US Army Corps
of Engineers
Philadelphia District

NEW JERSEY SHORE PROTECTION STUDY

BRIGANTINE INLET TO GREAT EGG HARBOR INLET

ABSECON ISLAND INTERIM FEASIBILITY STUDY

VOLUME 2

FINAL APPENDIX A

ENGINEERING TECHNICAL APPENDIX

August 1996

APPENDIX A
ENGINEERING TECHNICAL APPENDIX

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GENERAL

This Engineering Technical Appendix was prepared in accordance with ER 1110-2-1150, Engineering and Design for Civil Works Projects. Information in this appendix supplements data in the Feasibility Study and the Project Managment Plan (PMP) to satisfy criteris in ER 1110-2-1150.

SECTION 2

HYDROLOGY AND HYDRAULICS/COASTAL PROCESSES

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PHYSICAL PROCESSES OF THE COAST

WAVE DATA. Field measurements of waves at two locations have been collected by Offshore and Coastal Technologies-East, (OCTI) for the Philadelphia District during the period November 1993 to January 1995 (Figure 1). The data provide bulk parameters and directional spectral information at an offshore site (approximately 35 ft depth, 8000 ft offshore) and at a nearshore site (approximately 800 ft south of Absecon Inlet in about 20 ft of water). The offshore wave measurement site is considered representative of incident wave conditions along the project area. The nearshore wave site at Absecon Inlet reasonably monitors the transformed waves reaching the Absecon Inlet/Atlantic City shoreline after passing over the ebb delta and main navigation channel. The two gages provide data needed to validate a nearshore wave transformation model used in this feasibility study. Figures 2 to 4 present typical plots of significant wave height, wave direction and period collected at the offshore gage in March and April 1994. Figures 5 to 7 present typical plots of wave data collected at the inshore gage for November 1993.

WATER LEVEL DATA. Water level measurements were also collected by OCTI at the offshore and inlet wave and current measurement stations at three hour sample periods. Figures 8 and 9 present typical plots of water level elevation for February and March 1994. Figure 10 shows a comparison of measurements made at the NOAA gage and those made at the Coast Guard Basin gage in March 1994.

The dataset of ranked maximum stages measured at the Atlantic City gage is presented in Table 1. These water level values have been adjusted for sea level rise.

CURRENTS. Tidal current data was collected offshore just south of the Absecon Inlet mouth from November 1993 to January 1995, with some gaps in the data due to redeployment of the instruments for a related project and weather conditions. This data includes a large set of current speed and direction measurements at a single location from a bottom mounted self-recording current meter. This data is more relevant to ocean facing shoreline parallel tidal currents than inlet currents because of the location of the current meters. The data was taken at three hour intervals. Figure 11 shows a typical plot of tidal current data collected at Absecon Inlet in November 1993.

In addition, tidal currents and flow estimates for Absecon and Brigantine Inlets are available from a study conducted in September 1994 by CERC for the Philadelphia District. Acoustic Doppler Current Profiler (ADCP) measurements were taken at Absecon Inlet to provide estimates of depth averaged currents at specified cross-sections and flow volumes as a function of time over most of a tidal cycle. Typical plots of the current data are provided in Figures 12 through 14. Complete analysis results are provided in a comprehensive report entitled "Current Survey of Absecon Inlet, NJ with a Broadband Acoustic Doppler Current Profiler" available at the Philadelphia District.

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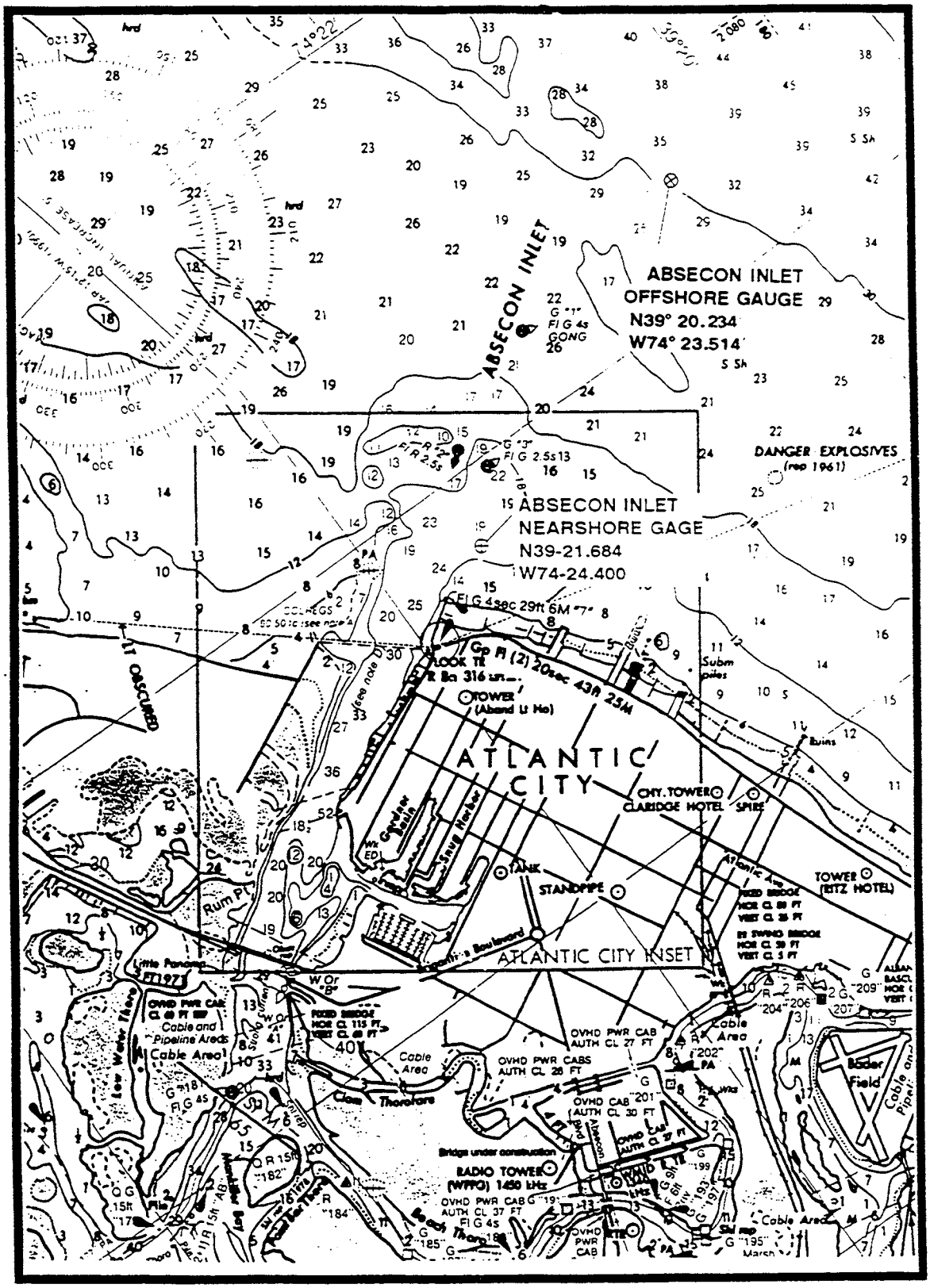


Figure 1. Absecon Inlet Gage Locations.

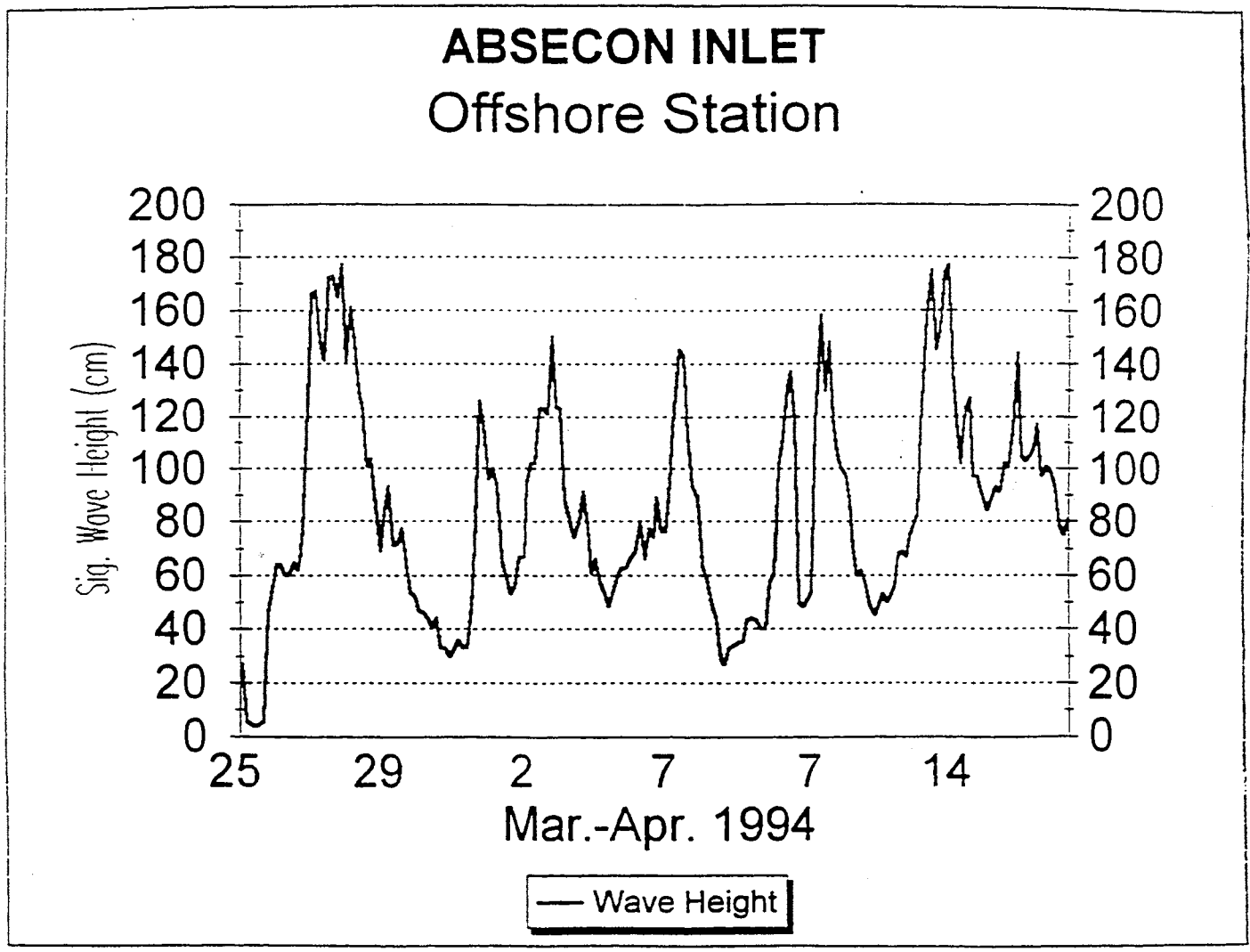


Figure 2. Typical Plot of Wave Height at Offshore Station.

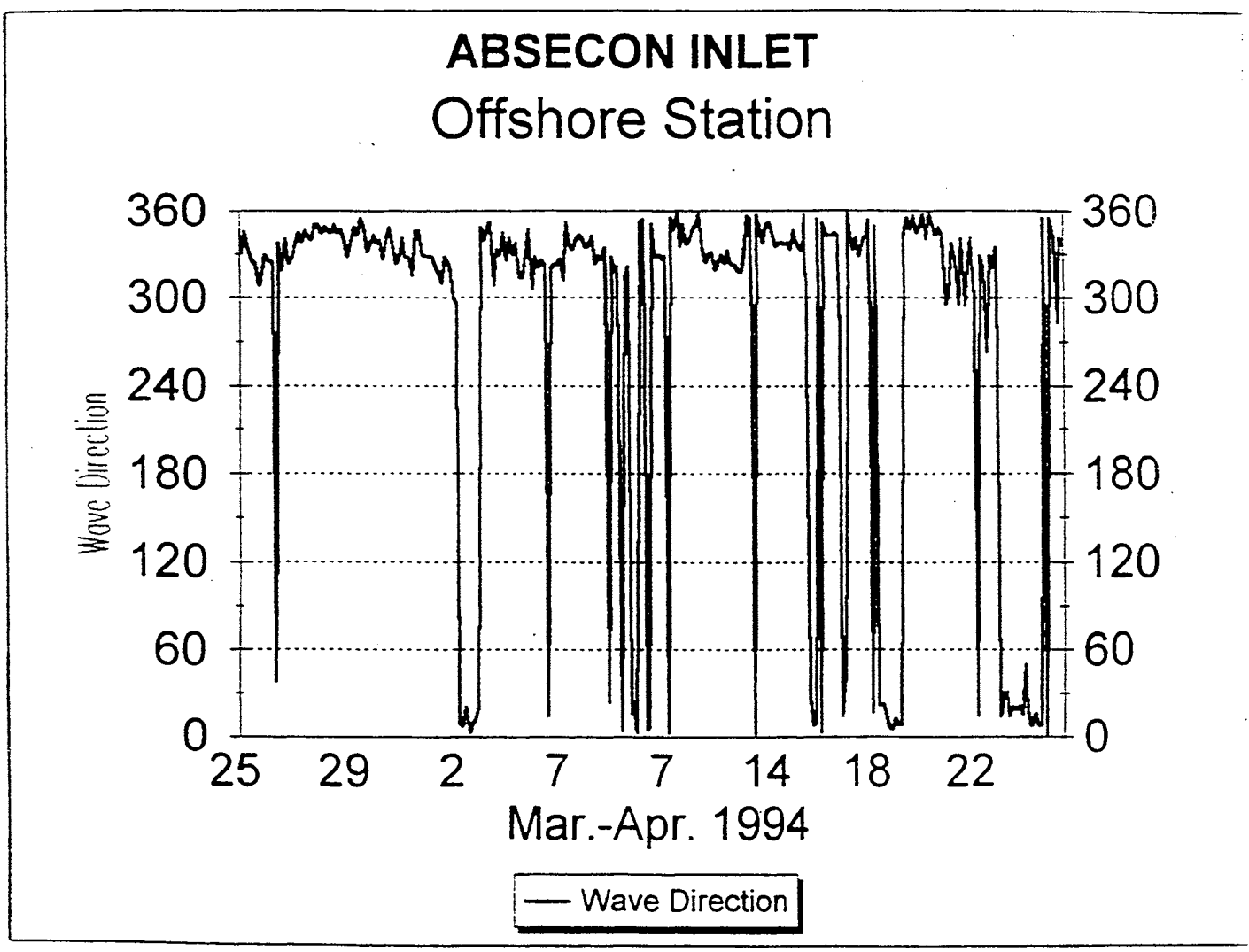


Figure 3. Typical Plot of Wave Direction at Offshore Station.

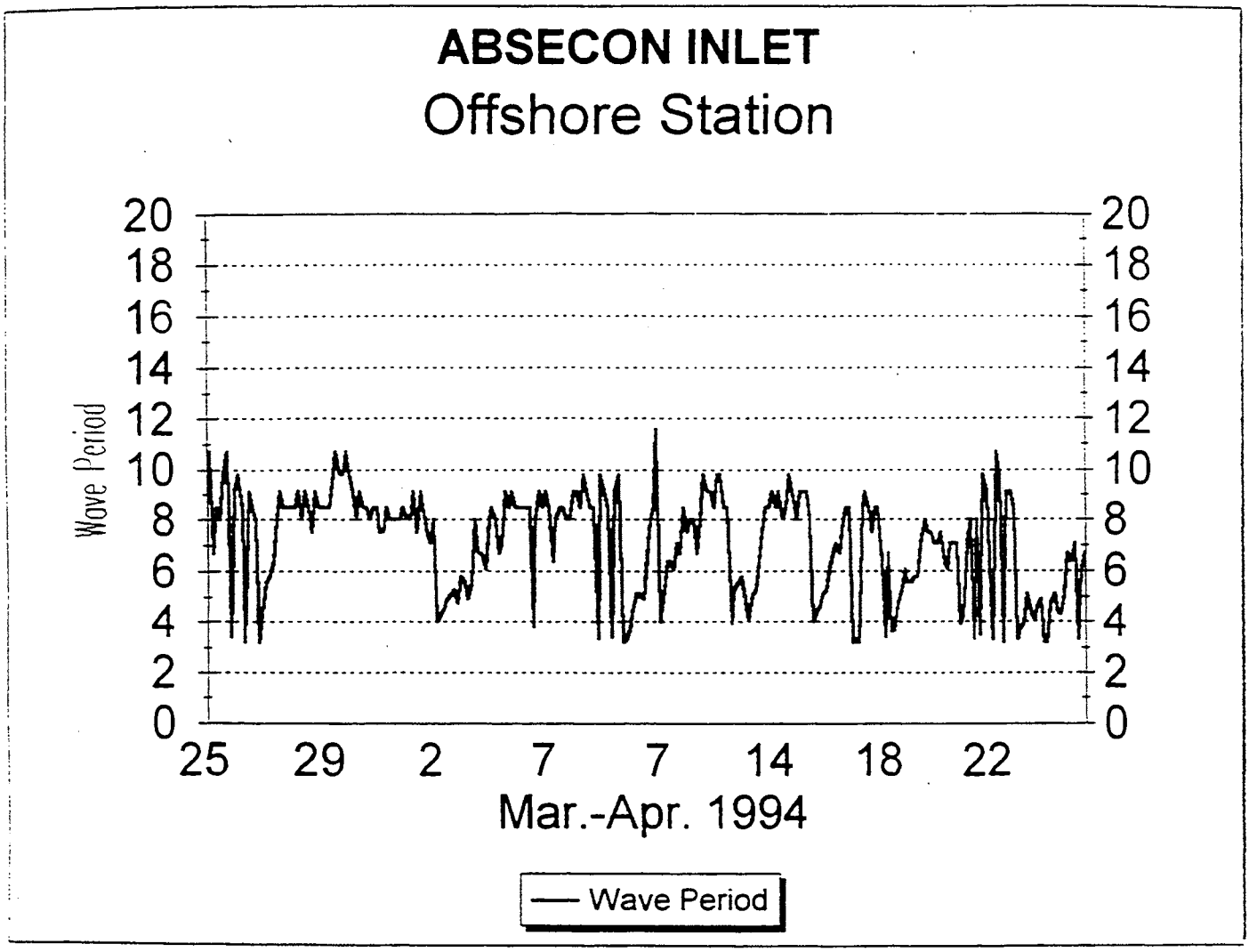


Figure 4. Typical Plot of Wave Period at Offshore Station.

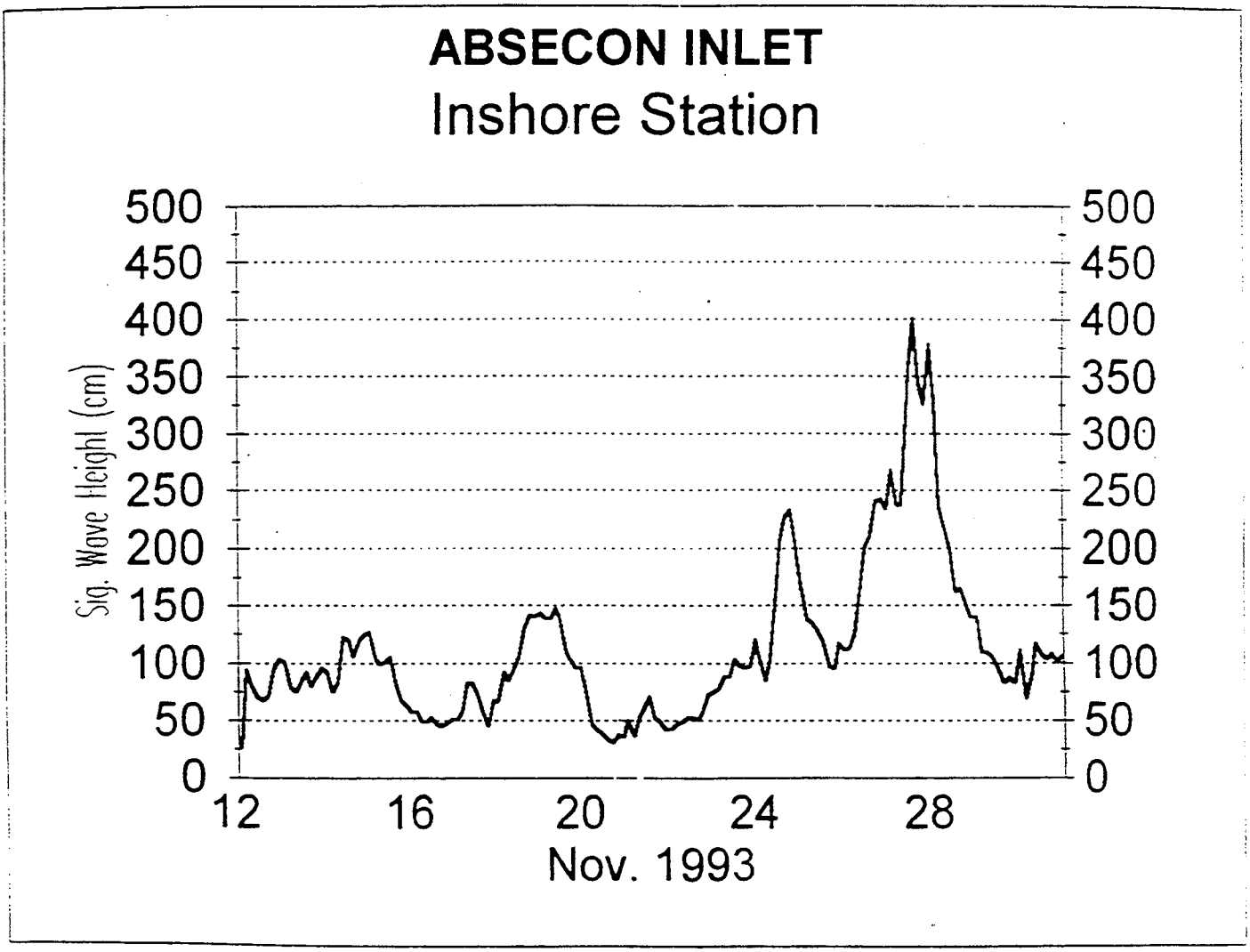


Figure 5. Typical Plot of Wave Height at Inshore Station.

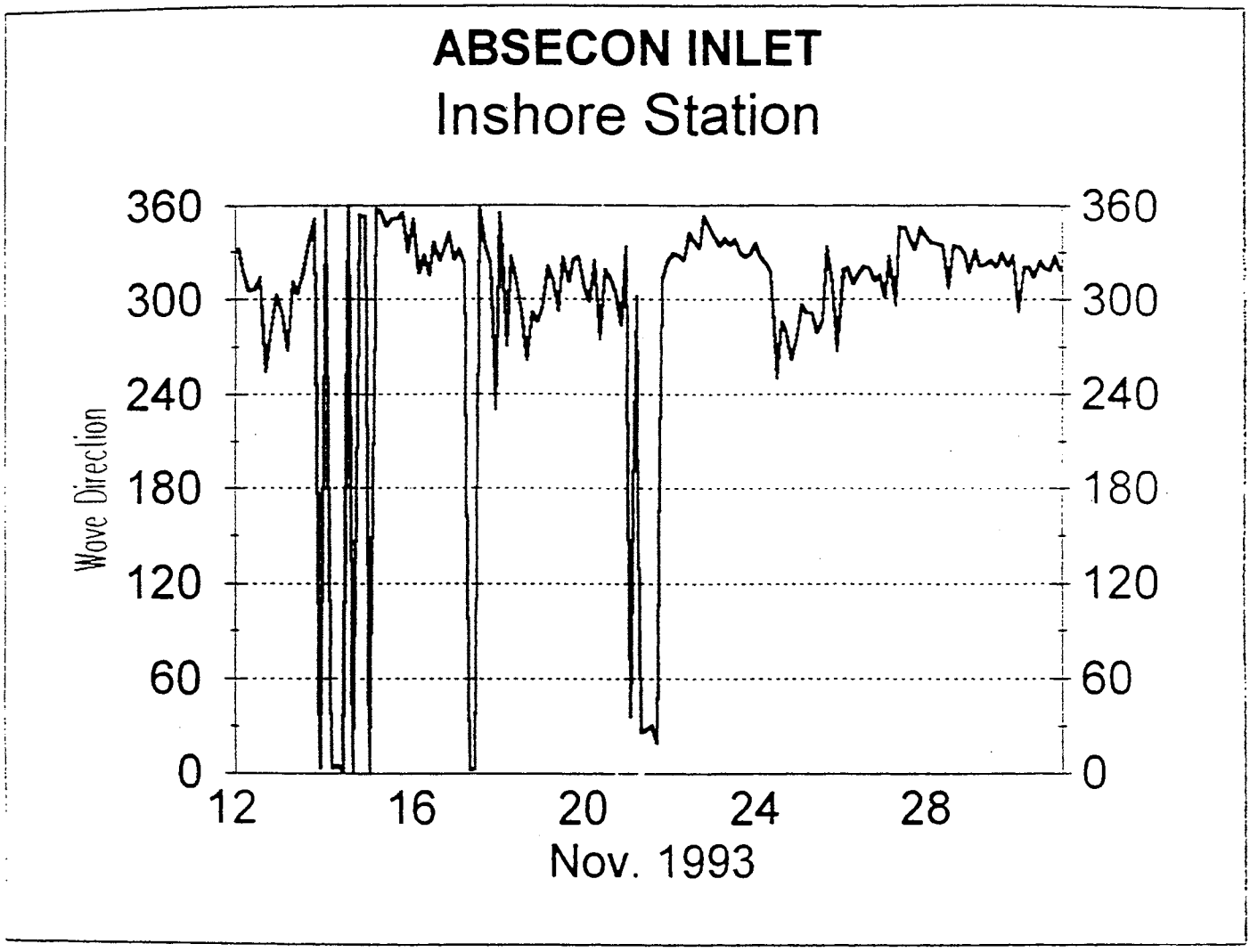


Figure 6. Typical Plot of Wave Direction at Inshore Station.

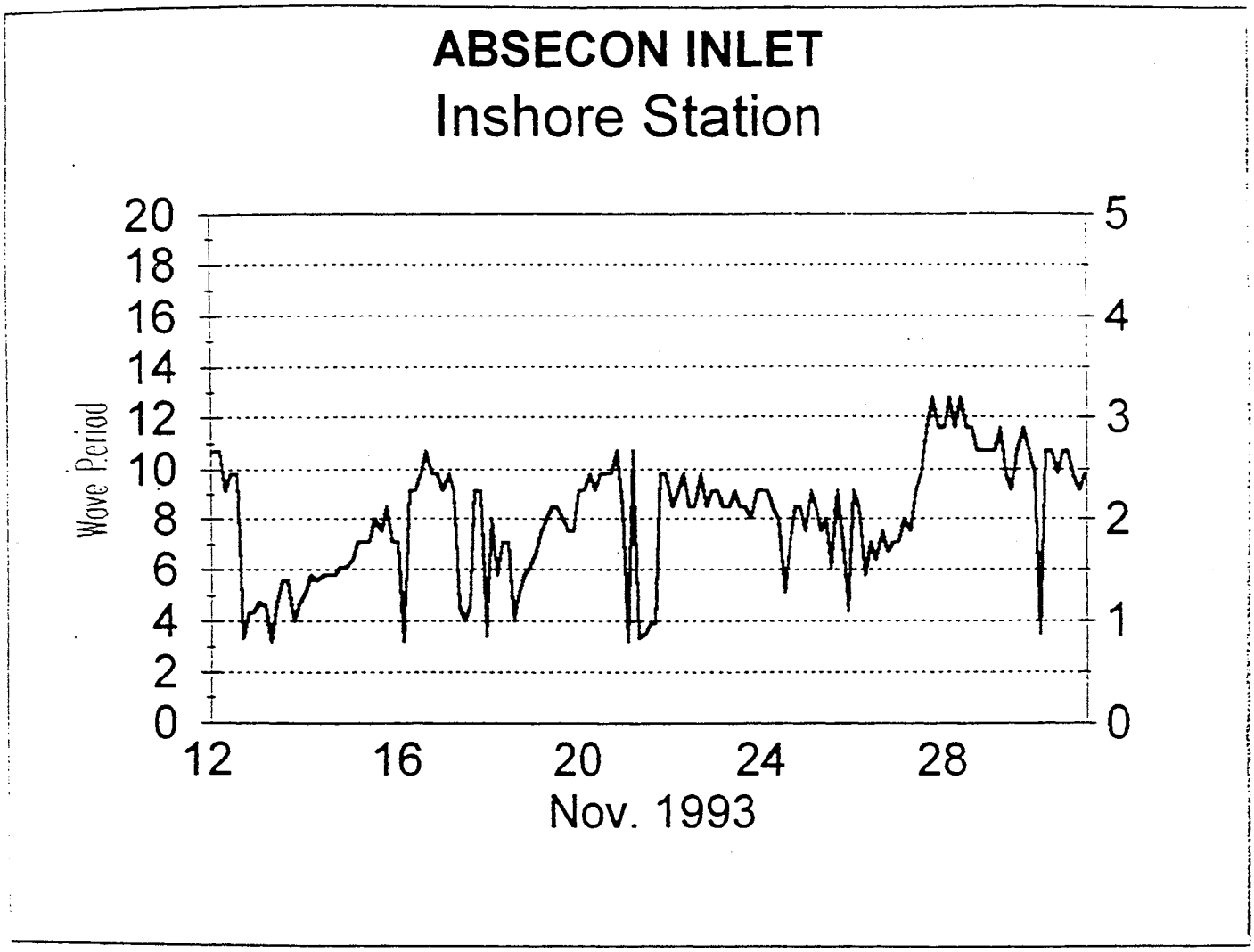


Figure 7. Typical Plot of Wave Period at Inshore Station.

