Plain from oldest to youngest are the Black Creek, Peedee, Castle Hayne, and the Tertiary or Surficial. Three main confining units, the Black Creek, Peedee and Castle Hayne (Figure 2) separate the aquifers. Only the Peedee, Castle Hayne and Surficial aquifers occur in or along the Cape Fear River between Wilmington and Southport and are discussed below. All three aquifers have been shown to have discharge relationships with the Cape Fear River (Lautier, 1994, 1998).

Peedee Aquifer

In the downtown Wilmington area, the Peedee aquifer (lithostratigraphic unit = Rocky Point Member of the Peedee Formation) underlies the Cape Fear River channel (between the Isabell Holmes Bridge on the Northeast Cape Fear River and Memorial Bridge on the Cape Fear River). North of the Isabell Holmes Bridge, the Castle Hayne confining unit occurs in the Northeast Cape Fear River channel (= the Island Creek Member of the Peedee Formation). The Peedee aquifer continues south of the Cape Fear Memorial Bridge to approximately the North Carolina State Ports (Anchorage Basin to the northern part of the Fourth East Jetty Channel) (Figures 3-6). Deepening this area of the channel to -50 MLLW will remove the upper part of the Peedee aquifer (Rocky Point

Member), increase its exposed surface area and enhance its discharge relationship into the river. A potentiometric map of the surface of the Peedee aquifer exhibits a higher elevation than the surface of the Cape Fear River in this area, documenting the discharge relationship of the aquifer (Lautier, 1998). The Peedee aquifer only occurs for a short distance west of the Cape Fear River (about ½ mile) in the area of the Anchorage Basin. Although deepening the river channel to -50' MLLW will have an impact on amount of portable water in the aquifer, the impact will be minimal. However, deepening the channel in this area will result in an increase in fresh water discharge into the river.

The Peedee aquifer also occurs south along the Cape Fear River from Lower Brunswick Channel to Keg Island Channel (Figures 8-11). In this part of the Cape Fear River, the Peedee aquifer is thinner, generally less than 10', than in the Anchorage Basin. In this area, the Castle Hayne aquifer also occurs, and is discussed below under the section titled Castle Hayne Aquifer. In this area, no confining unit occurs between the Peedee aquifer and the Castle Hayne aquifer. This is the southernmost occurrence of the Peedee aquifer in the Cape Fear River channel.

Peedee Confining Unit

Peedee confining unit is composed of aquitards that occur between the Peedee aquifer and the Castle Hayne aquifer that are within the Upper Cretaceous or the Paleocene. Lithostratigraphic units comprising the Peedee confining unit include the Island Creek Member of the Peedee Formation and the Yaupon Beach Formation of the Beaufort Group. In the channel of the Northeast Cape Fear River north of the Isabell Holmes Bridge, the Peedee confining unit crops out along the river. In this area it is formed by the Island Creek Member of the Peedee Formation and can be seen on the east

bank of the river at Hilton Park. South of the Fourth East Jetty Channel (Figure 6) continuing on to Lower Brunswick Channel (Figure 8), the Cape Fear River is cut into that part of the Peedee confining unit that occurs below the Peedee aquifer. River deepening in this area will have no impact on the Peedee aquifer. The relationship of the Peedee aquifer to the Peedee confining unit is shown in cross section in Figure 7.

Castle Hayne Aquifer

Between Upper Big Island and Keg Island Channel, Units A and B of the Castle Hayne Limestone occur along the Cape Fear River Channel (Figures 13-16). The Castle Hayne Limestone generally occurs in bore holes where the Rocky Point Member is also present. In these bore holes, the Castle Hayne Limestone has a variable lithology that ranges from dense wackestone to friable grainstone. Frequently, the friable grainstone has a high amount of interparticle porosity and thus the capability of containing large quantities of portable water. However, local variations in lithologic character and the discontinuous nature of the Castle Hayne Limestone in this area, make it difficult to geographically delineate the Castle Hayne aquifer. The lack of a mappable confining unit between the Peedee aquifer and the Castle Hayne aquifer in this area result in a single aquifer system (Figures 17, 18). Deepening the Cape Fear River channel to -50 MLLW in this area will cut through the Castle Hayne aquifer and into the Peedee aquifer, particularly in Upper Big Island Channel (Figure 13). As both aquifers have potentiometric surfaces above river elevation, any fresh water in the units will discharge into the Cape Fear River (Lautier, 1998).

Between Keg Island Channel and Upper Lilliput Channel (Figures 16, 20), the Cape Fear River occupies the Peedee confining unit. Deepening the river to -50 MLLW in this area will have no impact on aquifers in the area.

Between Upper Lilliput Channel (Figure 20) and Battery Island Channel (Figure 28), the Cape Fear River channel is cut into the Castle Hayne aquifer system. This system includes rocks of the Eocene Castle Hayne Limestone, the Oligocene River Bend Formation, and the Paleocene Bald Head Shoals Formation. This system is separated from the underlying Peedee aquifer by the Peedee confining unit. The Castle Hayne Limestone occurs in the river channel in cores from the Upper Lilliput Channel (Figure 20) and the Lower Lilliput Channel (Figure 21). South of Lower Lilliput Channel, the Castle Hayne Limestone does not re-emerge in bore holes until Snow Marsh Channel (Figure 25) in one core (WH98-121) and then in bore holes from Lower Swash Channel (Figures 27, 28). Throughout this part of the river, TOR stays below -50 MLLW except for Battery Island Channel and Lower Swash Channel (Figures 27, 28). In this area the Castle Hayne Limestone rises to about -47' MLLW. In Snow Marsh Channel, TOR is above -5- ' MLLW where the Bald Head Shoals Formation is present (Figures 29, 30).

Tertiary Confining Unit

Overlying the Castle Hayne aquifer is the Tertiary confining unit. Parts of the upper Castle Hayne Limestone (Unit B) and the River Bend Formation comprise this confining unit. This confining unit occurs between Snow Marsh Channel and Lower Lilliput Channel corresponding to areas in the river where TOR is below -50' MLLW (Figures 22 and 24). Consequently, channel deepening to -50' MLLW from Lower

Lilliput Channel to Snow Marsh Channel will have no impact on the Castle Hayne aquifer system as the river is developed in the Tertiary confining unit.

Surficial Aquifer

The Surficial aquifer overlies the Tertiary confining unit and is composed primarily of sediments ranging in age from Plio-Pleistocene to Holocene. Based on the outcrop distribution and elevation, where overlying confining units are missing, the Peedee aquifer and the Castle Hayne aquifer become the Surficial aquifer. As the Surficial aquifer is recharged by rainwater, it is a conduit to discharge water into the Cape Fear River and its tributaries.

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Zullo, V.A. and Harris, W.B., 1993, Identification of geologic formations, Bald Head Shoals Channel off Cape Fear, North Carolina – Update: Report of Investigation, U.S. Army Corps of Engineers, 9 p.

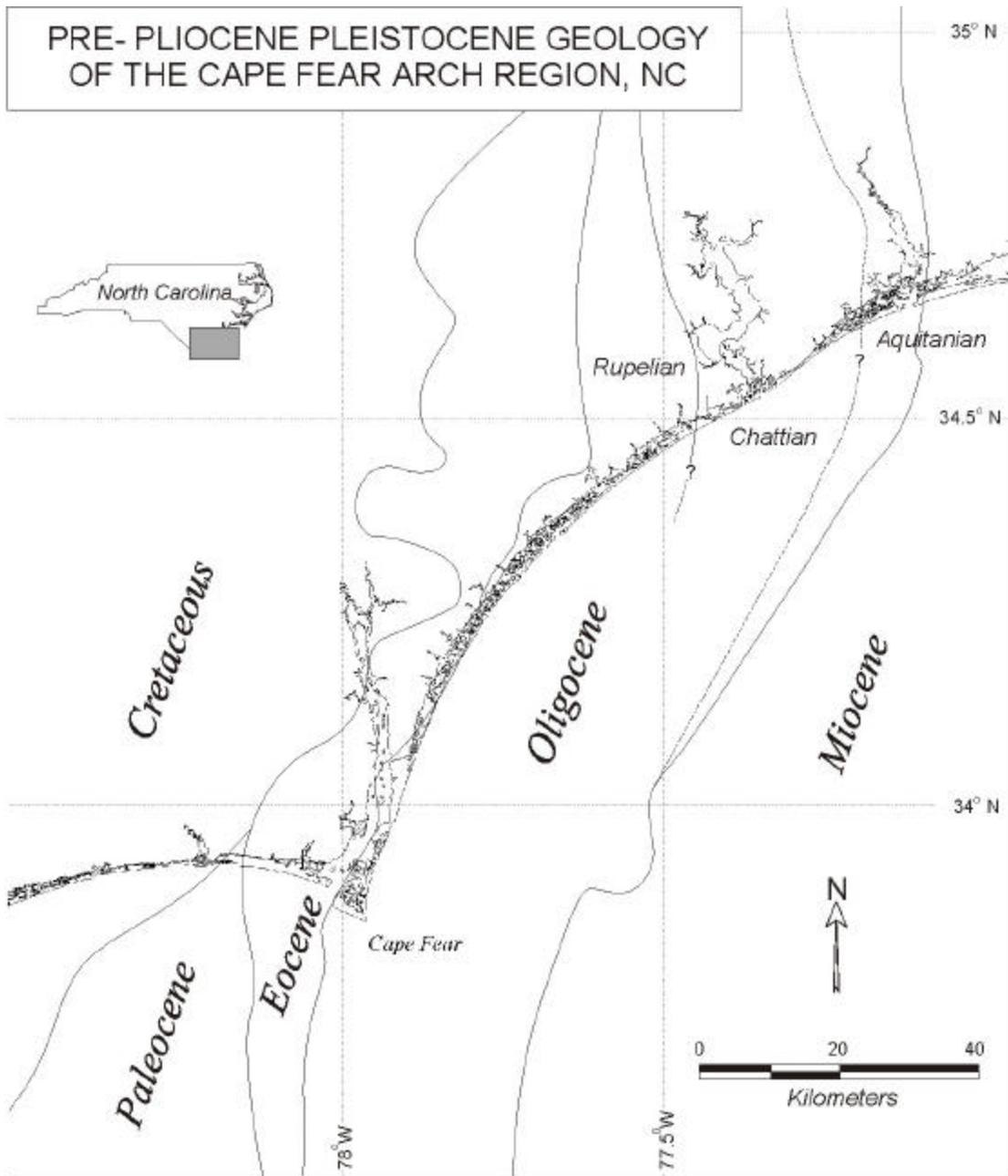


Figure 1. The distribution of Mesozoic and Cenozoic age rocks in the onshore and offshore area of southeastern North Carolina (modified from Riggs et al., 2000, and Harris et al., 2000).

