ADDENDUM

DARE BEACHES WATER AND SEWER AUTHORITY

PRELIMINARY ENGINEERING REPORT
for

Regional Water and Sewerage Service

JANUARY 1974

Preparation of this Addendum
was financed by
The Coastal Plains Regional Commission

HENRY VON OESEN AND ASSOCIATES - CONSULTING ENGINEERS & PLANNERS - WILMINGTON, N. C.

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ADDENDUM

TO
PRELIMINARY ENGINEERING REPORT

ADDENDUM

Dare Beaches Water and Sewer Authority

PRELIMINARY ENGINEERING REPORT
for
Regional Water and Sewerage Service

BACKGROUND

A Preliminary Engineering Report (PER) outlining a proposed Regional Water System (Phase I) and Regional Wastewater Collection and Treatment System (Phase II) for the Dare Beaches area was completed in September 1973. This report was prepared at the direction of the Dare Beaches Water and Sewer Authority. The study and report was made possible with the cooperation and financial assistance of the North Carolina Department of Administration, the State Board of Health, the Office of Water and Air Resources of the Department of Natural and Economic Resources and the Coastal Plains Regional Commission (CPRC).

ADDENDUM OBJECTIVE

At the time of completion of the PER resources were not available to allow construction of test wells to prove the productive capacity of the identified source of water supply, and to collect engineering field data on which certain report assumptions were based. These additional confirming requirements have now been met with the assistance of the CPRC. This addendum is intended to summarize the results and conclusions of this field investigation work.

TEST WELL DRILLING PROGRAM

General:

Part II of the PER described the original test well drilling program designed to locate an adequate source of water supply to meet the present

and projected water supply needs of the Dare Beaches Region. A primary acquifer was located which indicated a good potential source of supply extending from the mainland south and west of Manns Harbor, through the southern half of Roanoke Island, and finally deminishing as the acquifer extended eastward under the barrier beach islands. Further study and analysis lead to the decision to locate the production test wells on the southern half of Roanoke Island. Two widely separated sites were selected and the test wells were installed. These test well locations are shown on Map A.

Test Well Construction Requirements:

A qualified well drilling contractor was selected through normal competitive bidding procedures to drill the test wells. Strict technical and performance requirements were established and the contractor proceeded with the work. (An extract from the contract prescribing the test well construction requirements is attached to this addendum as Appendix A).

Test Well Program Results:

The results of test well Number 1 (located at about the center of the Island - See Map A) exceeded all expectations. Estimates from the original ground water search program indicated that we might expect the wells to produce up to 500 gallons per minute (gpm), or about 360,000 gallons per day (gpd), based on twelve hours of pumping per day. Actual test results demonstrated that test well No. 1 was capable of producing approximately 955 gpm without excessive drawdown or fear of other adverse effects. In this particular case the well (screen) appeared to be located in a sand and gravel strata in the principal acquifer with a high degree of transmissivity which facilitated this extremely high yield.

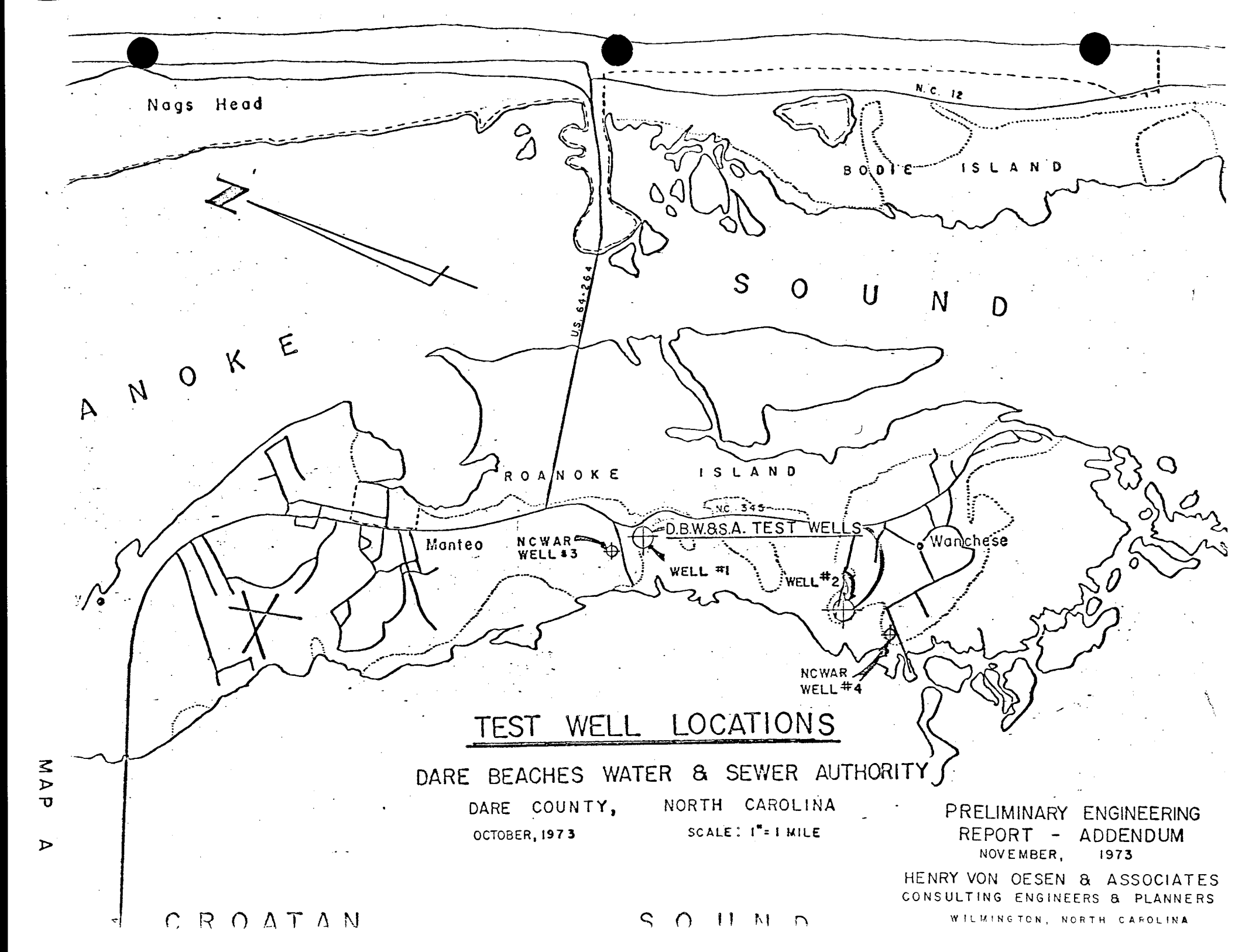
The results experienced on Test Well No. 2 were not so spectacular, although good results were obtained, test well number 2 produced only 300 gpm with a higher rate of drawdown than that experienced for Well No. 1. The excellent transmissivity characteristics encountered in Well No. 1 were not present at Well No. 2 in that materials encountered in the principal acquifer were fine-grained and there was an absence of the coarse gravelly material that was so productive in Well No. 1. It is not known whether this was an isolated situation in this case, or whether well productivity will gradually decrease as you move southward from the central portion of Roanoke Island. This possibility is contrary to the general transmissivity characteristics reported in the Office of Water and Air Resources Report of Investigation No. 9 (Potential Ground Water Supplies for Roanoke Island and the Dare County Beaches, N. C.) which indicate increased transmissivity as you move southward on the Island. In any case, we feel that the test well drilling program has conclusively indicated that good quality water is available from the principal acquifer located on the central and southern portion of Roanoke Island.

The actual boring logs and test pumping results are tabulated in Tables 1 and 2 following Map A. The water appears to be of excellent quality; however, it is quite hard and has certain mineral constituants that indicate the desirability of providing some treatment. The chemical analysis of water samples taken from each well are shown on Plate 1 and 2 following Table 2.

The only items specifically requiring treatment is the manganese of 0.12 PPM in Well No. 1 and in Well No. 2. All other constituants are within U. S. Public Health Service recommendations. (Recommended limit for manganese is 0.05 PPM). It would also be desirable but not mandatory to reduce the hardness to 100 or less.

Conclusions:

The test well drilling programs described above have conclusively demonstrated that the immediate and projected mid-range (1990 time frame) water supply needs of the Dare Beaches region can be met with water obtained from the identified and tested principal acquifer on the southern half of Roanoke Island. It has been determined that production wells located approximately 1500 to 2000 feet apart throughout the area may be expected to produce an average of at least 500 to 700 gpm, or a minimum of 360,000 gpd each, with twelve hours per day of pumping. The actual number of wells that will be required to produce the initial desired 5 million gallons per day (gpd) will have to be determined as the production wells are placed; however, the test well program has effectively demonstrated that the total number required should not exceed the PER estimate of 14 wells. Every effort will be made to reduce this total number by selectively locating the wells in the more productive areas of the principal acquifer to produce the maximum yield.



TEST WELL LOCATIONS

DARE BEACHES WATER & SEWER AUTHORITY

DARE COUNTY, NORTH CAROLINA

OCTOBER, 1973

SCALE: 1" = 1 MILE

MAP A

PRELIMINARY ENGINEERING REPORT - ADDENDUM

NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA

TEST WELL NO. 1

WELL RECORD

NORTH CAROLINA DEPARTMENT OF WATER AND AIR RESOURCES
DIVISION OF GROUND WATER
BOX 9392 - RALEIGH, N. C.

Drilling Contractor Carolina Well & Pump Co. Reg. No. 136 Well Permit No.

1. Town Dare County Water & Sewer County Dare
2. Location On Road to Wanchese Quadrangle No.
   Show a sketch of location on back of form
3. Owner Dare Co. Water & Sewer
   Address Manteo
4. Topography: draw, slope, Hilltop, valley, flat
5. Use of Well water system Date Completed 10-11-73
6. Rig type or method Rotary Total Depth 200 ft.
7. Casing:

	Depth		Diam.		Type
From	0	to 117 ft.	10	in.	# 40 steel

8. Grout:

	Depth		Material	Method
From	0	to 115 ft.	cement	pumped

9. Screen:

	Depth		Diam.	Type and opening
From	120	to 130 ft.	8	in. SS 40 stat
	139	149	8	SS 40 stat
	~~154~~	~~169~~	8	SS 40 stat
	~~175~~	~~190~~	8	SS 40 stat

10. Water zones (depth)
11. Static Water Level: 4.3 ft. above/below top of casing which is 2 ft. above land surface.
    Date 10-10-73
12. Yield (gpm) 955 Method of testing pumped
13. Pumping Water Level: 50.3 ft. after .28 hrs. at 955 gpm.
14. Water Quality good Temperature (°F)
15. Well sterilization method
16. Permanent Pump: Type Make
    Installed- Date By
    Capacity (gpm) Hp.
    Intake depth Airline depth
17. Remarks:

I do hereby certify that this well record is true and exact.

SIGNATURE OF CONTRACTOR OR AGENT

DRILLING LOG

Depth From	Depth To	Formation
0	2	Top Soil
2	22	Sand (Yellow)
22	140	Clay & Sand mixed
140	150	Gravel & Clay
150	190	Gravel & Marl
190	230	Sand (off white)

TABLE 1

White copy - Department of Water & Air Resources; Blue-Drillers copy; Green-Owner's copy.

PUMPING TEST DATA

t conducted by: _____

l Owner: _____ Address: _____

mp[redacted]Well No.: _____ Location: _____ County: _____

ervation Well Locations: _____

line Lengths: Pumped Well _____ Observation Wells _____

marks: _____

nping rate measured with: _____ Water levels measured with: _____

Pump Well Data

Date and Time	Elapsed Time Min.	Piezometer Tube Reading Inches	Pumping Rate GPM	Pump Discharge Pressure	Altitude Gauge Reading Feet	Feet to Water	Remarks
:00	630	38	950			49.6	
:00	690	38	950			49.9	
:00	750	38	955			50.0	
1:00	810	38	950			50.0	
2:00	870	38	950			50.0	
:00	950	38	950			50.0	
:00	1010	38	950			50.0	
:00	1070	38	955			50.0	
:00	1130	38	950			50.0	
:00	1190	38	955			50.2	
:00	1250	38	950			50.3	
:00	1310	38	950			50.3	
:00	1370	38	950			50.3	
:00	1430	38	950			50.3	
:00	1490	38	955			50.3	
1:00	1550	38	955			50.3	
2:00	1610	38	955			50.3	
							Stopped
ecovery							
1:01						40.0	
:02						30.6	
:03						22.9	
1:04						18.1	
:05						17.4	
:06						16.9	
1:07						16.4	
1:08						15.9	
:09						15.5	
:10						15.3	
1:15						15.0	
:20						14.9	
:25						13.0	
1:30						12.5	
:35						11.8	
:40						11.0	
1:45						10.2	
1:50						9.1	
:55						8.6	
2:00						8.0	
2:05						7.11	

PUMPING TEST DATA

t conducted by: Carolina Well and Pump Co. (Joe Seagroves)
ll Owner: Dare Co. Water & Sewer Address: Nags Head N. C.
mp Well No.: 1 Location: County: Dare
ervation Well Locations:
line Lengths: Pumped Well Observation Wells
marks: Well flowed at one time

nping rate measured with: 6x.0 orfice Water levels measured with: Electric Tape

Pump Well Data

Date and Time 9-10-73	Elapsed Time Min.	Piezometer Tube Reading Inches	Pumping Rate GPM	Pump Discharge Pressure	Altitude Gauge Reading Feet	Feet to Water	Remarks
:55							
:00	started	32.5	800			[illegible]	
:05	5	32.5	800			4.6	
:10	10	32.5	800			4.9	
:15	15	32.5	800			3.4	
:20	20	32.5	800			3.3	
:25	25	32.5	800			2.[illegible]	
:30	30	32.5	800			2.0	
:35	35	32.5	800			1.6	
:40	40	32.5	800			1.2	
:45	45	32.5	800			11.0	
:50	50	32.5	800			3.0	
:55	55	32.5	800			2.0	
0:[illegible]	60	32.5	800			0	well flowing
0:05	65	32.5	800			0	
0:10	70	32.5	800			0	
0:15	75	32.5	800			0	
0:20	80	32.5	800			0	
0:25	85	32.5	800			0	
0:30	90	32.5	800			0	
0:35	95	32.5	800			0	
0:40	100	32.5	800			0	
0:45	105	32.5	800			0	
0:50	110	32.5	800			0	
0:55	115	32.5	800			0	
1:00	120	32.5	800			0	
1:15	135	32.5	800			0	
1:30	150	32.5	800			0	
1:45	165	32.5	800			0	
2:00	180	32.5	800			0	
:00	240	32.5	800			0	
:00	300	61	1075			3.5	
:00	330	61	1075			5.0	
:00	360	61	1075			3.5	
:00	390	61	1075			20.0	
:00	420	61	1075			50.0	
:00	450	38	855			[illegible].0	
:00	510	38	855			40.0	
:00	570	38	855			[illegible].3	