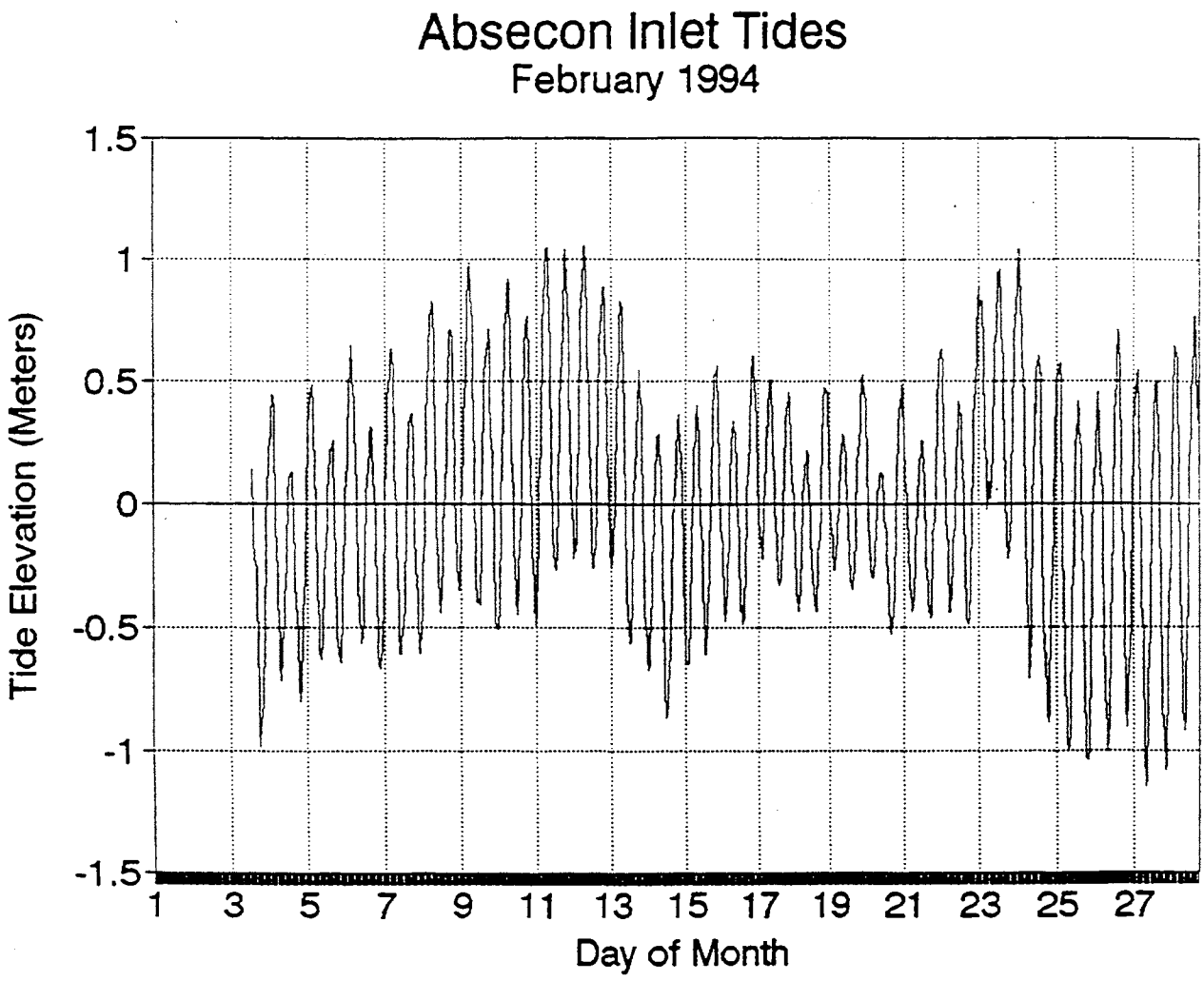


Figure 8. Typical Plot of Tidal Data - February 1994.

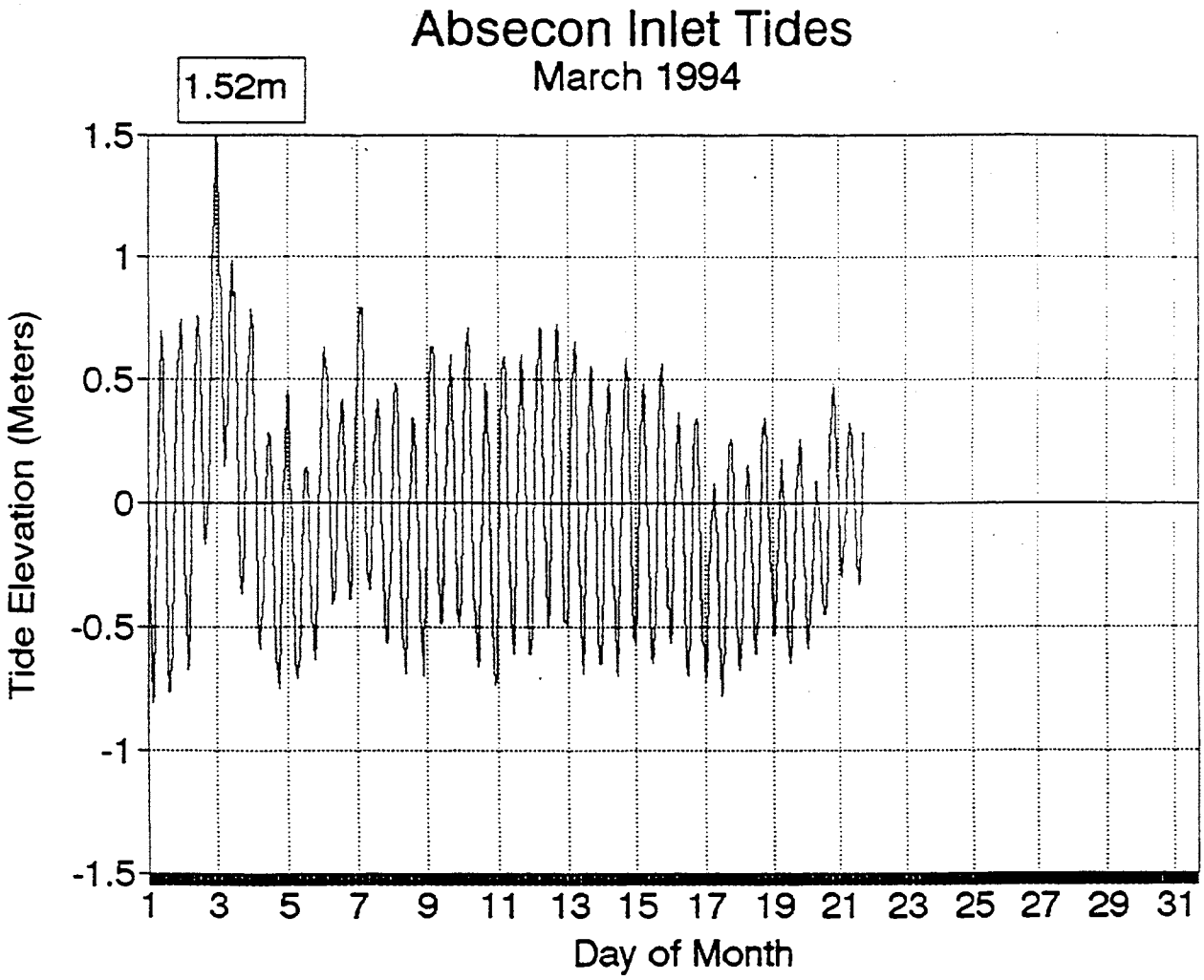


Figure 9. Typical Plot of Tidal Data - March 1994.

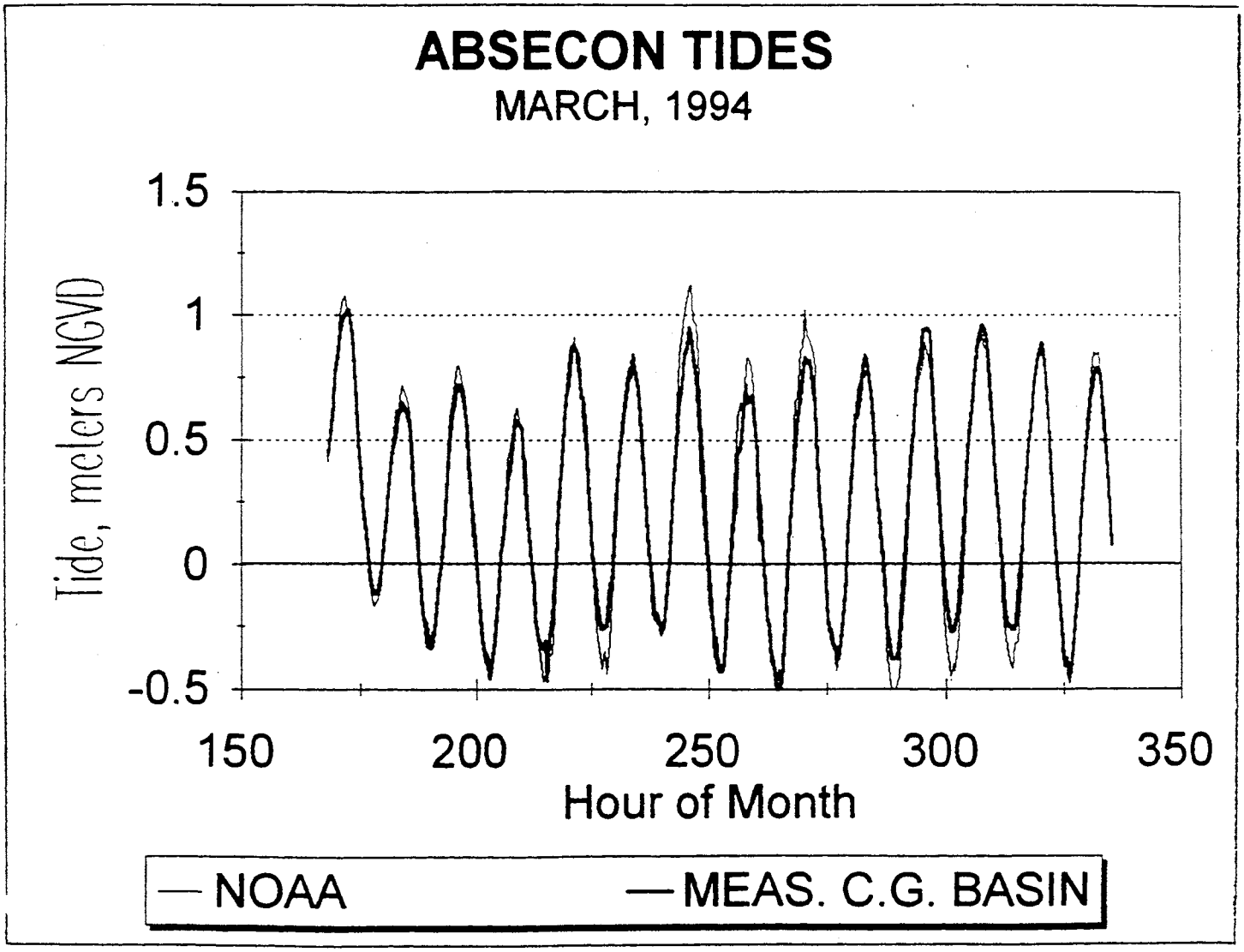


Figure 10. Comparison of Atlantic City NOAA and Absecon Inlet Tidal Measurements.

Table 1
Atlantic City, NJ Gage (1912-1994) Ranked Annual Maximum Stages

Year	Date	Stage Ht. Gage	Stage Ht. NGVD	Sea Level Adj.	Adj. Stage NGVD	Rank
1944	9/14/44	13.80	7.57	0.645	8.22	1
1962	3/7/62	13.40	7.17	0.413	7.58	2
1950	11/25/50	13.20	6.97	0.568	7.54	3
1992	12/11/92	13.64	7.4	0.026	7.43	4
1985	9/27/85	28.97	7.28	0.116	7.40	5
1976	8/9/76	13.40	7.16	0.232	7.39	6
1991	10/31/91	28.89	7.2	0.039	7.24	7
1984	3/29/84	12.95	6.71	0.129	6.84	8
1980	10/25/80	12.78	6.54	0.181	6.72	9
1953	10/23/53	12.30	6.07	0.529	6.60	10
1989	10/19/89	27.13	6.44	0.065	6.51	11
1977	10/14/77	12.50	6.26	0.220	6.48	12
1947	11/1/47	12.10	5.87	0.607	6.48	13
1972	12/22/72	12.40	6.17	0.284	6.45	14
1960	9/12/60	12.20	5.97	0.439	6.41	15
1961	10/22/61	12.20	5.97	0.426	6.40	16
1932	11/10/32	11.80	5.57	0.800	6.37	17
1935	9/6/35	11.80	5.57	0.761	6.33	18
1920	2/5/20	11.60	5.37	0.955	6.33	19
1994	3/94	12.53	6.3	0.000	6.30	20
1966	1/23/66	12.10	5.87	0.361	6.23	21
1973	12/9/73	12.18	5.95	0.271	6.22	22
1914	12/7/14	11.40	5.17	1.032	6.20	23
1918	4/11/18	11.4	5.17	0.981	6.15	24

Table 1 (continued)

Year	Date	Stage Ht. Gage	Stage Ht. NGVD	Sea Level Adj.	Adj. Stage NGVD	Rank
1943	10/26/43	11.7	5.47	0.658	6.13	25
1931	3/4/31	11.5	5.27	0.813	6.08	26
1939	5/3/39	11.6	5.37	0.710	6.08	27
1971	8/28/71	12	5.77	0.297	6.07	28
1987	1/2/87	27.62	5.94	0.091	6.03	29
1974	12/2/74	11.99	5.76	0.258	6.02	30
1968	11/12/68	11.9	5.67	0.336	6.01	31
1915	1/3/15	11.2	4.97	1.019	5.99	32
1981	11/15/81	12.03	5.79	0.168	5.96	33
1979	2/26/79	11.93	5.69	0.194	5.88	34
1940	10/1/40	11.4	5.17	0.697	5.87	35
1948	10/6/48	11.5	5.27	0.594	5.86	36
1942	3/3/42	11.4	5.17	0.671	5.84	37
1927	2/20/27	11.2	4.97	0.865	5.84	38
1978	2/7/78	11.86	5.62	0.207	5.83	39
1945	12/2/45	11.4	5.17	0.632	5.80	40
1930	8/22/30	11.2	4.97	0.826	5.80	41
1969	11/10/69	11.7	5.47	0.323	5.79	42
1924	3/21/24	11.1	4.87	0.903	5.77	43
1919	8/13/19	11	4.77	0.968	5.74	44
1951	11/1/51	11.4	5.17	0.555	5.73	45
1959	12/29/59	11.5	5.27	0.452	5.72	46
1993	/93	11.9	5.7	0.013	5.71	47
1923	12/6/23	11	4.77	0.916	5.69	48

Table 1 (continued)

Year	Date	Stage Ht. Gage	Stage Ht. NGVD	Sea Level Adj.	Adj. Stage NGVD	Rank
1956	1/10/56	11.4	5.17	0.490	5.66	49
1990	8/20/90	27.28	5.59	0.052	5.64	50
1937	4/26/37	11.1	4.87	0.736	5.61	51
1986	8/18/86	27.15	5.47	0.103	5.57	52
1958	4/3/58	11.3	5.07	0.465	5.54	53
1928	9/19/28	10.9	4.67	0.855	5.53	54
1929	10/2/29	10.9	4.67	0.839	5.51	55
1955	10/5/55	11.2	4.97	0.503	5.47	56
1967	5/24/67	11.3	5.07	0.349	5.42	57
1936	9/18/36	10.9	4.67	0.748	5.42	58
1983	12/4/83	11.5	5.26	0.142	5.40	59
1982	10/10/82	11.48	5.24	0.155	5.40	60
1949	10/18/49	11	4.77	0.581	5.35	61
1913	12/26/13	10.5	4.27	1.045	5.32	62
1952	12/22/52	11	4.77	0.542	5.31	63
1946	6/2/46	10.9	4.67	0.619	5.29	64
1954	5/3/54	11	4.77	0.516	5.29	65
1963	11/7/63	11.1	4.87	0.400	5.27	66
1925	12/3/25	10.6	4.37	0.890	5.26	67
1933	1/26/33	11.8	4.47	0.787	5.26	68
1965	1/17/65	11.1	4.87	0.374	5.24	69
1934	10/24/34	10.7	4.47	0.774	5.24	70
1938	5/29/38	10.7	4.47	0.723	5.19	71
1916	6/6/16	10.4	4.17	1.006	5.18	72

Table 1 (continued)

Year	Date	Stage Ht. Gage	Stage Ht. NGVD	Sea Level Adj.	Adj. Stage NGVD	Rank
1917	5/5/17	10.4	4.17	0.994	5.16	73
1964	2/19/64	11	4.77	0.387	5.16	74
1941	1/12/41	10.7	4.47	0.684	5.15	75
1957	2/5/57	10.9	4.67	0.478	5.15	76
1926	2/10/26	10.5	4.27	0.877	5.15	77
1912	1/4/12	10.2	3.97	1.058	5.03	78
1988	1/20/88	26.63	4.94	0.078	5.02	79
1975	11/24/75	10.84	4.61	0.245	4.86	80

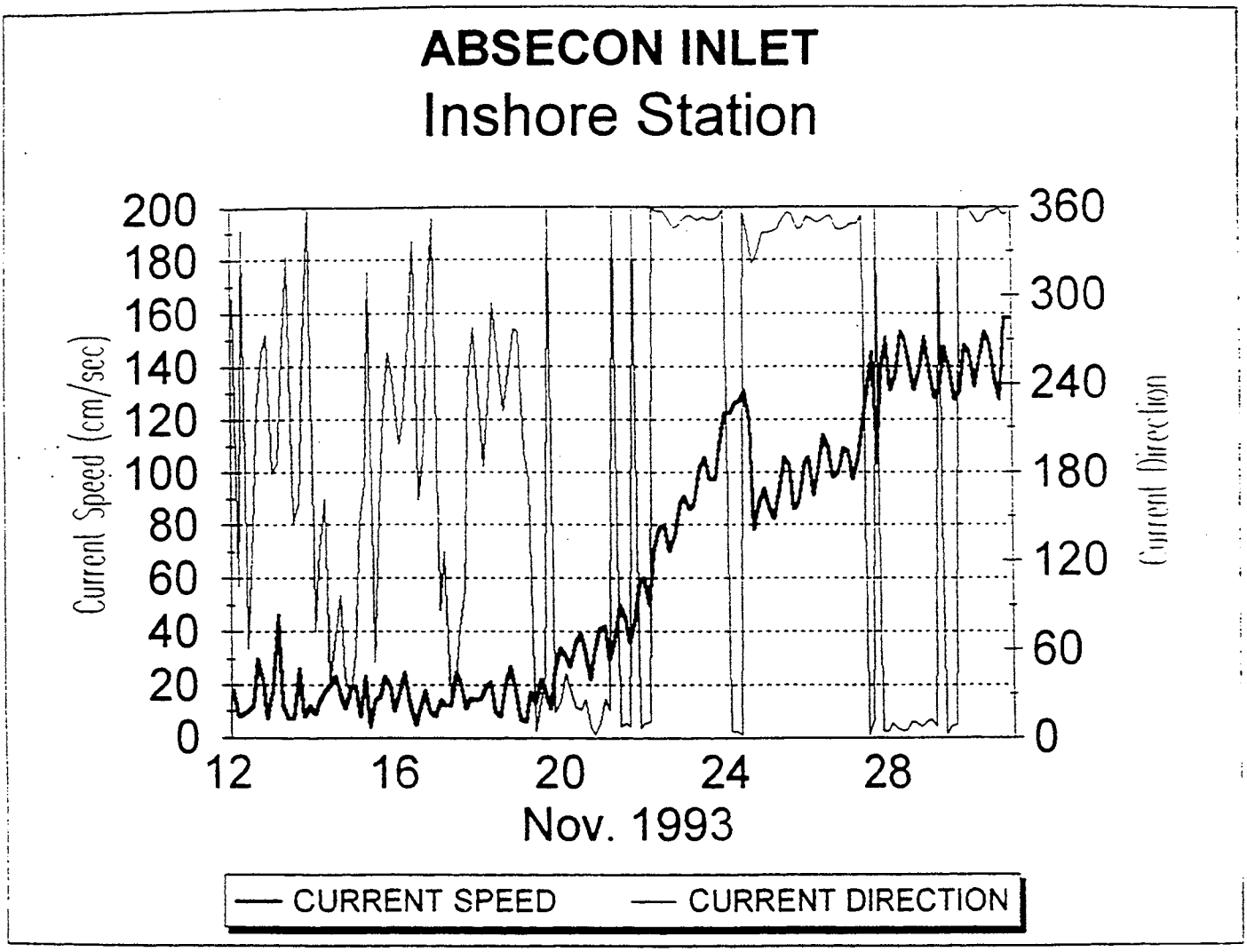


Figure 11. Typical Plot of Current Data at Inshore Station.

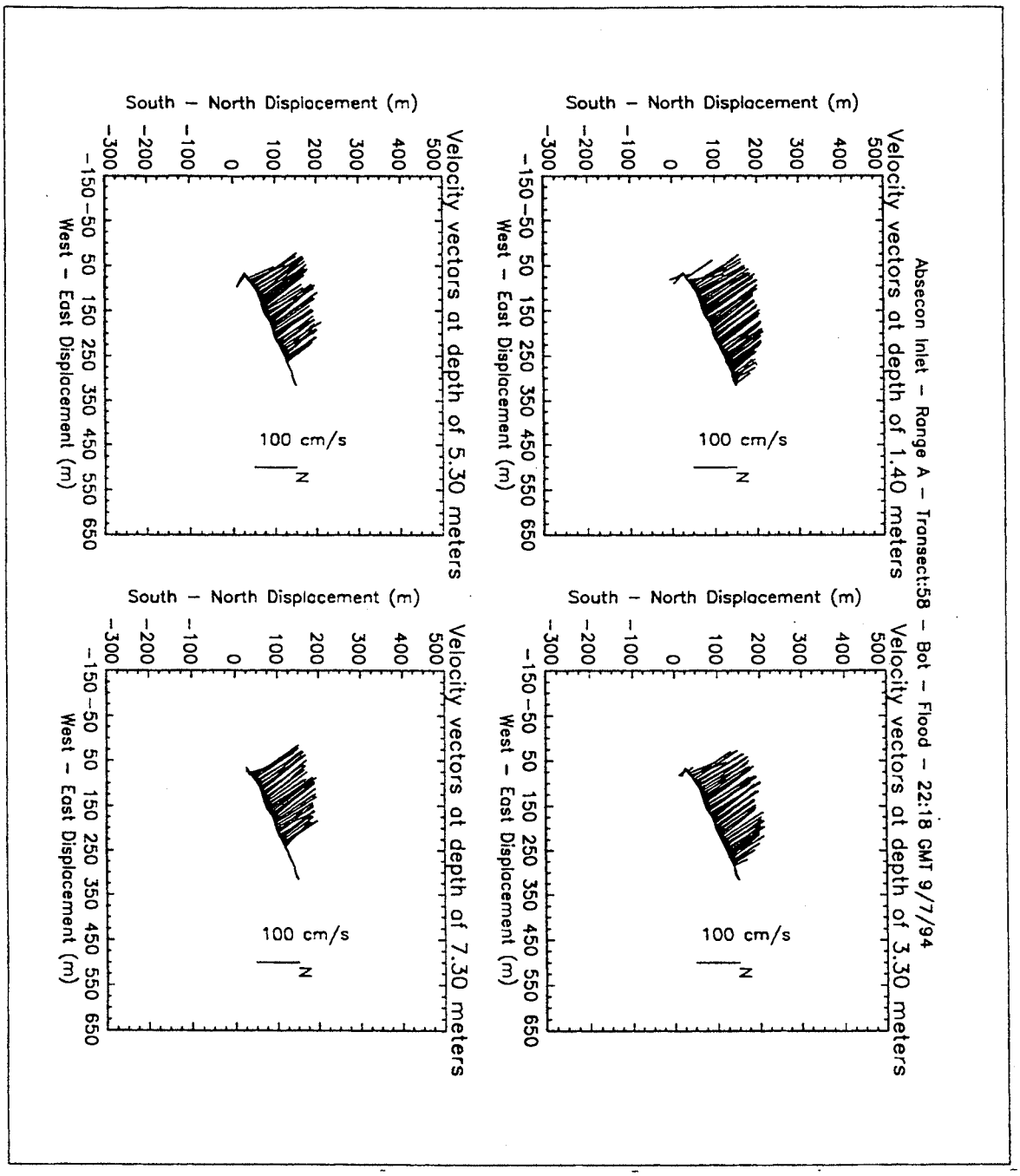


Figure 12. Example of Velocity Vector Plots at Various Depths.

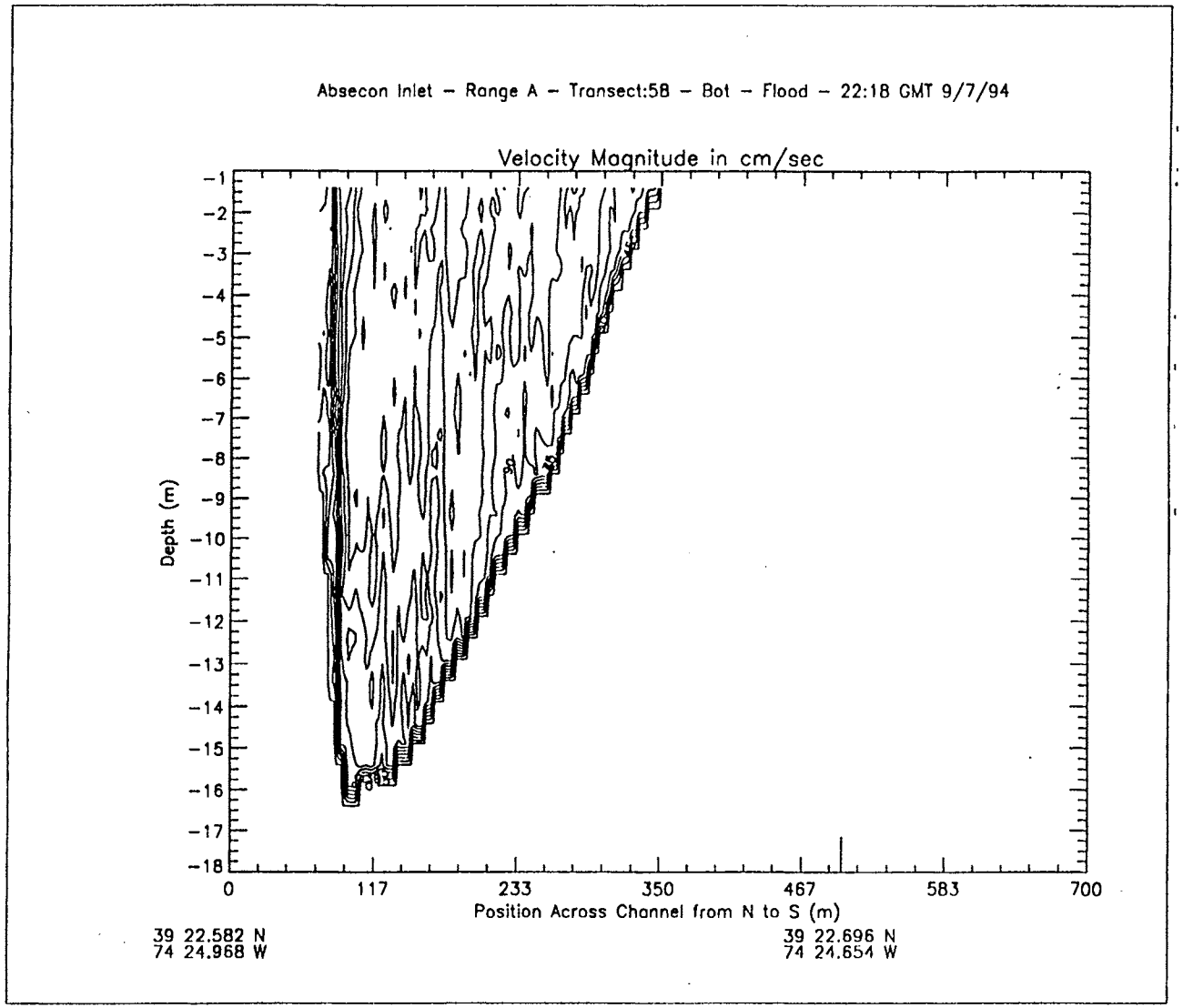


Figure 13. Example of Contour Plot of Velocity Magnitude.