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
SYSTEM	SERIES	LITHOLOGIC UNITS	AQUIFERS AND CONFINING UNITS
Quaternary	Holocene	Undifferentiated	Surficial Aquifer & Confining Unit
	Pleistocene	Undifferentiated	
Tertiary	Pliocene		Pungo River Fm.
	Miocene		
	Oligocene	River Bend Fm.	Castle Hayne Aquifer & Confining Unit
	Eocene	Castle Hayne Fm.	
	Paleocene	Beaufort Group	
Cretaceous	Upper	Peedee Formation	Peedee Aquifer & Confining Unit

Figure 2. Lithostratigraphic units, aquifers and confining units in the southeastern North Carolina Coastal Plain.

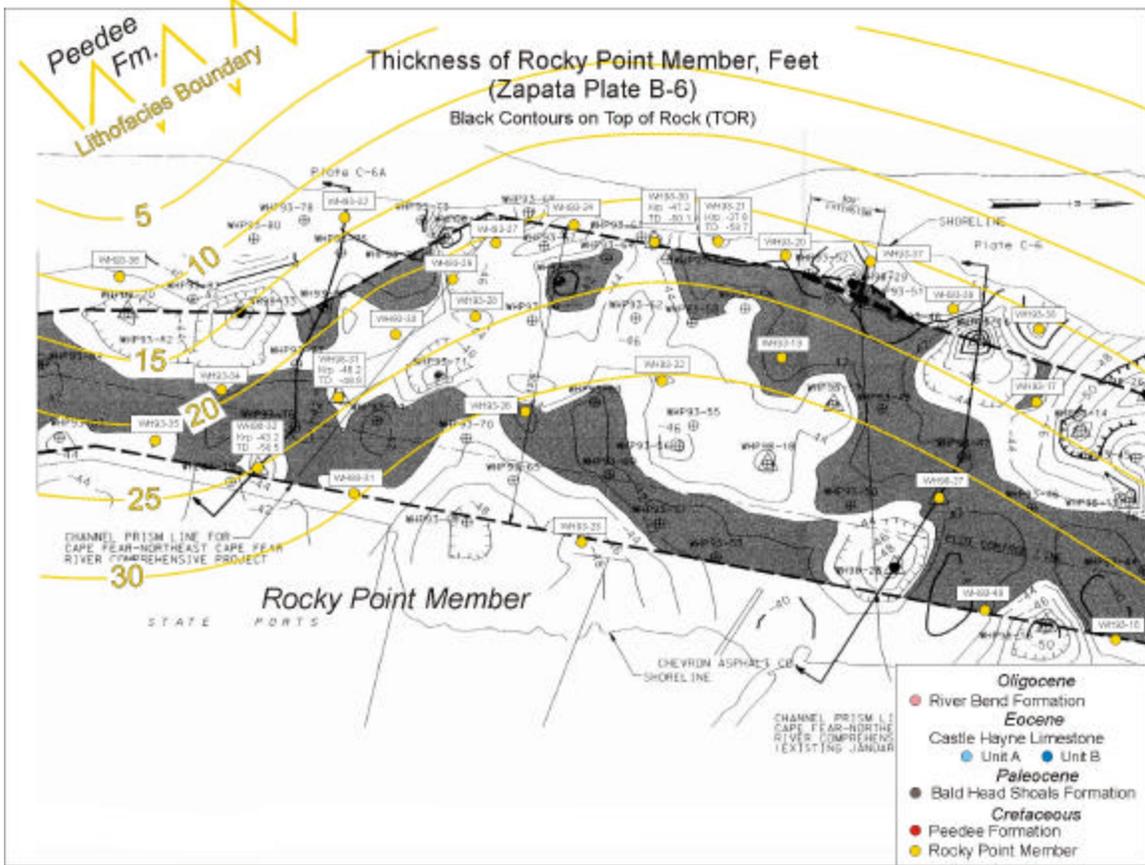


Figure 4. Thickness of Rocky Point Member, Feet, Zapata Plate B-6.

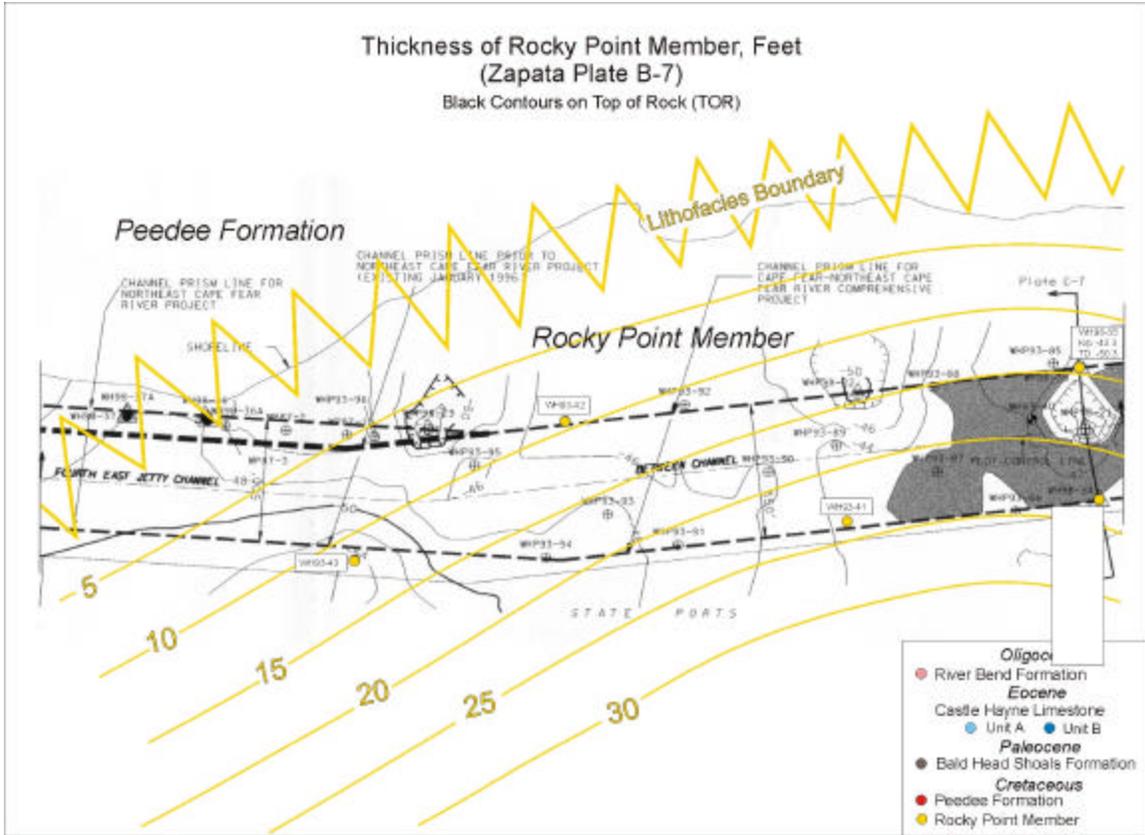


Figure 5. Thickness of Rocky Point Member, Feet, Zapata Plate B-7.

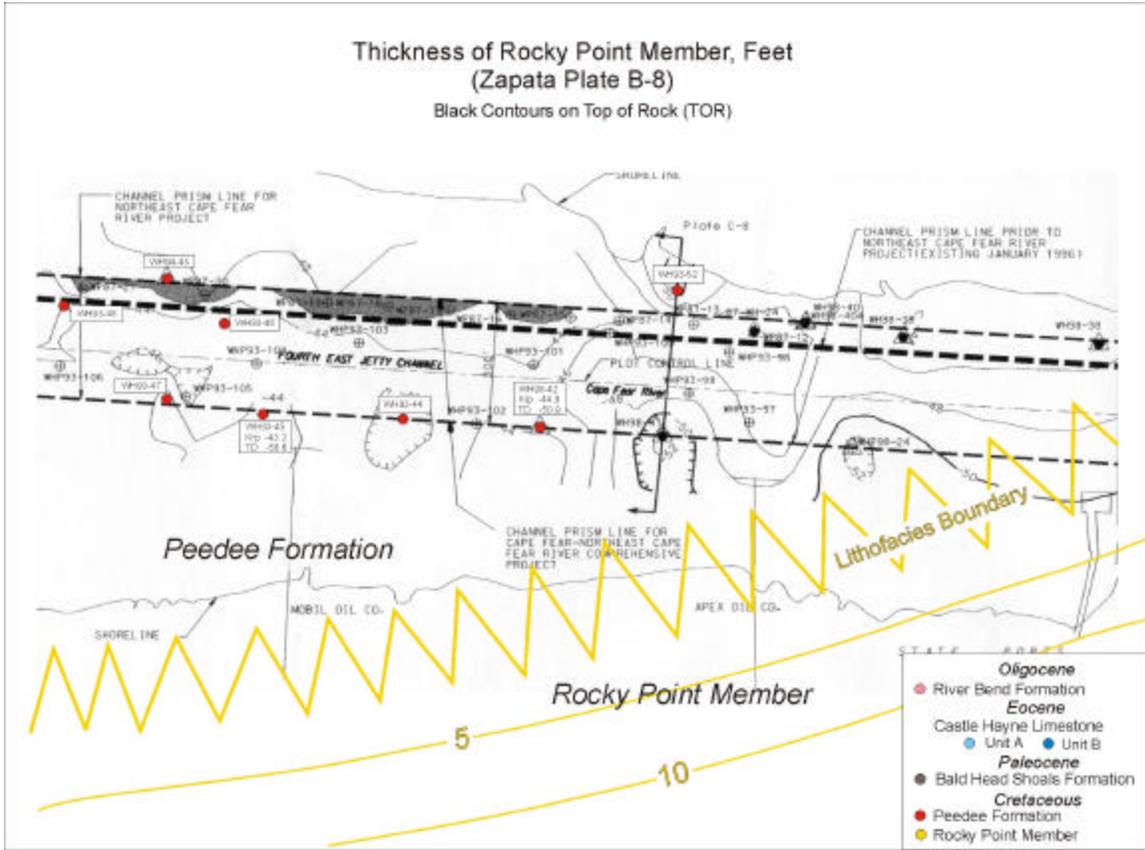


Figure 6. Thickness of Rocky Point Member, Feet, Zapata Plate B-8.