PUMPING TEST DATA Page III.

t conducted by: _____

l Owner: _____ Address: _____

mp[redacted]Well No.: _____ Location: _____ County: _____

ervation Well Locations: _____

line Lengths: Pumped Well _____ Observation Wells _____

narks: _____

_____

nping rate measured with: _____ Water levels measured with: _____

_____

Pump Well Data

Date and Time	Elapsed Time Min.	Piezometer Tube Reading Inches	Pumping Rate GPM	Pump Discharge Pressure	Altitude Gauge Reading Feet	Feet to Water	Remarks
2:10						7.9	
2:15						7.6	
2:20						7.6	
2:25						7.4	
2:30						7.3	
2:35						7.3	
2:40						7.2	
2:45						7.1	
2:50						7.1	
2:55						7.0	
3:00						7.0	

TEST WELL NO. 2

NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES
OFFICE OF WATER AND AIR RESOURCES
GROUND WATER DIVISION
P. O. BOX 27687 – RALEIGH, N. C. 27611

WELL RECORD

DRILLING CONTRACTOR _____ REG. NO. _____ WELL CONSTRUCTION PERMIT NO. _____

1. WELL LOCATION: (Show a sketch of the location on back of form)
   Nearest Town: _____ County: Dare
   On Road to Manchesse (Road, Community or Subdivision and Lot No.) Quadrangle No. _____
2. OWNER: Dare County Water & Sewer
3. ADDRESS: Manteo
4. TOPOGRAPHY: draw, valley, slope, hilltop, flat
5. USE OF WELL: water system DATE: 12-13-73
6. DOES THIS WELL REPLACE AN EXISTING WELL? no
7. TOTAL DEPTH: 236 RIG TYPE OR METHOD: rotary
8. FORMATION SAMPLES COLLECTED: [X] YES No. of Bags 26
9. CASING:

	Depth		Inside Diam.	Wall thick. or weight/ft.	Type
From 0	to 120	ft.	10	#40	SS
112	132		8	#40	SS
142	162		8	#40	SS
167	183		8	#40	SS
220	236		8	#40	SS

10. GROUT: Depth Material Method
    From 0 to 120 ft cement pump
11. SCREEN:

	Depth		Diam.	Type and Opening	
From 132	to 142	ft.	8	SS	25
162	147		8	SS	25
183	220		8	SS	25

12. GRAVEL: Depth Size Material
    From _____ to _____ ft. _____ _____
13. WATER ZONES (depth): 132-220
14. STATIC WATER LEVEL: 3-4 ft. above / below top of casing.
    Casing is 2 ft. above land surface. ELEV. _____
    DATE MEASURED: 12-13-73
15. YIELD (gpm): 300 METHOD OF TESTING: _____
16. PUMPING WATER LEVEL: 55-6 ft. after 25 hours
    at 300 gpm.
17. CHLORINATION: Type H T H Amount 5 lbs.
18. WATER QUALITY: _____ TEMPERATURE (°F) _____
19. PERMANENT PUMP: (Show a sketch of well head on back of form)
    Date Installed _____ Type _____ Make _____
    Capacity _____ (gpm) HP _____
    Intake Depth _____ Airline Depth _____
20. HAVE YOU INFORMED THE WELL OWNER OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS? _____
    REMARKS: well capped
    sample turned over to Willie Hardison

I do hereby certify that this well record is true and exact.

_____
SIGNATURE OF CONTRACTOR OR AGENT DATE

DRILLING LOG

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0	2	Top Soil
2	18	Sand & Clay Yellow
18	122	Clay & Sand mixed
122	180	Gravel & Clay
180	228	Gravel & White Sand
228	238	Fine Sand & Clay

TEST WELL NO. 1
(TABLE 2A)

PUMPING TEST DATA

Test conducted by: Carolina Well & Pump Co. (Joe Seagroves)
Well Owner: Dare County Water & Sewer Address:
Pumped Well No.: 2 Location: Fraum Town Road County: Dare
Observation Well Locations:
Airline Lengths: Pumped Well Observation Wells
Remarks: Mr. Willie Hardison was on site at start and finish of test

Pumping rate measured with: electric tape Water levels measured with:

Pump Well Data

Date and Time 2-13-73	Elapsed Time Min.	Piezometer Tube Reading Inches	Pumping Rate GPM	Pump Discharge Pressure	Altitude Gauge Reading Feet	Feet to Water	Remarks
10:30	1		200			3.4	
10:31	2		200			39.½	
10:32	3		200			47.	
10:33	4		200			49.9	
10:34	5		200			49.7	
10:35	6		200			49.10	
10:36	7		200			50.	
10:37	8		200			50.	
10:38	9		200			50.	
10:39	10		200			50.3½	
10:40	11		200			50.3½	
10[redacted]	12		200			50.4	
10:42	13		200			50.4	
10:43	14		200			50.5	
10:44	15		200			50.6	
10:45	16		200			50.6	
10:50	21		200			50.6	
10:55	26		200			50.6	
11:00	31		200			50.6	
11:01	32		250			58.00	
11:02	33		250			60	
11:03	34		250			61.11	
11:04	35		250			62.0	
11:05	36		250			62.0	
11:06	37		250			62.2	
11:07	38		250			62.1	
11:08	39		250			62.1	
11:09	40		250			62.3	
11:10	41		250			62.1	
11:15	46		250			62.3	
11:20	52		250			62.6	
11:25	55		250			62.6	
11:30	60		250			62.6	
11:35	65		300			80.2	
11:36	66		300			0.2	
11:37	67		300			80.3	
11[redacted]	68		300			81.2	
11:39	69		300			81.5½	
11:40	70		300			81.5	
11:41	71		300			81.5½	
11:42	72		300			81.5½	
11:43	73		300			81.5½	
11:44	74		300			81.6½	
11:45	75		300			81.6	

PUMPING TEST DATA

st conducted by: _____

ell [redacted]ner: _____ Address: _____

[redacted]mp[redacted] Well No.: _____ Location: _____ County: _____

servation Well Locations: _____

rline Lengths: Pumped Well _____ Observation Wells _____

emarks: _____

mping rate measured with: _____ Water levels measured with: _____

Pump Well Data

Date and Time	Elapsed Time Min.	Piezometer Tube Reading Inches	Pumping Rate GPM	Pump Discharge Pressure	Altitude Gauge Reading Feet	Feet to Water	Remarks
1:50	80		300			81.6	
1:55	85		300			81.6	
2:00	90		300			81.6	
2:10	95		300			81.6	
2:20	105		300			81.6	
2:30	115		300			81.6	
2 :45	130		300			81.6	
:00	145		300			81.6	
:15	160		300			82.6	
:30	175		300			82.7	
:00	205		300			83.	
:00	265		300			83	
:0[redacted]	325		300			82.6	
:00	340		300			83.6	
:00	355		300			83.8	
:00	415		300			83.8	
:00	475		300			83.8	
:00	535		300			83.8	
0:00	595		300			83.8	
1:00	655		300			83.8	
2:00	715		300			83.8	
:00	775		300			83.8	
:00	835		300			83.8	
3:00	895		300			83.8	
:00	955		300			83.8	
:00	1015		300			83.9	
:00	1075		300			83.9	
7:00	1135		300			84.2	
:00	1195		300			85.	
:00	1255		300			85.6	
10:00	1315		300			85.6	
11:00	1375		300			85.6	
12:00	1377		300			85.6	
12:02	1378		0			26.	
12:03	1379		0			14.11	
12:04	1380		0			11.8	
12:05	1381		0			10.7	
12[redacted]	1382		0			10.	
12:07	1383		0			9.10	
12:08	1384		0			9.6	
12:09	1385		0			9.3	
12:10	1386		0			9.1	
12.11	1387		0			9.11	
12.12	1388		0			9.10	

PUMPING TEST DATA

t conducted by: _____

ll Owner: _____ Address: _____

mp Well No.: _____ Location: _____ County: _____

ervation Well Locations: _____

line Lengths: Pumped Well _____ Observation Wells _____

marks: _____

_____

nping rate measured with: _____ Water levels measured with: _____

_____

Pump Well Data

Date and Time	Elapsed Time Min.	Piezometer Tube Reading Inches	Pumping Rate GPM	Pump Discharge Pressure	Altitude Gauge Reading Feet	Feet to Water	Remarks
2:13	1389		0			8.8	
:14	1390		0			8.2	
:15	1391		0			8.5	
:16	1392		0			8.4	
:17	1393		0			8.3	
:18	1394		0			8.3	
.19	1395		0			8.2	
:20	1396		0			8.12	
:25	1401		0			7.9	
:30	1406		0			7.6	
:35	1411		0			7.4	
:40	1416		0			7.2½	
:4[illegible]	1421		0			7½	
:50	1426		0			6.11½	
:55	1431		0			6.10	
00-	1436		0			6.8½	
05	1441		0			6.7	
10	1446		0			6.6	
15	1451		0			6.5	

WATER QUALITY ANALYSES
Test Well No. 1
Division of Health Services, Laboratory Section
P. O. Box 28047, Raleigh, North Carolina 27611

Complete all items above Heavy Line
(see instructions on reverse side)

Bill $5

Name of Owner or Supply: DARE COUNTY WATER

Address: MANTEO NC

Well No. 1

County: DARE

Report to: WORTH F. PICKARD

Address: PO Box 1085

SANFORD NC 27330

Collected by: J. SEAGROVE

Date Collected: 10-11-73 Time: 1:00

Remarks:

Type of Supplier.
[x] 1-Municipal
[ ] 2-Sanitary District
[ ] 3-Mobile Home Park
[ ] 4-Community
[ ] 5-Association
[ ] 6-Industrial
[ ] 7-Institution
[ ] 8-Private
[ ] 9-Other

Source of Water:
[x] 1-Ground
[ ] 2-Surface
[ ] 3-Both
[ ] 4-Purchased

Source of Sample:
[x] 1-Well tap
[ ] 2-House Tap
[ ] 3-Distribution Tap

Type of Sample:
[x] 1-Raw
[ ] 2-Treated

Type of Treatment:
[x] 0-None
[ ] 1-Chlorinated
[ ] 2-Fluoridated
[ ] 3-Filtered
[ ] 4-Alum
[ ] 5-Lime
[ ] 6-Soda Ash
[ ] 7-Polyphosphate
[ ] 8-Water Softener
[ ] 9-Other

Analysis Desired:
[x] 1-Complete analysis (18 tests)
[ ] 2-Partial analysis (9 tests)

ANALYSIS

Color	(000)	10	units	Ph	(00.0)	8.3

Results in Parts per Million

Alkalinity $CaCO_3$	(000)	244	Fluoride	(0.00)	0.16
Total Hardness	(000)	217	Arsenic	(*0.00)	<0.01
Iron	(*00.00)	0.18	Cadmium	(*0.00)	<0.01
Manganese	(*00.00)	0.12	Chromium^{+6}	(*0.00)	<0.05
Turbidity SiO_2	(000)	0.5	Copper	(*00.00)	<0.05
Acidity $CaCO_3$	(000)	0	Lead	(*0.00)	<0.05
Chloride	(000)	31	Zinc	(*00.00)	0.06
Sodium	(000)	24	CALCIUM		68.0
Potassium	(00.0)	10.0	MAGNESIUM		12.5

Date received 10-16-73 Date reported 10-19-73

Date analyzed Reported by CHILDERS

Lab. No. 00024

Flats 1

WATER QUALITY ANALYSIS
TEST WELL NO. 2

NORTH CAROLINA DEPARTMENT OF HUMAN RESOURCES

CHEMICAL ANALYSIS OF WATER

Division of Health Services, Laboratory Section
P. O. Box 28047, Raleigh, North Carolina 27611

Complete all Items above Heavy Line
(see instructions on reverse side)

ıme of Owner · Supply: DARE CO. SEWER & WATER

ıdress:

Well No. 2

ɔunty: DARE

eport to: WORTH PICKARD

ıdress: PO BOX 1085

SANFORD NC 27330

ɔıected by: JOE SEAGROVES

ıte Collected: 12-14-73 Time: 12:30

emarks:

*BOTTLE BEING SENT FOR REPEAT OF LEAD ANALYSIS.

Type of Supplier:
[X] 1-Municipal
[ ] 2-Sanitary District
[ ] 3-Mobile Home Park
[ ] 4-Community
[ ] 5-Association
[ ] 6-Industrial
[ ] 7-Institution
[ ] 8-Private
[ ] 9-Other

Source of Water:
[X] 1-Ground
[ ] 2-Surface
[ ] 3-Both
[ ] 4-Purchased

Source of Sample:
[X] 1-Well tap
[ ] 2-House Tap
[ ] 3-Distribution Tap

Type of Sample:
[X] 1-Raw
[ ] 2-Treated

Type of Treatment:
[X] 0-None
[ ] 1-Chlorinated
[ ] 2-Fluoridated
[ ] 3-Filtered
[ ] 4-Alum
[ ] 5-Lime
[ ] 6-Soda Ash
[ ] 7-Polyphosphate
[ ] 8-Water Softener
[ ] 9-Other

Analysis Desired:
[X] 1-Complete analysis (18 tests)
[ ] 2-Partial analysis (9 tests)

ANALYSIS

ɔlor	(000)	7 units	Ph	(00.0)	8.1

Results in Parts per Million

lkalinity $CaCO_3$	(000)	210	Fluoride	(0.00)	< 0.10
ɔtal Hardness	(000)	154	Arsenic	(*0.00)	< 0.01
ron	(*00.00)	0.20	Cadmium	(*0.00)	< 0.01
anganese	(*00.00)	0.11	Chromium^{+6}	(*0.00)	< 0.05
ɹrbidity SiO_2	(000)	0.7	Copper	(*00.00)	< 0.05
cidity $CaCO_3$	(000)	5	Lead	(*0.00)	*
nloride	(000)	35	Zinc	(*00.00)	0.05
ɔdium	(000)	21	CALCIUM		50.0
ɔtassium	(00.0)	5.2	MAGNESIUM		7.2

ıte received 12-20-73 Date reported 12-21-73

Plate 2

01954

FIELD ENGINEERING DATA COLLECTION

General:

During preparation of the PER a number of engineering assumptions were made concerning alternative methods of constructing water supply pipeline crossings over open water areas, and for effluent disposal from the proposed wastewater treatment system. Although the proposed solutions to these problems outlined in the PER are considered to be imminently sound, it was necessary to confirm some of the assumptions made in that the project costs can be affected by the schemes which are ultimately adopted. Thus, it was necessary to conduct field surveys and collect geological and soils data to reveal any problems that might influence the preliminary design concepts or original cost estimates.