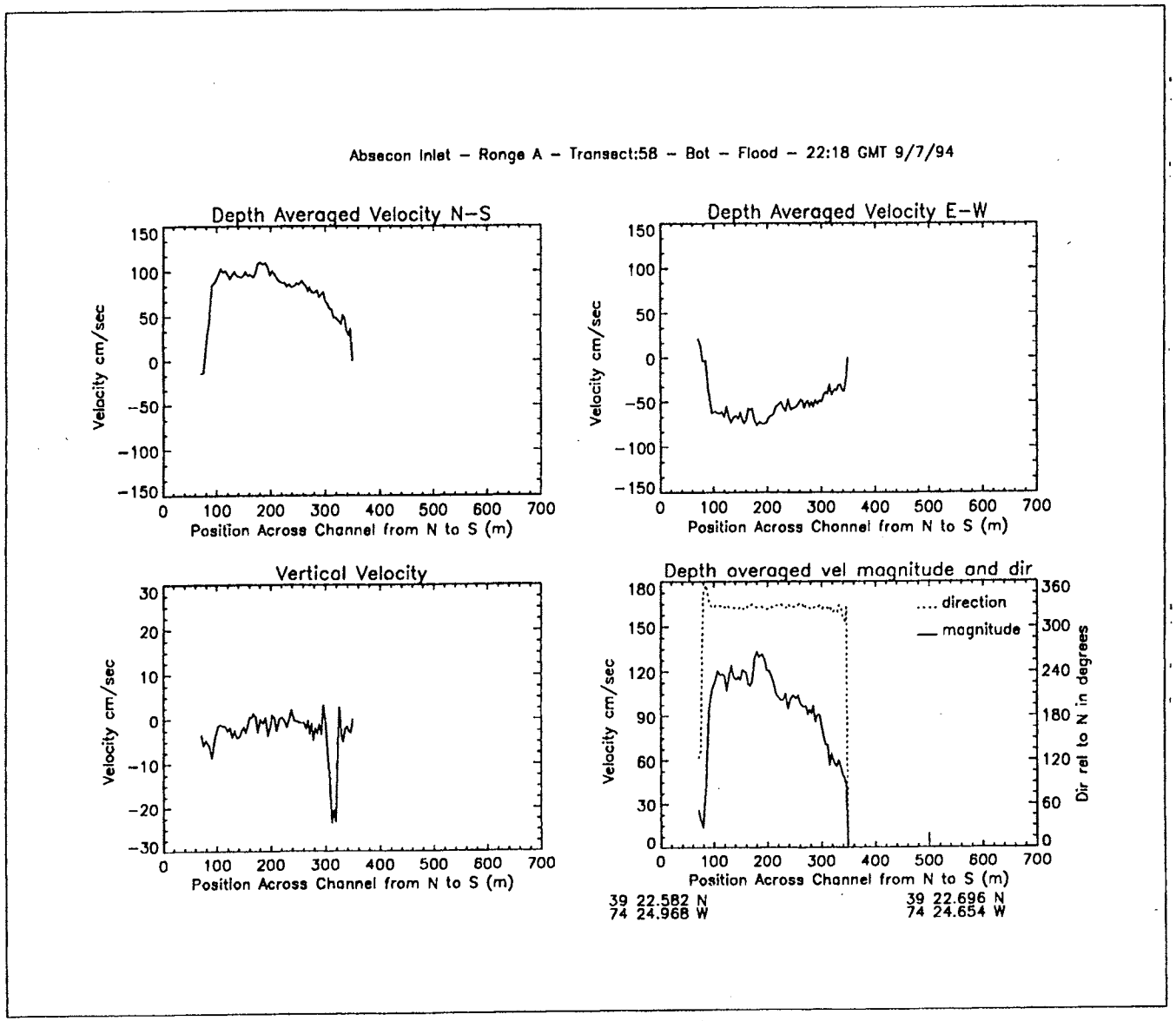


Figure 14. Example of Depth-Averaged Magnitude and Direction.

BRIGANTINE INLET TO GREAT EGG HARBOR INLET SEDIMENT BUDGET

A sediment budget reflects an application of the principle of continuity or conservation of mass to coastal sediment. The time rate of change is dependent upon the rate at which material enters a control volume versus the rate at which sediment leaves the same volume (Komar 1976). The budget assesses the sedimentary additions and losses and equates these to the net balance of sediment in a compartment. Any processs that results in a net sediment increase or loss in a control volume is called a source or sink, respectively. Examples of sources include beach erosion, onshore transport and riverine input. Examples of sinks include beach accretion, dredging and inlets. Engineer Manual 1110-2-1618 provides a more detailed explanation of sediment budget methodology.

The sediment budget study area is approximately 15 miles in length, extending from north of Brigantine Inlet to Great Egg Harbor Inlet. The study area lies entirely in Atlantic County, NJ and encompasses two barrier islands. The borough of Brigantine is on Brigantine Island. Atlantic City, Ventnor City, Margate City, and the borough of Longport are on Absecon Island.

SEDIMENT BUDGET ANALYSIS PROCEDURES. The selection of the specific time periods for analysis was dependent on the availability of shoreline position data and wave data for the study area during the general period of interest between 1950-1993. Review of the available data indicated that shoreline position data for 1952, 1977 and 1986 were available from a database developed by Dr. Steve Leatherman of the University of Maryland Laboratory for Coastal Research. In addition, shoreline position data for 1993 based on digital orthophoto mapping of significant segments of the study area shoreline were also available.

Available wave data for the study area included Wave Information Study (WIS) hindcasts for the period 1956-1975 calculated at 3 hour intervals. In addition, wave hindcasts for the period 1987-1993 developed by Offshore & Coastal Technologies, Inc. (OCTI) for the Philadelphia District at 3 hour intervals were available.

Based on the availability of shoreline position and wave data, the specific periods of analysis for the sediment budget were selected to include:

1952-1977
1977-1986
1986-1993

Seven control volumes for the sediment budget analysis were selected (Figure 15). The first control volume is Little Beach, which is located at the northern end of the study area, extending from Little Egg Inlet south for 2.7 miles to Brigantine Inlet. This control volume provides the source of longshore sand transport into Brigantine Inlet from the north which results in potential inlet shoaling and potential sand bypassing to the Brigantine Island shoreline. An assumption is made that there is negligible sand bypassing from Brigantine Inlet across the southern boundary into this control volume.

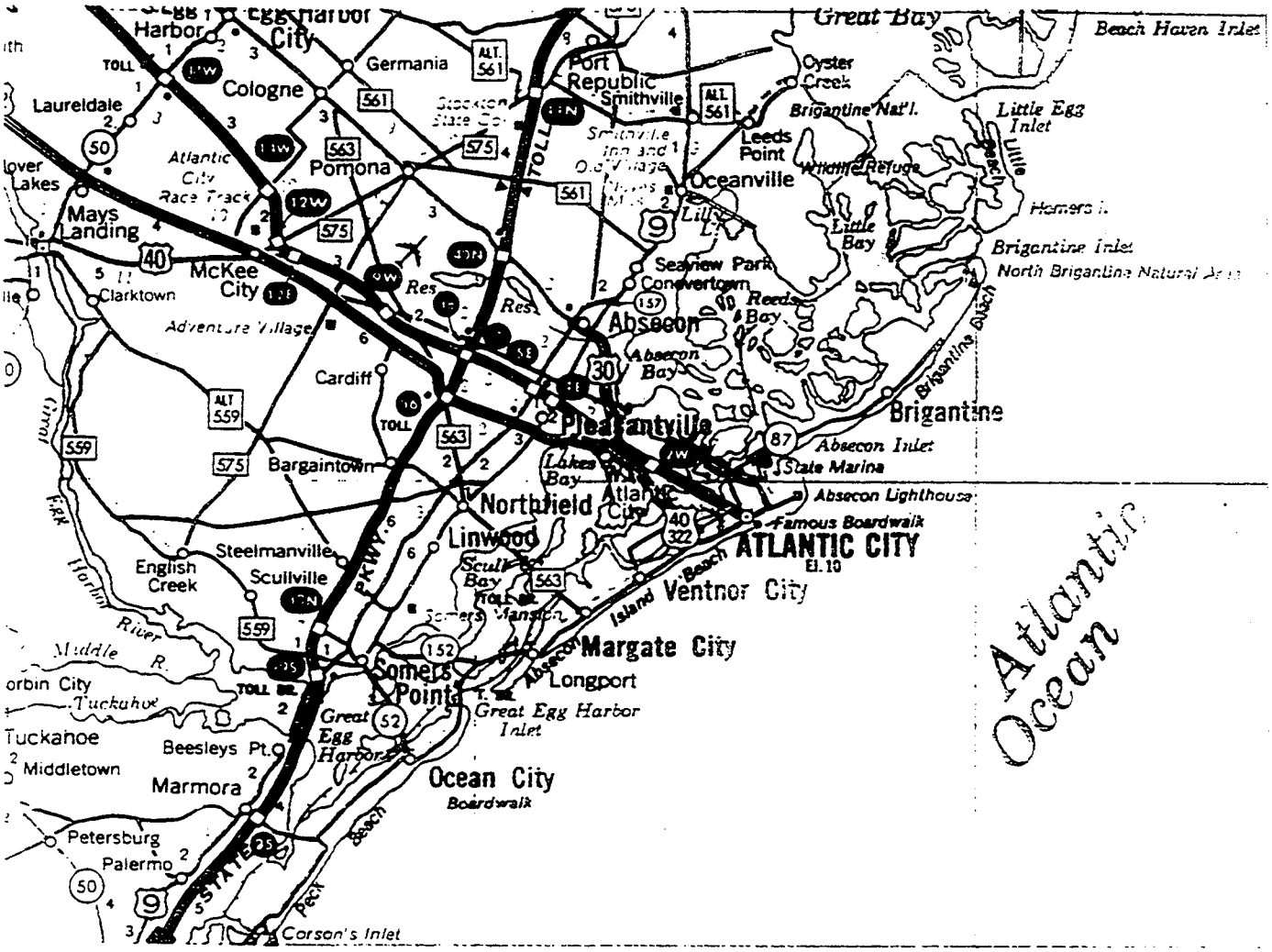


Figure 15. Sediment Budget Study Area Map.

The second control volume is Brigantine Inlet. Potential significant sand inputs to this control volume are assumed to be southerly sand transport from the north and northerly sand transport from the Brigantine Island shoreline. Potential sand outputs from this control volume are dredging, shoal growth, sand bypassing to the Brigantine oceanfront shoreline, and offshore losses.

The third control volume, Brigantine Island, extends from Brigantine Inlet south for 6.3 miles to the stone jetty at the southern end of Brigantine at Absecon Inlet. Potential sand inputs to this control volume are sand bypassing from Brigantine Inlet, shoreline erosion, and beach fills. Potential sand outputs from this control volume are northerly longshore sand transport across the northern boundary into Brigantine Inlet, southerly longshore transport across the southern boundary into Absecon Inlet, offshore losses, and shoreline accretion. Significant events in this control volume include a 393,000 cubic yard beach fill in 1962, a 175,000 cubic yard beach fill in 1963, a 66,000 cubic yard beach fill in 1966, and jetty construction and extensions in 1952, 1959, and 1974.

The fourth control volume, Absecon Inlet, extends from the southern boundary of the Brigantine Island control volume south to a southern boundary at the stone jetty in Atlantic City. Potential sand inputs to this control volume are southerly longshore transport across its northern boundary from Brigantine Island and northerly longshore transport across the southerly boundary from Atlantic City. Potential sand outputs are dredging, sand bypassing to Atlantic City, shoal growth, and offshore losses. The most significant events in this control volume are the annual dredgings between 1952-1972 and the 1,000,000 cubic yard dredging for beach fill in 1986.

The fifth control volume, Absecon Island, extends from the northern boundary at Absecon Inlet south 8.0 miles to a southern boundary at the jetty at the southern end of Longport at Great Egg Harbor Inlet. Potential sand inputs to this control volume are sand bypassing across Absecon Inlet, shoreline erosion loss and beach fills. It is assumed that there is negligible sand bypass into this area from the Ocean City shoreline. Potential sand outputs include northerly longshore transport across the northern boundary into Absecon Inlet, southerly longshore transport across the southern boundary into Great Egg Harbor Inlet, shoreline accretion, and offshore losses.

The sixth control volume, Great Egg Harbor Inlet, extends from the southern boundary of the Absecon Island control volume to the northern end of Ocean City. Potential significant sand inputs to this control volume are assumed to be southerly sand transport from the Absecon Island area and northerly sand transport from the Ocean City shoreline. Potential sand outputs from this control volume are dredging, shoal growth, sand bypassing to the Ocean City oceanfront shoreline, and offshore losses.

The seventh control volume, Ocean City, extends from the northern boundary at Great Egg Harbor Inlet south 1.0 mile along the Ocean City shoreline. Potential sand inputs to this control volume are sand bypassing across Great Egg Harbor Inlet, shoreline erosion and beach fills. Potential sand outputs include northerly longshore transport across the northern boundary into

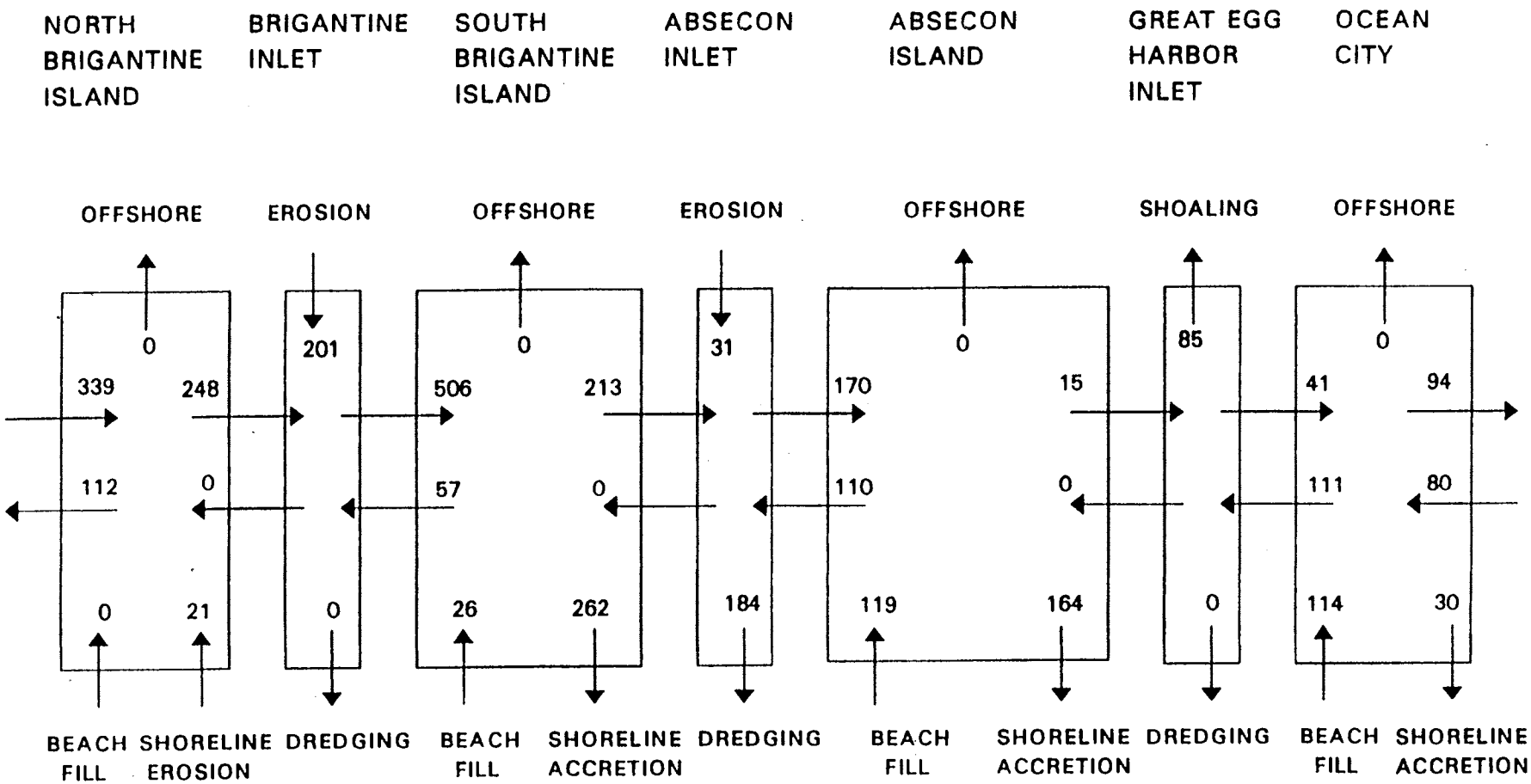


Figure 16. Sediment Budget 1952-1977

boundary into the control volume and sand entering the northern boundary of the control volume by bypassing from Little Egg Inlet. Since the offshore source is not likely, it was assumed that bypassing from Little Egg Inlet at a rate of 339,000 cubic yards per year was occurring. For the Brigantine Inlet control volume, sand inputs include 248,000 cubic yards per year across the northern boundary and 57,000 cubic yards per year across the southern boundary and possible shoal erosion. Sand outputs include losses due to shoal growth in the inlet control volume and sand bypassing to the oceanfront shoreline of South Brigantine Island.

Since there are several unknown quantities, the Brigantine Island control volume was analyzed to determine the rate of sand bypassing required to balance that control volume. The only other sand input to this control volume includes beach fill at a rate of 26,000 cubic yards per year since it is assumed that sand bypassing from Absecon Inlet into this control volume was not occurring. Sand outputs include 213,000 cubic yards per year across the southern boundary of the control volume and shoreline accretion at a rate of 262,000 cubic yards per year based on an analysis of shoreline changes. To balance the sediment budget for the Brigantine control volume, sand bypassing from Brigantine Inlet into the area at a rate of about 506,000 cubic yards per year would be required. Substituting this rate into the sediment budget for Brigantine Inlet results in a deficit of 201,000 cubic yards per year in that control volume.

Two potential inputs to balance this deficit of sand are shoal erosion in the Brigantine Inlet control volume and/or additional bypassing from the Little Beach control volume. Since the Little Beach control volume does not have excess sand available, it is assumed that shoal erosion provides the sand. Although this conclusion may be reasonable, confirmation is not possible due to a lack of bathymetric surveys during this period.

Balancing the sediment budgets of the Little Beach, Brigantine Inlet, and South Brigantine Island control volumes results in an estimated rate of 506,000 cubic yards per year of sand bypassing from Brigantine Inlet to the oceanfront shoreline of Brigantine Island. No quantitative data exists to confirm this rate. With this rate of bypassing, the net rate of accretion along the Brigantine shoreline was 262,000 cubic yards per year.

For the Absecon Inlet control volume, sand enters from the north at a rate of 213,000 cubic yards per year and enters from the south at a rate of 110,000 cubic yards per year. Based on the configuration of the inlet and analysis of aerial photographs, it was assumed that sand was not being bypassed from the inlet north to the South Brigantine Island control volume. Sand was dredged from the inlet at a rate of 184,000 cubic yards per year during this period. An additional sand input to this control volume was shoal erosion at a rate of 35,000 cubic yards per year based on analysis of the 1941-1972 surveys. Summation of these sand inputs and outputs results in about 174,000 cubic yards being bypassed from Absecon Inlet to Absecon Island for the period.

For the Absecon Island control volume, sand moves to the north out of the control volume at a rate of 110,000 cubic yards per year. Sand exits the southern boundary of the control volume at a rate of 15,000 cubic yards per year and enters the Great Egg Harbor Inlet control volume. Based on the configuration of Great Egg Harbor Inlet and the available data, it is assumed that sand does

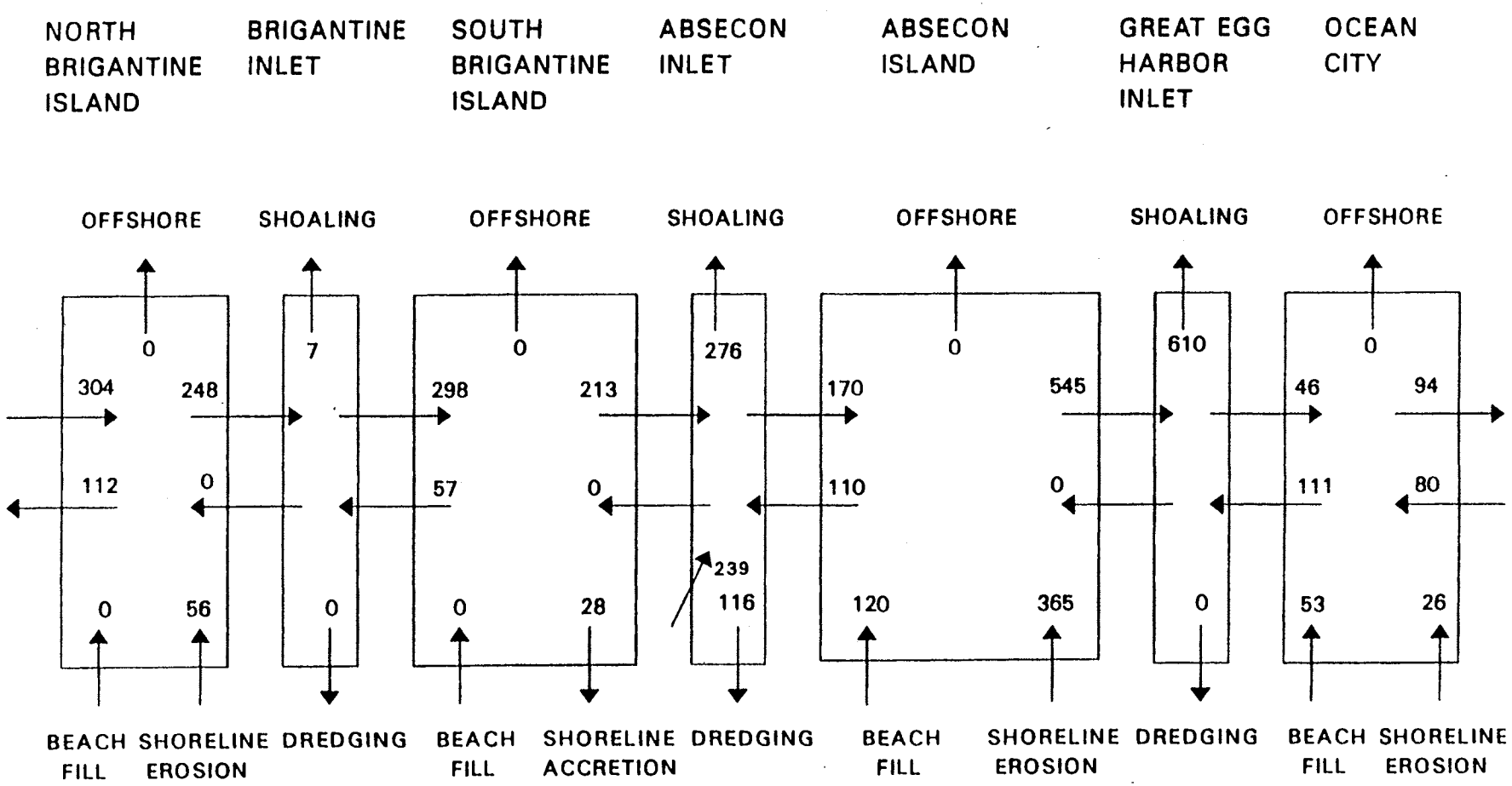


Figure 17. Sediment Budget 1977-1986

Since there are several unknown quantities, the Brigantine Island control volume was analyzed to determine the rate of sand bypassing required to balance that control volume. There are no other sand inputs, other than sand bypassing, to the Brigantine Island control volume. Shoreline accretion removed sand at a rate of 28,000 cubic yards per year during this period. It is assumed that sand did not bypass Absecon Inlet into this control volume. Sand outputs include 57,000 cubic yards per year across the northern boundary and 213,000 cubic yards per year across the southern boundary of the control volume. To balance the sediment budget for the Brigantine Island control volume, sand bypassing from Brigantine Inlet into the area at a rate of about 298,000 cubic yards per year would be required.

Substituting this rate into the sediment budget for Brigantine Inlet results in a surplus of 7,000 cubic yards per year in that control volume. The only potential output to balance this surplus sand is shoal growth in the Brigantine control volume. This assumption leads to the conclusion that negligible shoal growth occurred in the Brigantine Inlet control volume during this period. Confirmation of this conclusion on shoal growth is not possible due to a lack of historical bathymetric charts of the inlet for comparison.

Balancing the sediment budgets of Little Beach, Brigantine Inlet, and Brigantine Island control volumes results in an estimated rate of 298,000 cubic yards per year of sand bypassing Brigantine Inlet to the oceanfront shoreline of Brigantine Island. This bypassing rate is significantly lower than the estimated rate of 506,000 cubic yards per year between 1952 and 1977. With this reduced rate of bypassing, the rate of accretion along Brigantine Island decreased to 28,000 cubic yards per year.

For the Absecon Inlet control volume, sand enters from the north at a rate of 213,000 cubic yards per year and enters from the south at a rate of 110,000 cubic yards per year. Based on the configuration of the inlet and analysis of aerial photographs, it was assumed that sand was not being bypassed from the inlet north to the Brigantine Island control volume. Based on the analysis of bathymetric surveys between 1972-1994, no sand is lost to the control volume to shoal growth. Sand was dredged from the inlet at a rate of 116,000 cubic yards per year during this time period.

With the known sand inputs and outputs identified, an attempt to balance the sediment budget for the control volume identified a surplus of 207,000 cubic yards per year. With the lack of any further data on sediment movement, it would generally be assumed that this surplus material bypasses Absecon Inlet to Absecon Island. However, based on the measured shoreline erosion of Absecon Island, and the lack of nearshore shoals offshore Absecon Island to facilitate bypassing, it appears to be unlikely that bypassing at a rate of 207,000 cubic yards per year occurred during this period.

Accordingly, the results of numerical current and wave modeling of the inlet area were examined to determine likely sediment transport pathways for the excess sediment. The results of the tidal current modeling indicate that due to the large tidal prism and lack of offshore shoals at Absecon Inlet, ebb current velocities are sufficient to transport sand several thousand feet offshore, into

during this period. However, qualitative analysis of the extent of the shoals at the inlet from NOAA Chart 12316 indicates that a shoaling rate of on the order of 500,000 to 600,000 cubic yards per year is not unreasonable.

THE 1986-1993 SEDIMENT BUDGET. Data on shoreline erosion and accretion, beach fill volumes, and dredging were combined with calculated longshore sand transport rates to produce a sediment budget for the period 1986-1993 as shown in Figure 18. For the Little Beach control volume, sand moves to the north out of the control volume at a rate of 187,000 cubic yards per year. Sand exits the southern boundary of the control volume at a rate of 350,000 cubic yards per year and enters the Brigantine Inlet control volume. It is assumed that sand does not enter the Little Beach control volume from Brigantine Inlet. Shoreline erosion added sand to the control volume at a rate of 537,000 cubic yards per year during this period. There were no beach fills during this period. With these known sand inputs and outputs, the sediment budget for the control volume balanced.

Sand inputs to the Brigantine Inlet control volume include 350,000 cubic yards per year across the north boundary and 72,000 cubic yards per year across the south boundary. Sand outputs include losses due to shoal growth in the inlet control volume and potential sand bypassing to the oceanfront shoreline of South Brigantine.

Since there are several unknown quantities, the Brigantine Island control volume was analyzed to determine the rate of sand bypassing required to balance that control volume. Other sand input to this control volume includes shoreline erosion at a rate of 473,000 cubic yards per year. It is assumed that there was no sand bypassing from Absecon Inlet into this control volume. Sand outputs include 72,000 cubic yards per year across the northern boundary and 307,000 cubic yards per year across the southern boundary of the control volume. Summation of these inputs and outputs resulted in a surplus of 94,000 cubic yards per year in this control volume. To balance this control volume, it was assumed that this material overwashed the jetty into the Absecon Inlet control volume to result in a total input of 401,000 cubic yards per year to the inlet. Accordingly, no sand bypassing was required from Brigantine Inlet to balance this control volume.

Without bypassing to Brigantine Island, balancing the sediment budget in the Brigantine Inlet control volume led to the assumption that shoaling occurred at a rate of 422,000 cubic yards per year. Although this shoaling rate appears reasonable based on a qualitative analysis of the shoals shown on NOAA Chart 12316, quantification of the shoal growth based on a comparison of historical bathymetric charts of the inlet during this period is not possible due to a lack of surveys.