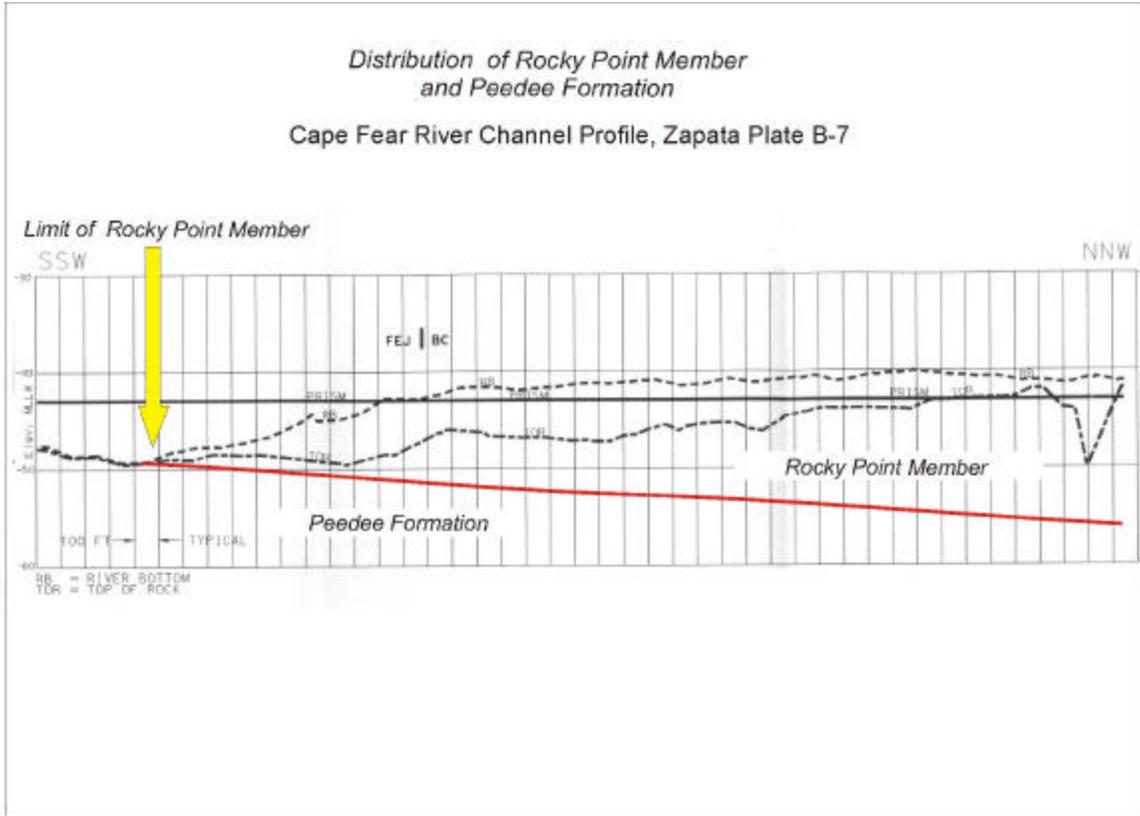


Figure 7. Distribution of Rocky Point Member and Peedee Formation, Cape Fear River Channel Profile, Zapata Plate B-7.

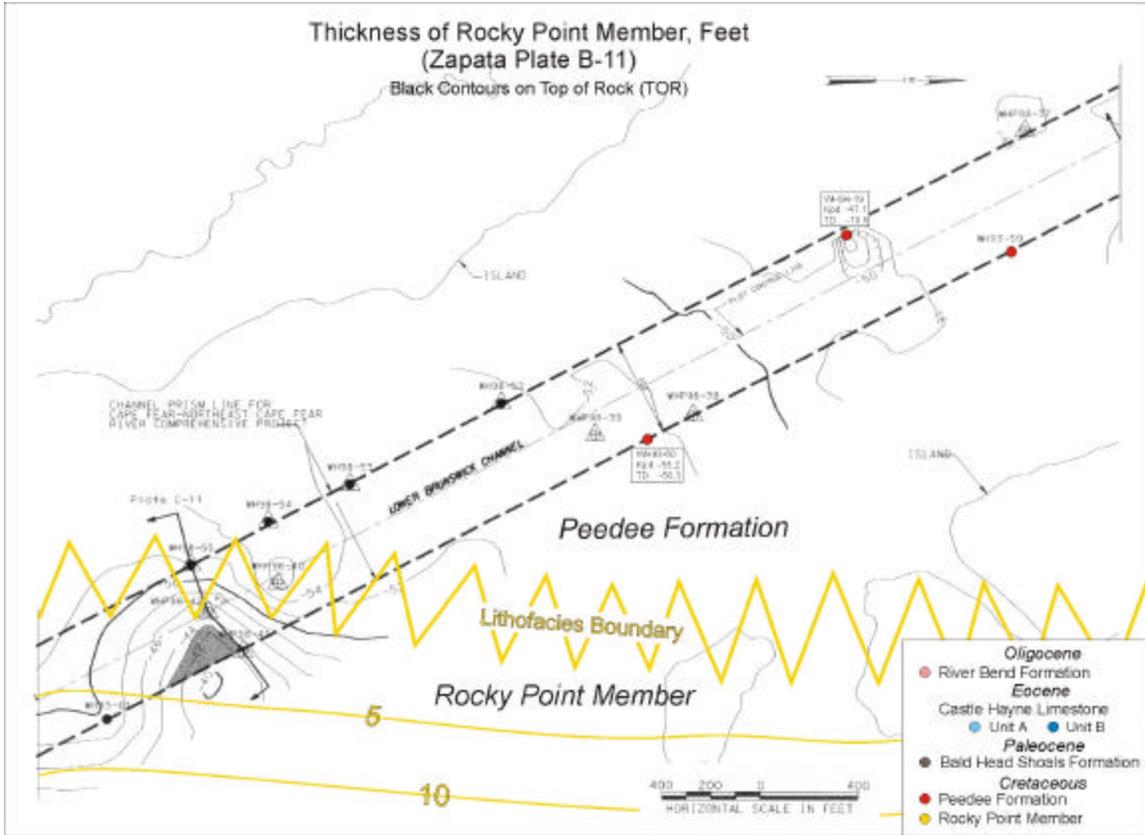


Figure 8. Thickness of Rocky Point Member, Feet, Zapata Plate B-11.

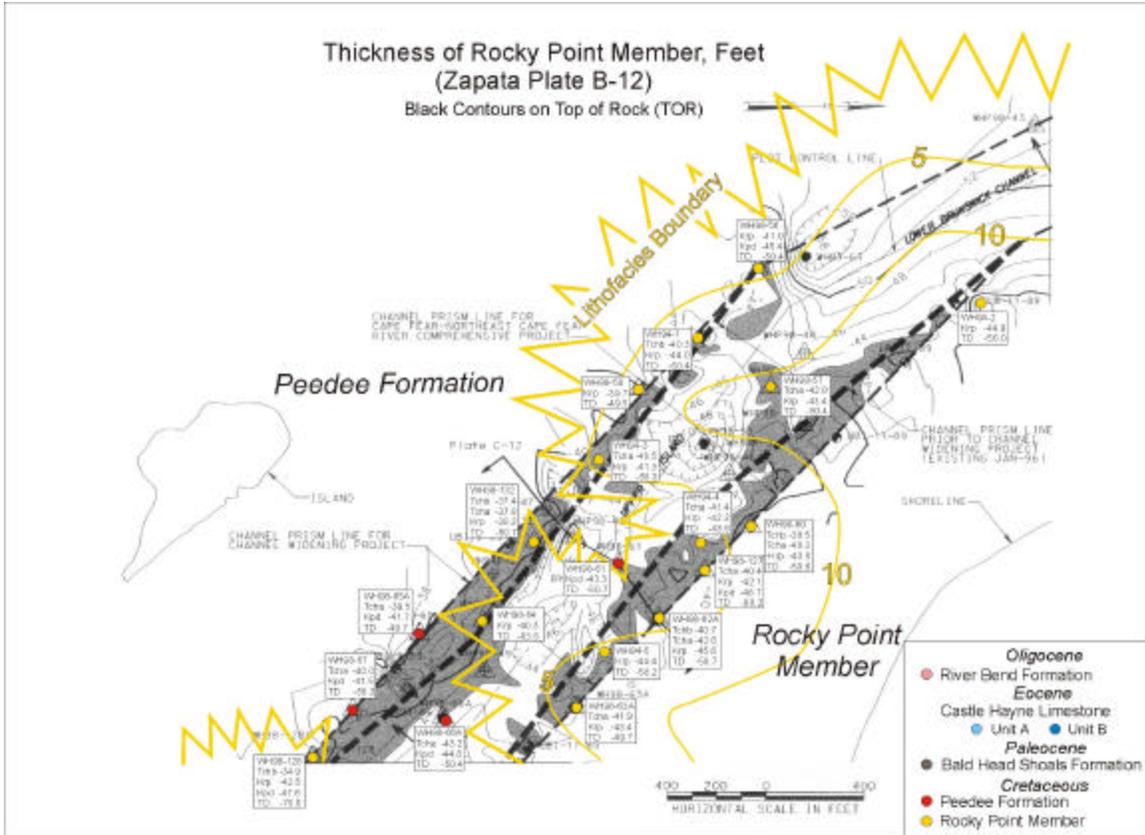


Figure 9. Thickness of Rocky Point Member, Feet, Zapata Plate B-12.