The data required included obtaining bottom profiles of proposed pipeline crossings, subsurface soil investigations reflecting soil characteristics, pile bearing capacities, pipe burial problems, etc. An off-shore profile extending from the beach into deep water was also required to determine the location and length of the proposed ocean outfall for effluent disposal from the regional sewage treatment plant.

The necessary field surveys were made and a search was conducted to obtain other useful information and data that might be available from other sources. The Bridge Design Division of the North Carolina State Highway Department assisted by providing test borings and test pile driving data collected during construction of the U. S. Highway 64-264 bridge crossing at Roanoke Sound. Test boring information, hydrographic and sismic survey data and geological data collected by the Geology Department of East Carolina University also proved

useful. This later information has been collected over the past four years by Professors Stanley R. Riggs, and Michael P. O'Conner as a part of a report prepared under the Sea Grant Program entitled "The Sediments, Sediment History, and Sedimentary Processes of Northeastern North Carolina's Coastal Area: Their Implication upon Coastal Zone Management". Data obtained from these sources are identified whenever they are used in this addendum. These engineering investigations have been compiled and are summarized in the following sections of this addendum.

Analysis of Alternative Pipeline Crossing:

Paragraph 5C, Part II of the PER discussed the water supply pipeline and offered a comparison of two proposed alternate pipeline routes. This initial analysis indicated that a possible pipeline crossing route extending from the northern tip to Roanoke Island directly across the sound to the Nags Head - Kitty Hawk area (Route B) would probably cost more than twice as much to construct as compared to Route A which crosses Roanoke Sound adjacent to the U. S. Highway 64-264 bridge crossing. This analysis was based on the assumption that the Route B crossing would be entirely sub-acqueous and it was assumed that the pipeline could be buried on the sound bottom without excessive difficulty. In order to confirm the initial comparative estimates, a bottom profile was run of the Route B crossing. This profile is attached as Plate 3 which shows the sound bottom to be relatively flat ranging from 7 to 10 feet in depth. Limited probings were taken which indicated that the bottom materials were sand or silty sand.

A more thorough investigation was conducted in conjunction with the previously referenced East Carolina University geological study of the area.

60+00 70+00 80+00 90+00 100+00 110+00 120+00 130+00 140+00 150+00 160+00 170+00 180+00 190+00 200+00 210+00

+5

DARE BEACES

0

-5

-10

ZONE OF REL

ICT BURIED CHANNEL

RELICT CHANNEL

ZONE OF RELICT BURIED CHANNEL

LEGEND:

EXIST. BOTTOM PROFILE ——— (Oct 73)

PROJECTED BOTTOM PROFILE - - - - - - -

A_TERNATE CROSSING - ROUTE 'B'

FROM NORTHERN TIP OF ROANOKE ISLAND TO DARE BEACHES AREA)

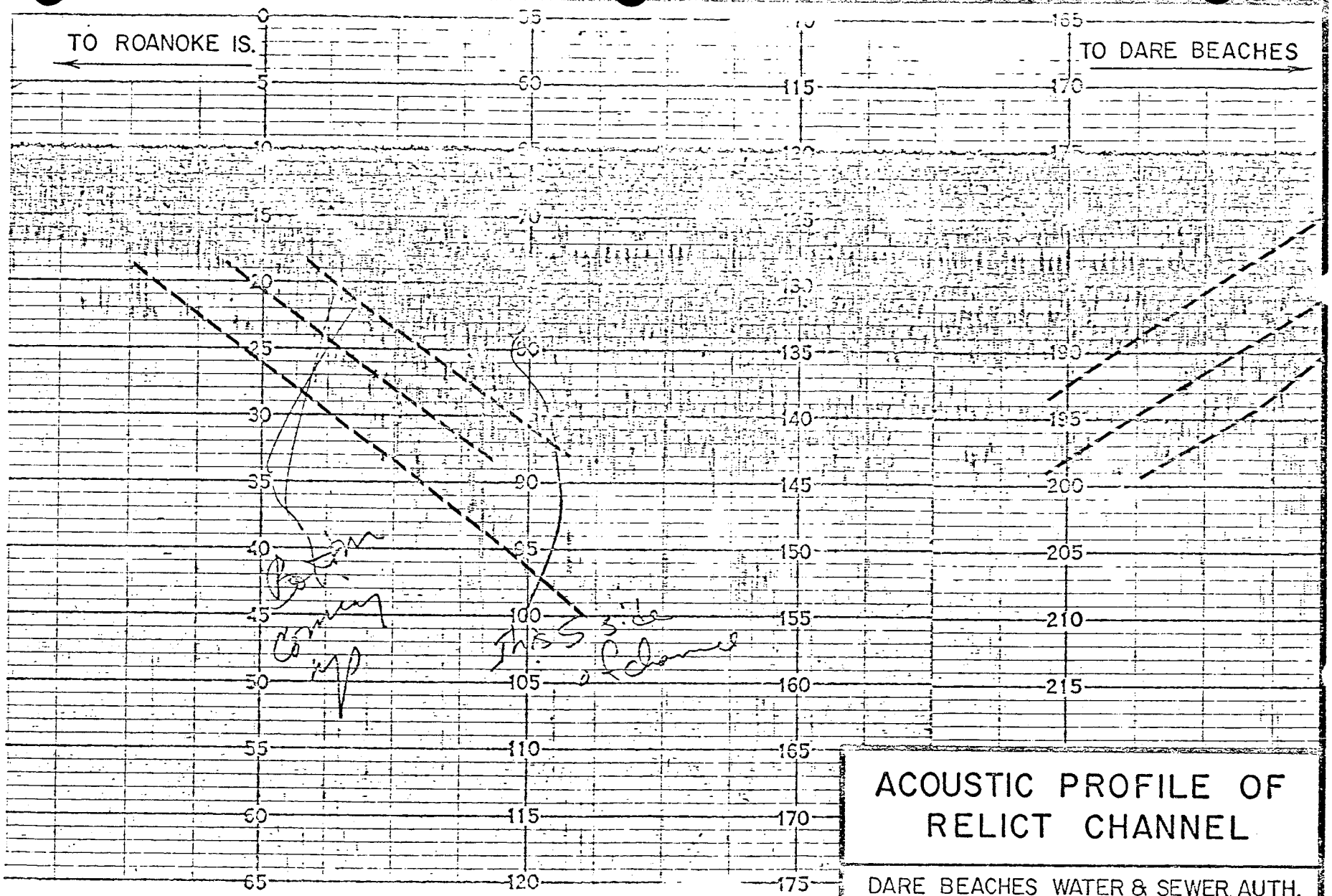
ENGINEERING FIELD DATA

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM
NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA

Hydrographic and acoustic profiles were run by that agency in the general vicinity of the proposed crossing which reveal that the sound in this area was transected at one time by deep channels which flowed through the old Roanoke Inlet which closed through natural processes in the early 1800's. When the Inlet was closed these deep channels were apparently filled with materials of poor quality which could present some difficulty if a subacqueous pipeline crossing was attempted in this area. Examples evidencing these old channels are shown on the acoustic profile of a section of the channel inserted as Plate 4 and also indicated on Plate 3. A sketch showing the general alignment of these old channels as revealed by the ECU study is also attached to Plate 5. It may easily be seen that any pipeline crossing in this vicinity would also have to cross these old channels which could present considerable construction difficulty. With this additional information it was positively concluded to abandon any further attempts to exploit the Route B pipeline crossing.

Based on the above decision efforts were concentrated on collecting information related to U. S. Highway 64-264 bridge crossing (Route A). A bottom profile was run and is included in this addendum as Plate 6. This profile reveals that the water depth is extremely shallow throughout most of the crossing area except in the navigation channel at the draw bridge, and a fairly deep natural channel under the short bridge span that connects Pond Island with Bodie Island in route to Whalebone Junction. Limited probes showed relatively hard sandy material was to be found 2 to 4 feet below the bottom surface, except in the deeper channel crossings as shown on the profile. This leads to the conclusion that the pipeline should be buried to approximately 15 foot depths in the channel areas and to about 8 feet deep throughout the rest of the sound if a subacqueous crossing method is used.



ACOUSTIC PROFILE OF RELICT CHANNEL

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM

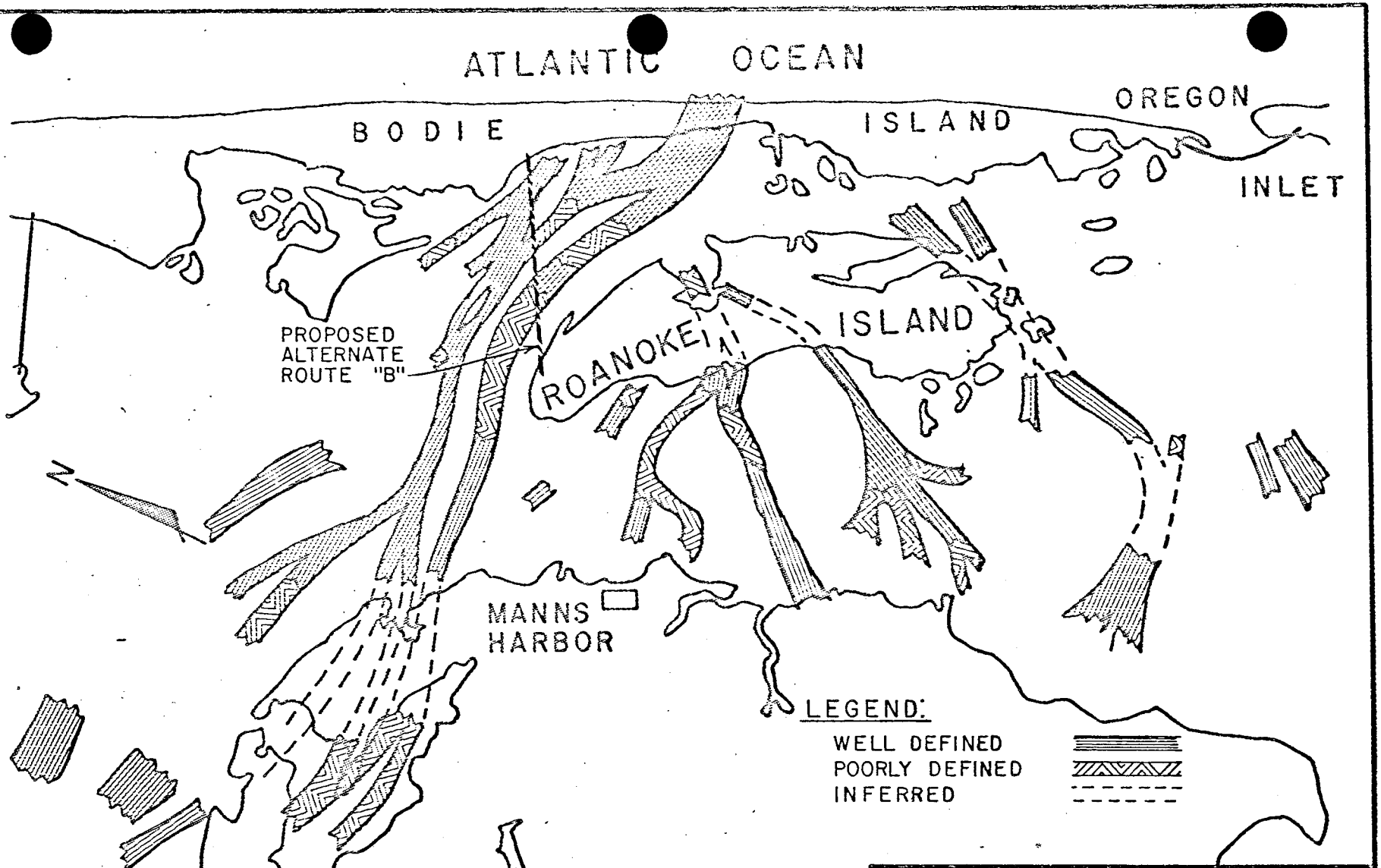
NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA

DATA SOURCE:

Dept. of Geology, East Carolina University, Sea Grant Program Study of Sediment History & Processes in Northeastern North Carolina

PLATE No. 4



DATA SOURCE:

Dept. of Geology, East Carolina University, Sea Grant Program Study of Sediment History & Processes in Northeastern North Carolina.

MAP OF RELICT CHANNELS

ROANOKE & ALBAMARLE SOUNDS

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM

NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA

PLATE No. 5

During preparation of the PER consideration was also given to the possibility of constructing an elevated pipeline crossing using pile bents to carry the initial and future additional pipeline across the sound areas. Design requirements for this possibility necessitated determining general soil bearing characteristics and pile bearing capacities of the bottom materials in the sound. Further research revealed that both the N.C. State Highway Department and the ECU investigative programs in the area contain useful data to aid in this analysis. Although the ECU study project did not include test borings in the immediate water areas adjacent to the bridge, numerous borings were taken in the vicinity of the proposed pipeline crossing. These boring locations are shown on Plate 7 and the actual boring logs are shown on Plate 8. These logs and the accompanying grain size analyses made of the materials extracted from the core borings show the material to be comprised of sand and shelly sandy materials with some quantities of silt and organic materials interspersed throughout the boring core.

Information obtained from the State Highway Department test drilling and pile driving program associated with the construction of the U. S. Highway 64-264 bridge also indicate a good pile bearing capacity at depths ranging between 20 and 28 feet throughout the sound crossing. Graphic illustration of this data is shown on Plates 9 and 10.

Careful analysis of information obtained from the two above references indicates that pipeline crossing can be satisfactorily accomplished either by subacqueous burial of the pipeline or by transporting the pipeline across the open water area by placing it on a pile bent structure which would be located approximately 200 feet south of the bridge centerline. Comparative cost

analyses of the subacqueous versus the pile supported crossing clearly indicates that the pile founded pipeline crossing would be the most economical method. The initial cost estimate in the PER was based on a pile supported pipeline crossing with the pile structures driven to a depth of approximately 30 feet. It is our opinion that this confirming data validates the preliminary estimate and design conclusions contained in the PER.