Balancing the sediment budgets of Little Beach, Brigantine Inlet, and Brigantine Island control volumes results in no sand bypassing Brigantine Inlet to the oceanfront shoreline of Brigantine Island. Without bypassing, the rate of erosion increased to 473,000 cubic yards per year along the Brigantine Island shoreline.

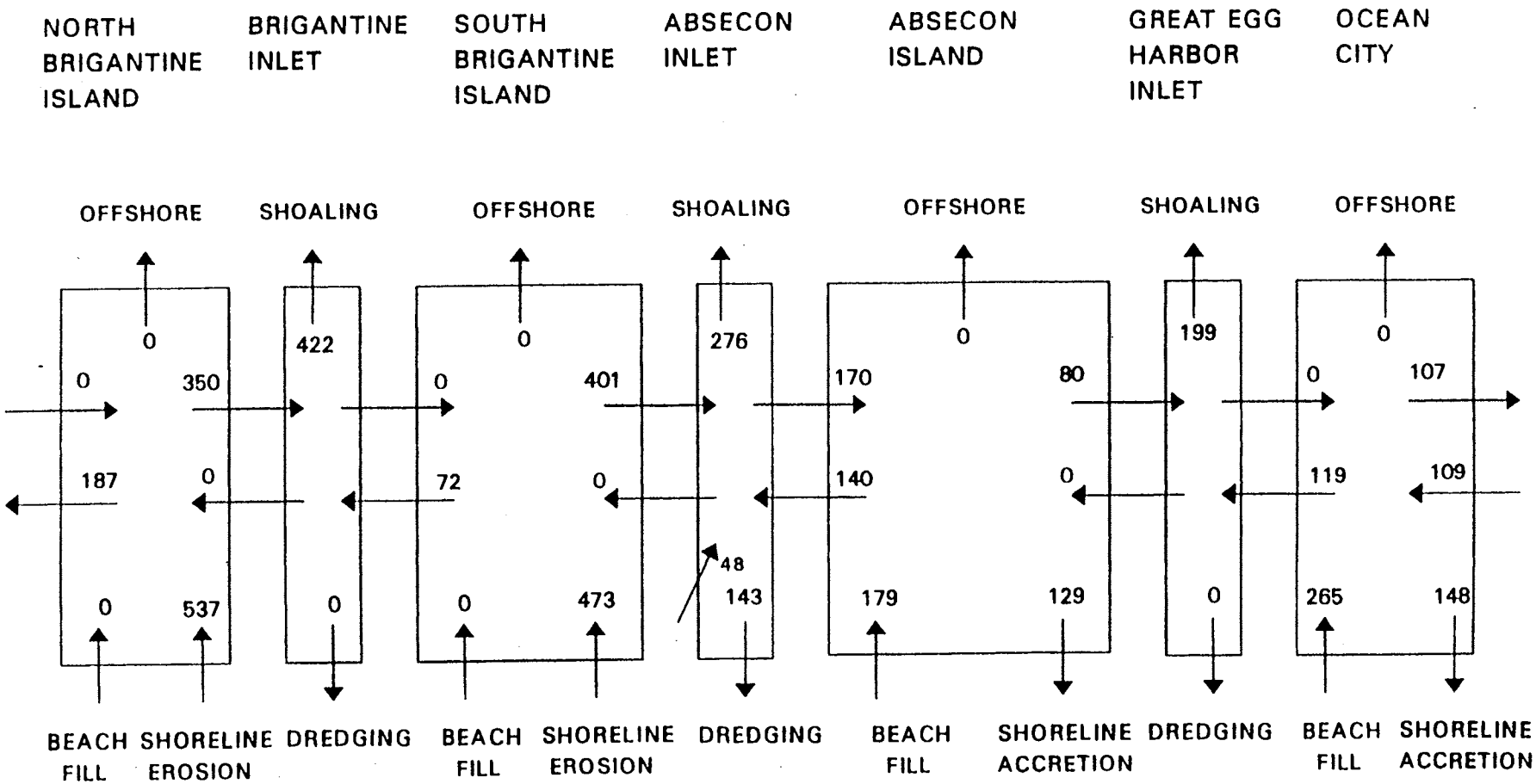


Figure 18. Sediment Budget 1986-1993.

For the Absecon Inlet control volume, sand enters from the north at a rate of 401,000 cubic yards per year and enters from the south at a rate of 140,000 cubic yards per year. It was assumed that sand was not being bypassed from the inlet north to the South Brigantine Island control volume. Additional sand outputs included dredging in the inlet at a rate of 143,000 cubic yards per year. No shoal growth occurred in the inlet based on inlet bathymetry change from 1972 to 1994.

With the known sand inputs and outputs identified, an attempt to balance the sediment budget for the control volume identified a surplus of 398,000 cubic yards per year. As noted in the previous section, the most likely destination for this surplus material is offshore shoals. With a maximum bypassing rate of 100,000 cubic yards per year, approximately 298,000 cubic yards per year may be lost offshore due to the high ebb tide currents.

For the Absecon Island control volume, sand moves to the north out of the control volume at a rate of 140,000 cubic yards per year. Sand exits the southern boundary of the control volume at a rate of 80,000 cubic yards per year and enters the Great Egg Harbor Inlet control volume. Based on the shoreline changes between 1986-1993, it is estimated that shoreline accretion removed sand from the control volume at a rate of 129,000 cubic yards per year. Beach fills during this period added sand at a rate of 179,000 cubic yards per year. Summation of these sand inputs and outputs results in a deficit of 70,000 cubic yards per year for the Absecon control volume.

For the Great Egg Harbor Inlet control volume, sand inputs include 80,000 cubic yards per year across the northern boundary, 119,000 cubic yards per year across the southern boundary and possible shoal erosion. Sand outputs include possible losses due to shoal growth in the inlet control volume and sand bypassing to the oceanfront shoreline of Ocean City.

Since there are several unknown quantities, the Ocean City control volume was analyzed to determine the rate of sand bypassing required to balance that control volume. Sand inputs to this control volume include beach fill at a rate of 265,000 cubic yards per year and longshore transport at a rate of 109,000 cubic yards per year across the southern boundary. Sand outputs include 107,000 cubic yards per year across the southern boundary of the control volume and shoreline accretion at a rate of 148,000 cubic yards per year. Summation of these sand inputs and outputs results in a balanced sediment budget for the Ocean City control volume without sand bypassing from Great Egg Harbor Inlet. For the Great Egg Harbor Inlet control volume, this results in a surplus of 199,000 cubic yards per year in that control volume. To balance this surplus of sand, it is assumed that shoal growth occurred at a rate of 199,000 cubic yards per year. Although this conclusion may be reasonable, confirmation is not possible due to a lack of bathymetric surveys during this period.

SEDIMENT BUDGET CONCLUSIONS. The preceding sediment budget analysis leads to conclusions for each of the time periods analyzed based on the data available. The lack of bathymetric surveys in Brigantine Inlet and Great Egg Harbor Inlet added to the difficulty in balancing the sediment budgets in the various control volumes. Without these surveys,

5. No shoal growth in Absecon Inlet occurred.

6. Sand bypassing from Absecon Inlet to the Absecon Island shoreline at a reduced rate, probably less than 100,000 cubic yards per year.

7. Sand was probably lost to shoals offshore of Absecon Inlet in deep water at a rate of approximately 100,000 cubic yards per year.

8. The Absecon Island shoreline transitioned from accretion at a rate of 164,000 cubic yards per year during 1952-1977 to erosion at a rate of 365,000 cubic yards per year.

9. Shoal growth in Great Egg Harbor Inlet increased significantly from a rate of 85,000 cubic yards per year during 1952-1977 to a rate of 610,000 cubic yards per year.

10. Sand continued to be bypassed from Great Egg Harbor Inlet to the Ocean City oceanfront shoreline at a rate of 46,000 cubic yards per year.

1986-1993

1. Sand was not bypassed from Little Egg Inlet to North Brigantine Island.

2. Shoreline erosion on North Brigantine Island increased significantly from 56,000 cubic yards per year during 1977-1986 to 537,000 cubic yards per year.

3. Sand was not bypassed from Brigantine Inlet to the Brigantine oceanfront shoreline.

4. Shoal growth in Brigantine Inlet increased significantly from 7,000 cubic yards per year during 1977-1986 to 422,000 cubic yards per year.

5. The Brigantine shoreline transitioned from accretion at a rate of 28,000 cubic yards per year during 1977-1986 to erosion at a rate of 473,000 cubic yards per year.

6. No shoal growth in Absecon Inlet occurred.

7. Sand bypassing from Absecon Inlet to Absecon Island continued at a rate of 100,000 cubic yards per year or less. Loss of sand to shoals offshore Absecon Inlet in deep water increased to a rate of approximately 300,000 cubic yards per year.

8. The Absecon shoreline transitioned from erosion at a rate of 365,000 cubic yards per year during 1977-1986 to accretion at a rate of 129,000 cubic yards per year.

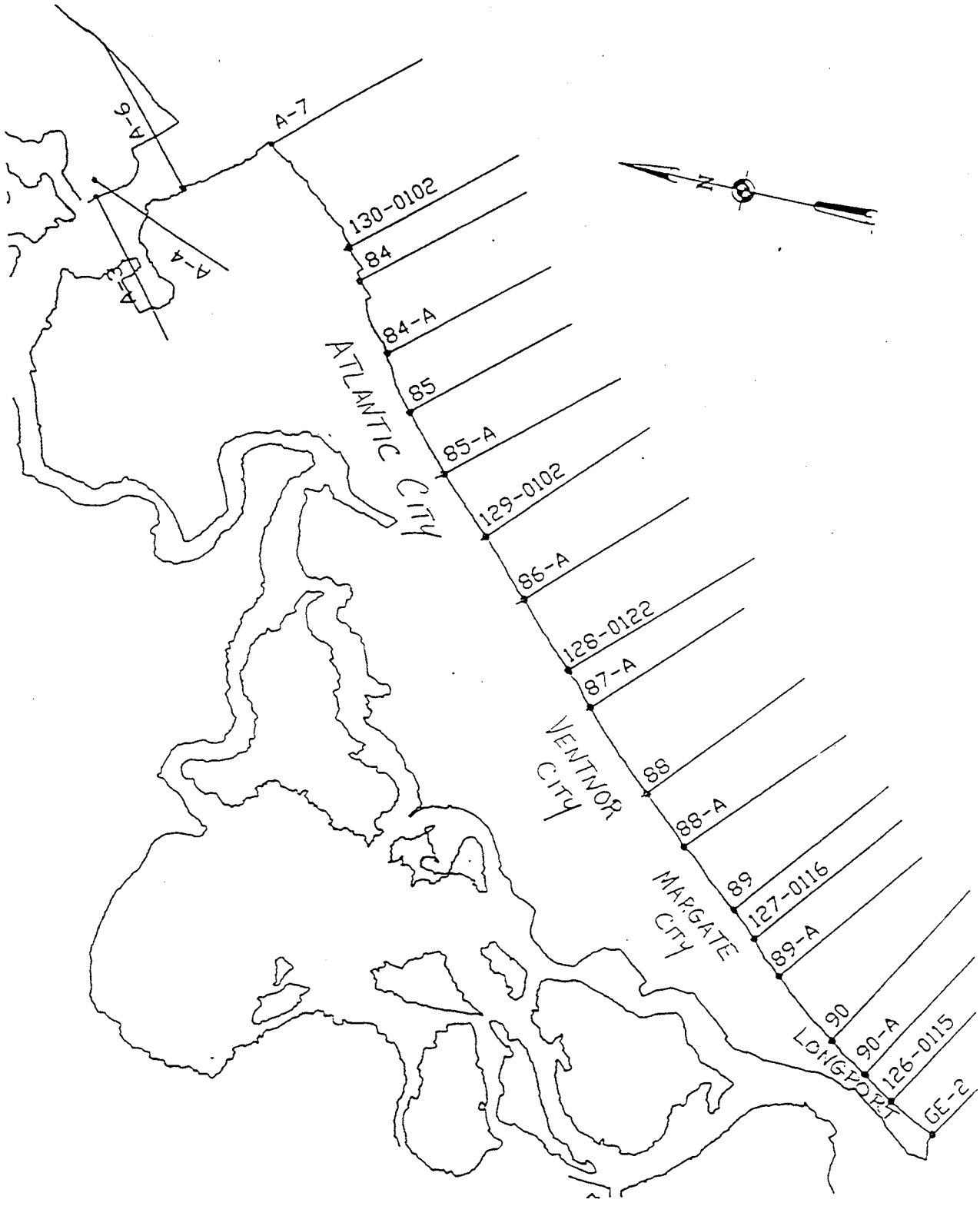


Figure 19. Beach Profile Lines.

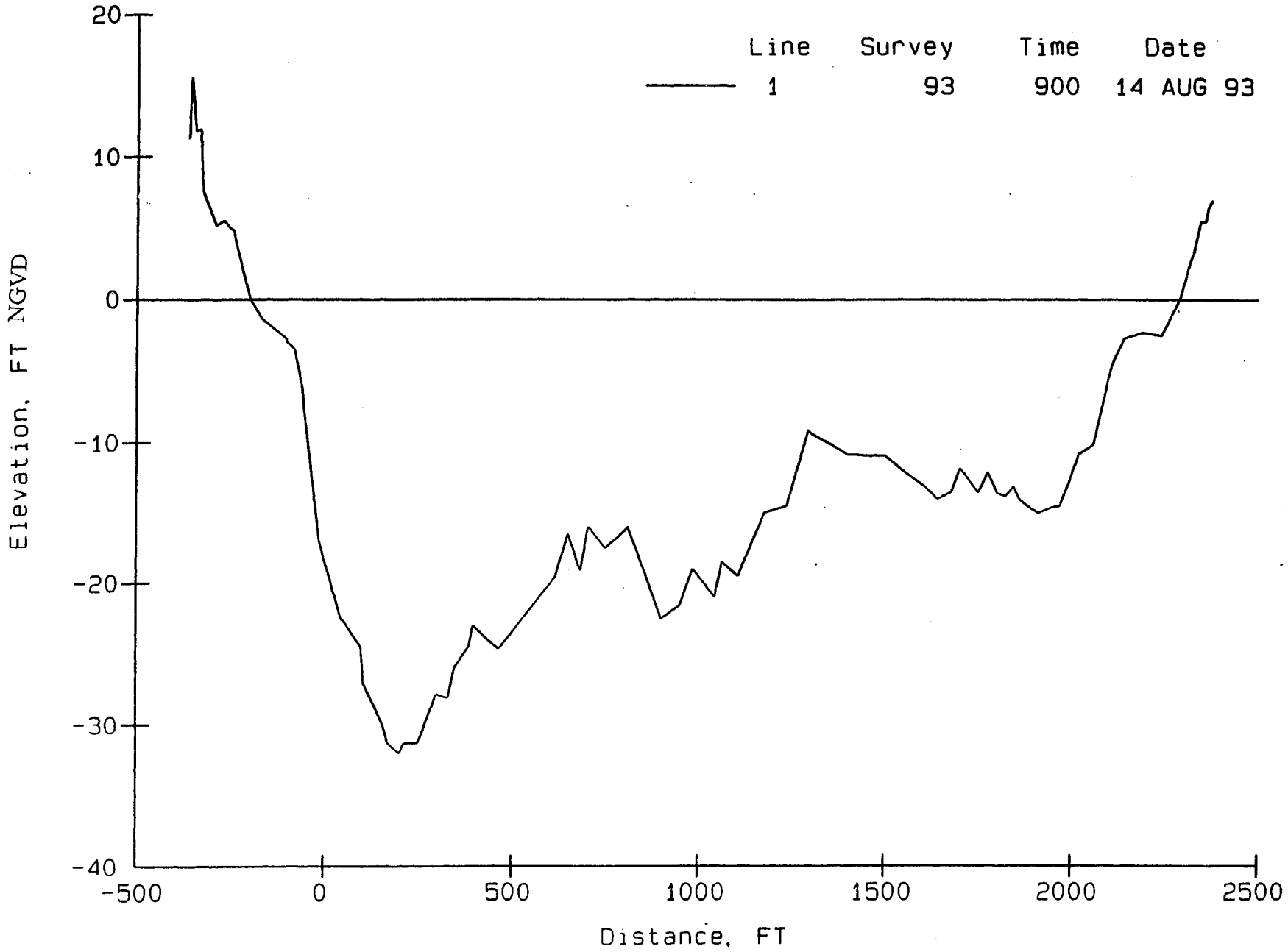
Table 2

USACE BEACH PROFILES ATLANTIC COUNTY, NJ

COORDINATE LIST - NEW JERSEY STATE PLANE - NAD83 - NGVD29

LINE#	LOCAL LINE#	EASTING (FT)	NORTHING (FT)	ELEV (FT)	DESCRIPTION
1	A-3-1993	516 330.55	199 879.83	5.99	NEW STAKED POINT
2	A-4-1993	516 339.04	199 503.31	4.58	RESTAKED N. PORTER POINT
3	A-6-1993	516 511.84	196 594.04	13.53	NEW STAKED POINT
4	A-7	518 361.45	193 248.38	10.38	DRILL HOLE @ END JETTY FND
5	130-0102	514 183.42	191 045.91	13.77	PK NAIL IN BOARDWALK FND ORIGINAL TRANSIT STATION
6	84-1993	513 135.66	190 629.17	13.08	RESET FROM REFERENCES
7	84-A-1993	510 370.13	189 664.62	8.88	NEW STAKED POINT
8	85-1993	508 399.51	189 071.42	12.14	RESET FROM REFERENCES
9	85-A-1993	506 081.27	187 980.22	8.17	NEW STAKED POINT
10	129-0102-1993	503 737.73	186 581.12	14.17	NEW STAKED POINT
11	86-A-1988	501 431.90	185 272.30	13.20	NAIL IN BOARDWALK FND
12	128-0122	499 072.83	183 806.44	13.12	PK NAIL IN BOARDWALK FND ORIGINAL TRANSIT STA
13	87-A-1988	497 731.90	182 960.87	13.18	NAIL IN BOARDWALK FND
14	88-1988	494 510.76	181 118.87	9.79	"X" CUT IN CONC. WALK FND
15	88-A-1993	492 586.65	179 917.41	8.41	RESET FROM REFERENCES
16	89-1993	490 397.25	178 201.68	13.01	NEW STAKED POINT
17	127-0116-1993	489 192.96	177 483.16	11.11	NEW STAKED POINT
18	89-A-1993	487 850.33	176 579.79	7.38	NEW STAKED POINT
19	'90-1975	485 566.51	174 618.04	10.67	DRILL HOLE FND
20	90-A-1988	484 369.48	173 512.99	11.61	"X" CUT IN SEAWALL FND
21	126-0115	483 302.52	172 516.52	8.49	PK NAIL IN SIDEWALK FND ORIGINAL TRANSIT STA
22	GE-2	482 084.43	171 240.78	11.58	USC&GS DISK ON SEAWALL