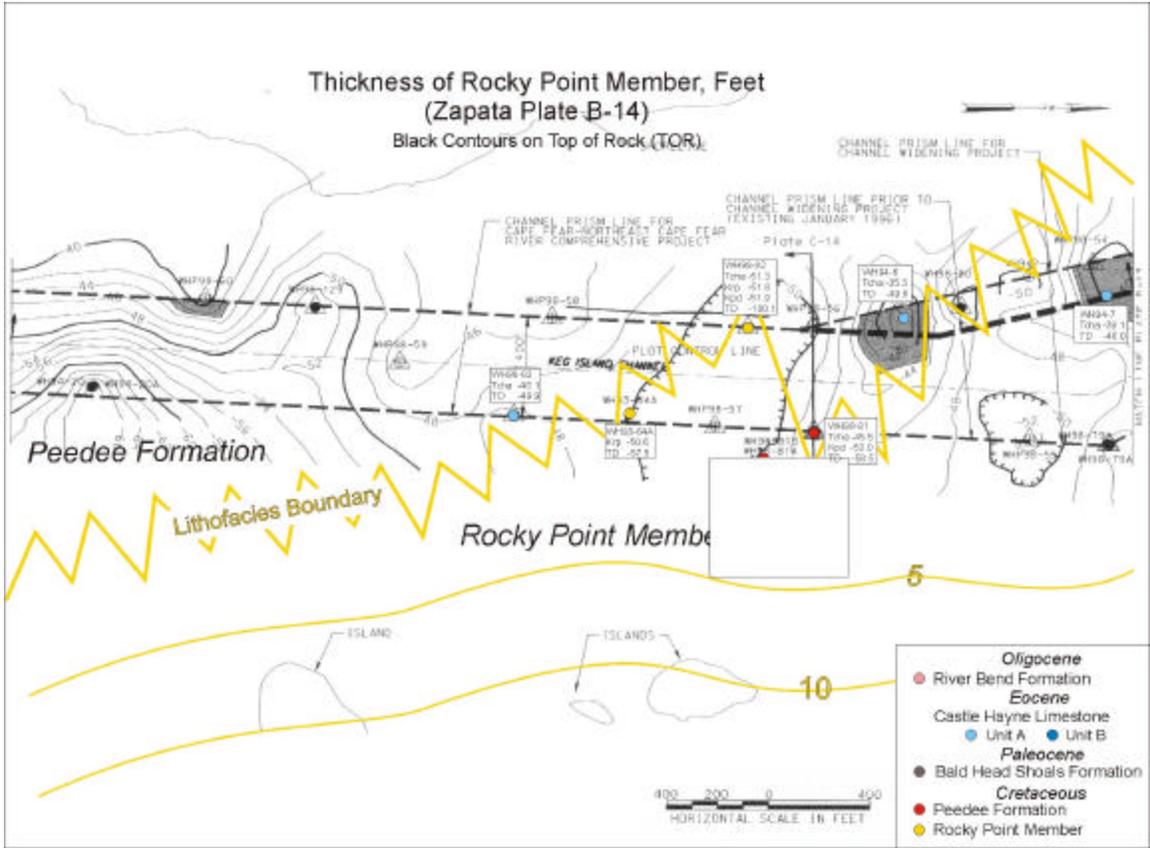


Figure 11. Thickness of the Rocky Point Member, Feet, Zapata Plate B-14.

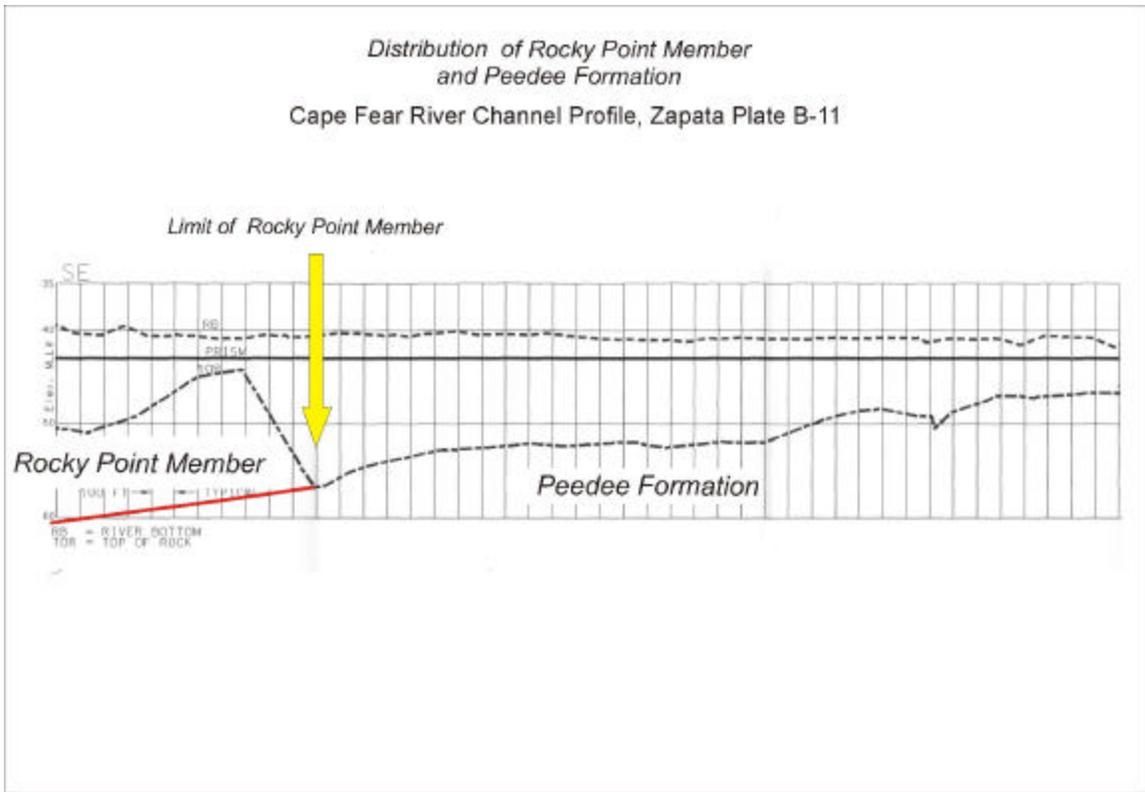


Figure 12. Thickness of the Rocky Point Member and Peedee Formation, Cape Fear River Channel, Feet, Zapata Plate B-11.

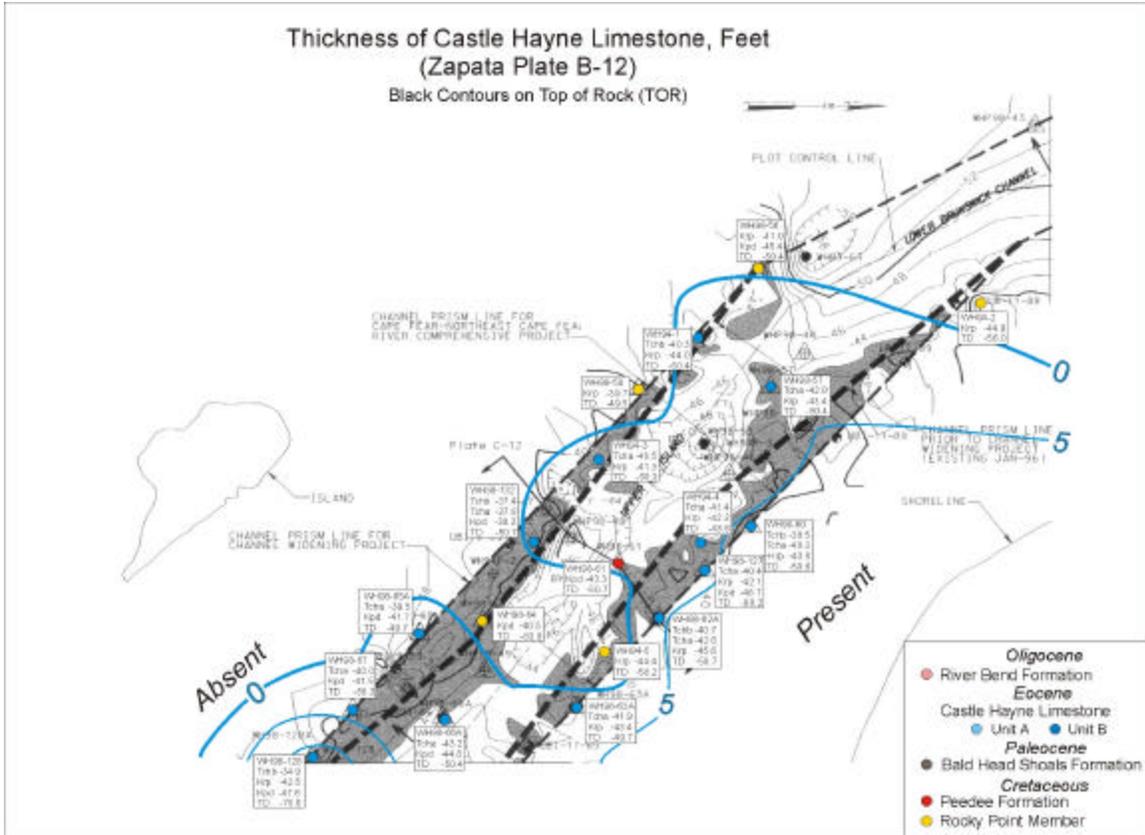


Figure 13. Thickness of the Castle Hayne Limestone, Feet, Zapata Plate B-12.

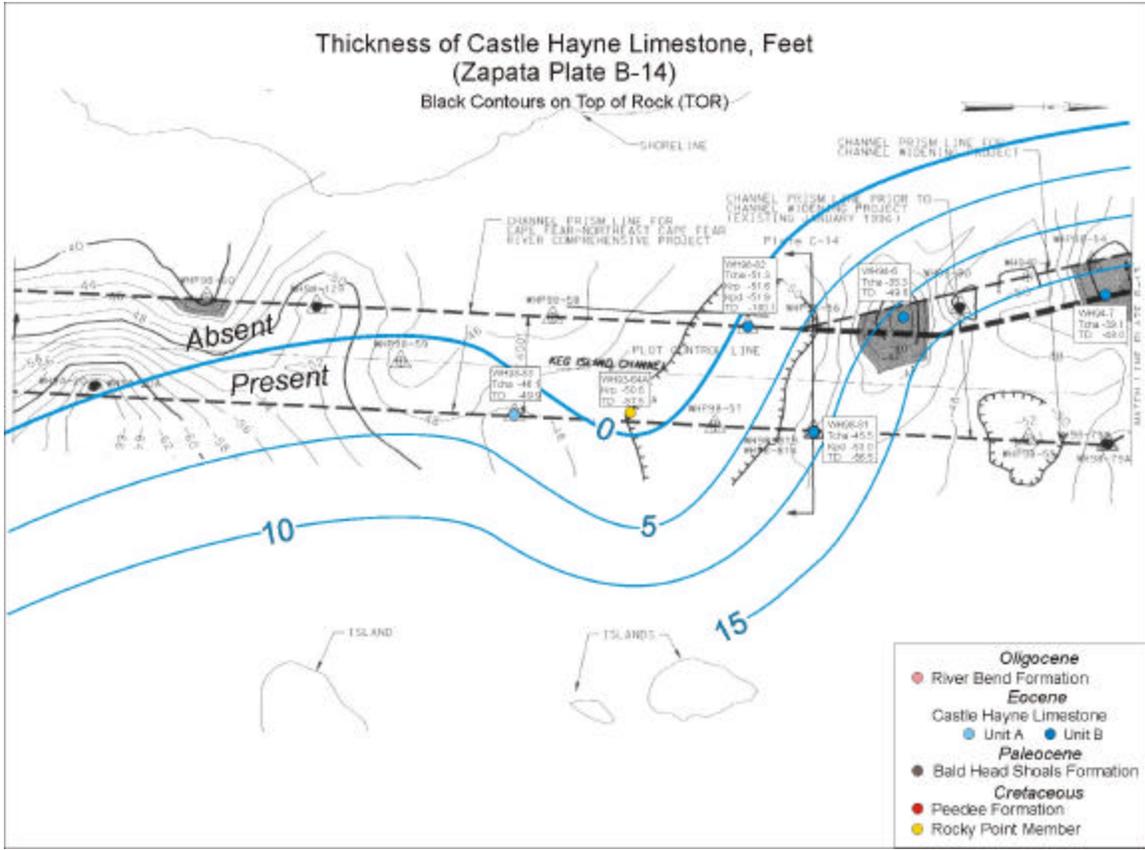


Figure 15. Thickness of the Castle Hayne Limestone, Feet, Zapata Plate B-14.