T L A N T I C O C E A N

PIPELINE SUPPLIES EXISTING PLANTS

U.S. 158

16"

16"

Nags Head

24"

N.C. 12

BODIE ISLAND

SOUND

ALTERNATE 24" ROUTE

U.S. 64-264

24"

Collington

COLLINGTON ISLAND

ROANOKE

ROANOKE ISLAND

DEEP

N.C. 345

WELL

FIELD

Wanchese

Manteo

24"

Fort Raleigh City

ELEVATED STORAGE & GROUND STORAGE PUMPING PLANT

LEGEND:

- PRIMARY WATER SUPPLY PIPELINE
- ALTERNATE ROUTE FOR PIPELINE
- GROUND STORAGE RESERVOIR
- EXISTING MUNICIPAL TREATMENT PLANTS
- ELEVATED TANK PRIMARY SUPPLY
- EXISTING & PROPOSED DISTRIBUTION SYSTEM TANKS

U.S. 64-264

C R O A T A N S O U N D

MAP SHOWING ALTERNATE PIPELINE ROUT

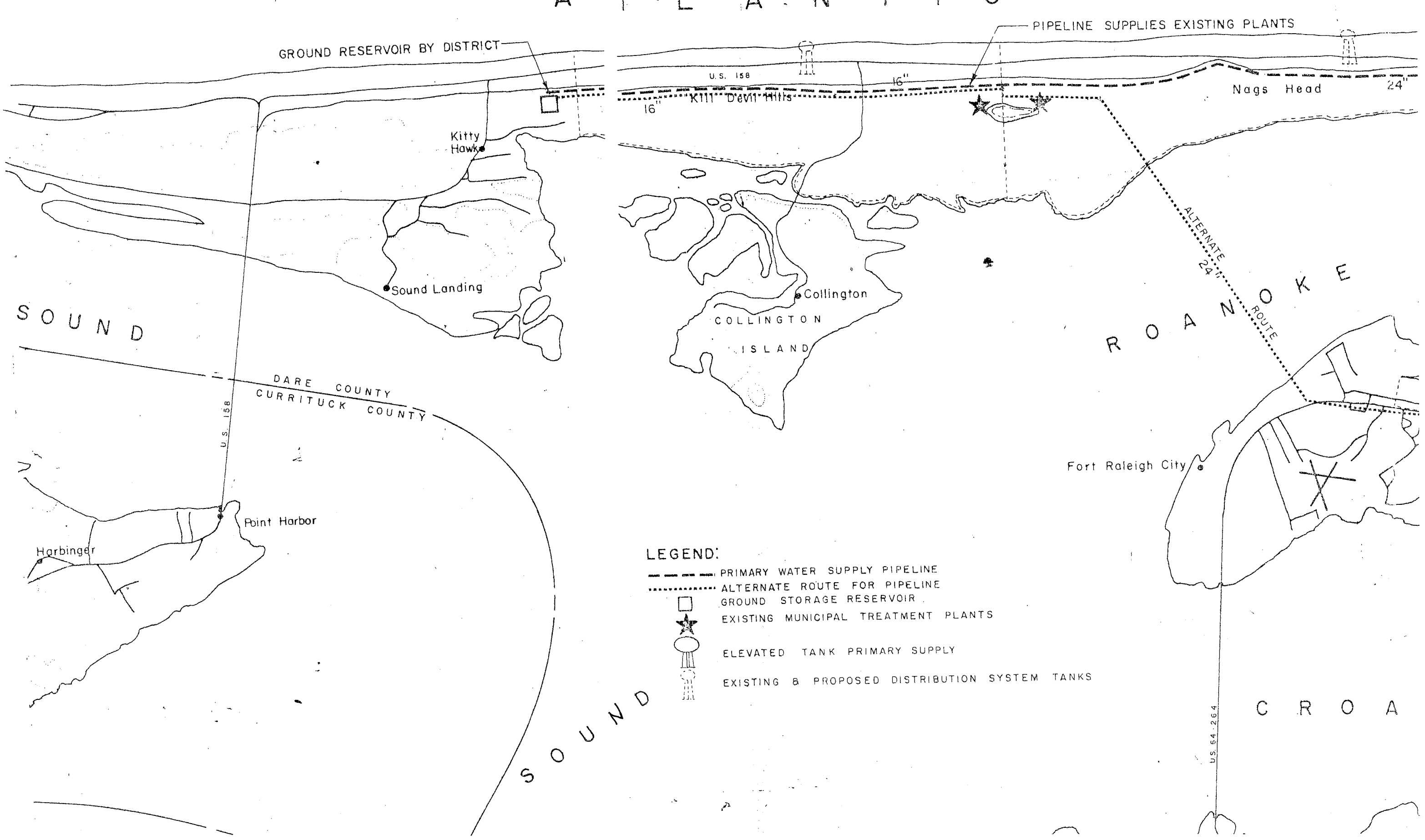
FROM ROANOKE ISLAND TO DARE BEACHES

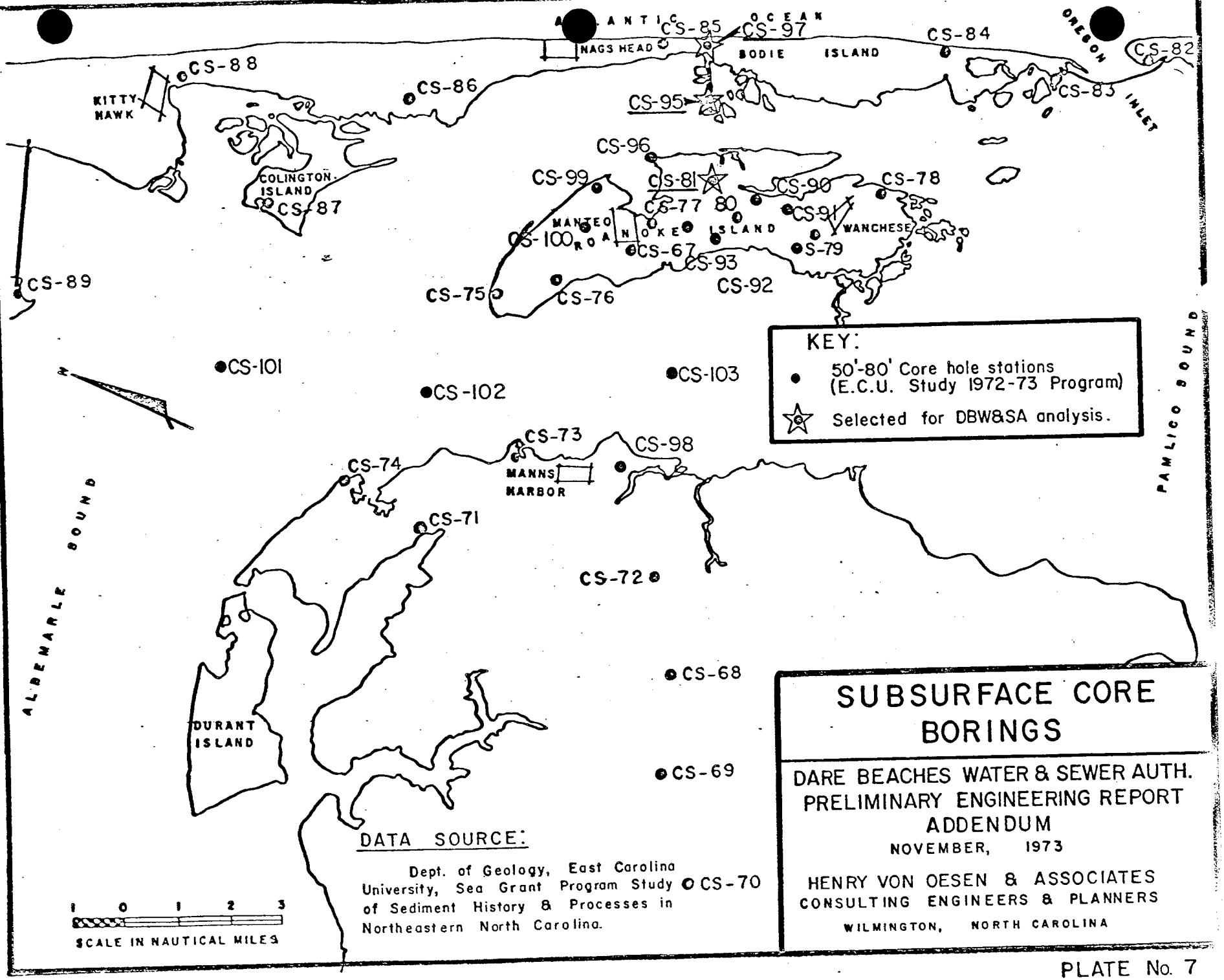
DARE BEACHES WATER & SEWER AUTHORIT

APRIL 1973

SCALE 1" = 1 Mile

HENRY VON OESEN & ASSOCIATES


A T L A N T I C
GROUND RESERVOIR BY DISTRICT
PIPELINE SUPPLIES EXISTING PLANTS
U.S. 158
16"
16"
Kill Devil Hills
Nags Head
24"
Kitty Hawk
Sound Landing
SOUND
DARE COUNTY
CURRITUCK COUNTY
U.S. 158
Point Harbor
Harbinger
Collington
COLLINGTON ISLAND
ALTERNATE 24" ROUTE
ROANOKE
Fort Raleigh City
U.S. 64-264
CROA
SOUND
LEGEND:
PRIMARY WATER SUPPLY PIPELINE
ALTERNATE ROUTE FOR PIPELINE
GROUND STORAGE RESERVOIR
EXISTING MUNICIPAL TREATMENT PLANTS
ELEVATED TANK PRIMARY SUPPLY
EXISTING & PROPOSED DISTRIBUTION SYSTEM TANKS



SUBSURFACE CORE BORINGS

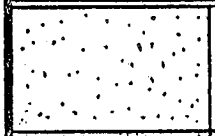
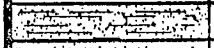
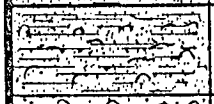
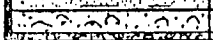
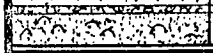
DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM
NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA

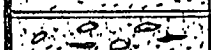
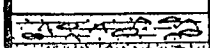
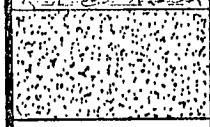
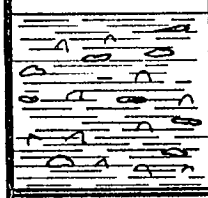
PLATE No. 7

PLATE No. 7

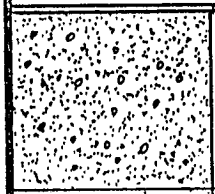
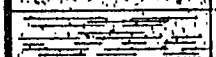
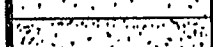
CORE BORING NO. CS-81

SYMBOL	DEPTH	DESCRIPTION
	0'-20'	Medium sand, mostly brownish black
	20'-25'	Muddy fine sand, park gray throughout
	25'-40'	Slightly fossilferous, muddy fine sandy material, med. gray
		Fossilferous med. sand, some shell fragments, grayish brown
	40'-43'	43'-44' fossilferous sand, shell fragments, dard gray
	44'-49'	Slightly fossilferous fine sand, mostly dark grayish brown

CORE BORING NO. CS-95

	0'-9'	Fine to medium; sand mostly gray
	10'-16'	Fine to medium sand with oyster shell fragments
	29'-29'	Fossilferous, muddy sandy material, oyster fragments, dark gray
		29-31' fine sand dark gray
	36'-52'	31-33 peat & organic rich muds & sands
		33-35 organic muds & fossilferous muck, oyster fragments
		very fine sand, dark greenish gray
	55'-83'	Fossilferous mud; oyster fragments

CORE BORING NO. CS-97

	0'-27'	Interbedded clear fine sands and gravelly sands with highly abraided shell fragments (washover sediments)
	27'-35'	Dark gray mottled sandy mud and muddy sand
	35'-44'	Red brown clean, granular medium sand
	44'-50'	Gray interbedded fine sand & granular medium sand
	50'-61'	Dark gray mud & sandy mud with mottles of fine sand

DATA SOURCE:
Dept. of Geology, East Carolina University, Sea Grant Program Study of Sediment History & Processes in Northeastern North Carolina.

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA

CORE BORING LOGS

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM
NOVEMBER, 1973

PLATE No. 8

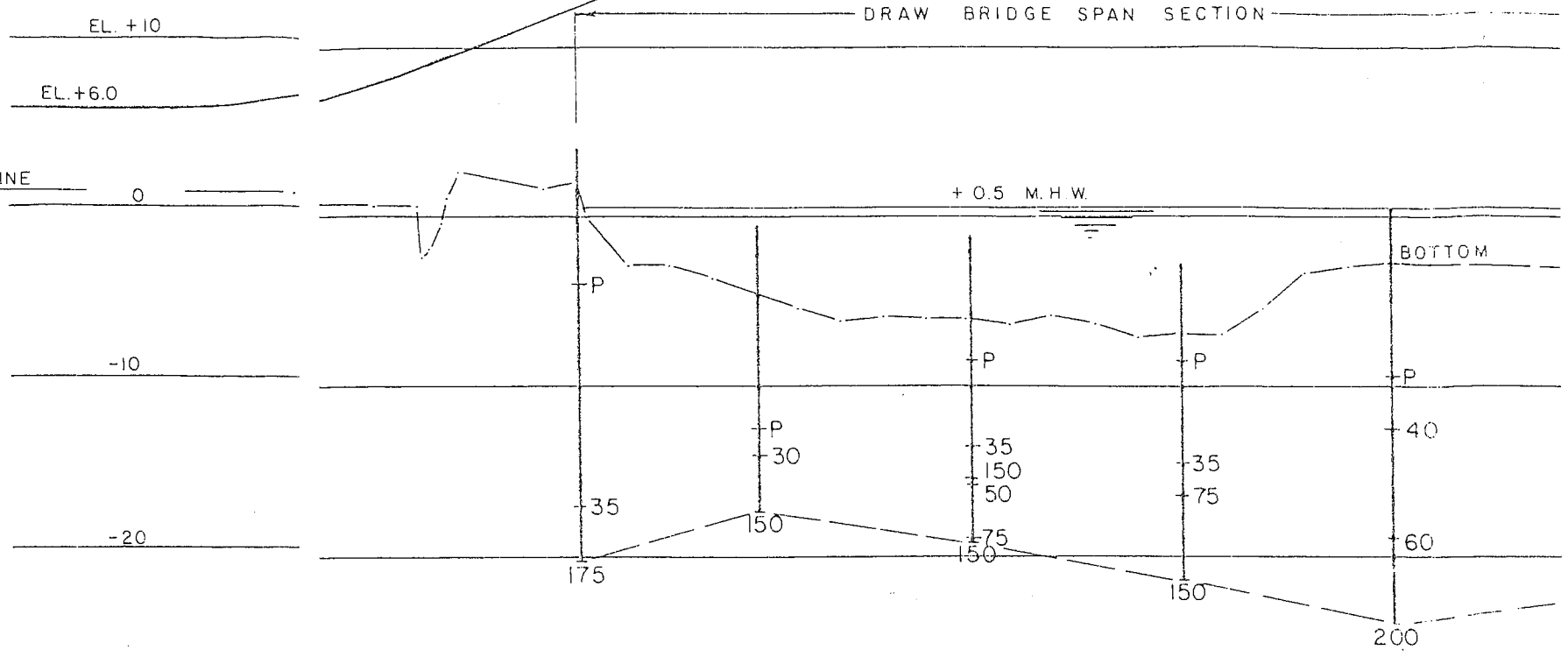
NOTES:

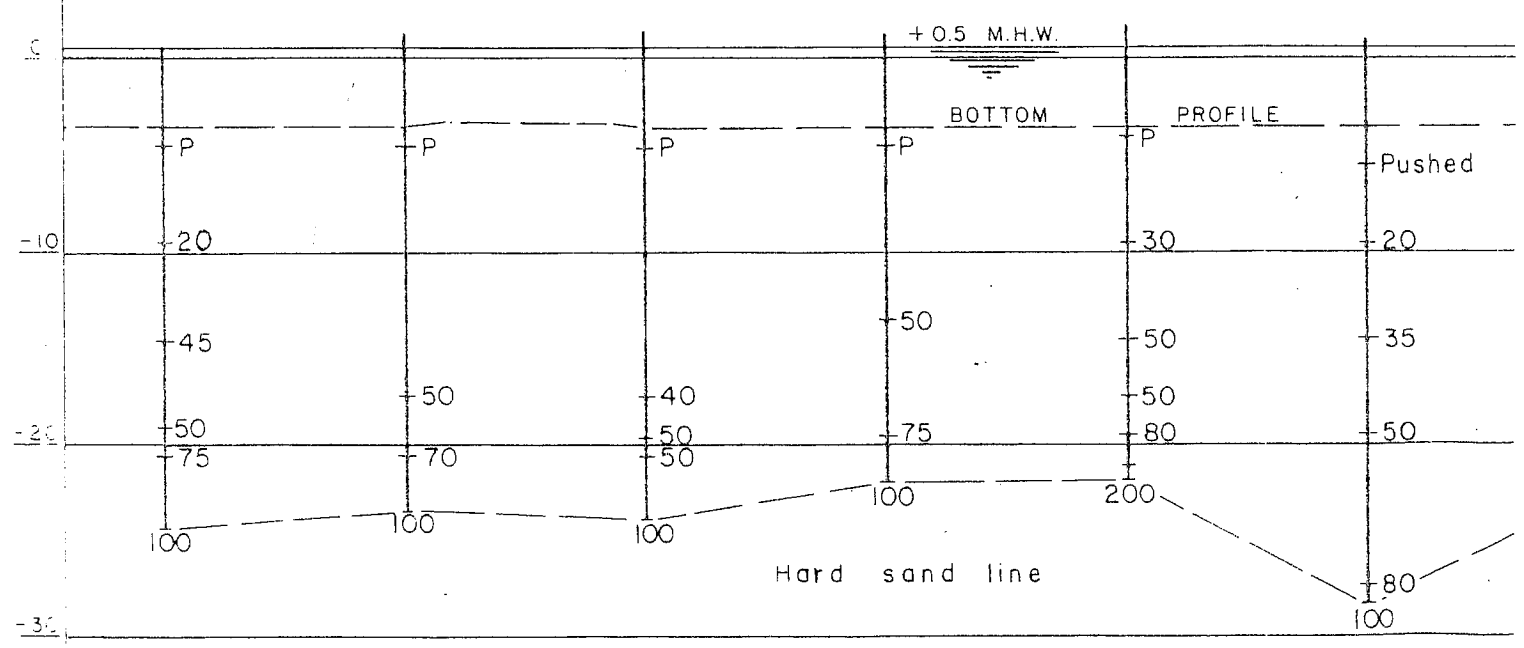
1. Total length of bridge is 4,762'-8". Pile bent spacing is either 17', or 18' on centers depending on their location in the structure.

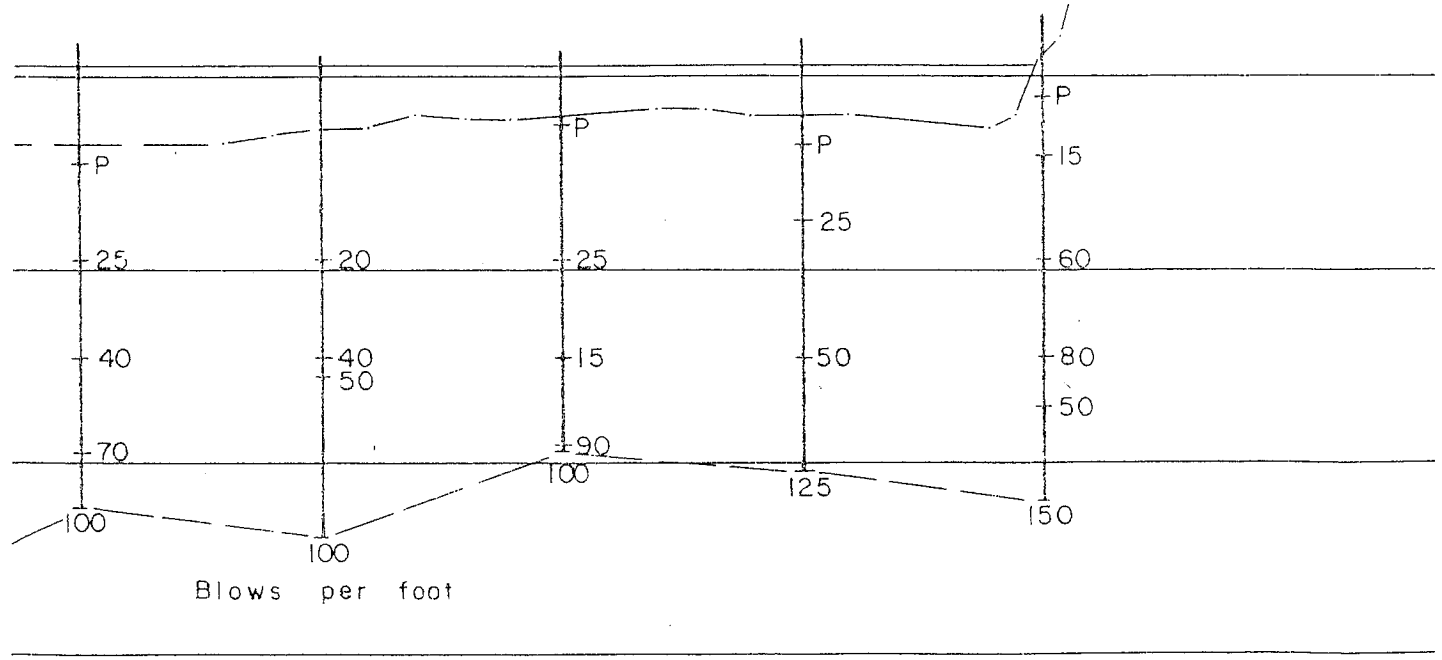
2. All spans are not shown. Schematic representation is intended only to show general pile lenghts and penetration data. Data shown is representative of the pile bearing capacity throughout the structure.

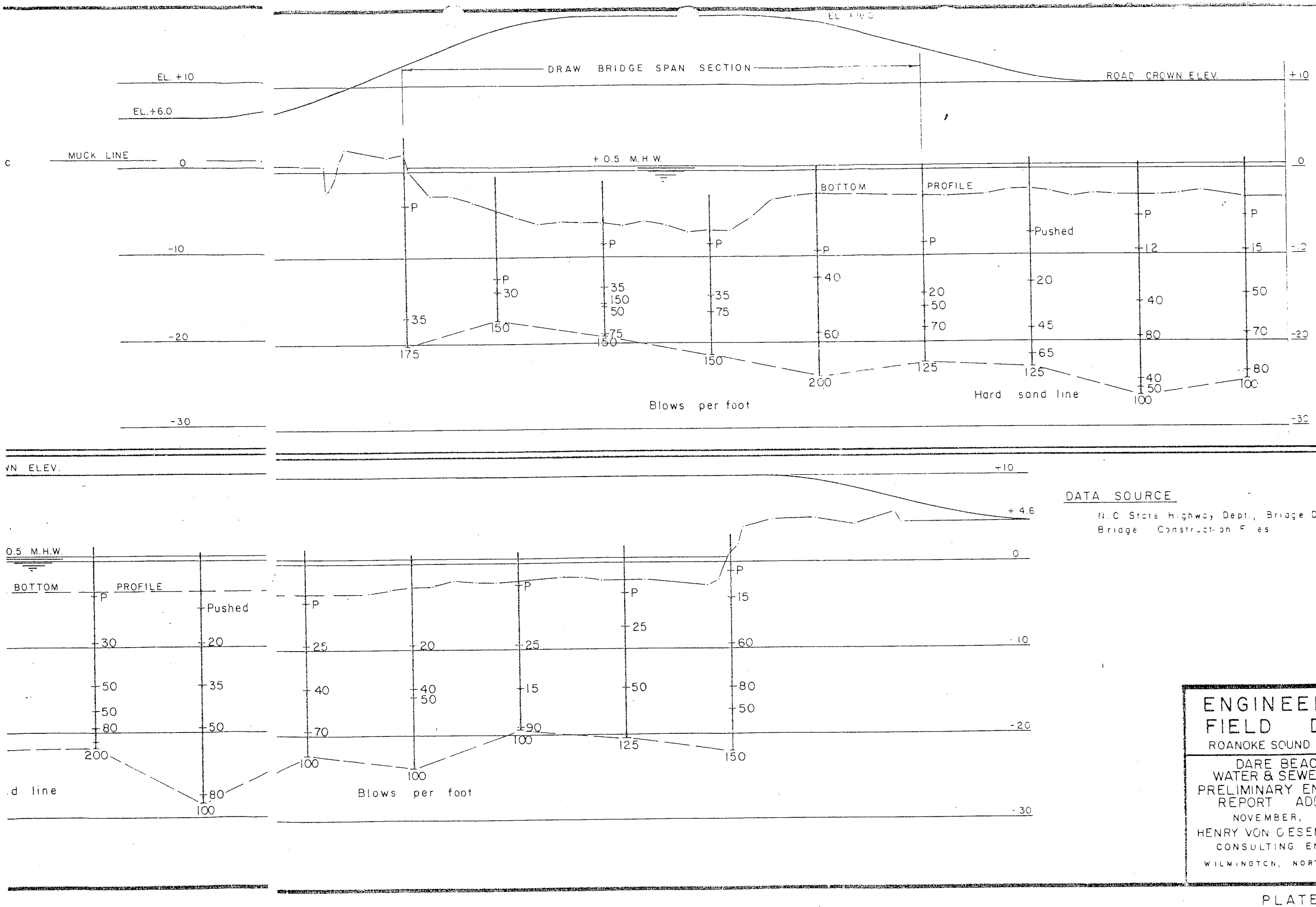
3. Average pile length for other than draw span is 34.34'. (Crown of bridge to hard sand line.)

4. Numbers by each pile shown is the number of blows required to drive piles one foot.









DATA SOURCE

N.C State Highway Dept., Bridge Design Div.
Bridge Construction Files

ENGINEERING FIELD DATA

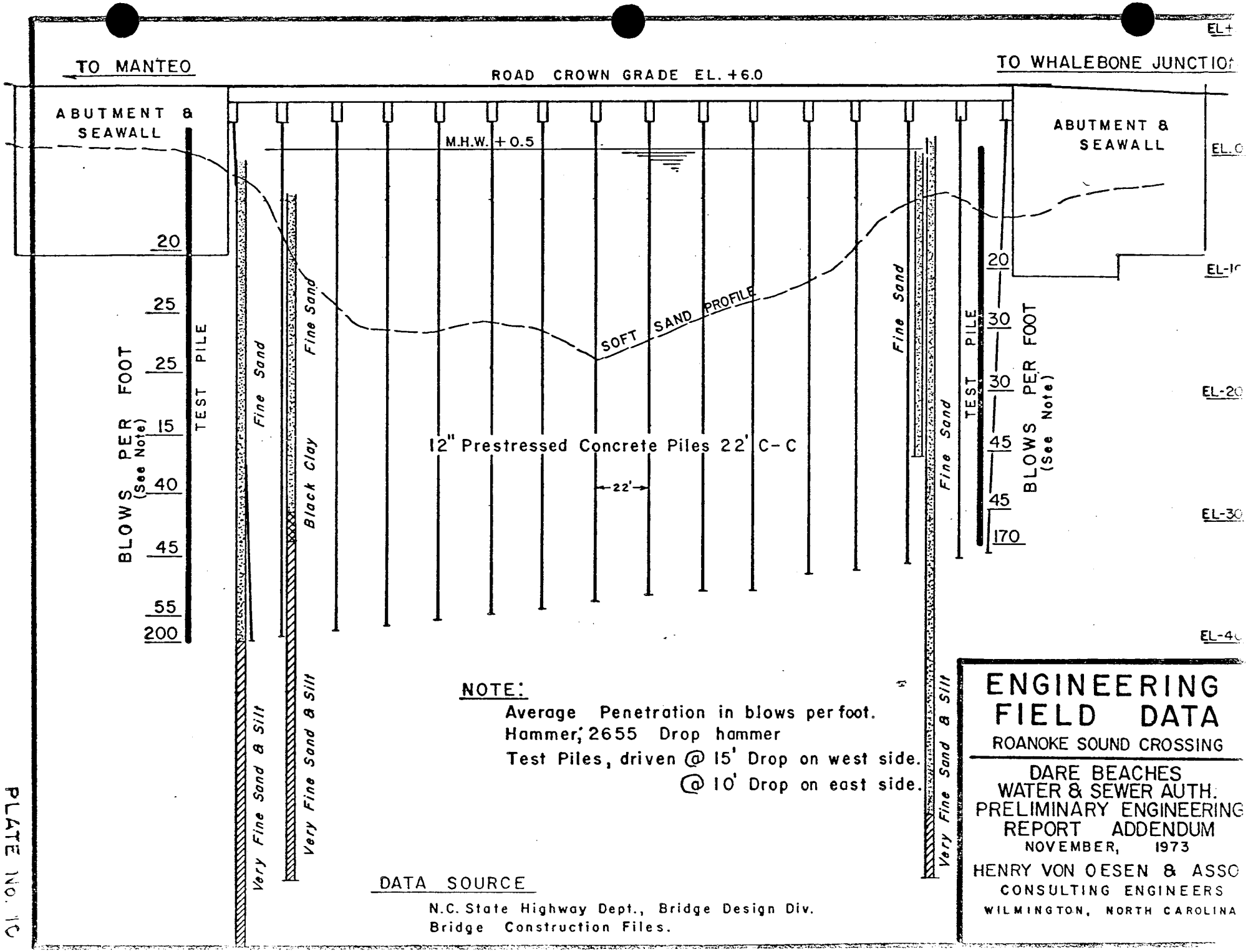
ROANOKE SOUND CROSSING

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT ADDENDUM

NOVEMBER, 1973

HENRY VON OESEN & ASSOC.
CONSULTING ENGINEERS
WILMINGTON, NORTH CAROLINA

PLATE No. 9



NOTE:

Average Penetration in blows per foot.
Hammer; 2655 Drop hammer
Test Piles, driven @ 15' Drop on west side.
@ 10' Drop on east side.

DATA SOURCE

N.C. State Highway Dept., Bridge Design Div.
Bridge Construction Files.