46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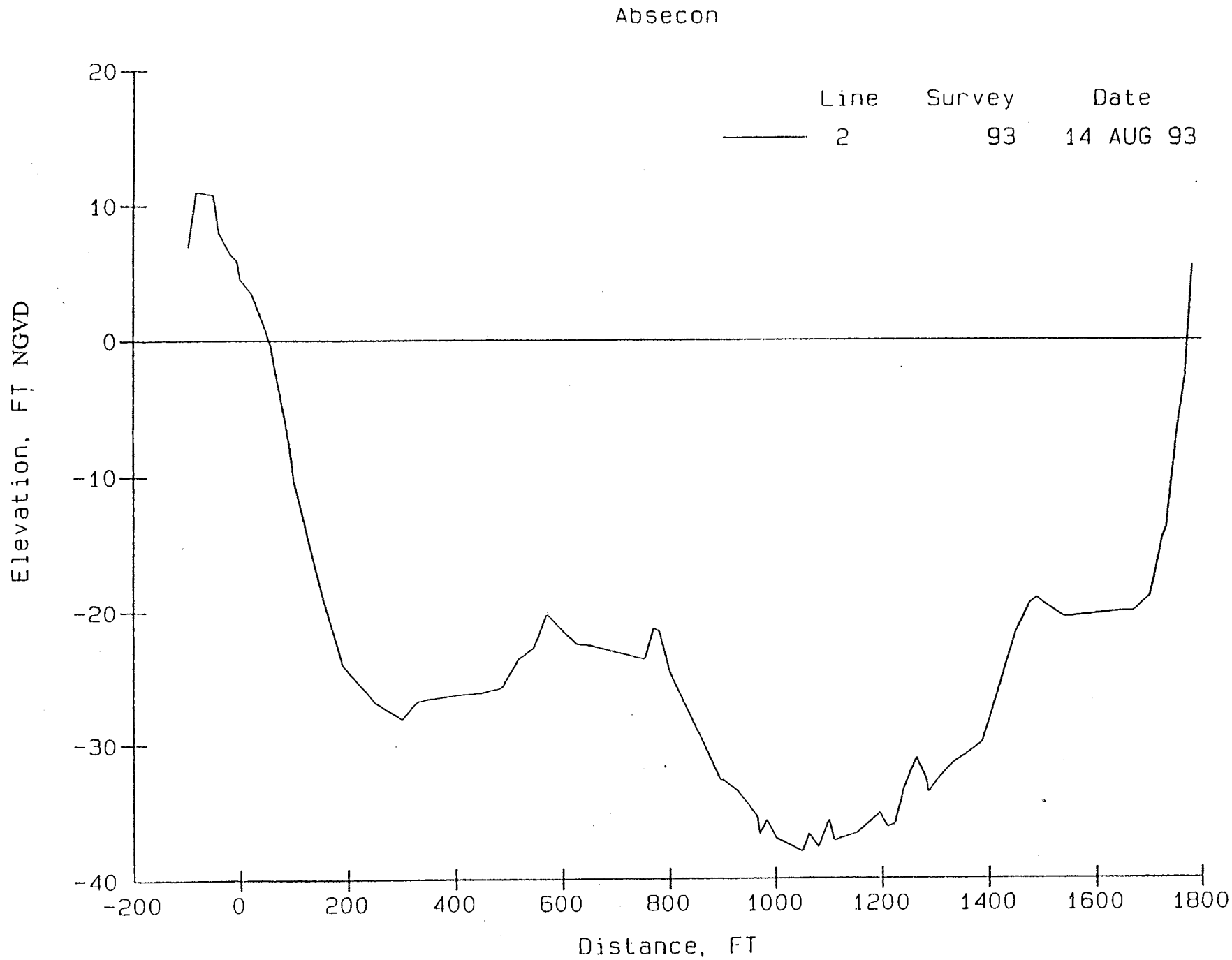
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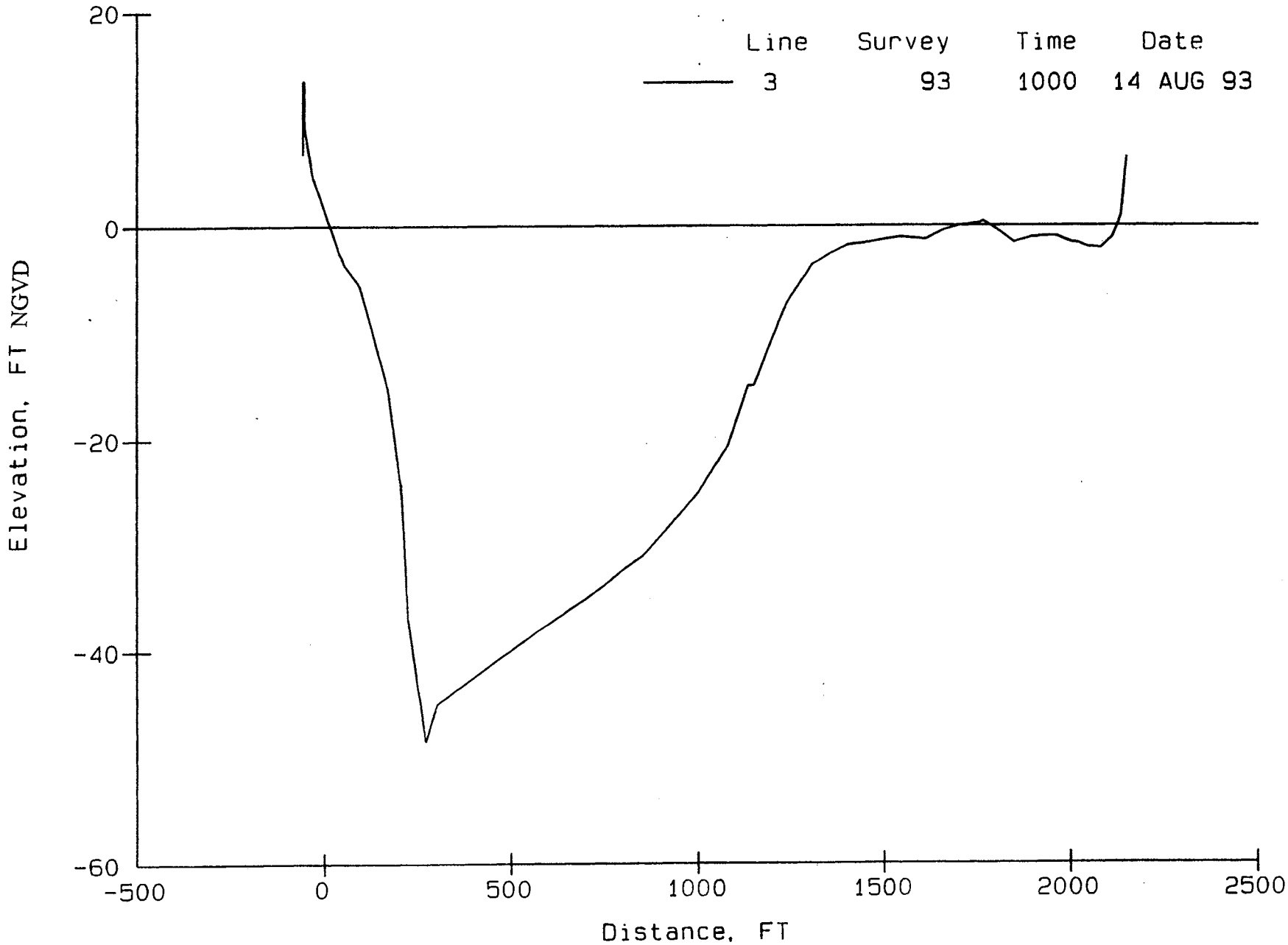
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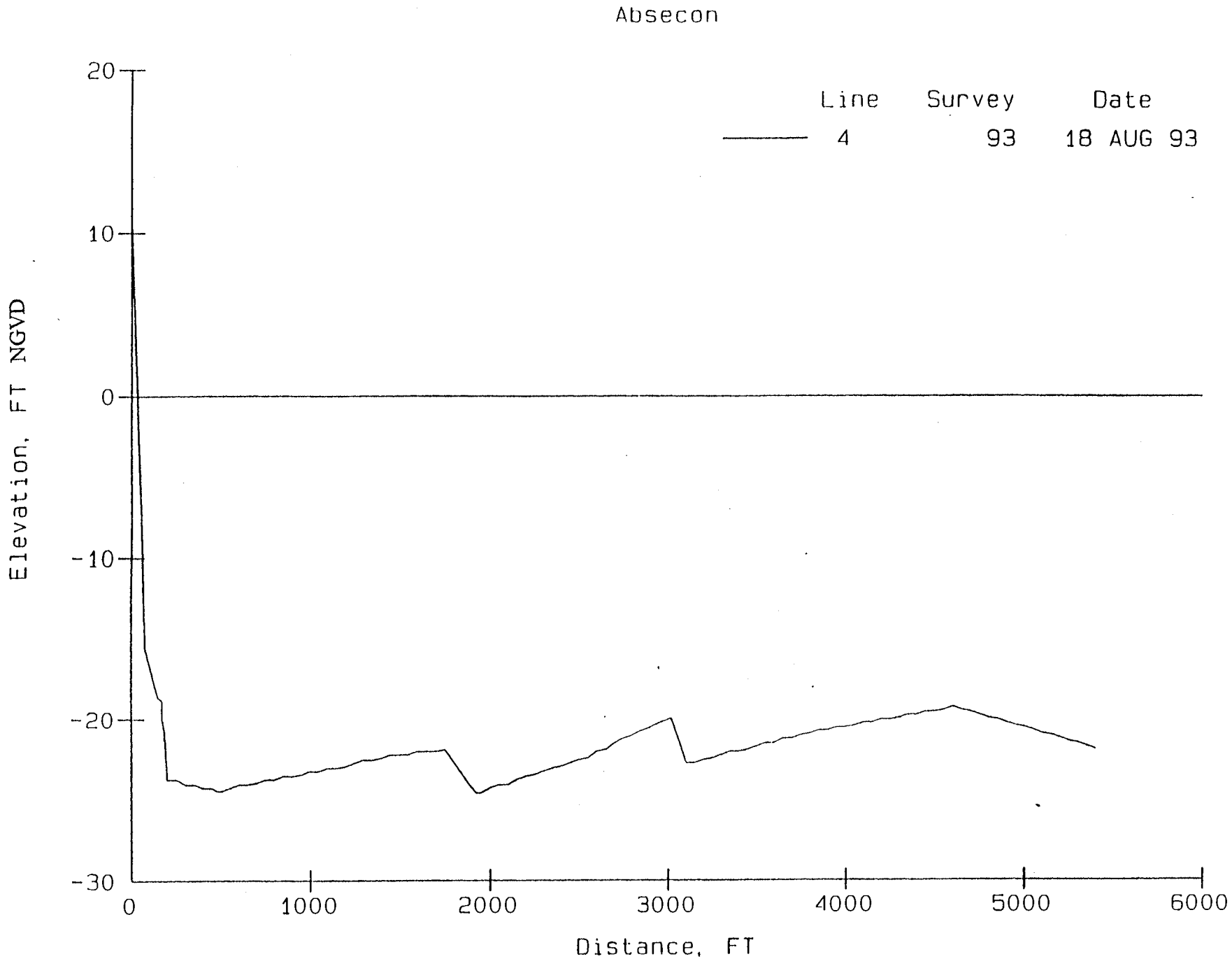
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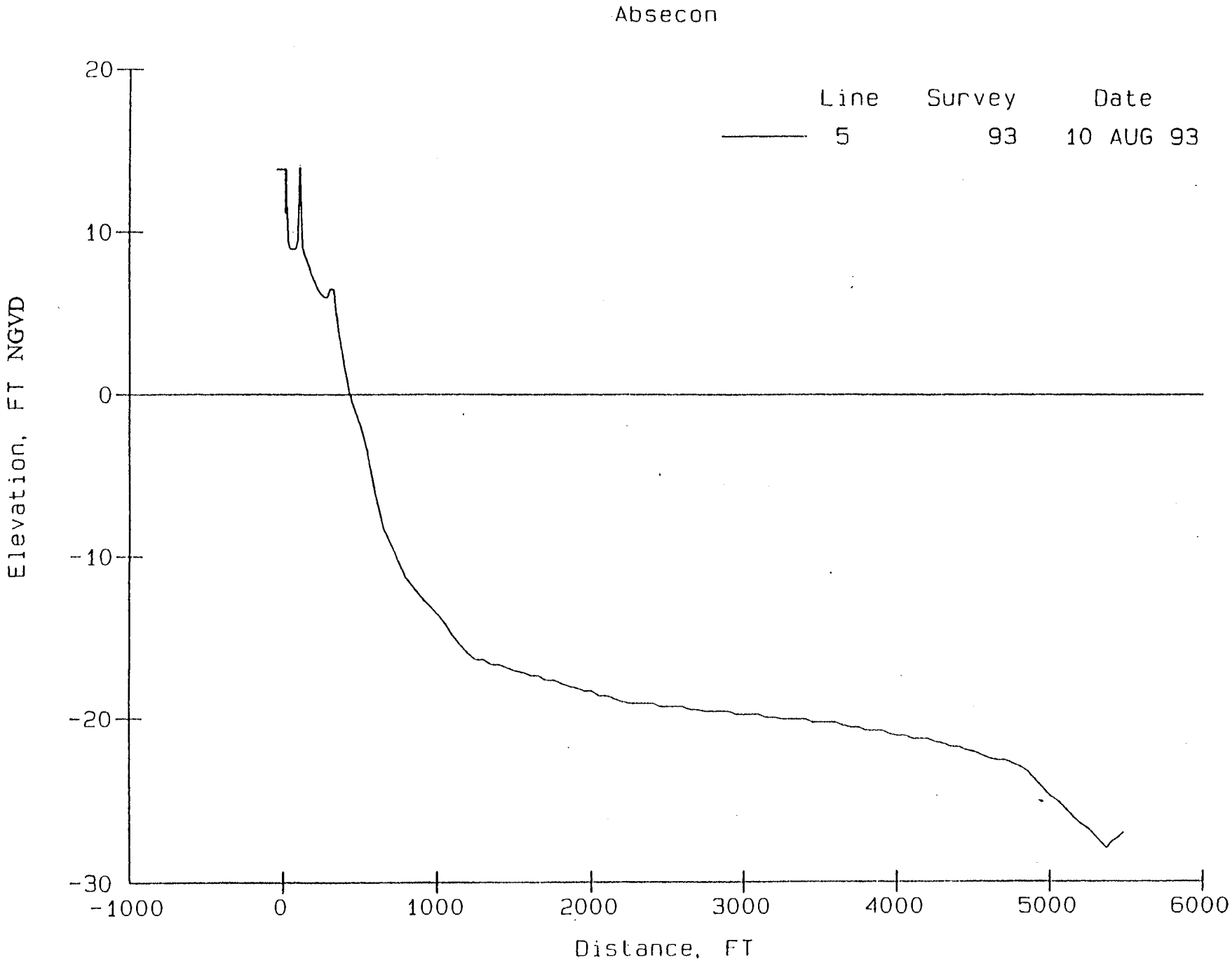
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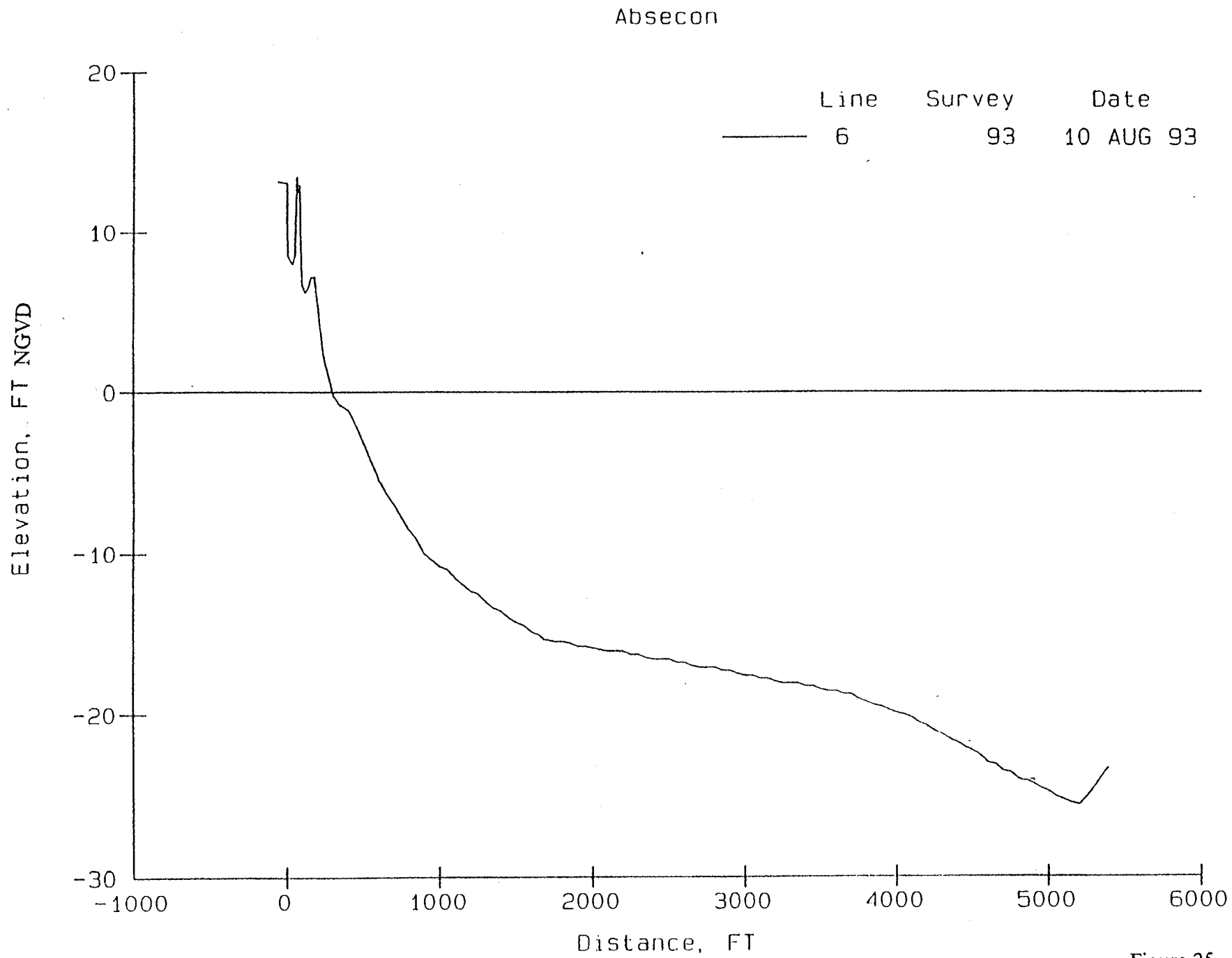
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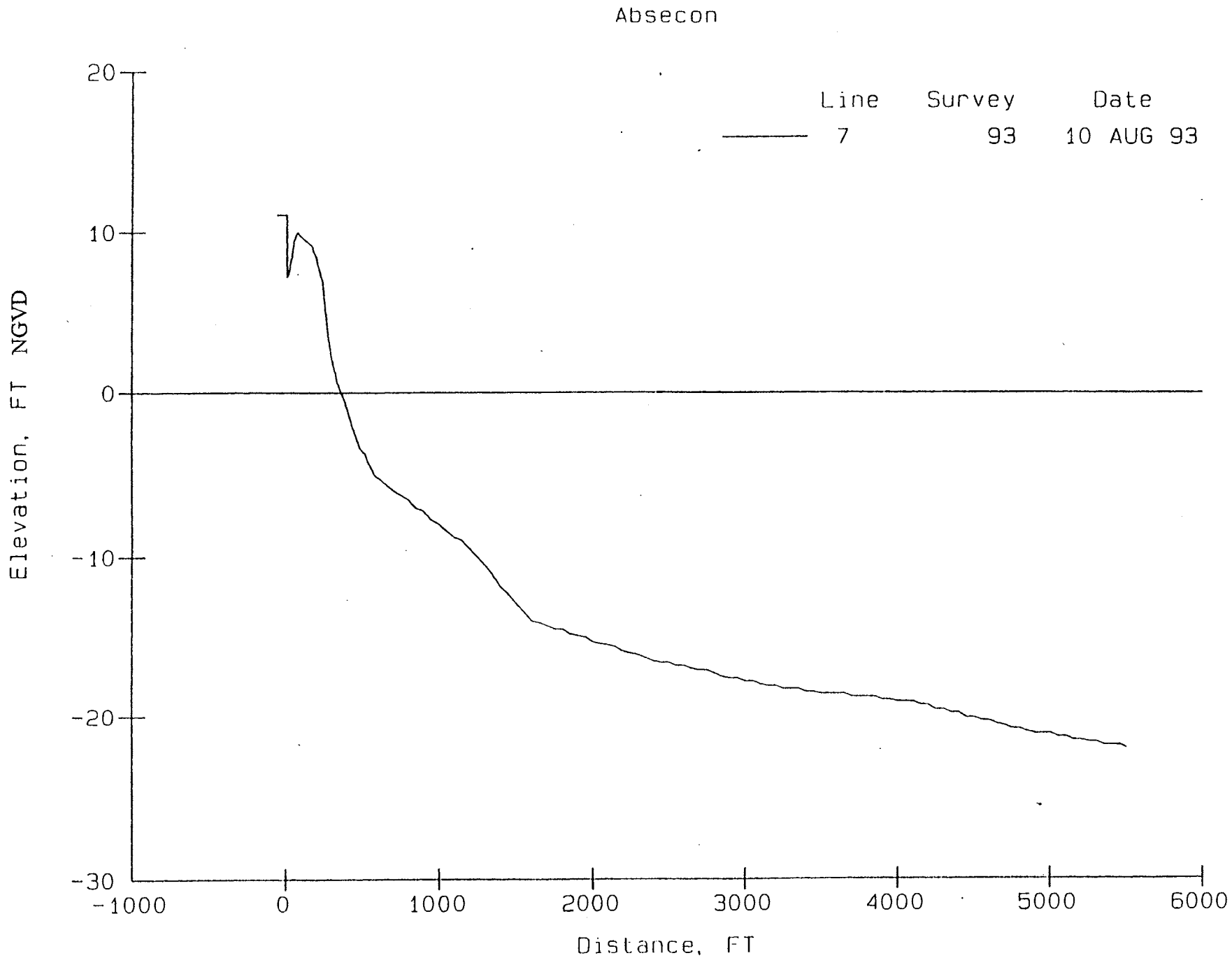
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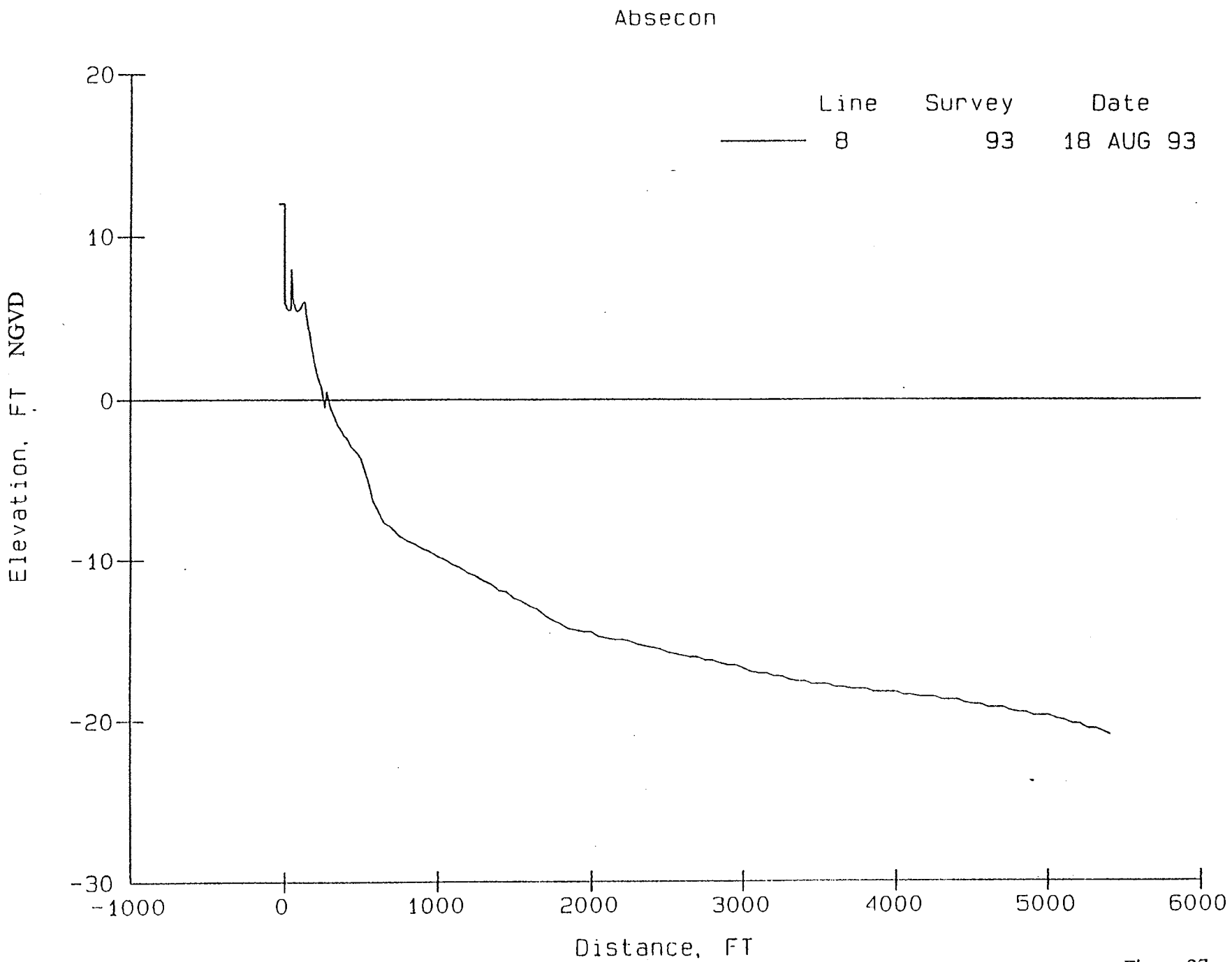
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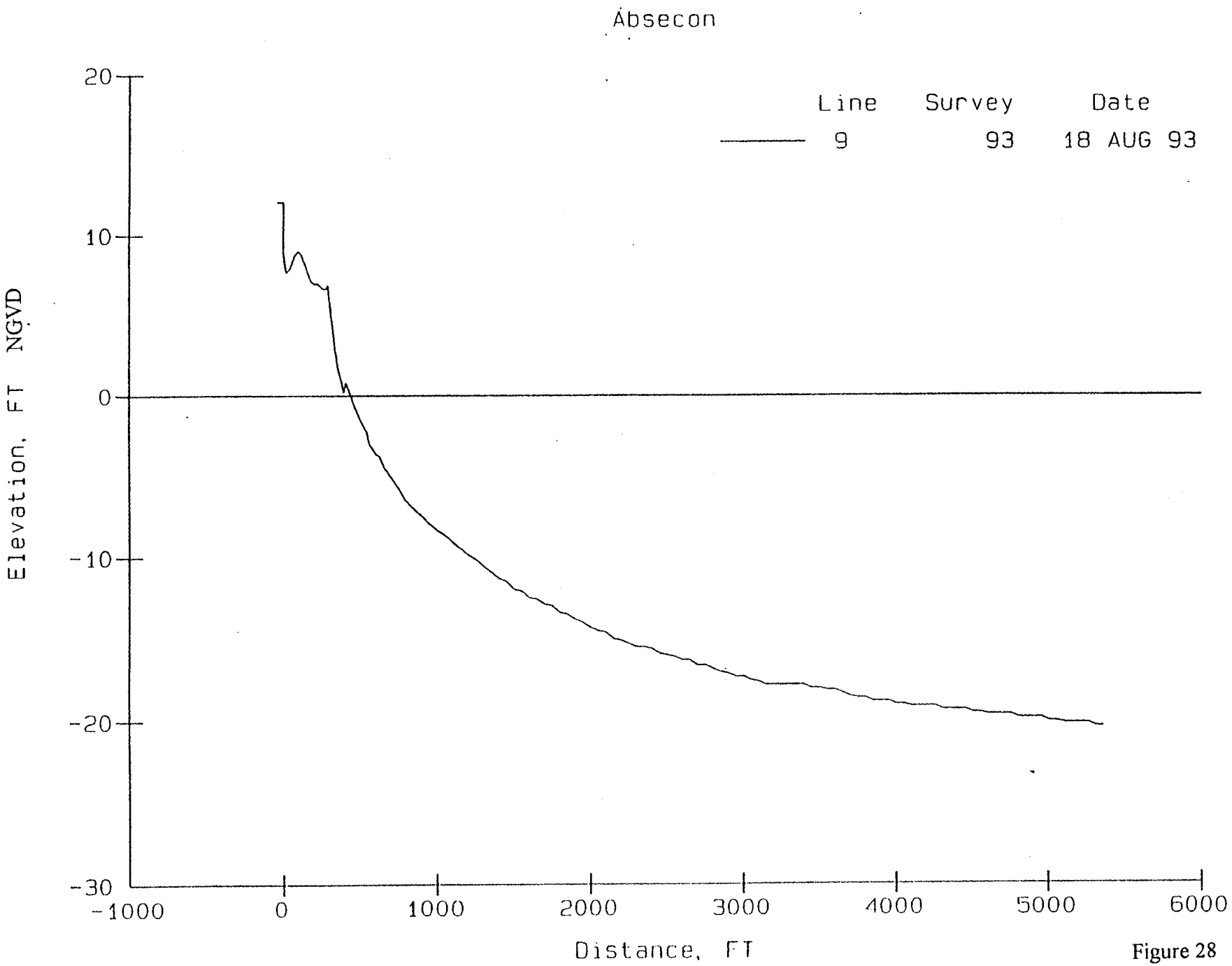
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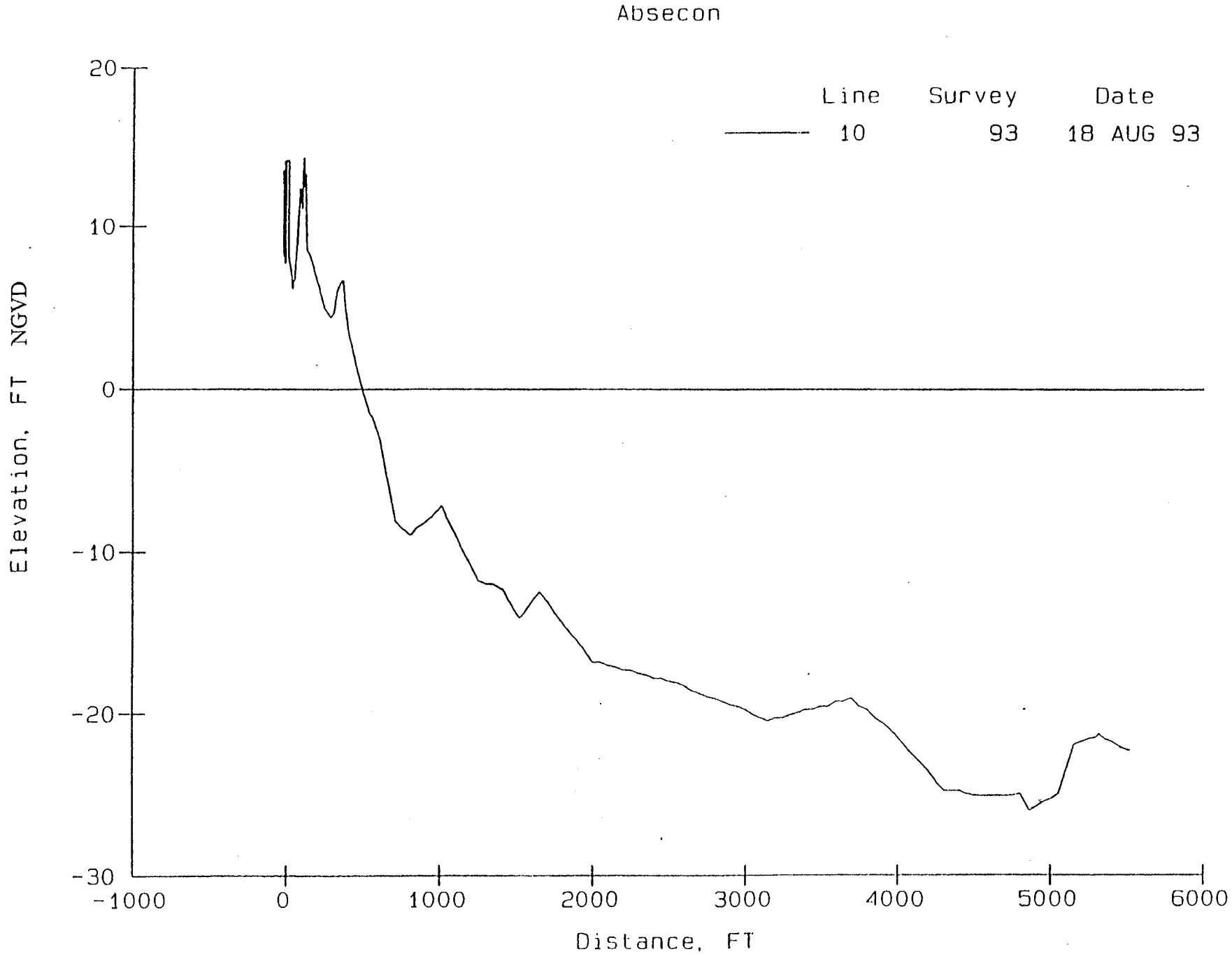
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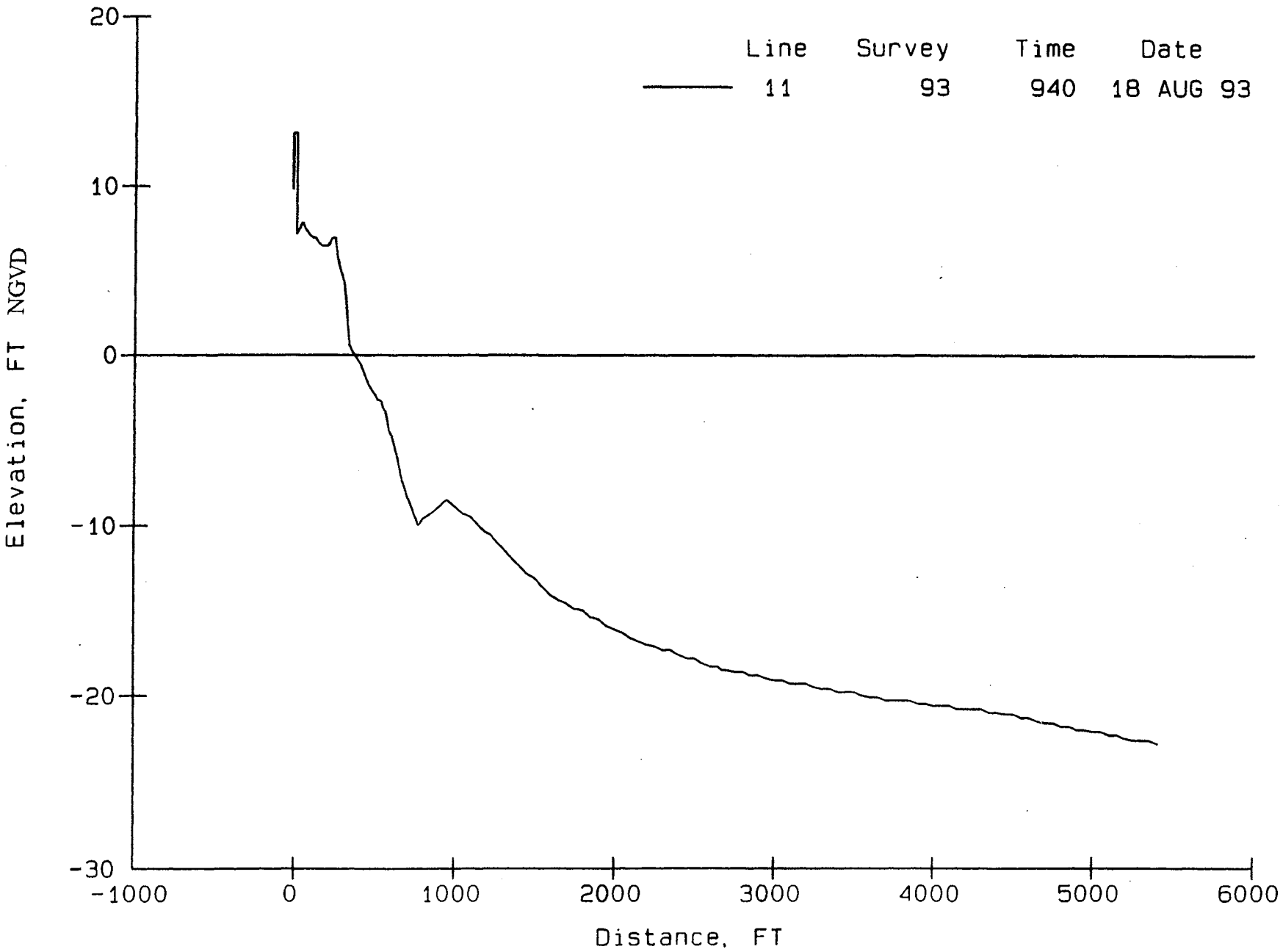
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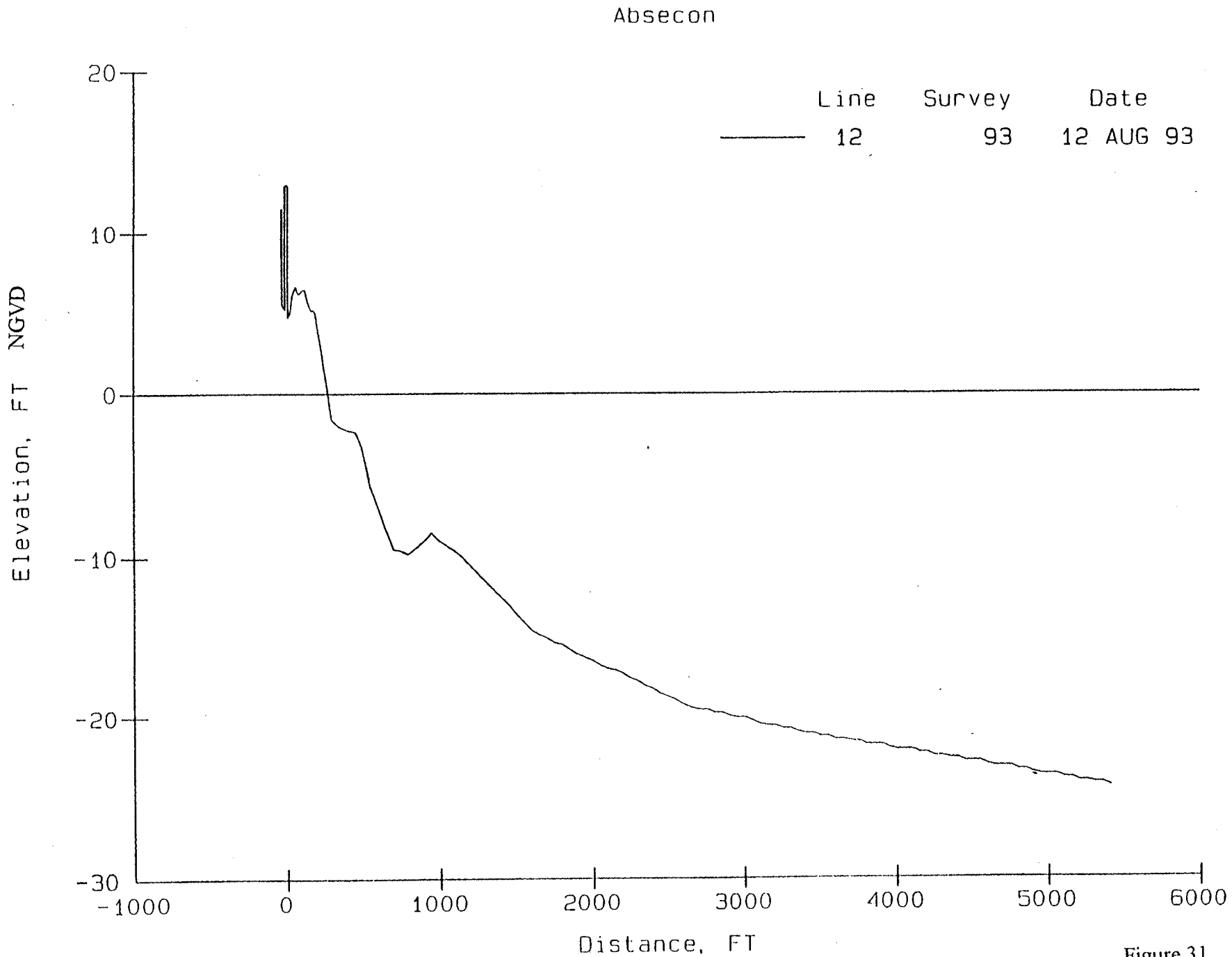
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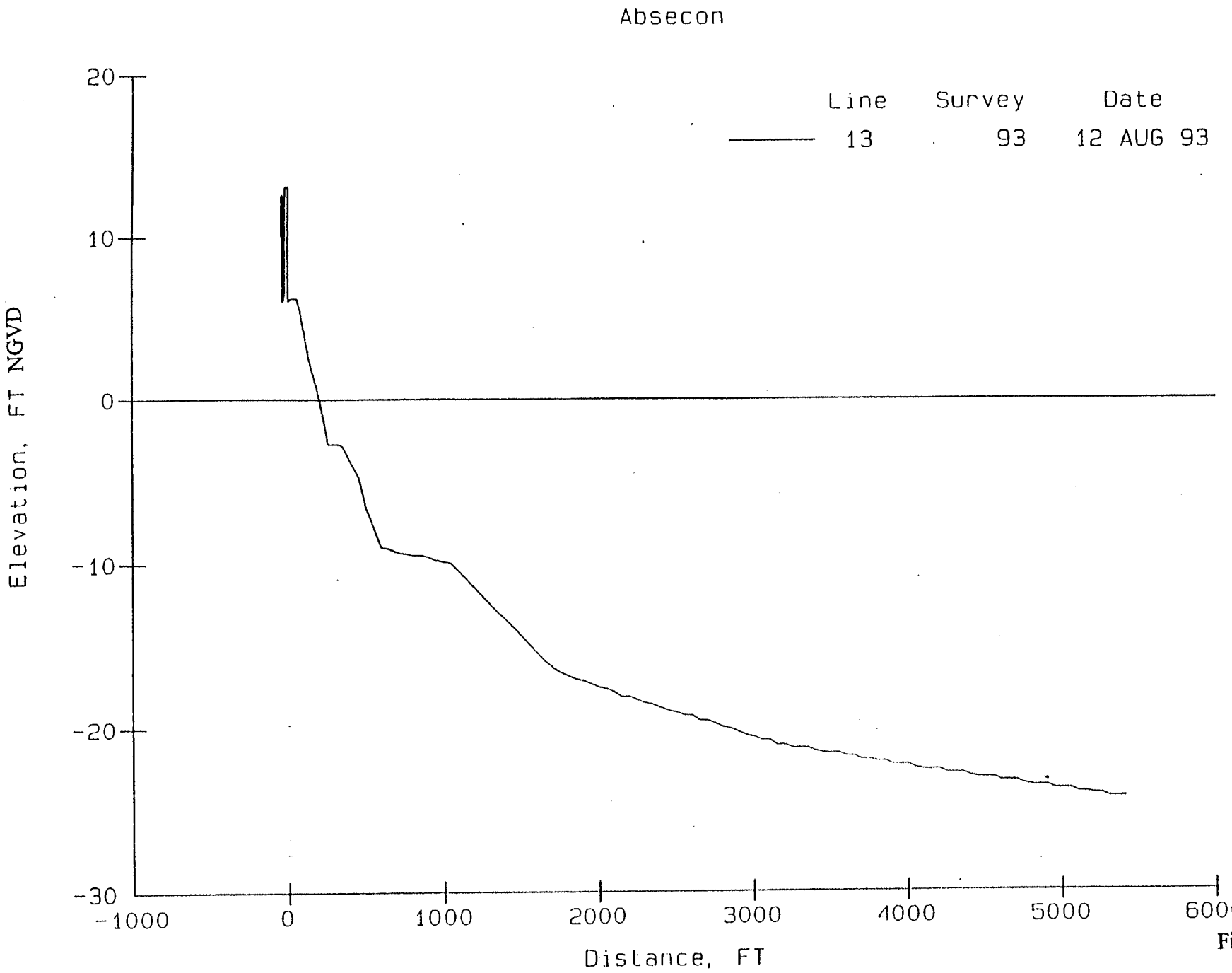
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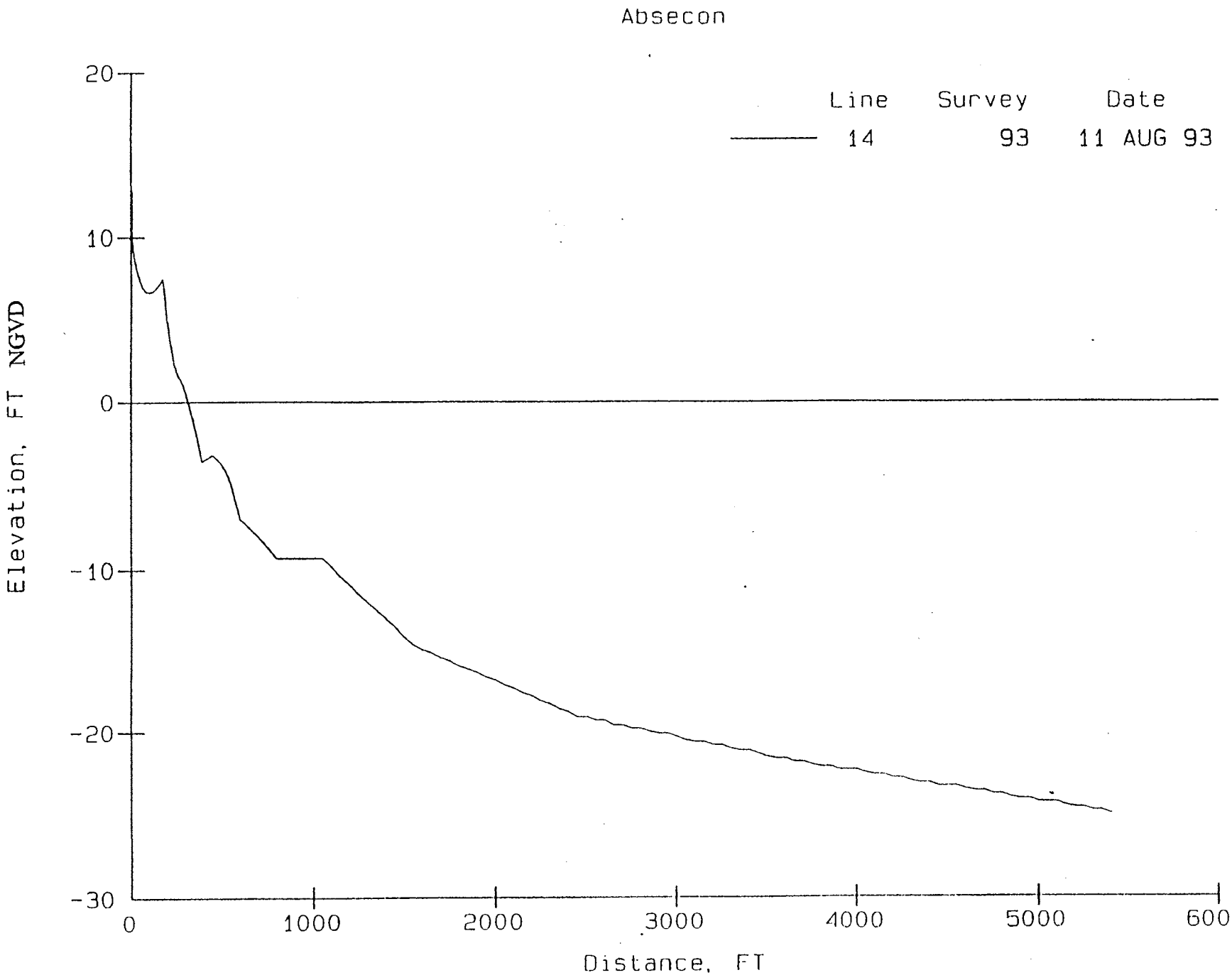
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-20
-30
Elevation, FT NGVD
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 33