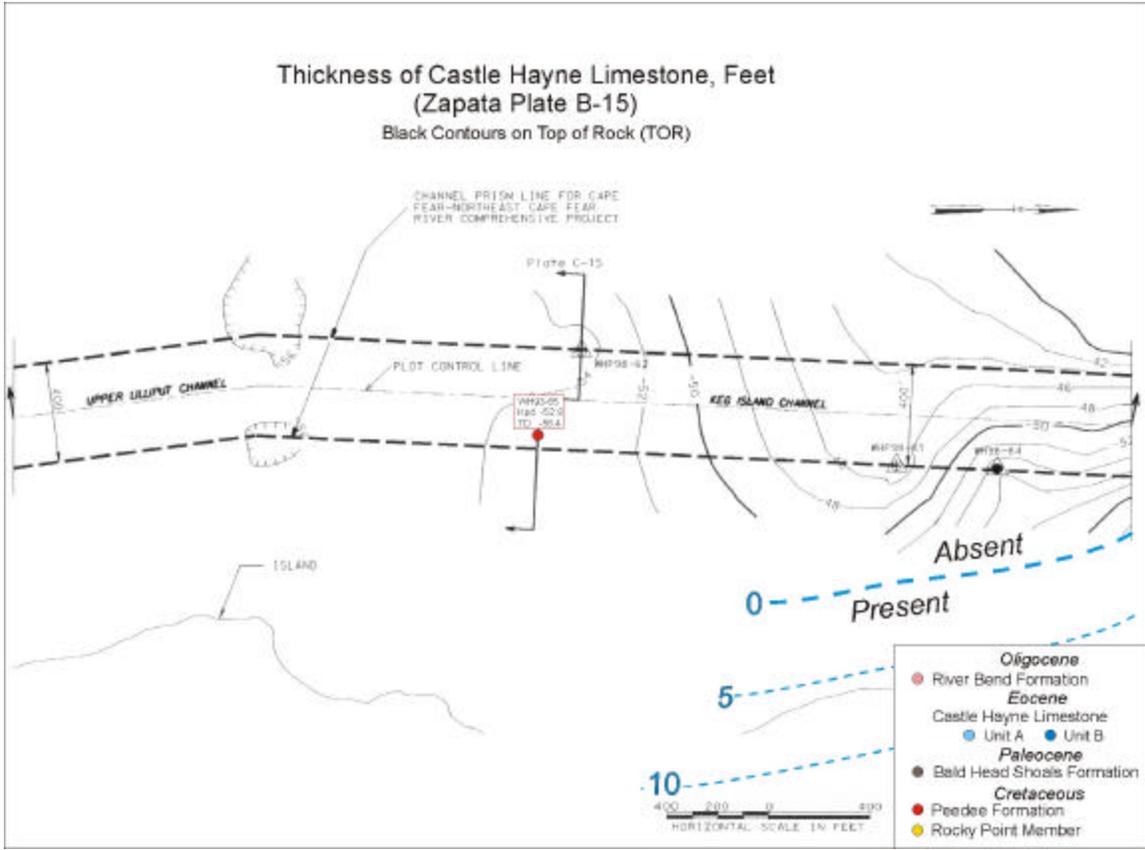


Figure 16. Thickness of the Castle Hayne Limestone, Feet, Zapata Plate B-15.

*Distribution of Castle Hayne Limestone
and Rocky Point Member*
Cape Fear River Channel Profile, Zapata Plate B-12

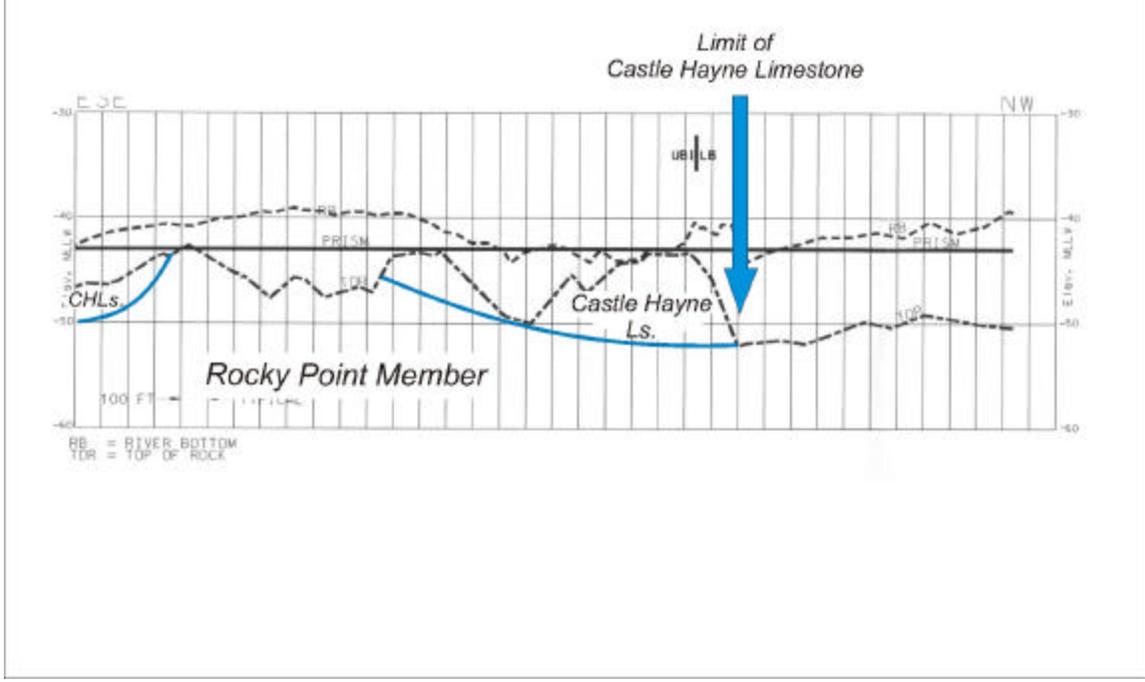


Figure 17. Distribution of Castle Hayne Limestone and Rocky Point Member, Cape Fear River Channel profile, Zapata Plate B-12.

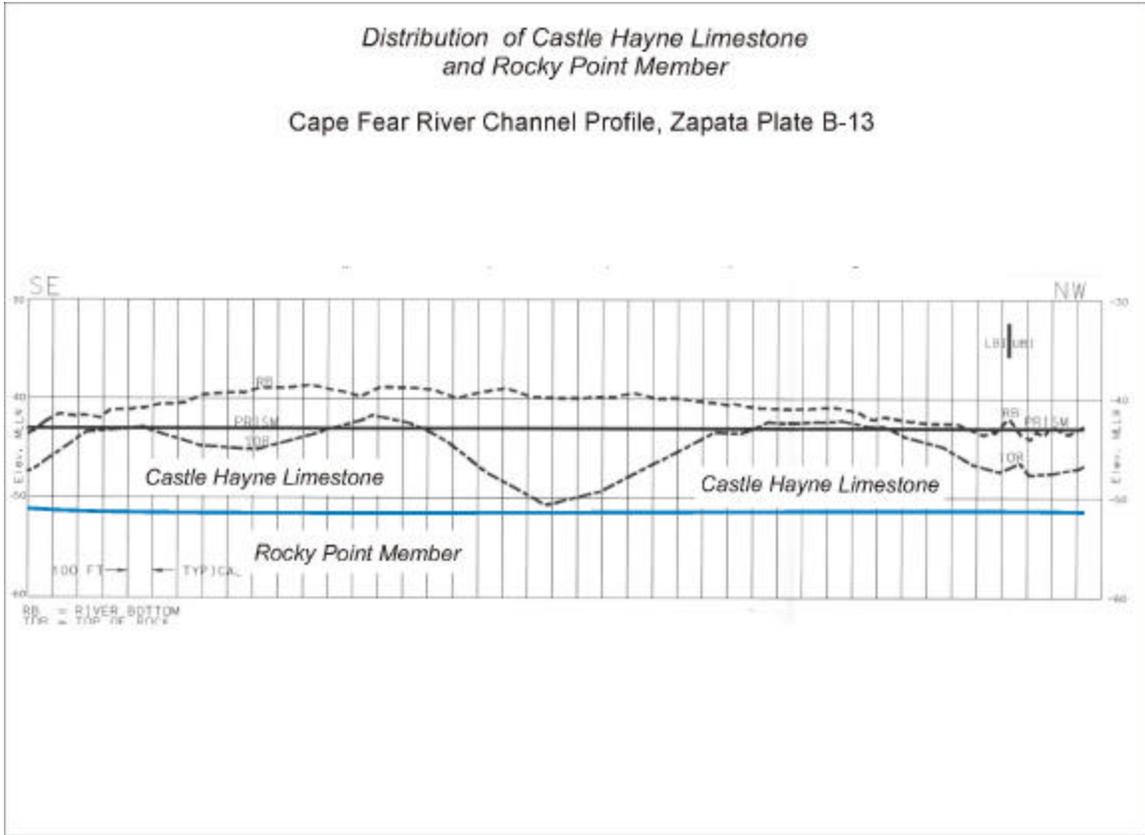


Figure 18. Distribution of Castle Hayne Limestone and Rocky Point Member, Cape Fear River Channel profile, Zapata Plate B-13.