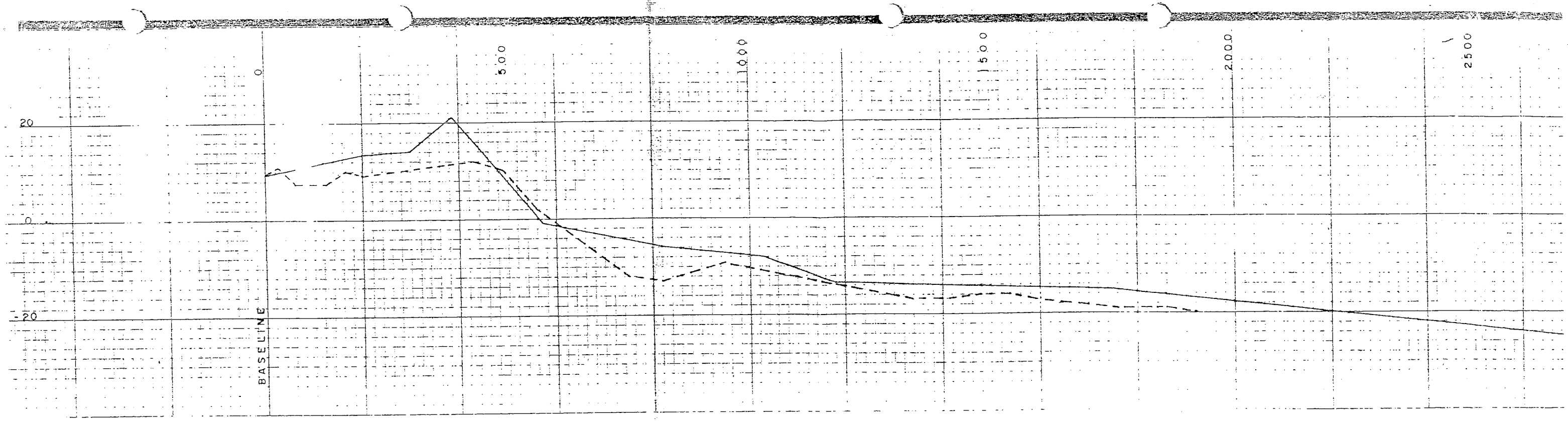
ENGINEERING FIELD DATA

ROANOKE SOUND CROSSING

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT ADDENDUM
NOVEMBER, 1973

HENRY VON OESEN & ASSOC
CONSULTING ENGINEERS
WILMINGTON, NORTH CAROLINA

PLATE NO. 10

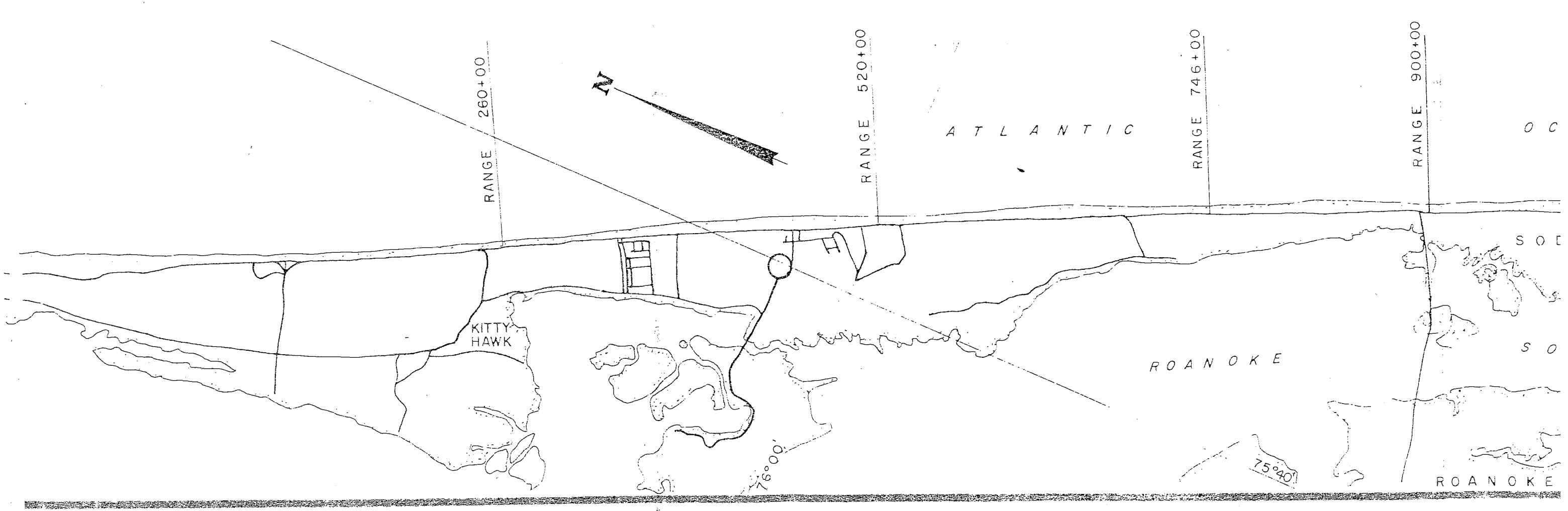


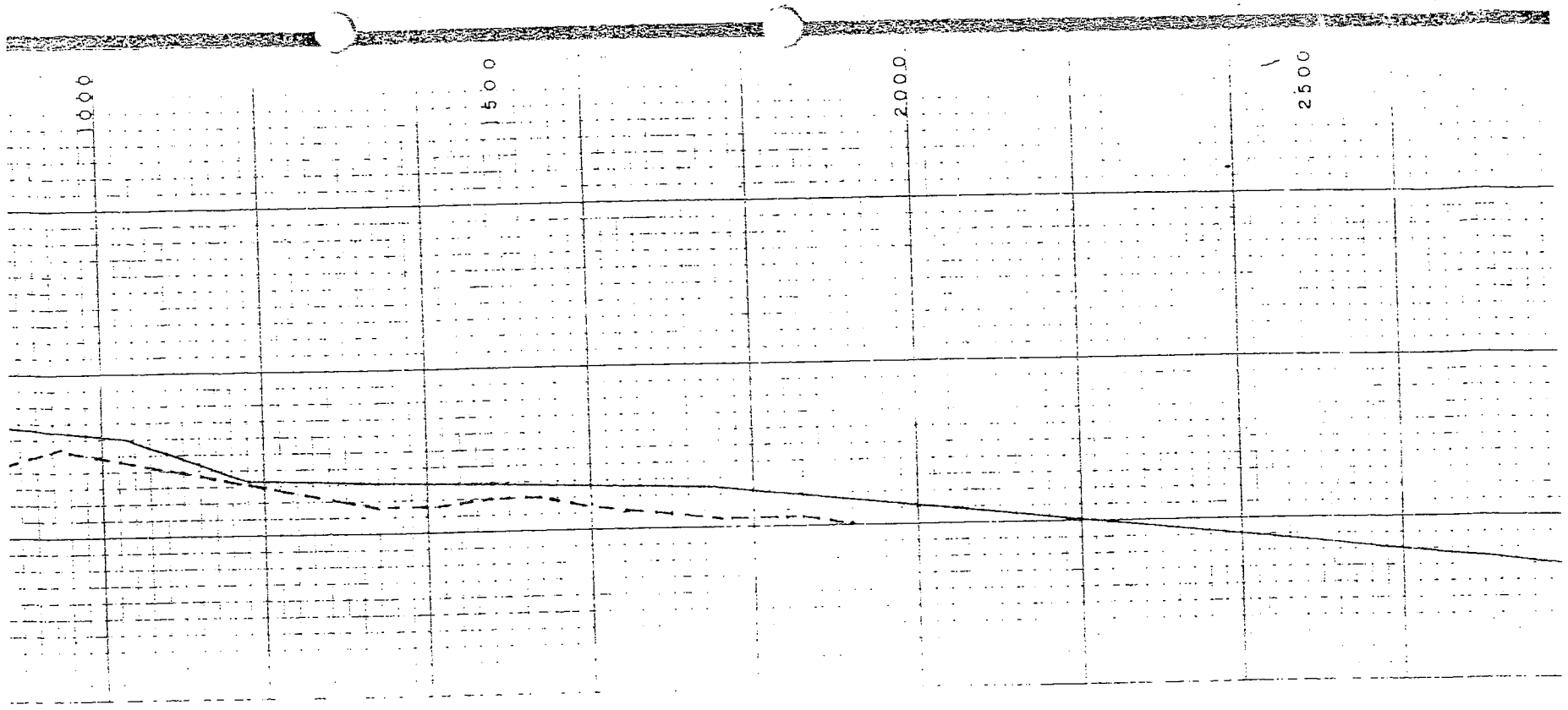
AUGUST 1962

AUGUST 1937

RANGE 520+00

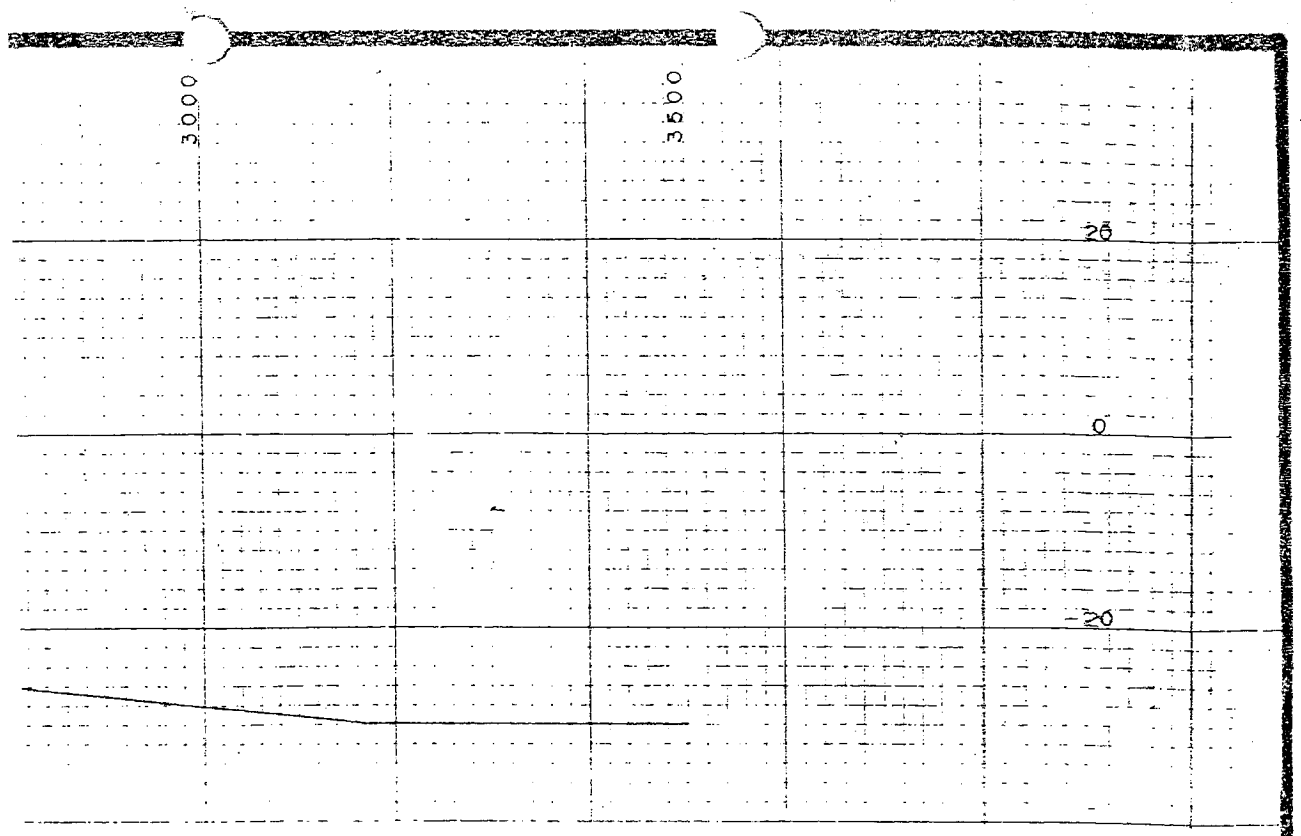
SCALE 1"=200'H ; 1"=20'V





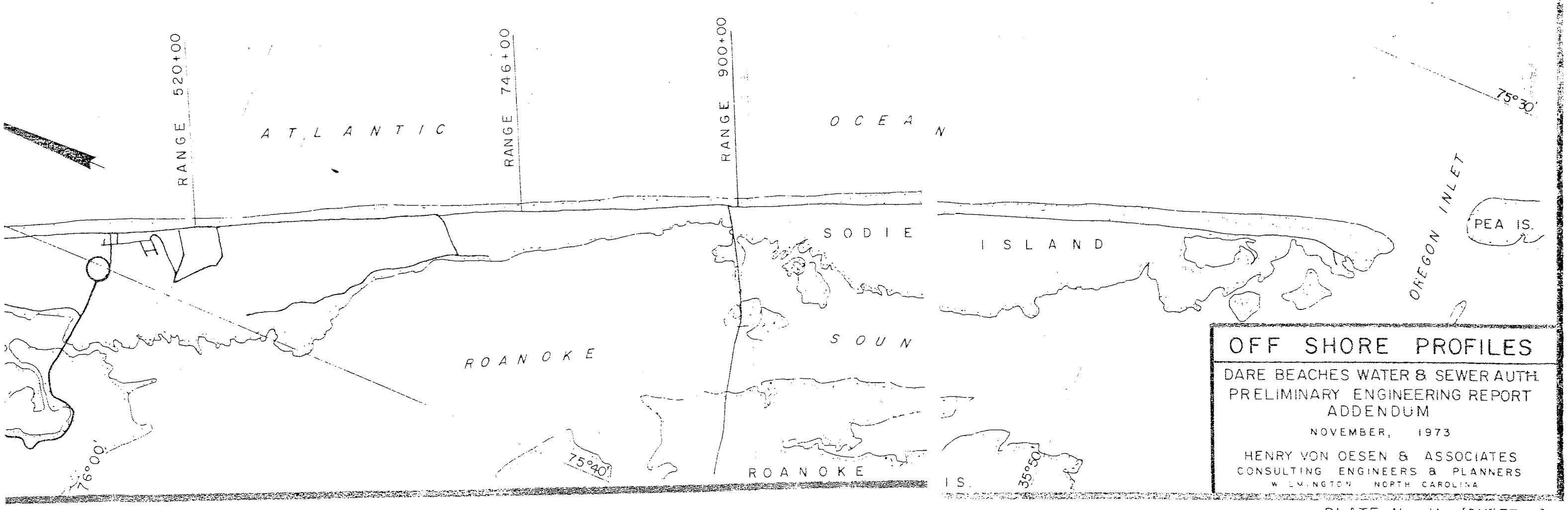
RANGE 520+00

SCALE 1"=200'H ; 1"=20'V



DATA SOURCE

U. S. Army Corps of Engineers
Wilmington District.



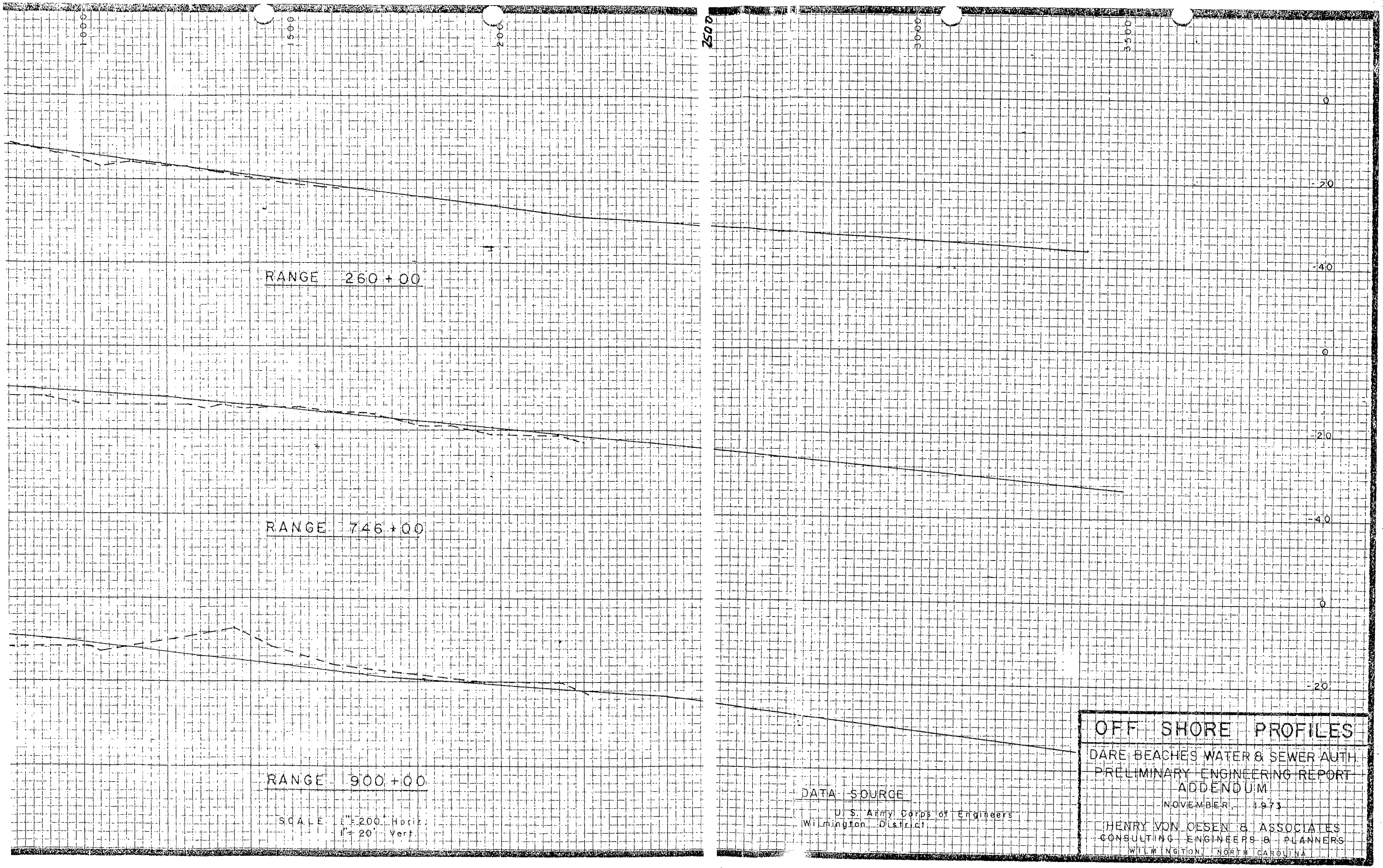
OFF SHORE PROFILES

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM

NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON NORTH CAROLINA

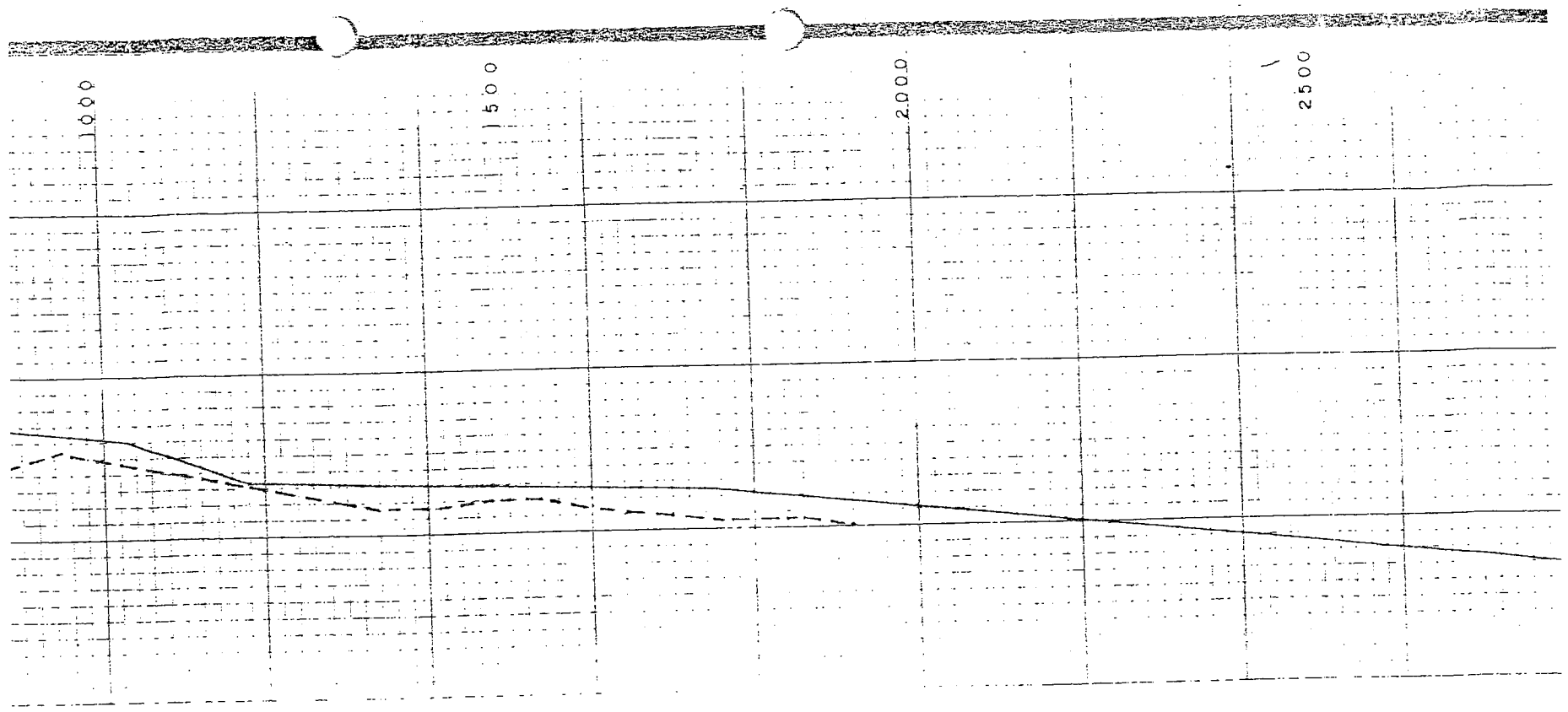
PLATE No. II (SHEET 1)



OFF SHORE PROFILES

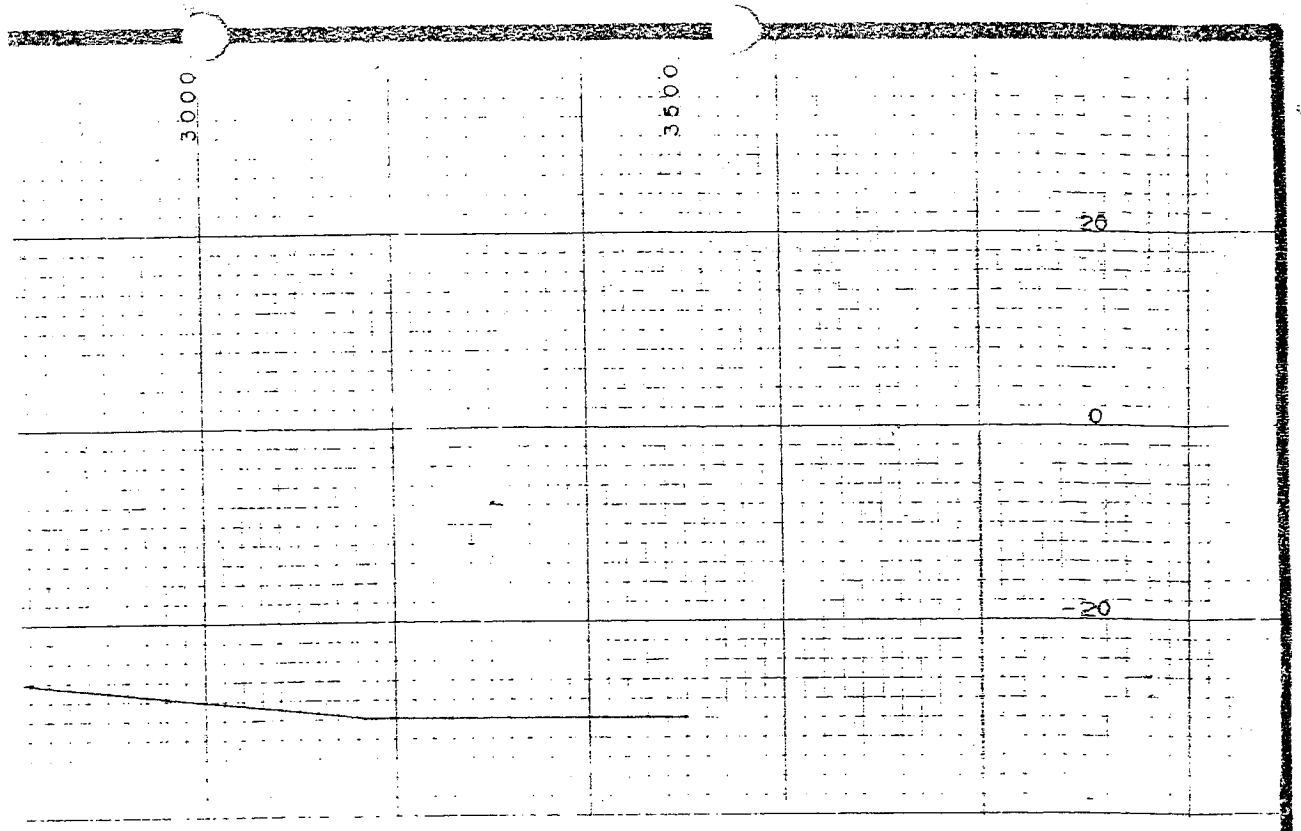
DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM
NOVEMBER 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON, NORTH CAROLINA



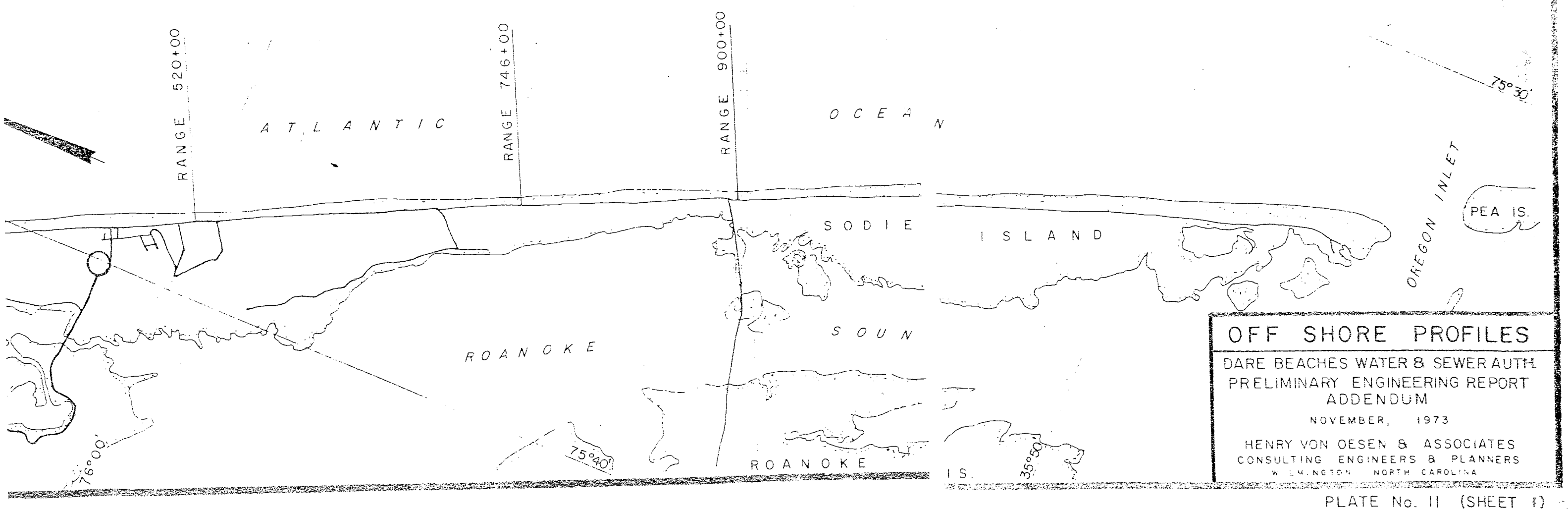
RANGE 520+00

SCALE 1"=200'H ; 1"=20'V



DATA SOURCE

U. S. Army Corps of Engineers
Wilmington District.



OFF SHORE PROFILES

DARE BEACHES WATER & SEWER AUTH.
PRELIMINARY ENGINEERING REPORT
ADDENDUM

NOVEMBER, 1973

HENRY VON OESEN & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
WILMINGTON NORTH CAROLINA

PLATE No. II (SHEET 1)

ADDENDUM

OCEAN OUTFALL EFFLUENT DISCHARGE LINE:

General:

Paragraph 6C, Part III of the PER discussed the concept of discharge of treated waste effluent from the sewage treatment facility well off-shore into the Atlantic Ocean. The report suggested that such an ocean outfall line should extend off-shore approximately 2500 feet or to the -25 foot depth contour. Further investigation was required to confirm this suggested length and depth characteristics as compared to actual bottom profile conditions.