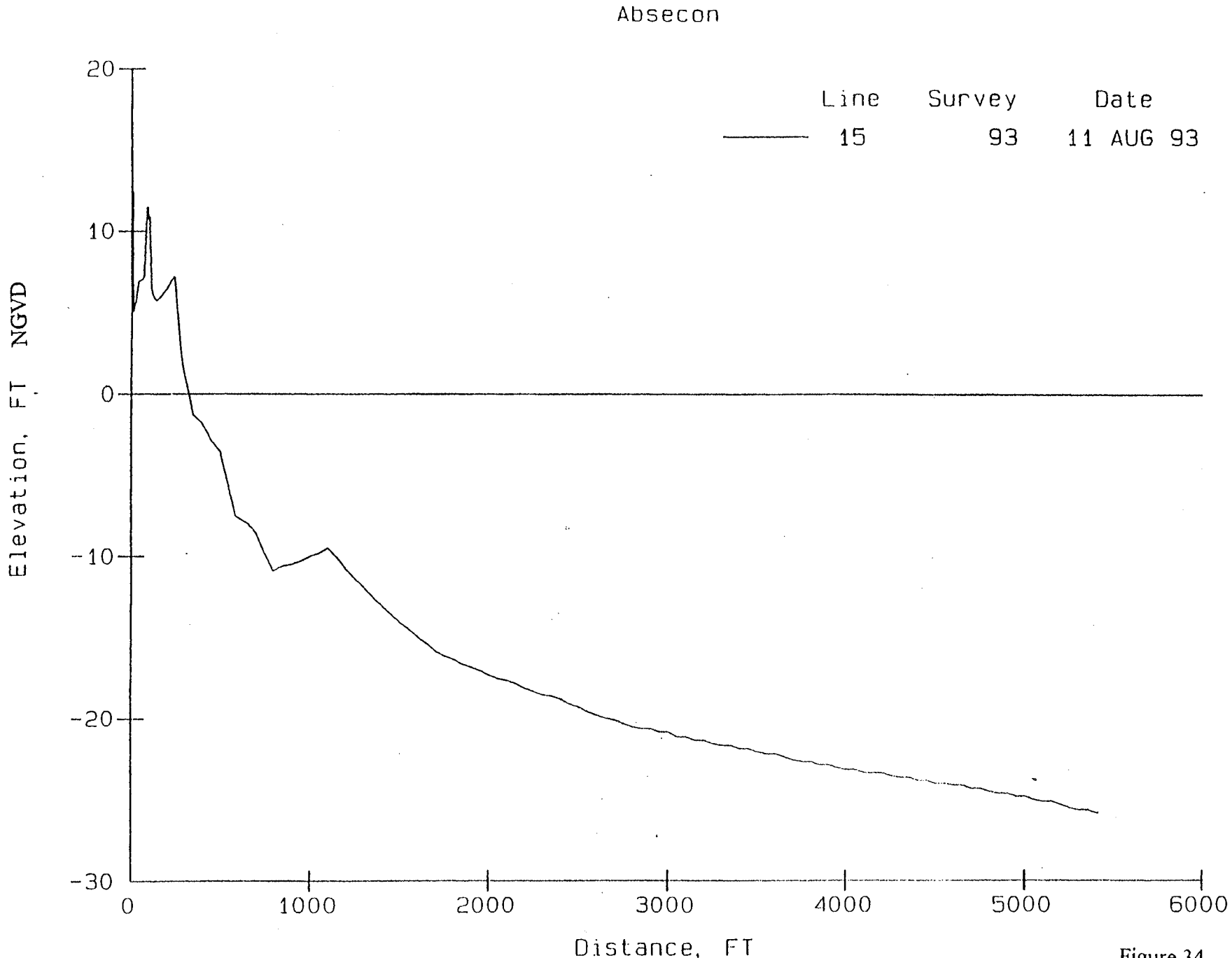

Absecon
Line
Survey
Date
15
93
11 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 34

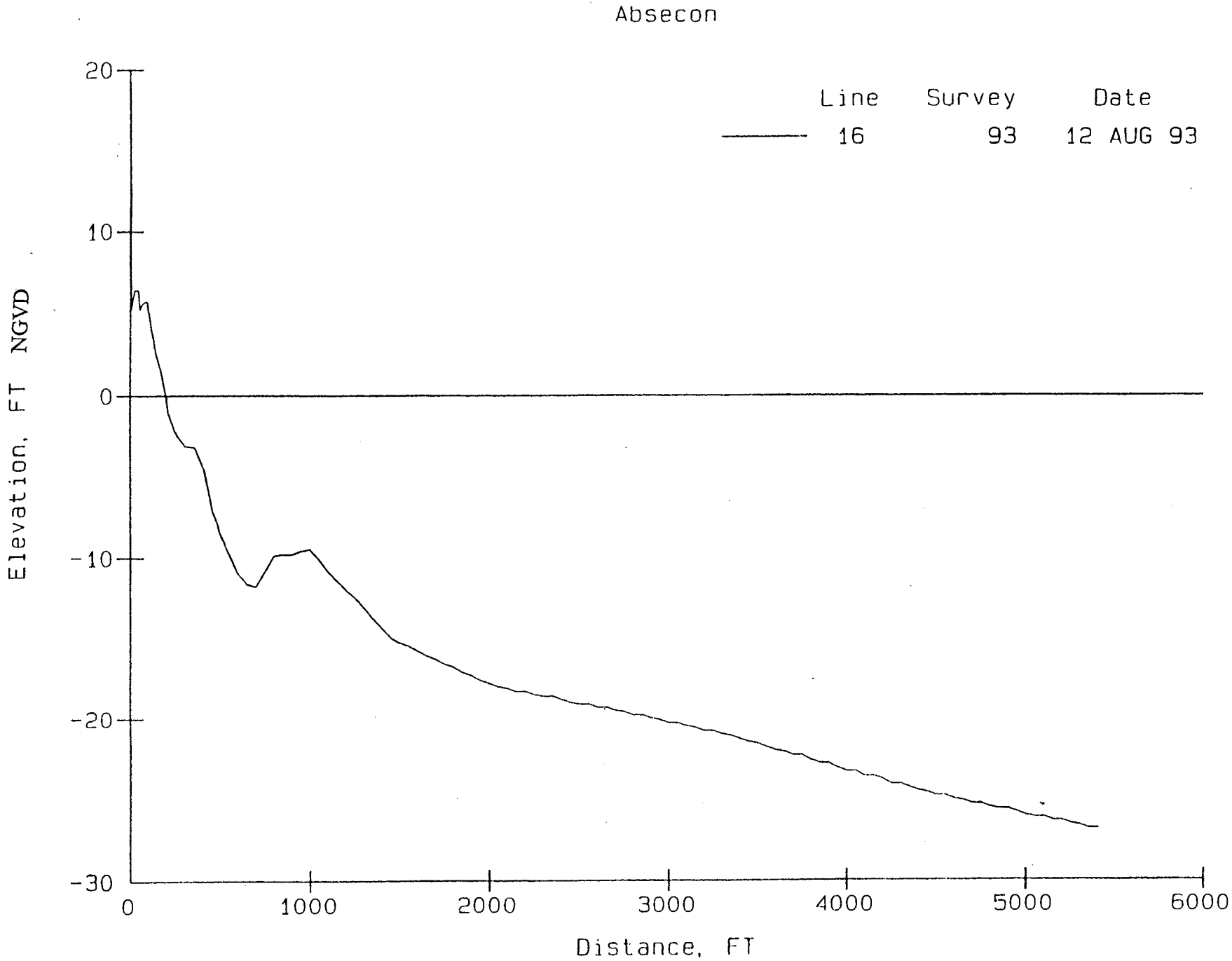

Absecon
Line Survey Date
16 93 12 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 35

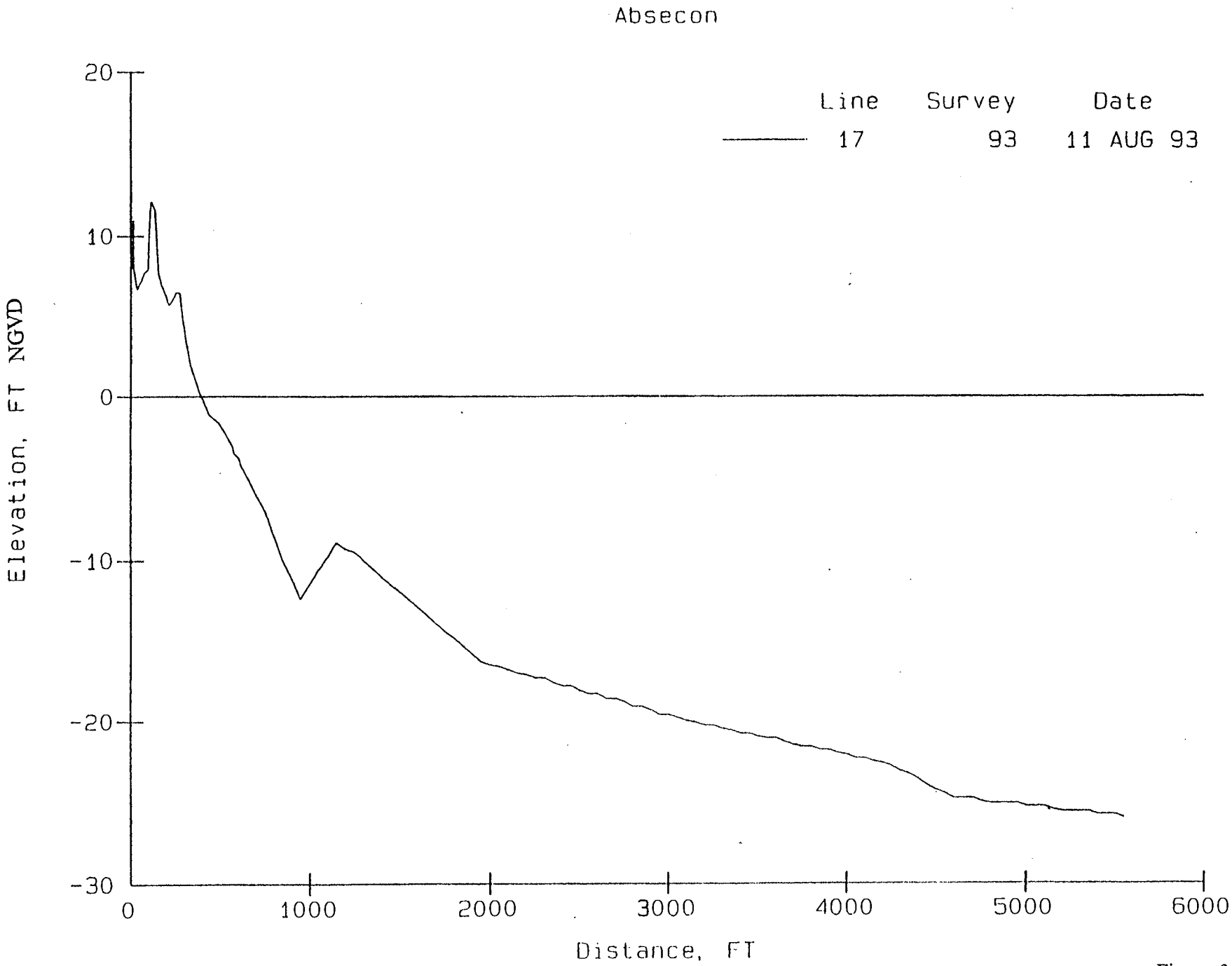

Absecon
Line
Survey
Date
17
93
11 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 36

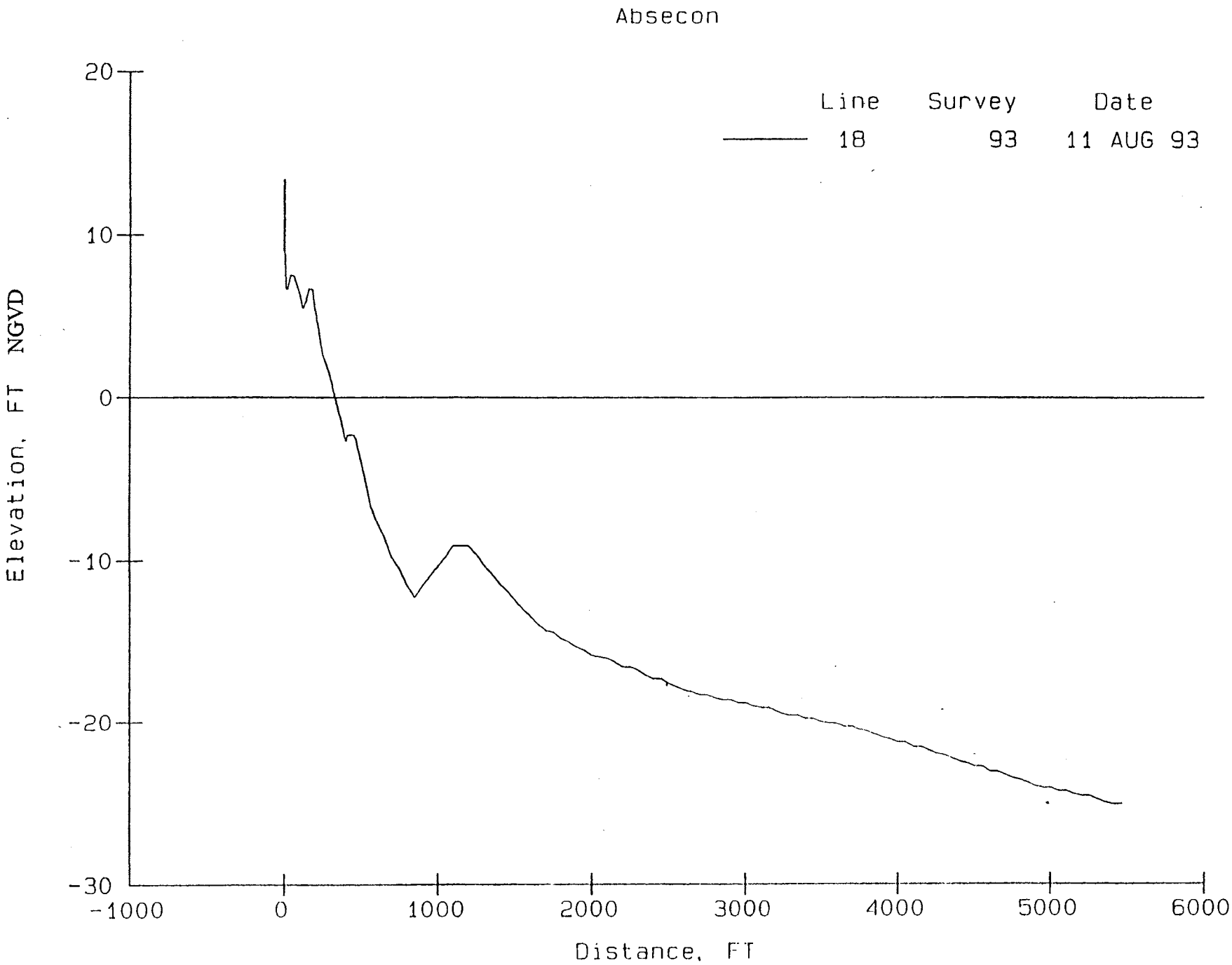

Absecon
Line Survey Date
18 93 11 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
-1000
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 37