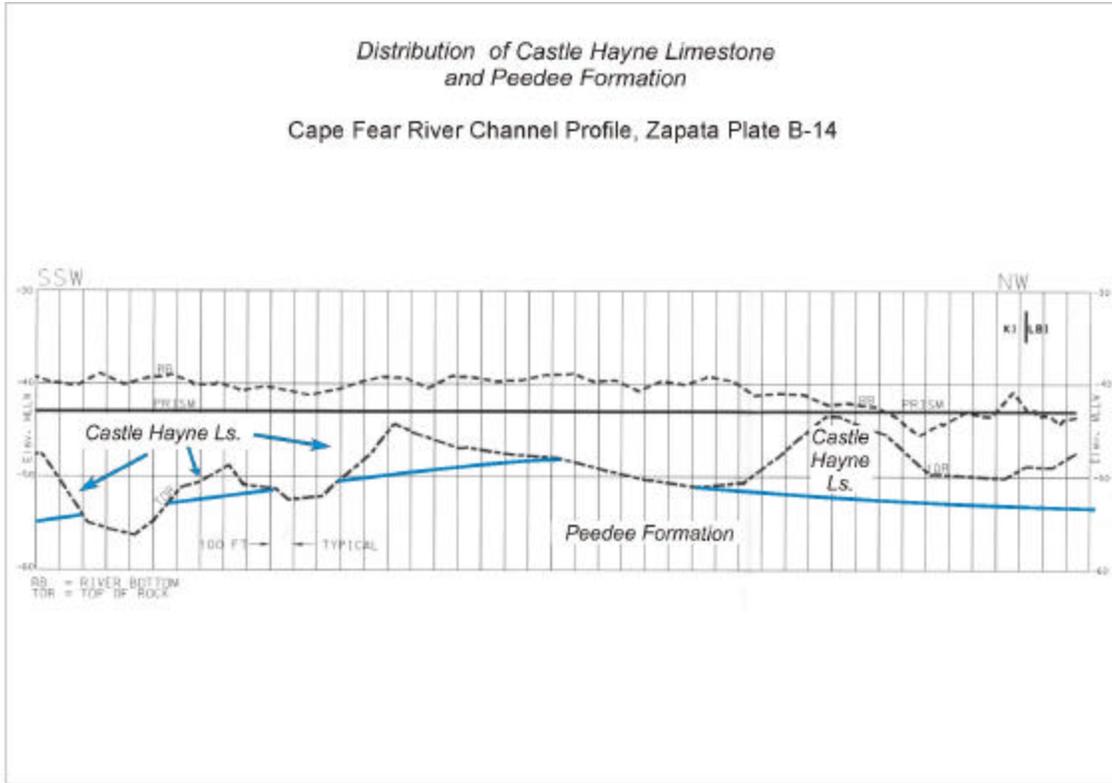


Figure 19. Distribution of Castle Hayne Limestone and Pee Dee Formation, Cape Fear River Channel profile, Zapata Plate B-14.

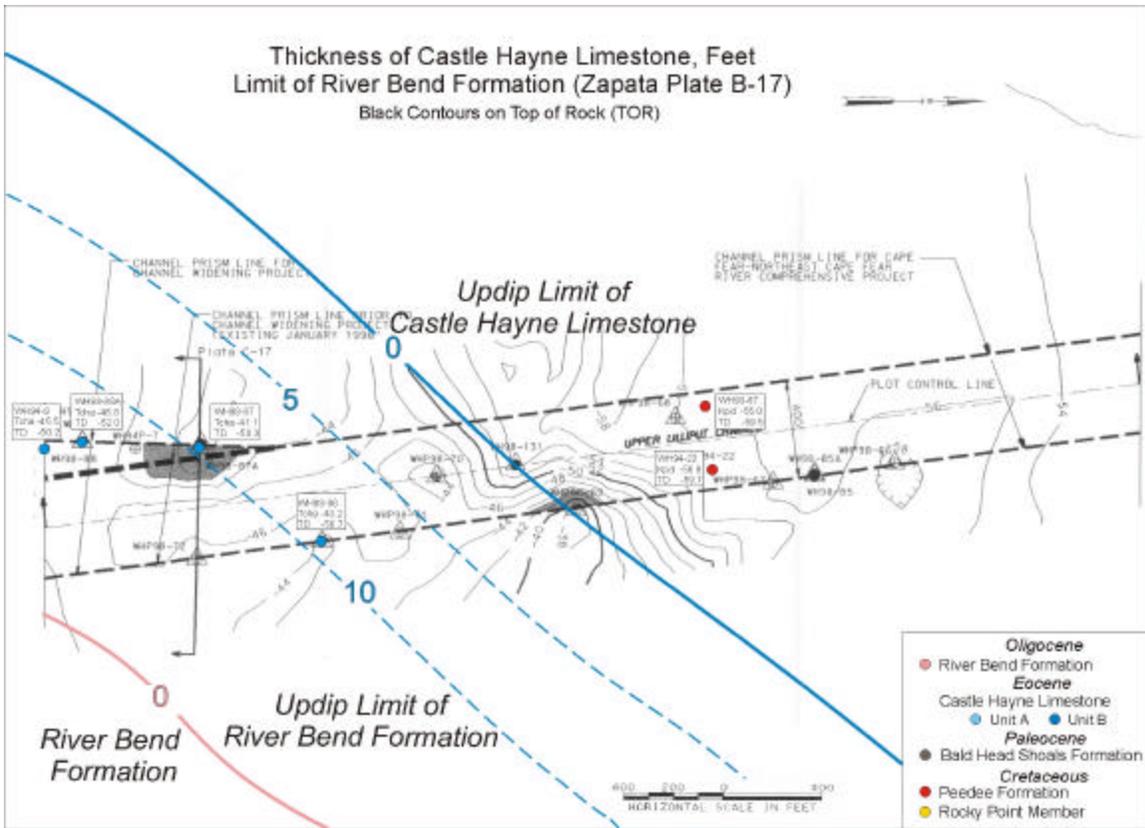


Figure 20. Distribution of Castle Hayne Limestone, Feet, and limit of the River Bend Formation, Zapata Plate B-17.

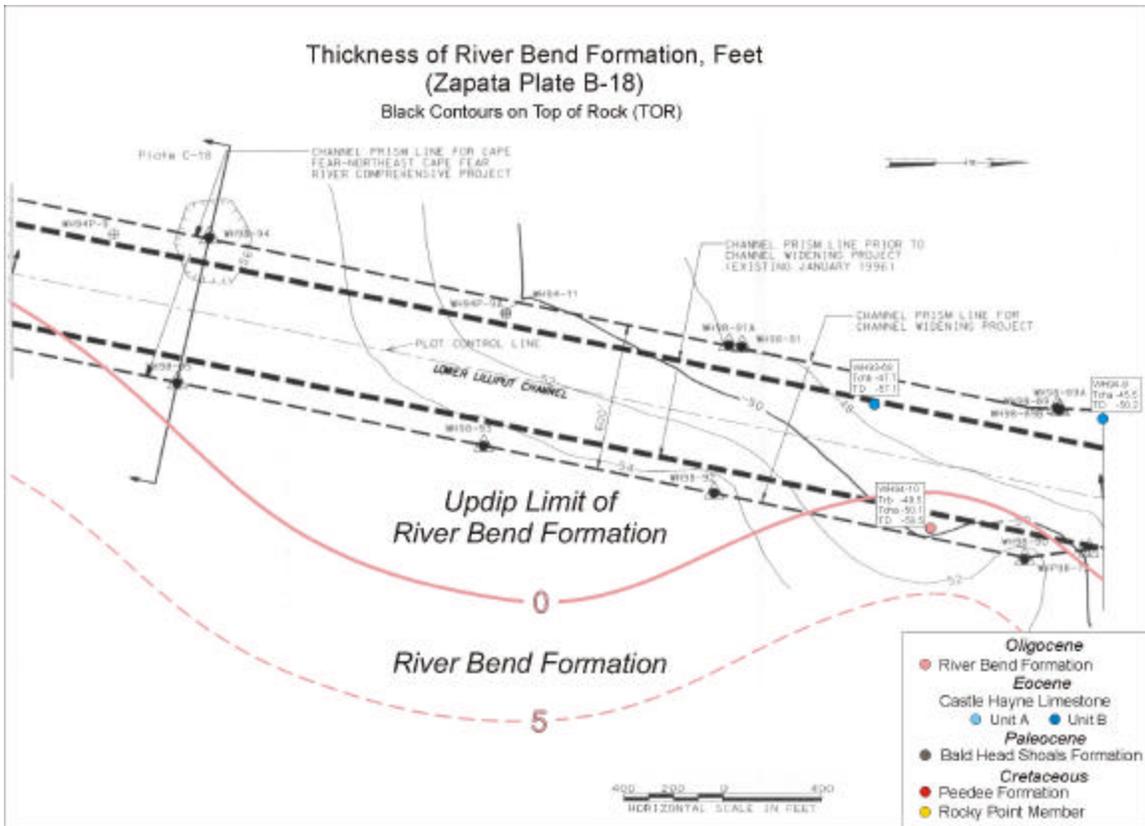


Figure 21. Thickness of the River Bend Formation, Feet, Zapata Plate B-18.

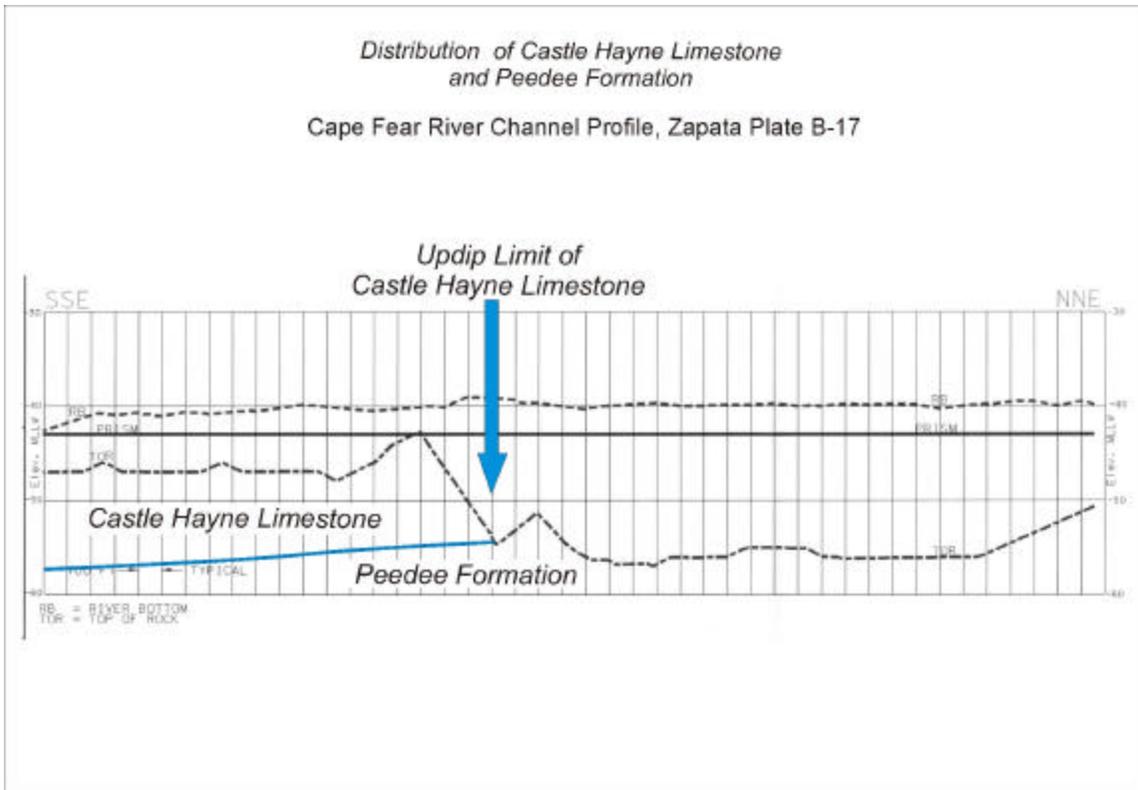


Figure 23. Distribution of the Castle Hayne Limestone and the Peedee Formation, Cape Fear River Channel Profile, Zapata Plate B-17.