Off-Shore Profiles:

A study of hydrographic charts and maps of the area indicates that the -30 water depth contour extends along the barrier island complex in the area in a constant line ranging from between 2300 to 3100 feet off-shore in the study area. U. S. Army Corps of Engineers bottom profiles in the area conducted over a number of years show a relatively constant bottom profile extending along the coast in this area, particularly in the deeper water zones. While some annual and seasonal fluctuations will occur in the bottom profiles in the near shore area, profiles taken 15 years apart reveal almost constant bottom elevations at distances in excess of 1500 feet off-shore. More recent profiles made by the Corps of Engineers for their Coastal Engineering Research Center research pier to be located near Duck (approximately 12 miles north of the proposed effluent outfall site) reveal a consistant continuity of beach profiles along this entire reach of beach. Profiles made in that area in July and September of 1973 remained relatively constant and show that the -20 foot depth contour was reached at a distance of approximately 1900 feet off-shore from the dune line. This coincides almost exactly with the off-shore

bottom profile conducted earlier by the Corps in the vicinity of the proposed outfall pipeline. Thus, this leads to the conclusion that little change might be expected in bottom profiles in off-shore areas over extended periods of time.

Typical profiles taken from Corps of Engineers surveys are shown on Plate II (two sheets). It will be noted that the characteristics described above prevail on these profiles. Recent depth soundings in the beach area in the proposed location of the ocean outfall indicate that the 25 foot depth contour is approximately 2500 to 2700 feet off-shore. Thus, the discharge pipe placement suggested in the PER appears to be valid. The ten foot burial recommended for the near-shore area should be adequate to protect against bottom scour which occurs during the worst storm periods. It is anticipated that this depth of burial will extend between 250 and 300 feet off-shore with the remainder of the pipe laid in a trench with approximately 4 to 5 feet of cover to the point of discharge at the -25 foot depth.

Conclusions:

This additional investigation and analysis leads to the conclusion that the initial assumptions contained in the PER are valid. Thus, no adjustments in concept or cost estimates for this phase of the work are required.

PROJECT FINANCING

Part II, Regional Water Supply System (paragraphs 6 & 7) of the Preliminary Engineering Report (PER) discussed the economic feasibility of the various parts of the system and suggested a method of financing the project based on Federal and State Grants and Loans. The Loan subsidies would be backed by bonds issued by the County as the Project Sponsor. While this system of financing is considered to be eminently sound and is the normal procedure for financing projects of this nature and magnitude, developments in the Federal sector over the past year or so have seriously clouded the Federal Grant Program to the extent that other methods of financing the proposed regional water supply project must be considered. Although this question is not integral to the test well and field engineering requirements of this addendum, it is considered appropriate to discuss this item briefly in this report adjunct to the PER.

The PER proposed that $1,900,000 of the total project cost of $3,800,000 be obtained from Federal Grant Programs. The Dare Beaches Water and Sewer Authority has initiated aggressive action to obtain such grant assistance from both the Economic Development Administration (EDA) and the Farmers Home Administration (FHA). Both agencies have expressed an interest in supporting the project; however, they have also indicated that current program and funding restraints make it appear unlikely that any Grant assistance can be forthcoming in the foreseeable future.

While it is not recommended that these efforts to obtain Federal Grant funding assistance be abandoned, in view of the urgent need for the water supply project it is recommended that alternatives for funding the project entirely from local revenue sources and State Clean Water Bond Act Grant Funds be explored.

Assuming that $900,000 can be obtained from the State and that the project will support a bond issue of approximately $1,000,000, then the remaining $1,900,000 in revenues, required to construct the project, must be obtained from local sources. This may be accomplished by increasing water rates or increasing property taxes to help pay some of the costs for the system (as discussed in the PER). These alternatives do not appear as reasonable or attractive as imposing some sort of general assessment against all property in the water supply service area. This assessment should apply to all property that lies within the authority's main water supply distribution area whether or not distribution systems are initially fully extended into all of the potential service areas.

One method of imposing such an assessment could be based on the taxed valuation of the property under the provisions of N. C. General Statute 153-294-1. Thus the assessment for unimproved properties and those without existing water distribution services would be considerably less than that for improved and more valuable properties. In this manner the cost for providing the proposed regional water supply system would be equitably distributed among property owners throughout the entire service area.

The present tax valuation of the property lying within the three major subdivisions of the proposed water supply service area is summarized in the following table: (Geo-political subdivisions are keyed to the areas previously delinlated in the PER, the Dare Beaches Sketch Development Plan and the Economic Study of the Dare Beaches (Stevens Associates, Report).

Tax Valuation Table - Dare Beaches Area *

Geo-Political Subdivision	Present Tax Valuation (1973 Rates)
Nags Head - South	$ 13,761,957.
Kill Devil Hills	$ 11,493,433.
Kitty Hawk - North	$ 10,703,509
TOTAL TAX VALUATION:	$ 35,958,889.

* Source: Tax Records: Dare County, North Carolina

As indicated in the foregoing table, the tax valuations shown are based on 1973 rates and a 70% property valuation. The County is presently making a detailed re-evaluation of its tax base and revised valuations are due to be published by 1 April 1974. It is anticipated that property values in this revised assessment will reflect a considerably higher valuation than those reported for 1973; however, the 1973 official tax valuation figures are used for purposes of this analysis. If much higher tax values are reported for 1974 the assessment rates ultimately determined may be adjusted to reflect the revised assessment rates.

* NOTE: The present County tax rate for the Towns of Nags Head and Kill Devil Hills is $1.15 per $100.00 assessed property value. The Town tax rates for Nags Head and Kill Devil Hills are $1.55 and $1.20 per $100.00 respectively. The County tax rate for the Kitty Hawk area is $1.60 per $100.00 tax valuation. This unincorporated area has no other local tax.

A second alternative assessment option available under GS 153 would be to impose an area assessment based on acreage. In this case, a flat tax rate would be imposed on all lands within the service area based on the amount of land (acres or fractions thereof) held by individual property owners, corporate bodies, institutions, etc. This method would have the effect of spreading the cost evenly throughout the entire service area.

As a matter of interest, the acreage totals used in preparation of the Dare Beaches Sketch Development (land Use) Plan are summarized as follows:

Planning area	Total acreage considered for development
Nags Head	3962
Kill Devil Hills	3073
Kitty Hawk - North (To Duck)	9136
Total	16,171 acres

The assessment method selected would have to be devised, approved and adopted by the responsible local governing bodies, and ultimately be approved by the people. The objective would be to adopt a plan and assessment scale that would produce the required local funds to insure construction of the project. Once again, it should be pointed out that these assessment revenues could be collected over a period of up to ten years as described for funding the Kitty Hawk - North distribution system (PER - Section II A(8)). It should be mentioned that this general assessment (area assessment) would apply throughout the entire service area and would be in addition to the small "front foot" assessment recommended for financing the Kitty Hawk-North distribution system.

These general areas or tax valuation assessments may be looked upon as a "one time tax" to provide regional water supply to the entire Dare Beaches Area. Experience over the past few years has effectively demonstrated that without dependable, large quantities of water supply the Dare Beaches area will experience seriously increasing economic problems and health hazards due to inadequate water supply. It would appear that the above proposed method of locally financing a portion of the cost of providing regional water supply is worthy of serious consideration.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

Based on the test well drilling program and the field engineering data collection program it is concluded that:

1. an adequate supply of good quality water may be obtained from the principal acquifer on the southern half of Roanoke Island. Individual water supply wells are capable of producing from 500 to 750 gpm or 360,000 to 540,000 gallons per day. Thus, ten to fourteen wells are capable of supplying the initial project requirement of 5 million gallons per day.
2. analysis of the water samples extracted from the test wells indicates a relatively high degree of hardness and the presence of some chemical characteristics which indicate the desirability of affording some treatment to the water.
3. the most satisfactory route for transporting the water from the point of supply to the beach area is across Roanoke Sound adjacent to the U. S. Highway 64-264 bridge (Route A). The alternate crossing from the northern end of Roanoke Island to the beaches area (Route B) is not considered to be feasible because of excessive cost and technical difficulty which might be encountered as a result of the ancient deep channels known to exist in the sound in the crossing area.
4. sub-surface investigation information in the sound area adjacent to the highway 64 bridge indicated that the sub-surface soil conditions can be satisfactorily adapted to either sub-acqueous or elevated pipeline crossings.

5. analysis indicates that the most economical means of transporting the pipeline across the open water areas would be on a pile bent structure.

6. the off-shore profile information reveals that the wastewater treatment plant effluent disposal outfall should extend approximately 2500 feet off-shore to the minus 25 foot water depth.

7. the project cost estimate presented in the PER appears to be reasonable and the overall cost estimate is considered to be valid; however, adjustments of costs for some components of the system may be required during the detailed design phase.

8. Serious consideration should be given by the County Commission, Local Governments and Property Owners, in the proposed Regional Water Supply Service area to the proposition of imposing a one time area tax based on property valuation or on an acreage basis to provide sufficient funds to facilitate early construction of the project.

Recommendations:

(1) Based on the findings and conclusions of this report it is recommended that the Dare Beaches Water and Sewer Authority approve the findings and conclusions presented in this addendum to the Preliminary Engineering Report.

(2) Further, it is recommended that action be initiated to determine public acceptance of one of the area assessment proposals outlined in the PROJECT FINANCING Section of this Addendum.

(3) Upon approval of the above referenced financing concept it is

recommended that action be initiated to obtain General Obligation Bond Approvals and State Grant and Federal Loan approvals to facilitate design and construction of the Regional Water Supply Project.

Respectfully submitted,

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APPENDIX "A"

Extract of Section 3 - "Test Well Construction Report" from well drilling contract.

APPENDIX "A"

SECTION 3 - TEST WELL CONSTRUCTION

3.01 GENERAL REQUIREMENTS:

The work shall consist of the construction of a cased test well together with the necessary screens and the test pumping equipment necessary including all of the power and all other requirements of labor, plant and equipment to construct and test each well. The wells shall be constructed at the site indicated to the Contractor in the field by the Engineer. The Contractor shall follow precisely the procedure set out for testing each well, obtaining samples, recording same, and shall hold all information which is so obtained confidential. Results of each test will be reported by the Owner through their Engineer to the necessary Governmental Agencies having jurisdiction. Generally all materials, and workmanship in the construction of each test well shall conform to the requirements of AWWA Specification A-100, except as specified otherwise herein.

3.02 APPROVALS AND PERMITS:

The Contractor shall obtain the necessary approvals of the Division of Ground Water, Department of Water and Air Resources. The Owner will obtain the necessary approvals and permits from the State Board of Health.

3.03 TEST WELL CONSTRUCTION:

The Contractor shall drill to a depth as required to fully develop the acquifer as directed by the Engineer (approximately 225 feet). The drilled hole shall be suitable for installation of a 10 inch screened and cased well. After drilling, an electric log shall be made. A 10 inch screen line and casing shall then be set and grouted as required by the Office of Water and Air Resources requirements. Particular care shall be taken to assure sealing the well casing at the impervious clay layer overlying the acquifer to be developed. Samples of the materials in the acquifer shall be obtained and analyzed to assure proper screen slot opening size. Well casing shall terminate at an elevation of 12 feet mean sea level. Contractor shall fill around the casing upon completion of the work so that finished grade is within 36 inches of the upper end of well casing.

3.04 WELL SPECIFICATIONS:

A. Well casings shall be 10 inch seamless black steel pipe conforming to ASTM Specification A-120, Schedule 40.

B. Well screens shall be 10 inch, not less than 6 gauge material and shall be of the stainless steel type with continuous openings of proper size to hold back and support the sand and gravel materials of the acquifer. Joints shall be made with heavy butt type couplings of the same materials or by welding. The length of the screen will be as agreed upon with the Engineer in an effort to develop the maximum amount of water possible from the well.

C. The wells shall be provided with an airline. The airline shall be a 3/8 inch copper tubing conforming to Federal Specifications WW-T-799 type K

with solder joint, wrought copper fittings. The airline shall extend a minimum of 10 feet below the greatest possible drawdown level. A drawdown gate and air connection shall be provided.

3.05 TEST PUMP:

The Contractor shall provide a suitable vertical turbine deep well test pump and shall provide the power source to drive the pump. The pump shall be suitable for pumping at various speeds in order to deliver quantities of water up to 750 gallons per minute. Power trains or shafts or belts used in driving this pump shall be properly screened and protected to avoid injury to persons at the site. Measuring device shall be a 6" main line propeller type meter with indicator and totalizer.

3.06 DEVELOPMENT:

Upon completion of the well, it shall be pumped and surged as necessary to remove all drilling mud, cuttings, and other materials and water delivered shall be clear.

3.07 TESTING:

Upon completion of the development, the well shall be tested for quantity and quality as follows:

A. Immediately upon completion of development and before beginning pumping test, collect one water sample for chemical analysis.

B. Record static water level.

C. Begin pumping test at a delivery of 250 gpm. Record pumping level once a minute for 5 minutes and thereafter once each 15 minutes until pumping level stabilizes for 30 minutes. Increase pumping rate in 100 gpm increments, recording pumping levels each 15 minutes until level stabilizes for 30 minutes at each rate. Continue increasing rates up to 750 gpm or until the capacity of the well is determined. Well recovery shall be recorded for two hours. The capacity of the well shall be the rate of delivery at a pumping level 10 feet above the top of the uppermost screen.

D. Collect another water sample for chemical analysis upon completion of this portion of the pumping test.

E. A 24 hour continuous pumping test shall be made at a rate as directed by the Engineer based on the results of the previous testing (approx. 500 gpm). Pumping level shall be recorded at 5 minute intervals for the first 15 minutes, then at 15 minute intervals for the first hour and then at one hour intervals for the remainder of the test. A 2 hour recovery test shall be made at the end of the test. Recovery levels shall be measured at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter.

F. A water sample for chemical analysis shall be taken at the mid point and at the completion of the pumping test.

3.08 DISINFECTION:

Upon completion of testing the well shall be disinfected in accordance with State Board of Water and Air Resources and Board of Health requirements.

3.09 CAPPING:

Upon completion of the work the well shall be capped and an identification tag installed in accordance with the State Board of Water and Air Resources standards.

3.10 SAMPLES AND ANALYSES:

All water samples shall be taken by the Contractor and delivered to the laboratory of the N. C. State Board of Health for complete (18 tests) chemical analysis. Samples shall be taken in container obtained from the Board of Health for this purpose.

3.11 RECORDS AND TEST REPORTS:

Upon completion of each well the contractor shall deliver to the Engineer in triplicate the following information:

A. A formation log of the well containing a classification of each stratum.

B. An electric log of the well.

C. Pumping test results

D. Results of all water analyses.

E. Record of the well as constructed, including locations of screens, grouting, etc.

3.12 CLEANUP:

Upon completion of work at each site the contractor shall remove from the site all equipment, materials, debris, and other materials resulting from his operations. All trenches shall be filled in unless otherwise directed and the site shall be left in essentially the same condition as existed prior to beginning work.