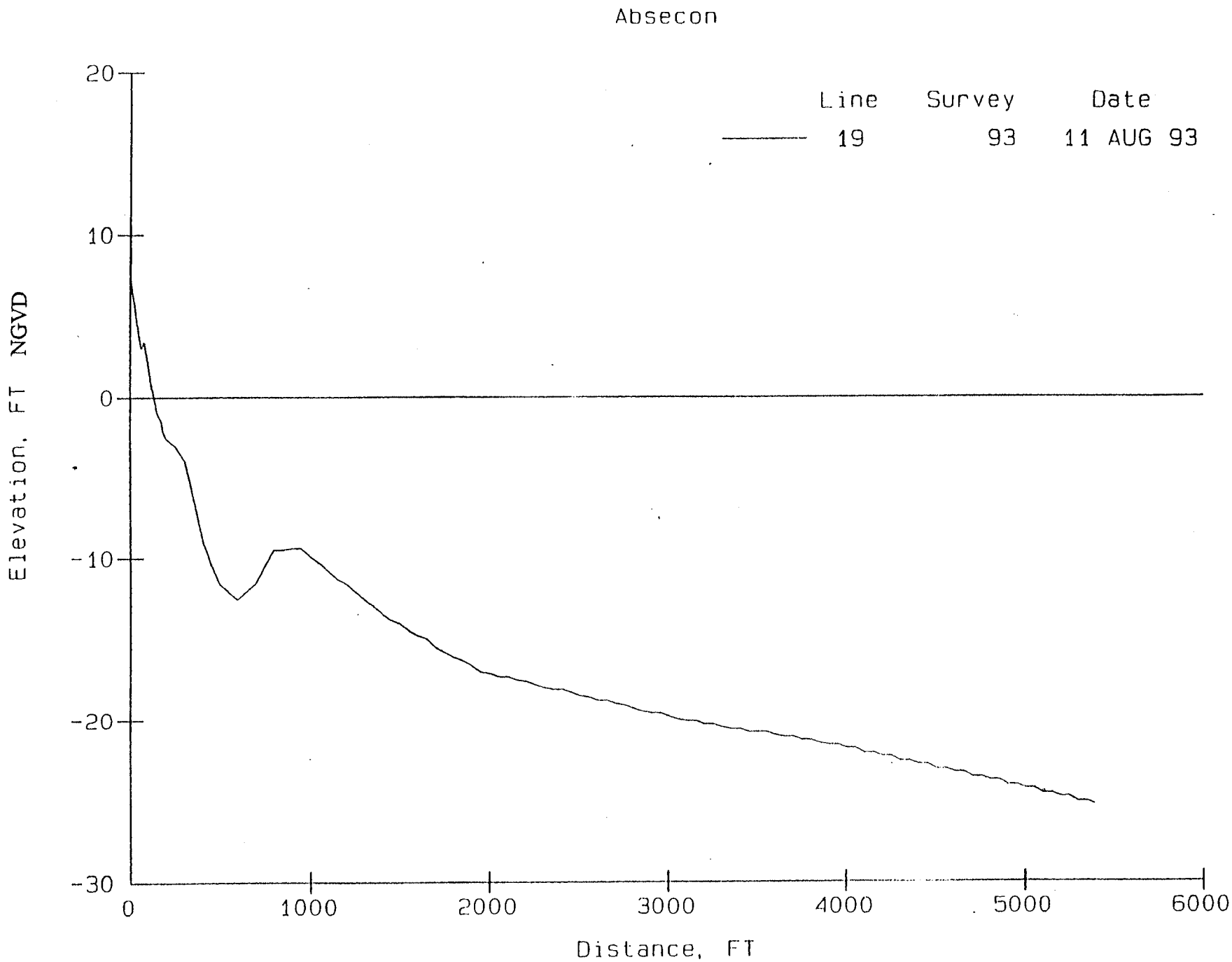
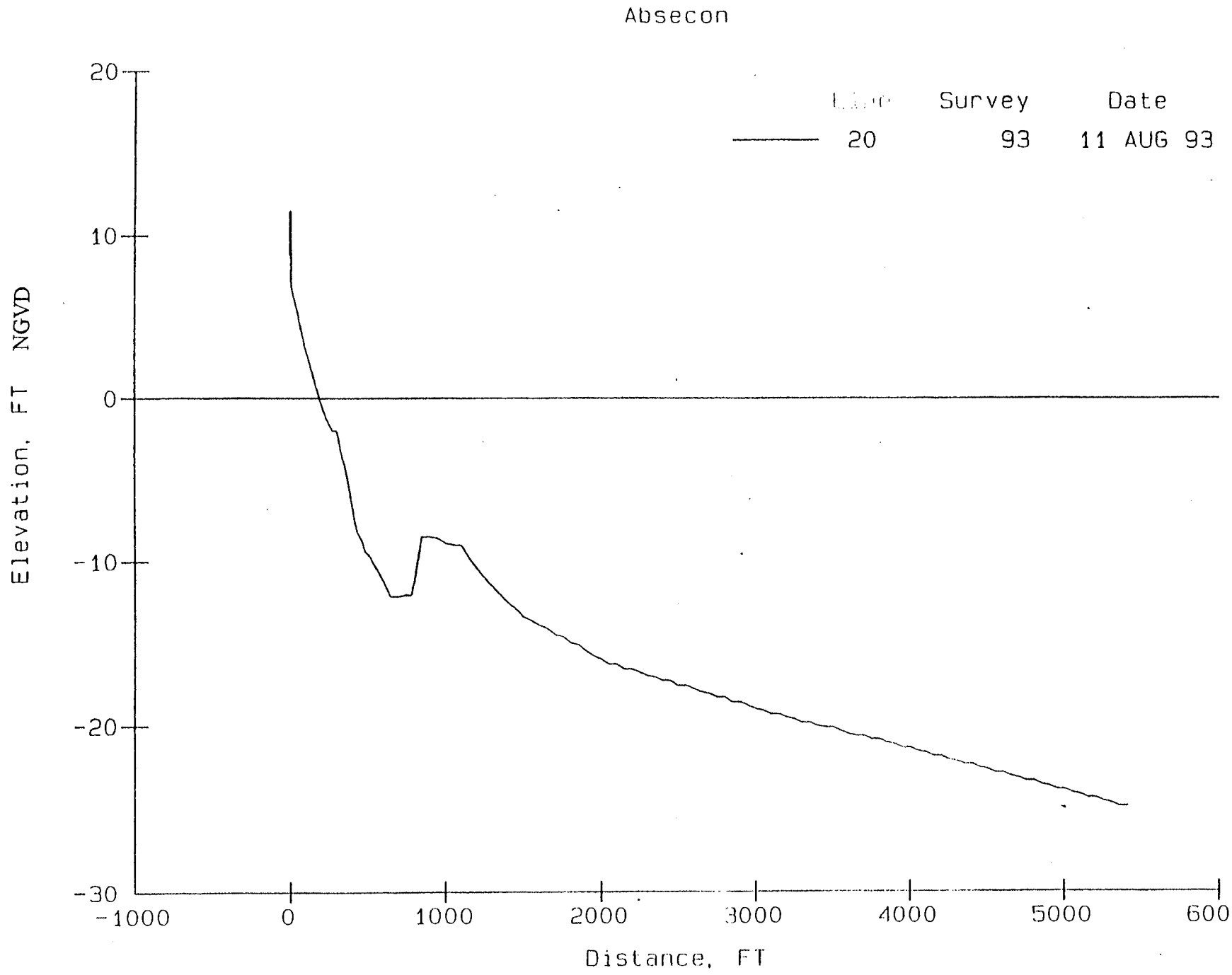
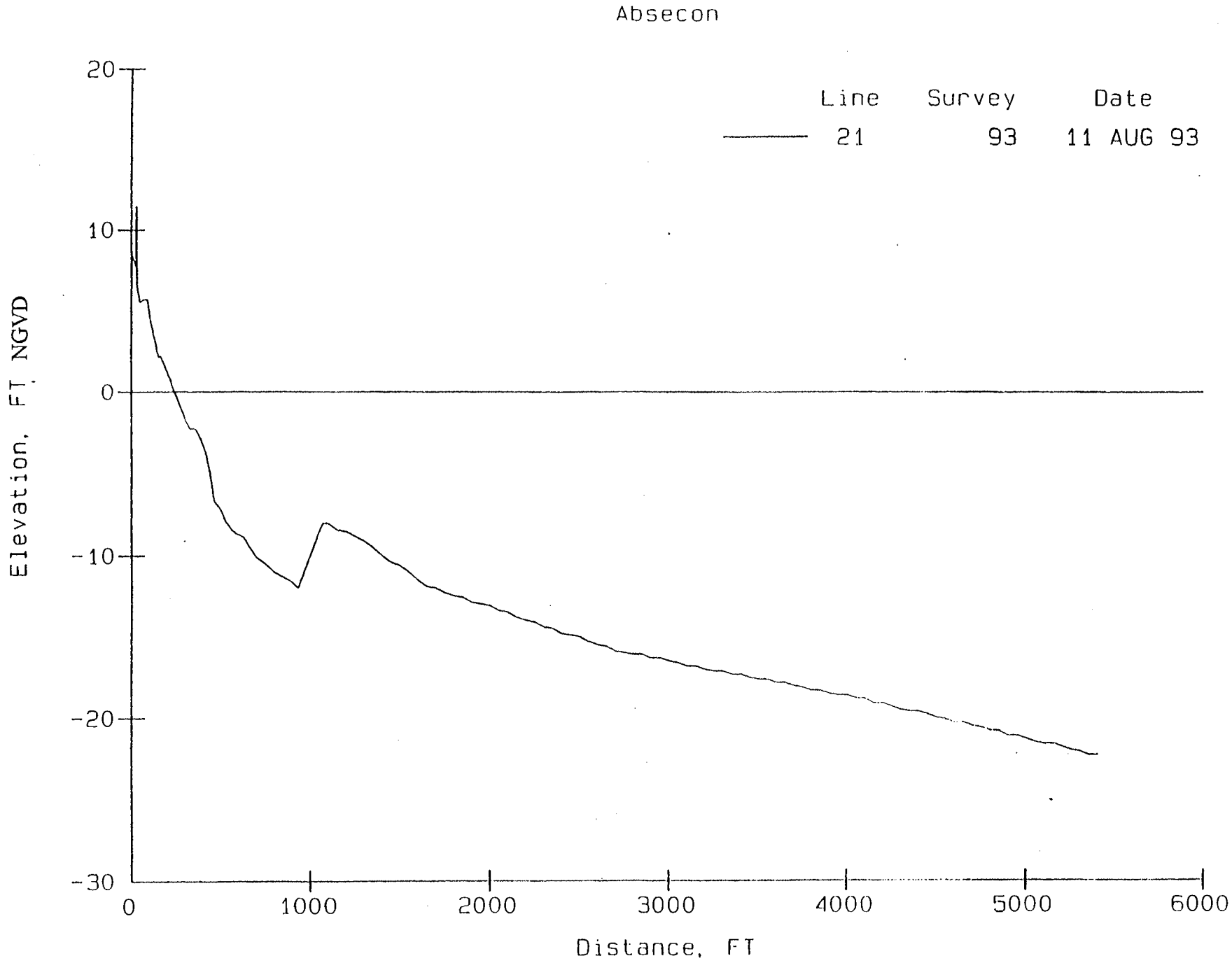

Absecon
Line Survey Date
19 93 11 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 38


Absecon
Line
Survey
Date
20
93
11 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
-1000
0
1000
2000
3000
4000
5000
6000
Distance, FT


Absecon
Line Survey Date
21 93 11 AUG 93
20
10
0
-10
-20
-30
Elevation, FT NGVD
0
1000
2000
3000
4000
5000
6000
Distance, FT

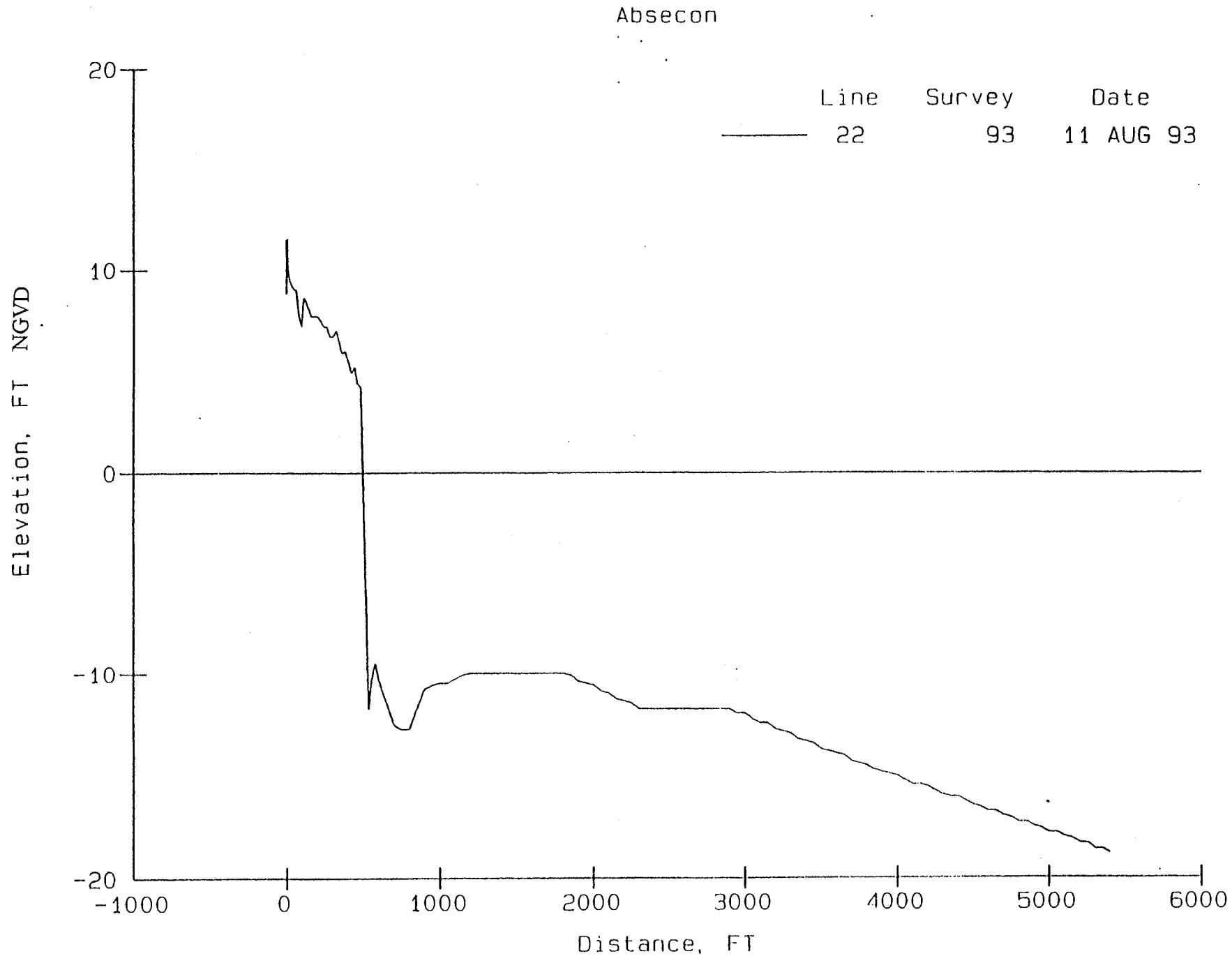

Absecon
Line Survey Date
22 93 11 AUG 93
20
10
0
-10
-20
Elevation, FT NGVD
-1000
0
1000
2000
3000
4000
5000
6000
Distance, FT

Figure 41

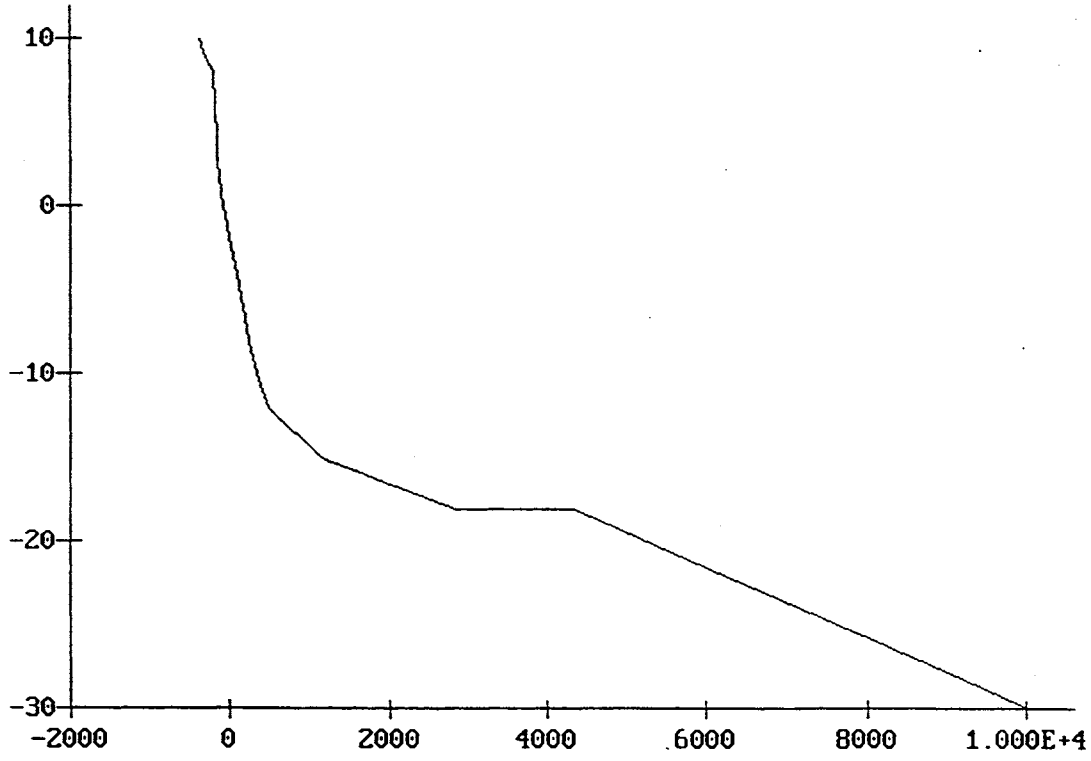


Figure 42. SBEACH Profile Line 1

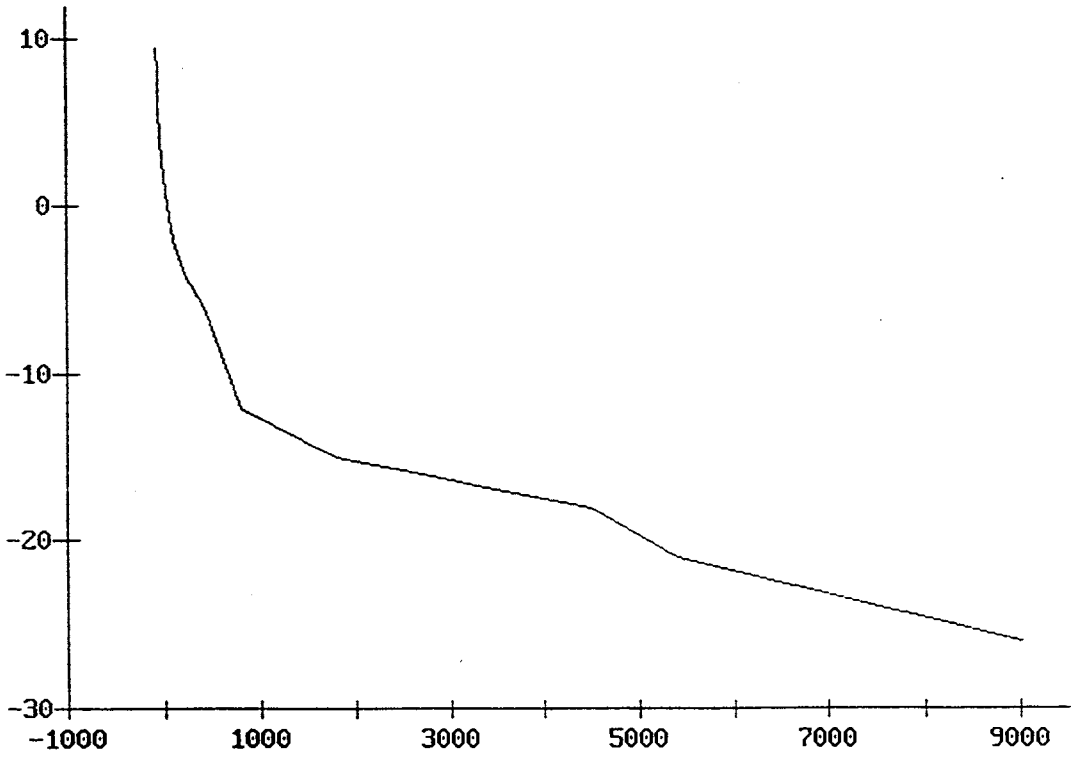


Figure 43. SBEACH Profile Line 2.

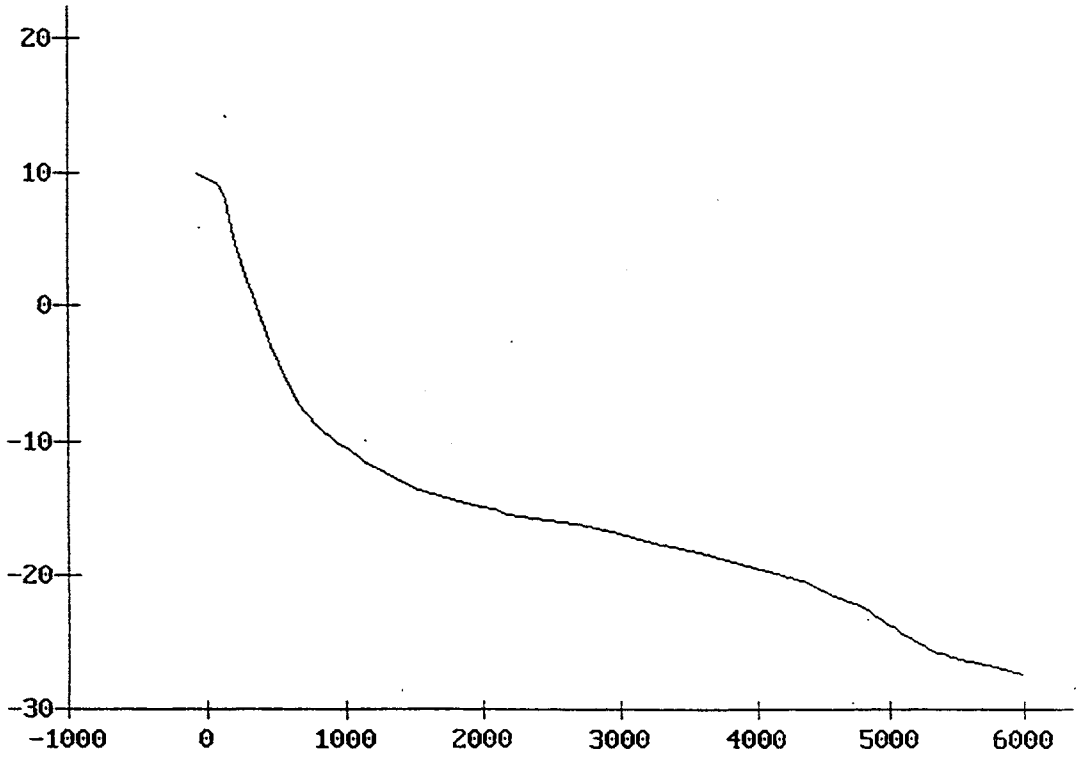


Figure 44. SBEACH Profile Line 3.

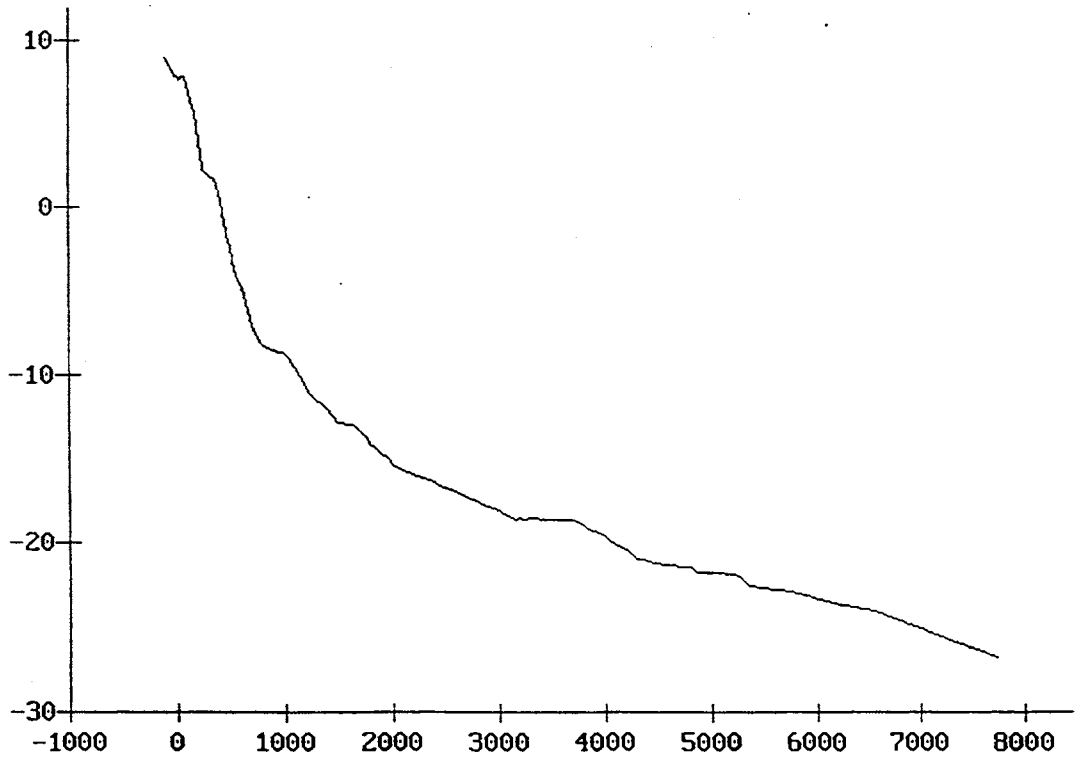


Figure 45. SBEACH Profile Line 4.

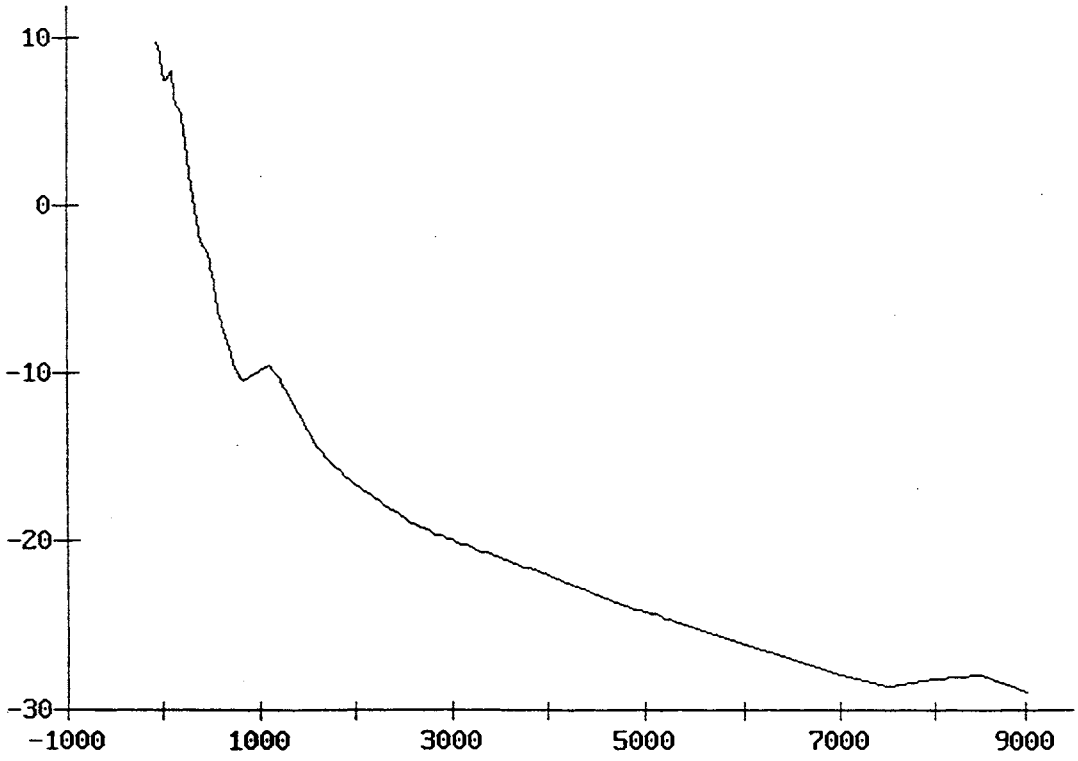


Figure 46. SBEACH Profile Line 5.

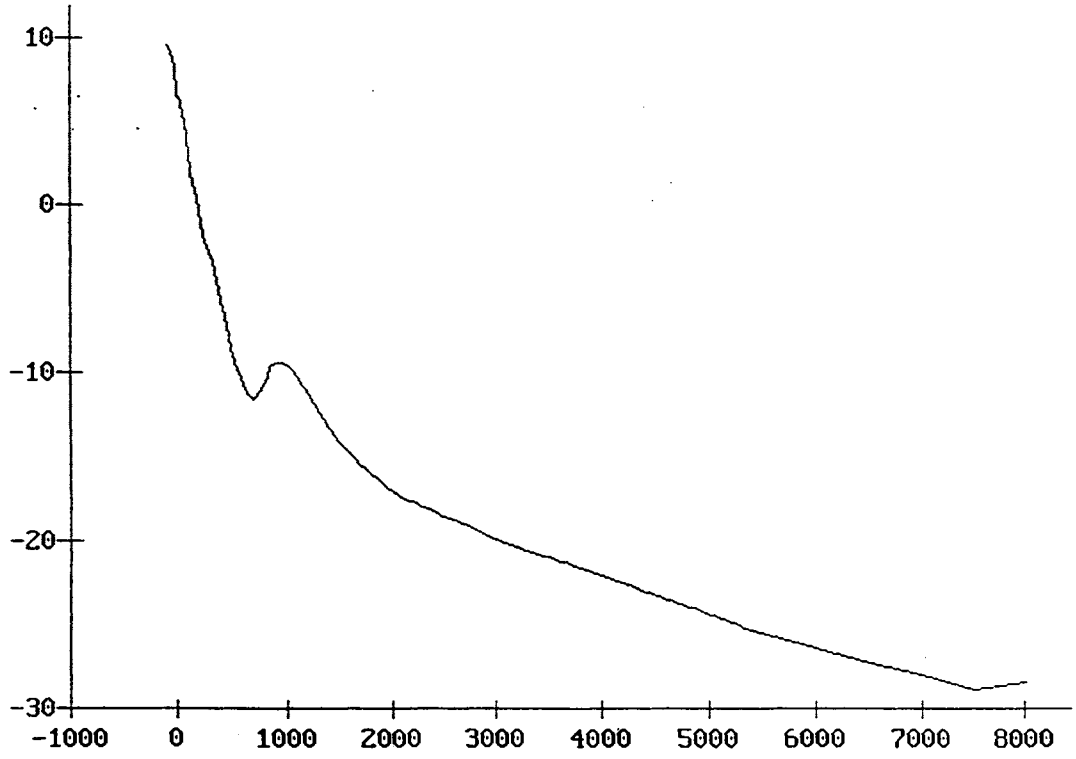


Figure 47. SBEACH Profile Line 6.

WITHOUT PROJECT STORM EROSION MODELING

The USACE has developed, released and adopted the numerical storm-erosion model SBEACH (Storm induced BEAch CHange) for use in field offices (Rosati, et al., 1993). SBEACH is available via a user interface for the personal computer, or through the Coastal Modeling System (CMS) (Cialone et al., 1992). Comprehensive descriptions of development, testing, and application of the model are contained in Reports 1 and 2 of the SBEACH series (Larson and Kraus 1989; Larson, Kraus, and Byrnes 1990).

OVERVIEW OF SBEACH METHODOLOGY. SBEACH Version 3.0 was used in this analysis. SBEACH is a geomorphic-based two-dimensional model which simulates beach profile change, including the formation and movement of major morphologic features such as longshore bars, troughs, and berms, under varying storm waves and water levels (Rosati, et al. 1993). SBEACH has significant capabilities that make it useful for quantitative and qualitative investigation of short-term, beach profile response to storms. However, since SBEACH is based on cross-shore processes, there are shortcomings when used in areas having significant longshore transport.