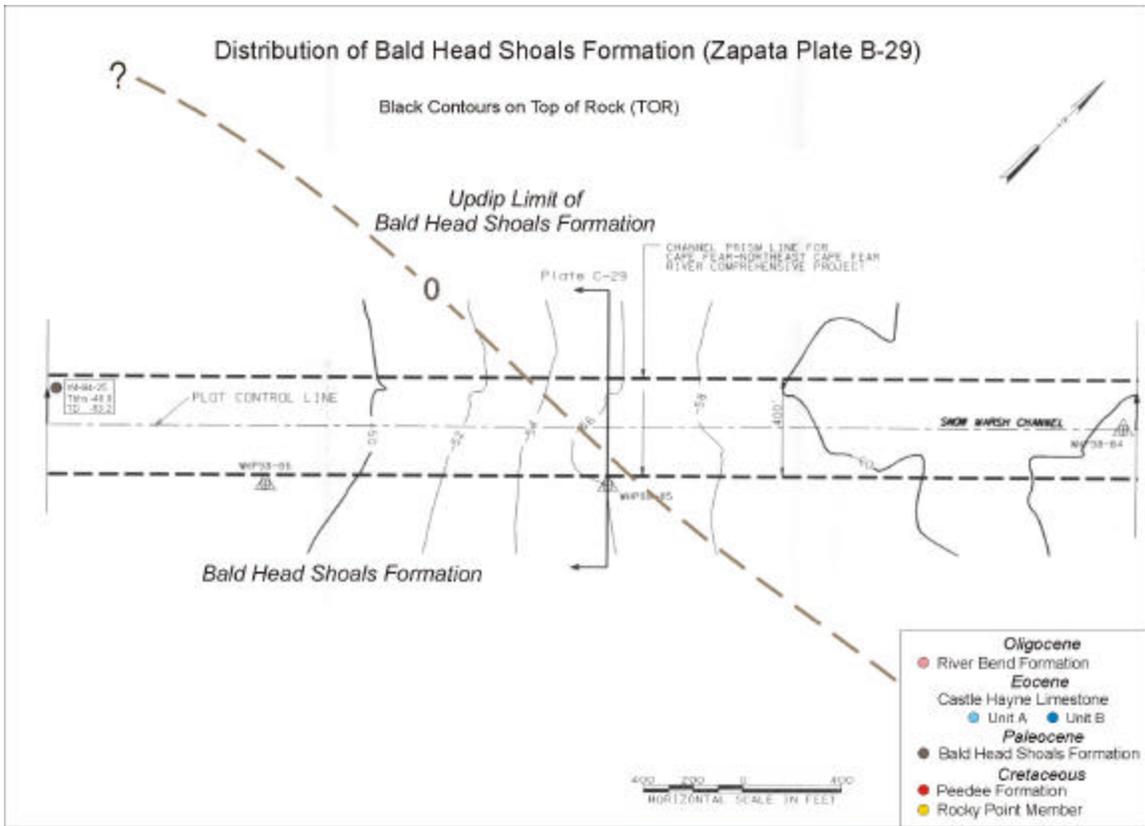


Figure 24. Distribution of the Bald Head Shoals Formation, Zapata Plate B-29.

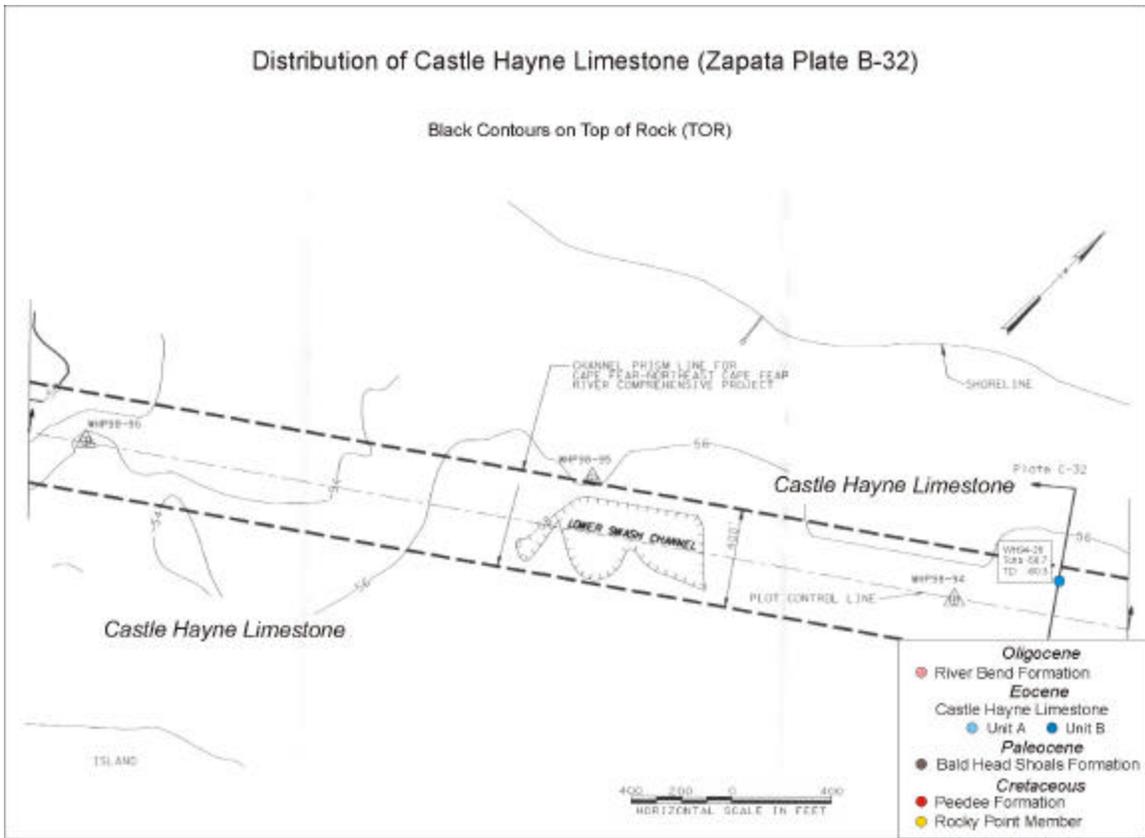
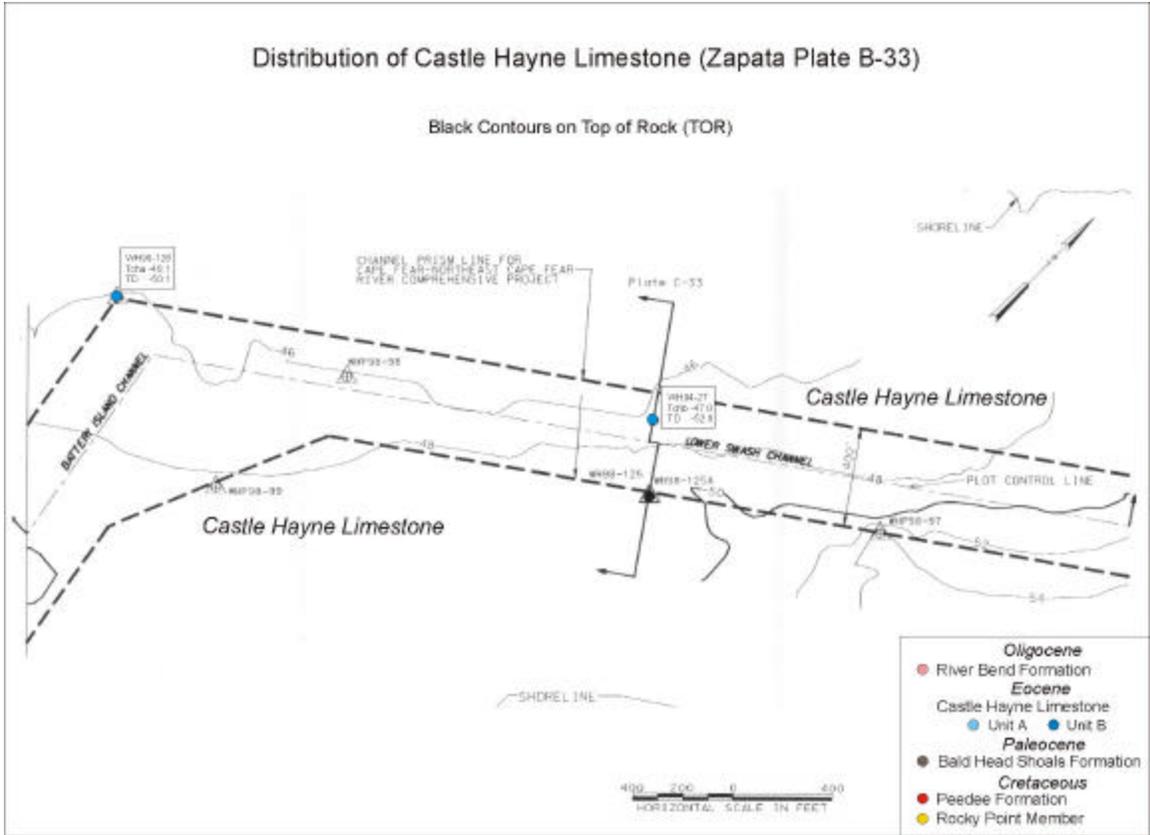


Figure 27. Distribution of Castle Hayne Limestone, Zapata Plate B-32.



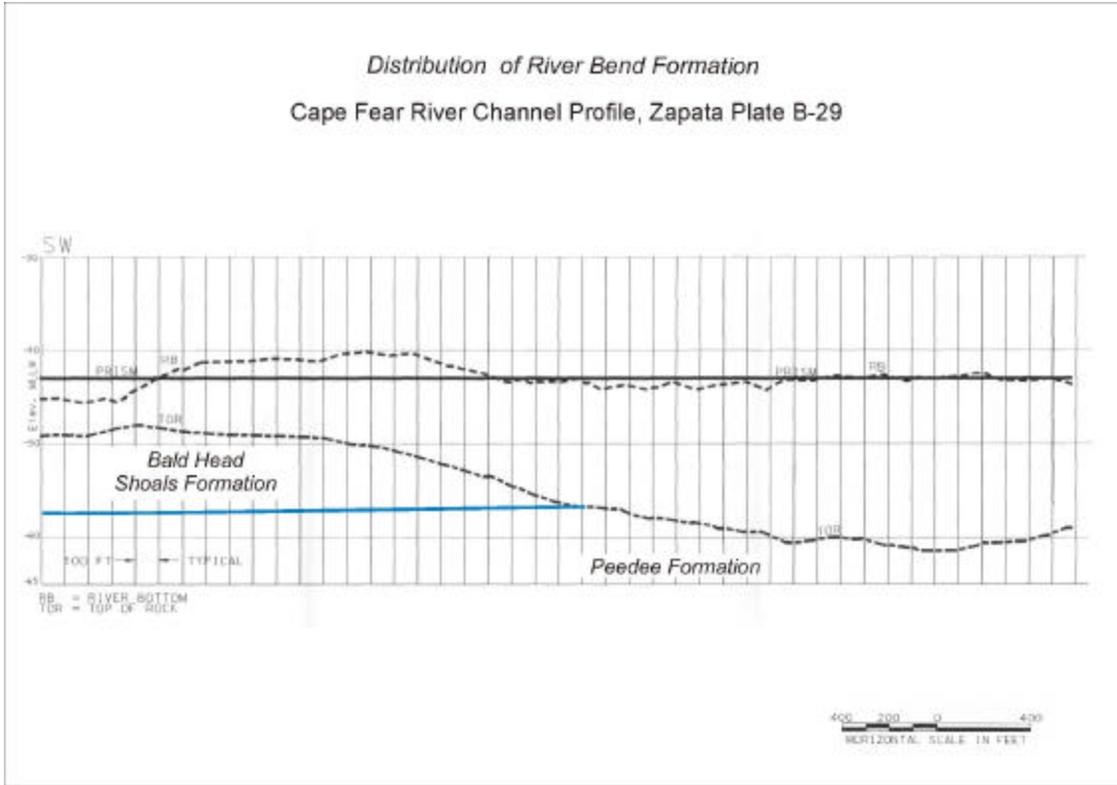


Figure 29. Distribution of River Bend Formation, Cape Fear River Channel Profile, Zapata Plate B-29.

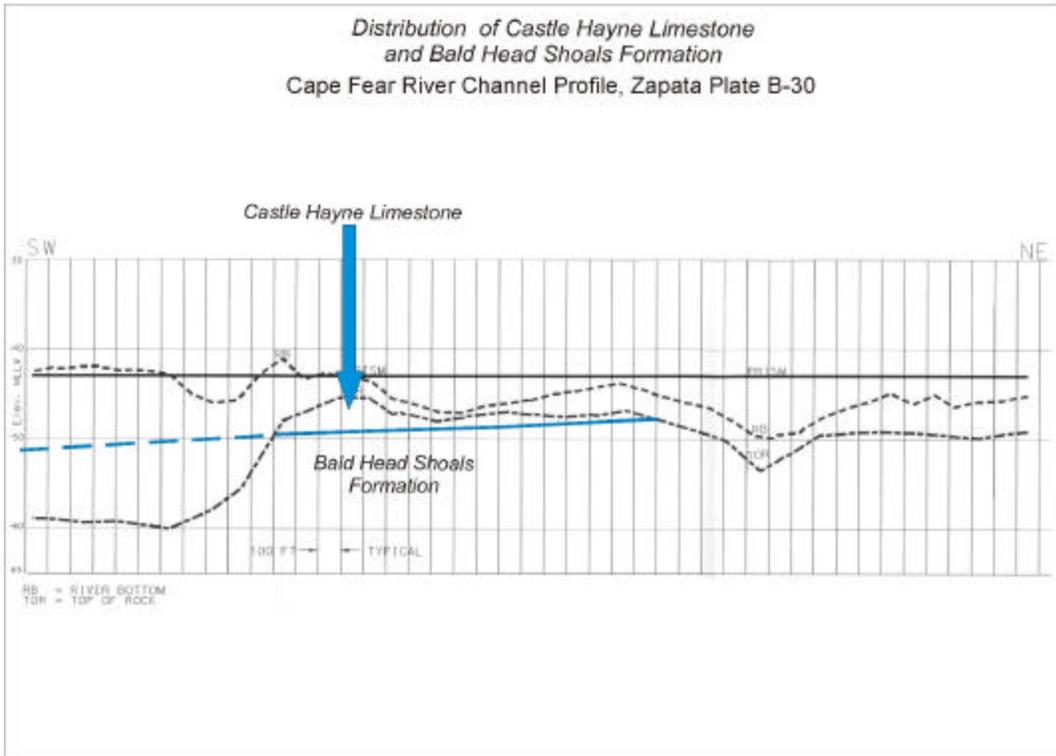


Figure 30. Distribution of Castle Hayne Limestone and Bald Head Shoals Formation, Cape Fear River Channel Profile, Zapata Plate B-30.

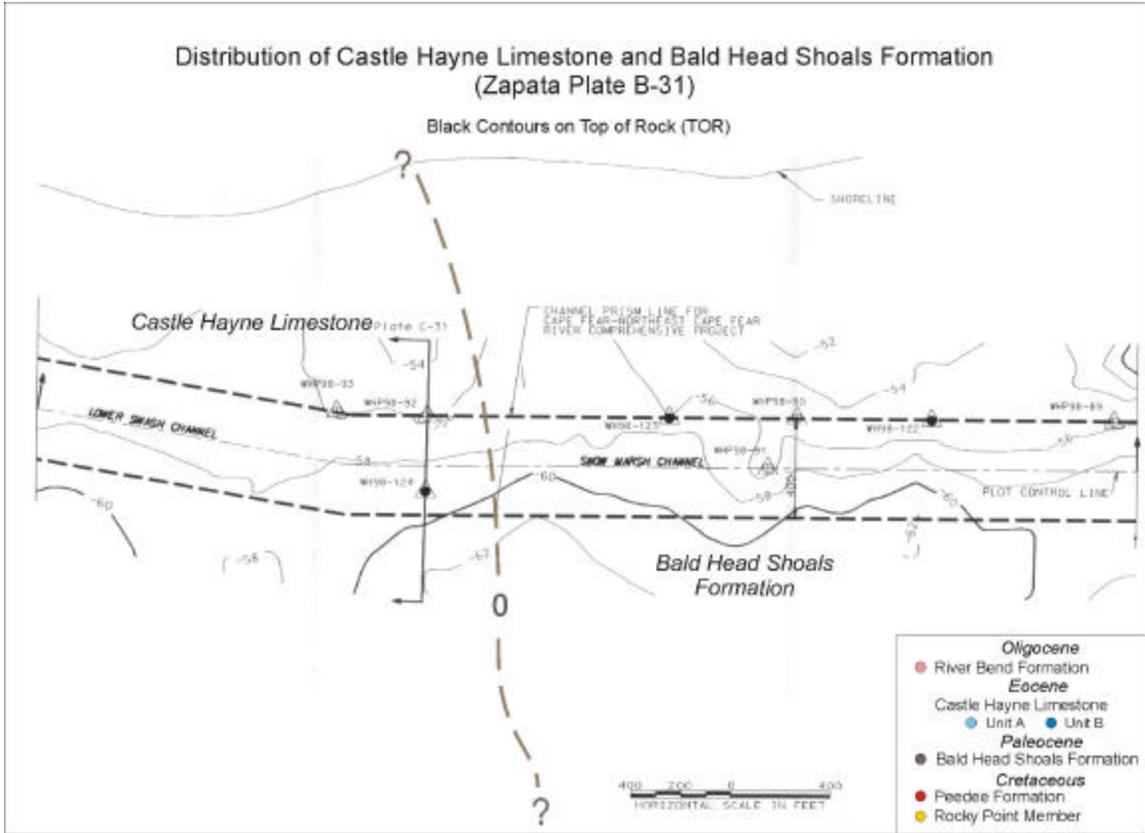


Figure 31. Distribution of Castle Hayne Limestone and Bald Head Shoals Formation, Cape Fear River Channel Profile, Zapata Plate B-31.

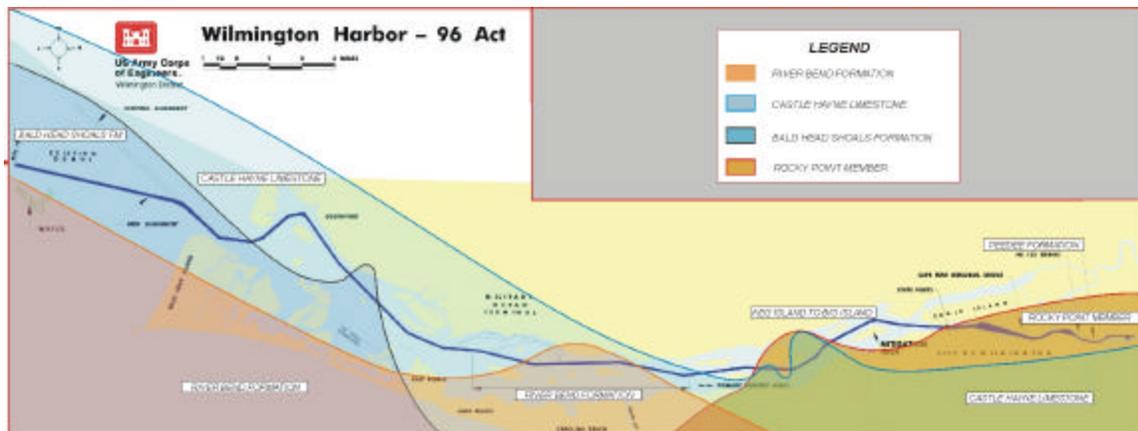


Figure 32. Distribution of selected geologic formations along the Cape Fear River between Wilmington and Baldhead Shoals.