Input parameters include varying water levels as produced by storm surge and tide, varying wave heights and periods, and grain size in the fine-to-medium sand range. The initial beach profile can be input as either an idealized dune and berm configuration or as a surveyed total profile configuration. SBEACH allows for variable cross-shore grid spacing, simulated water-level setup due to wind, advanced procedures for calculating the wave breaking index and breaker decay, and provides an estimation of dune overwash. Shoreward boundary conditions that may be specified include a vertical structure (that can fail due to either excessive scour or instability caused by wave action/water elevation) or a beach with a dune. Output results from SBEACH include calculated profiles, cross-shore parameters, a log for each SBEACH run, and a report file.

SBEACH CALIBRATION. Calibration refers to the procedure of reproducing with SBEACH the change in profile shape produced by an actual storm. Due to the empirical foundation of SBEACH and the natural variability that occurs along the beach during storms, the model should be calibrated using data from beach profiles surveyed before and after storms at the project coast or a similar coast. The calibration procedure involves iterative adjustments of controlling simulation parameters until agreement is obtained between measured and simulated profiles. The best profile data set for calibration along the Absecon Island study area consisted of USACE profile surveys taken at Ocean City, NJ prior to and just after the December 1992 storm. Shoreline configuration, grain size, and coastal processes at Ocean City, NJ are similar to those for the Absecon Island study area, therefore, calibration using this well-documented pre- and post-storm data is considered sound. Additionally, a wave hindcast of the December 1992 storm (Andrews Miller, 1993) was prepared for the Philadelphia District, and water level data for the storm was recorded at the Atlantic City tide gage. Initial calibration simulations produced insufficient erosion when compared to the post-storm profile data. With CERC's assistance, minor modifications were made to the SBEACH program to allow for factors particular to the southern New Jersey coastline. Final calibration was satisfactorily completed and typical

calibration plots are provided in Figures 48 and 49. Controlling simulation parameters determined for the Absecon Island study area are as follows:

$K = 2.5e^{-6}$ m^4/N
EPS = 0.005 m2/sec
LAMM = 0.10
BMAX = 40 deg
D_{50} = 0.24 mm

where K is the empirical transport rate coefficient, EPS is the transport rate coefficient for the slope dependent term, LAMM is the transport rate decay coefficient multiplier, BMAX is the maximum profile slope prior to avalanching, and D_{50} is the effective grain size.

MODEL PARAMETERS. Various model parameters required to run SBEACH are included in the input configuration file. The configuration file is separated into five sections: A - Model Setup; B - Waves/Water Elevation/Wind; C - Beach; D - Beach Fill; and E - Seawall/Revetment. Section A (Model Setup) deals with the initial and measured profiles, grid arrangement, output parameters, and calibration parameters. Section B facilitates entry of information about waves, water elevations, and winds. Section C allows entry of basic information related to beach profile data, and Section D allows for definition of a beach fill placed on the initial profile. An example configuration file is provided in Figure 50.

In Section E of the configuration file, the location and failure criteria for a seawall or revetment can be entered. Unlike many other storm erosion models, SBEACH can account for the presence of a vertical structure such as a seawall or bulkhead. The majority of Absecon Island, especially Ventnor, Margate, and Longport, is fronted with a nearly continuous line of some type of bulkhead or seawall. These structures were accounted for by inputing their locations along the profile along with appropriate failure criteria by waves, water levels, and profile scour. In Atlantic City, the concrete footings of the large buildings such as the casinos were treated in the model as unfailable seawalls. The northernmost and southernmost sections of Atlantic City have intermittent private bulkheads which were considered to not represent "average" conditions for those areas.

STORM EROSION SIMULATIONS. The SBEACH model was applied to predict storm-induced erosion for the Absecon Island study area. All representative storm events were run against the six pre-storm profiles. Model output for each simulation includes a post-storm profile plot, and several report and post-processing files. Simulation results from each particular combination of profile geometry and storm characteristics yield predicted profile retreat at three selected elevation contours. In this analysis, profile retreat for any given storm event was measured landward from the reference line to the location of the top of the erosion scarp on the beach face. Typical plots of pre-storm profiles and the resultant post-storm profiles are provided in Figures 51 to 56. These figures show SBEACH predicted retreat along each of the profiles for the 50-year storm event. Tables 3 and 4 present predicted shoreline erosion positions and inundation results, respectively, for without project conditions.

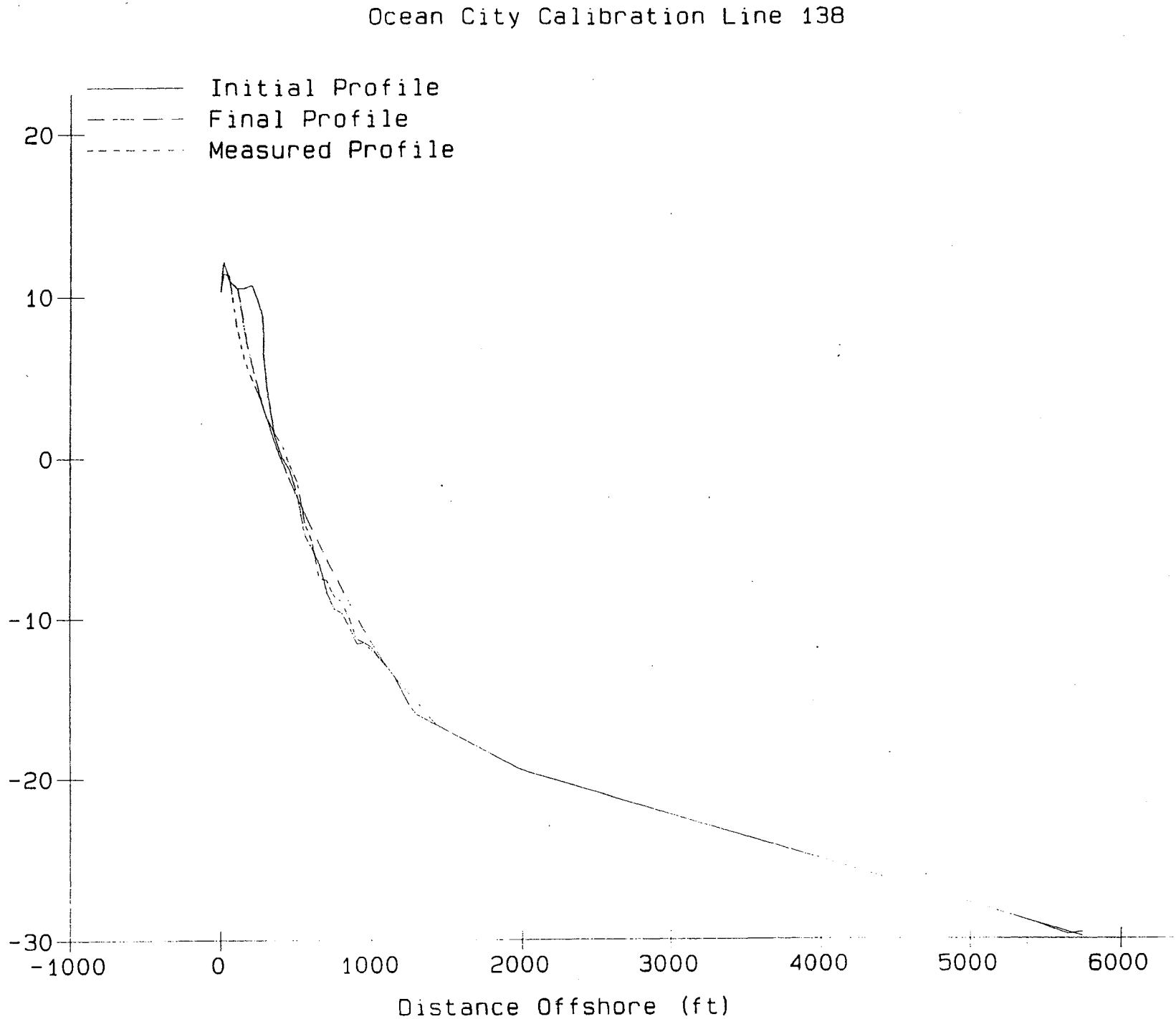

Ocean City Calibration Line 138
Initial Profile
Final Profile
Measured Profile
Profile Elevation (ft)
20
10
0
-10
-20
-30
-1000
0
1000
2000
3000
4000
5000
6000
Distance Offshore (ft)

Figure 48

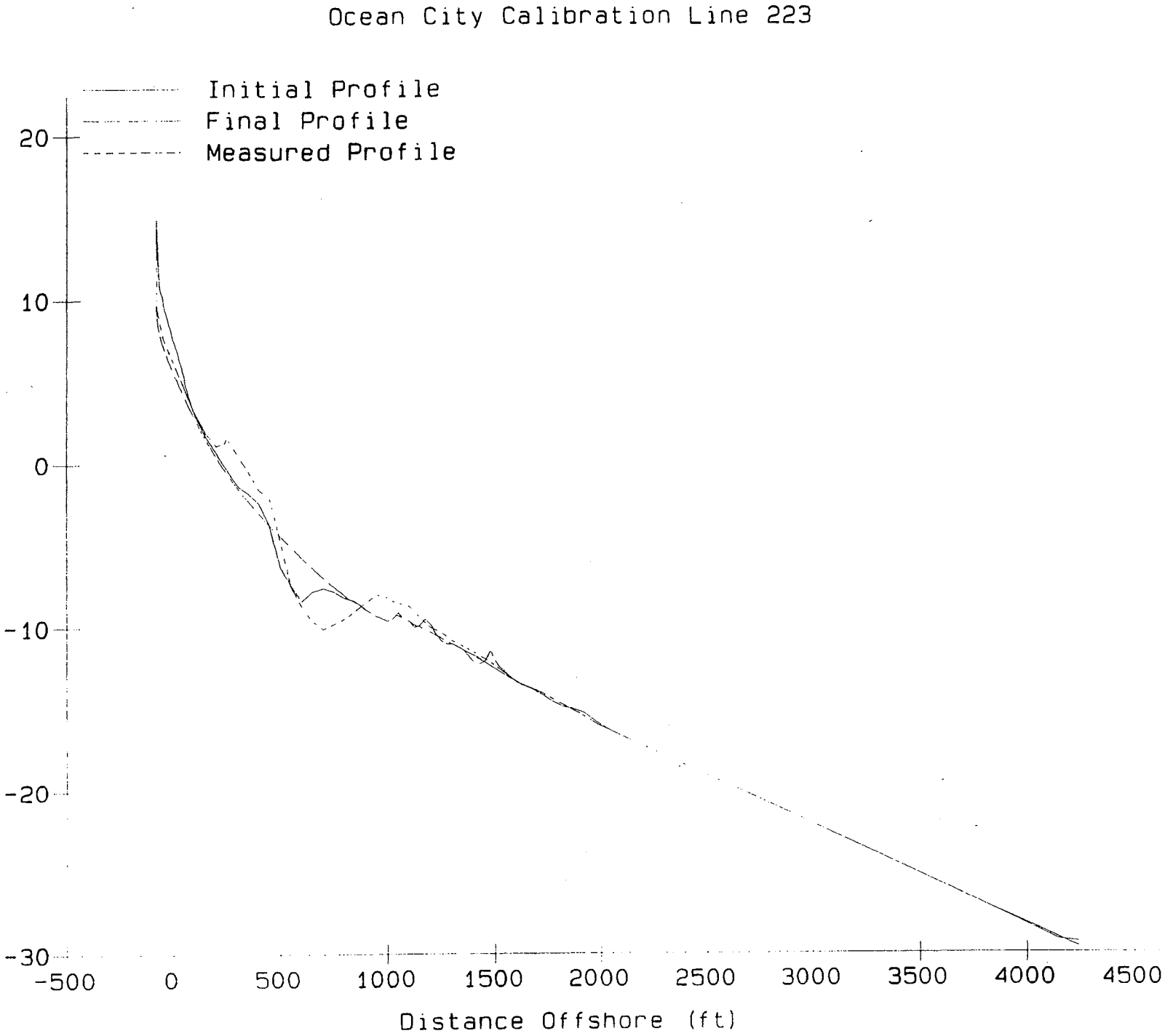

Ocean City Calibration Line 223
Initial Profile
Final Profile
Measured Profile
Profile Elevation (ft)
20
10
0
-10
-20
-30
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance Offshore (ft)

Figure 49

```
          ************************************************************
          *   SBEACH model configuration file:        6.CFG          *
          ************************************************************
A--------------------------- MODEL SETUP -----------------------------A
A.1  RUN TITLE: TITLE
     Absecon Average Profile 6
A.2  INPUT UNITS (SI=1, AMERICAN CUST.=2): UNITS
     2
A.3  TOTAL NUMBER OF CALCULATION CELLS AND POSITION OF LANDWARD BOUNDARY
     RELATIVE TO INITIAL PROFILE: NDX, XSTART
     719       -900.00
A.4  GRID TYPE (CONSTANT=0, VARIABLE=1): IDX
     1
A.5  COMMENT: IF GRID TYPE IS VARIABLE, CONTINUE TO A.8
A.6  CONSTANT GRID CELL WIDTH: DXC
     10
A.7  COMMENT: IF GRID TYPE IS CONSTANT CONTINUE TO A.10
A.8  NUMBER OF DIFFERENT GRID CELL REGIONS: NGRID
     4
A.9  GRID CELL WIDTHS AND NUMBER OF CELLS IN EACH REGION FROM LANDWARD
     TO SEAWARD BOUNDARY: (DXV(I), NDXV(I), I=1,NGRID)
     50, 14, 5, 640, 50, 30, 100, 35
A.10 NUMBER OF TIME STEPS AND VALUE OF TIME STEP IN MINUTES: NDT,DT
     864         5.00
A.11 NUMBER OF TIME STEP(S) INTERMEDIATE OUTPUT IS WANTED: NWR
     0
A.12 TIME STEPS OF INTERMEDIATE OUTPUT: (WRI(I), I=1,NWR)
     0
A.13 IS A MEASURED PROFILE AVAILABLE FOR COMPARISON? (NO=0, YES=1): ICOMP
     0
A.14 THREE PROFILE ELEVATION CONTOURS (MAXIMUM HORIZONTAL RECESSION OF EACH
     WILL BE DETERMINED): ELV1, ELV2, ELV3
        5.00       0.00      -5.00
A.15 THREE PROFILE EROSION DEPTHS AND REFERENCE ELEVATION (DISTANCE FROM
     POSITION OF REFERENCE ELEVATION ON INITIAL PROFILE TO POSITION OF
     LANDWARD MOST OCCURRENCE OF EACH EROSION DEPTH WILL BE DETERMINED
     EDP1, EDP2, EDP3, REFELV
        0.10       0.50       1.50      0.00
A.16 TRANSPORT RATE COEFFICIENT (m^4/N): K
     2.5e-6
A.17 COEFFICIENT FOR SLOPE-DEPENDENT TERM (m^2/s): EPS
     0.005000
A.18 TRANSPORT RATE DECAY COEFFICIENT MULTIPLIER: LAMM
     0.100000
A.19 WATER TEMPERATURE IN DEGREES C: TEMPC
       10.00
B---------------------- WAVES/WATER ELEVATION/WIND ----------------------B
B.1  WAVE TYPE (MONOCHROMATIC=1, IRREGULAR=2): WVTYPE
     2
B.2  WAVE HEIGHT AND PERIOD INPUT (CONSTANT=0, VARIABLE=1): IWAVE
     1
```

Figure 50. Typical SBEACH Configuration File.

```
D---------------------------- BEACH FILL ------------------------------D
D.1  IS A BEACH FILL PRESENT? (NO=0, YES=1): IBCHFILL
     0
D.2  COMMENT: IF NO BEACH FILL, CONTINUE TO E.
D.3  POSITION OF START AND END OF BEACH FILL RELATIVE
     TO INITIAL PROFILE: XBFS, XBFE
        0.00      0.00
D.4  NUMBER OF REPRESENTATIVE POINTS BETWEEN START
     AND END OF BEACH FILL: NFILL
     0
D.5  LOCATION AND ELEVATION OF REPRESENTATIVE POINTS RELATIVE TO THE
     INITIAL PROFILE: (XF(I), EFILL(I), I=1,NFILL)

E--------------------------- SEAWALL/REVETMENT ---------------------------E
E.1  IS A SEAWALL PRESENT? (NO=0, YES=1): ISWALL
     1

E.2  COMMENT: IF NO SEAWALL, CONTINUE TO F.
E.3  LOCATION OF SEAWALL RELATIVE TO INITIAL PROFILE: XSWALL
        0.00
E.4  IS SEAWALL ALLOWED TO FAIL? (NO=0, YES =1): ISWFAIL
     1
E.5  COMMENT: IF NO SEAWALL FAILURE, CONTINUE TO F.
E.6  PROFILE ELEVATION AT SEAWALL WHICH CAUSES FAILURE, TOTAL WATER ELEVATION
     AT SEAWALL WHICH CAUSES FAILURE, AND WAVE HEIGHT AT SEAWALL WHICH CAUSES
     FAILURE: PEFAIL, WEFAIL,HFAIL
        0.00     12.80      8.00
F---------------------------- COMMENTS ------------------------------F
---------------------------------- END ----------------------------------
-----
```

Figure 50 (continued).

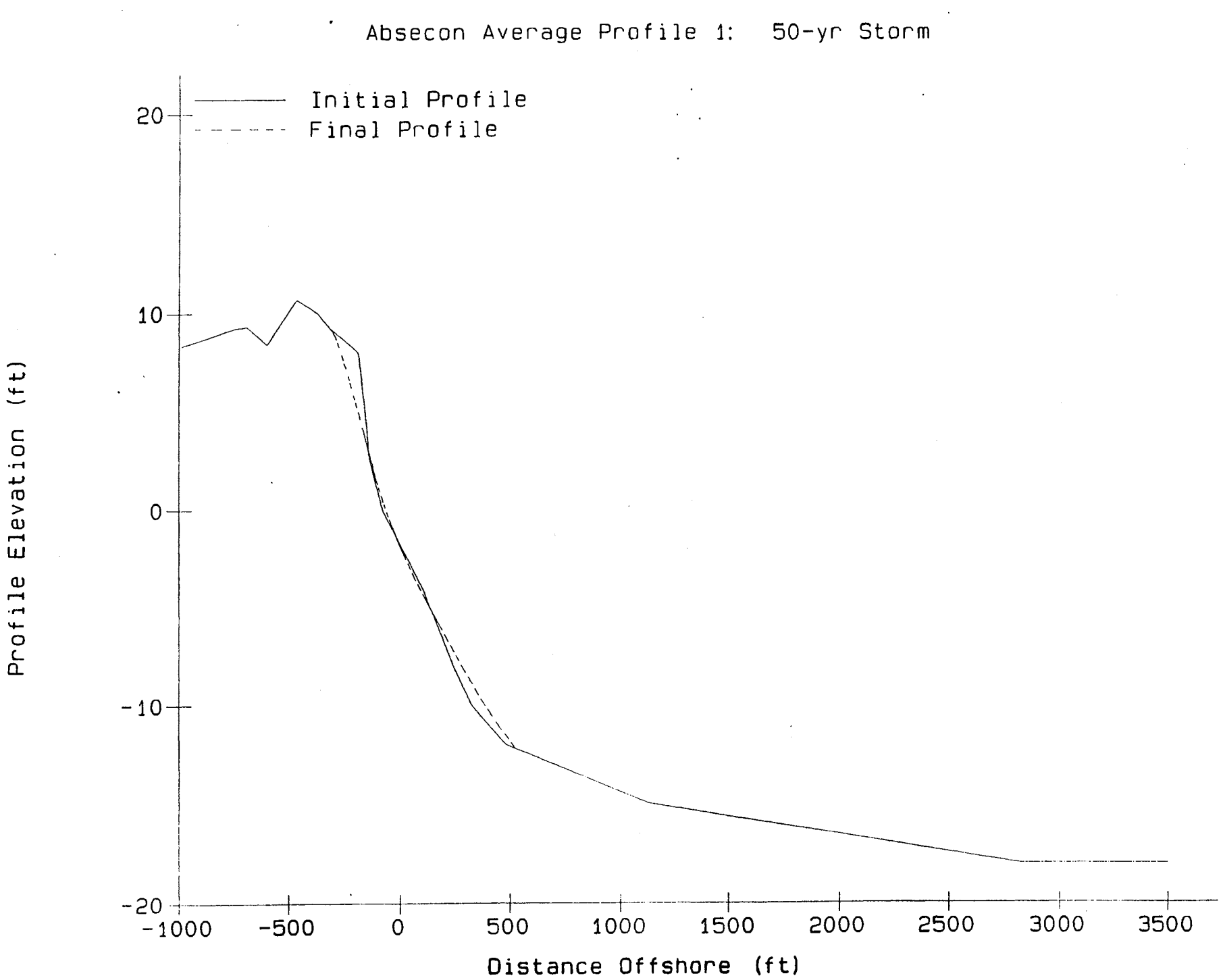

Absecon Average Profile 1: 50-yr Storm
Initial Profile
Final Profile
Profile Elevation (ft)
20
10
0
-10
-20
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
Distance Offshore (ft)

Figure 51

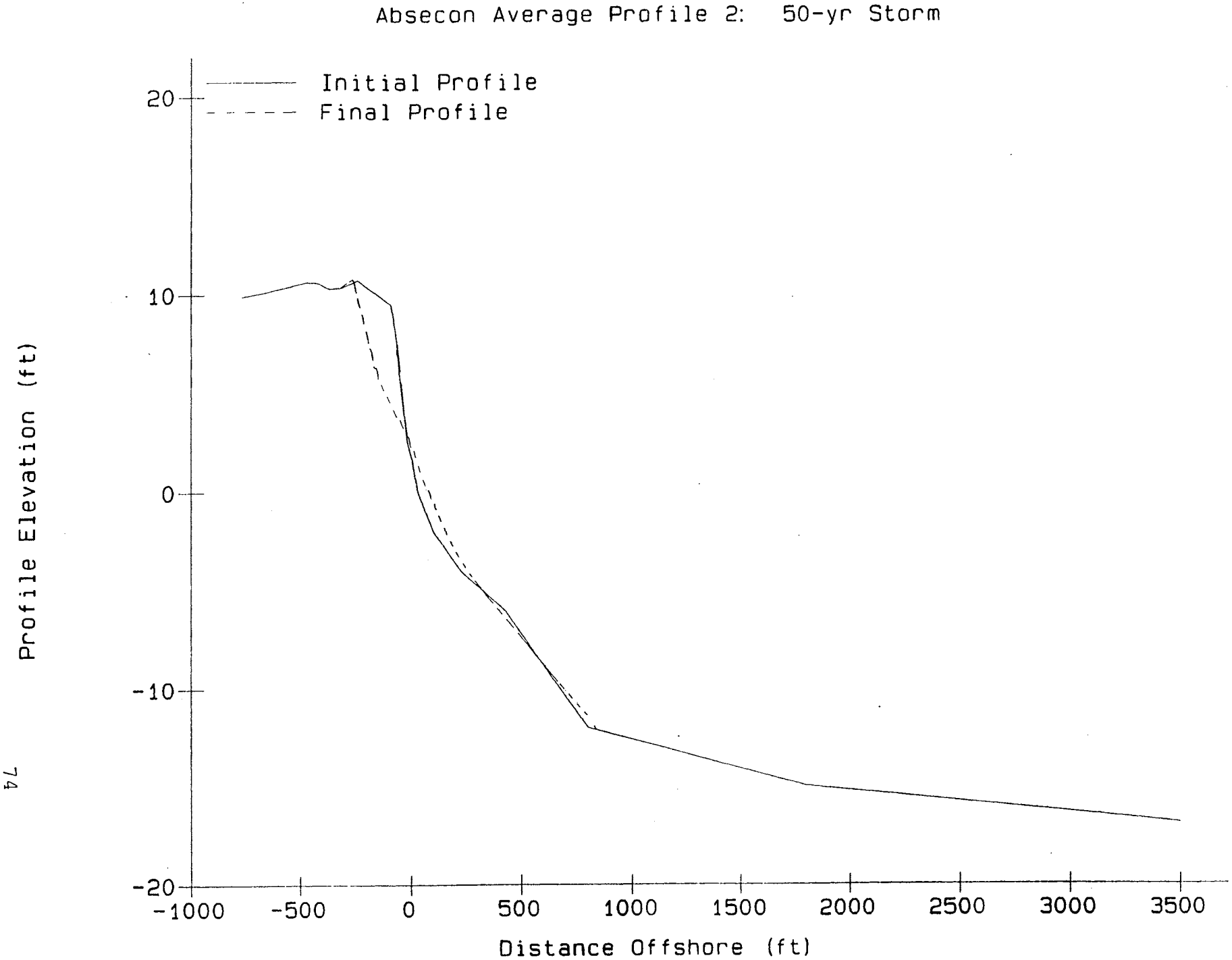

Absecon Average Profile 2: 50-yr Storm
Initial Profile
Final Profile
Profile Elevation (ft)
20
10
0
-10
-20
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
Distance Offshore (ft)

Figure 52.

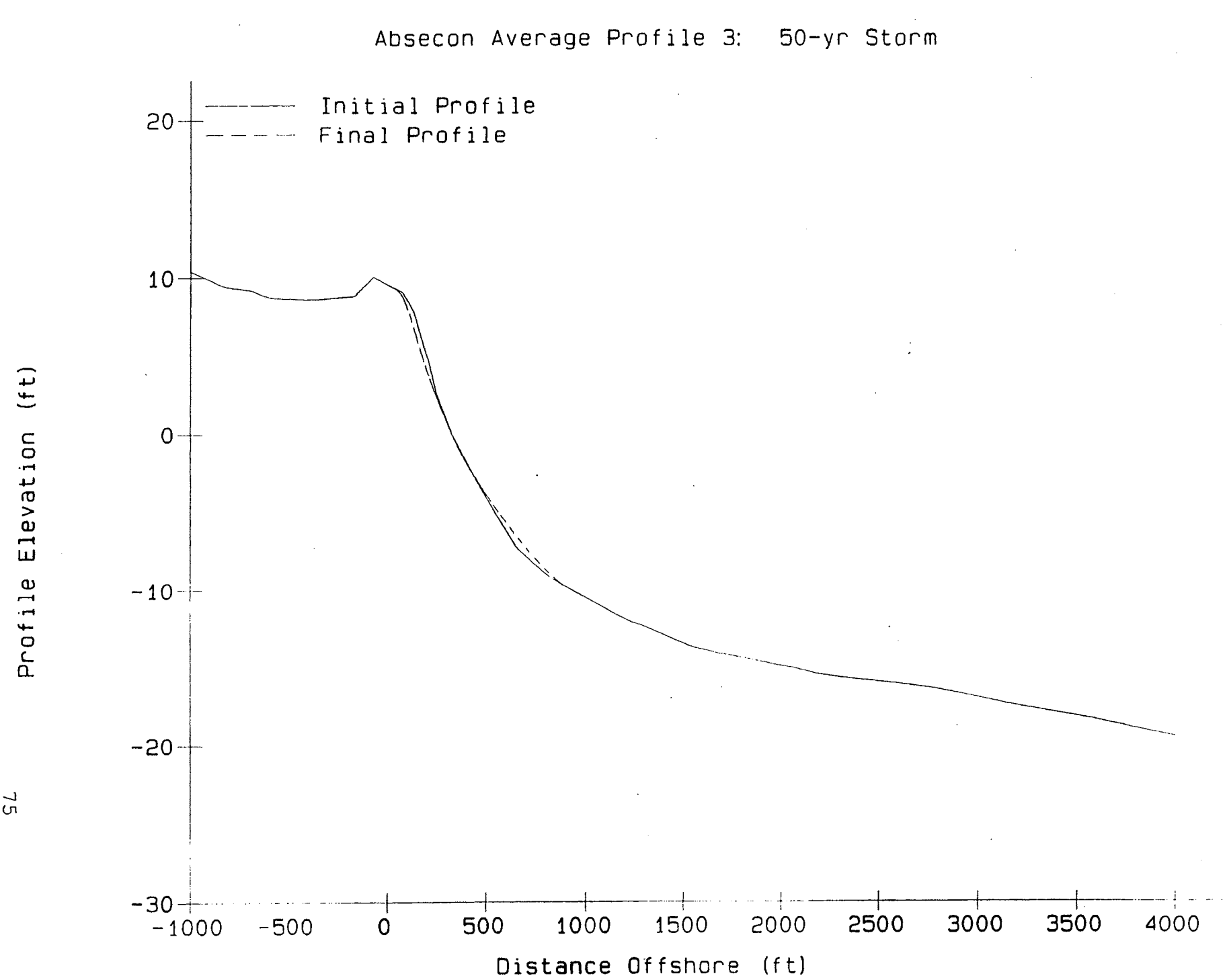

Absecon Average Profile 3: 50-yr Storm
Initial Profile
Final Profile
Profile Elevation (ft)
20
10
0
-10
-20
-30
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
Distance Offshore (ft)

Figure 53

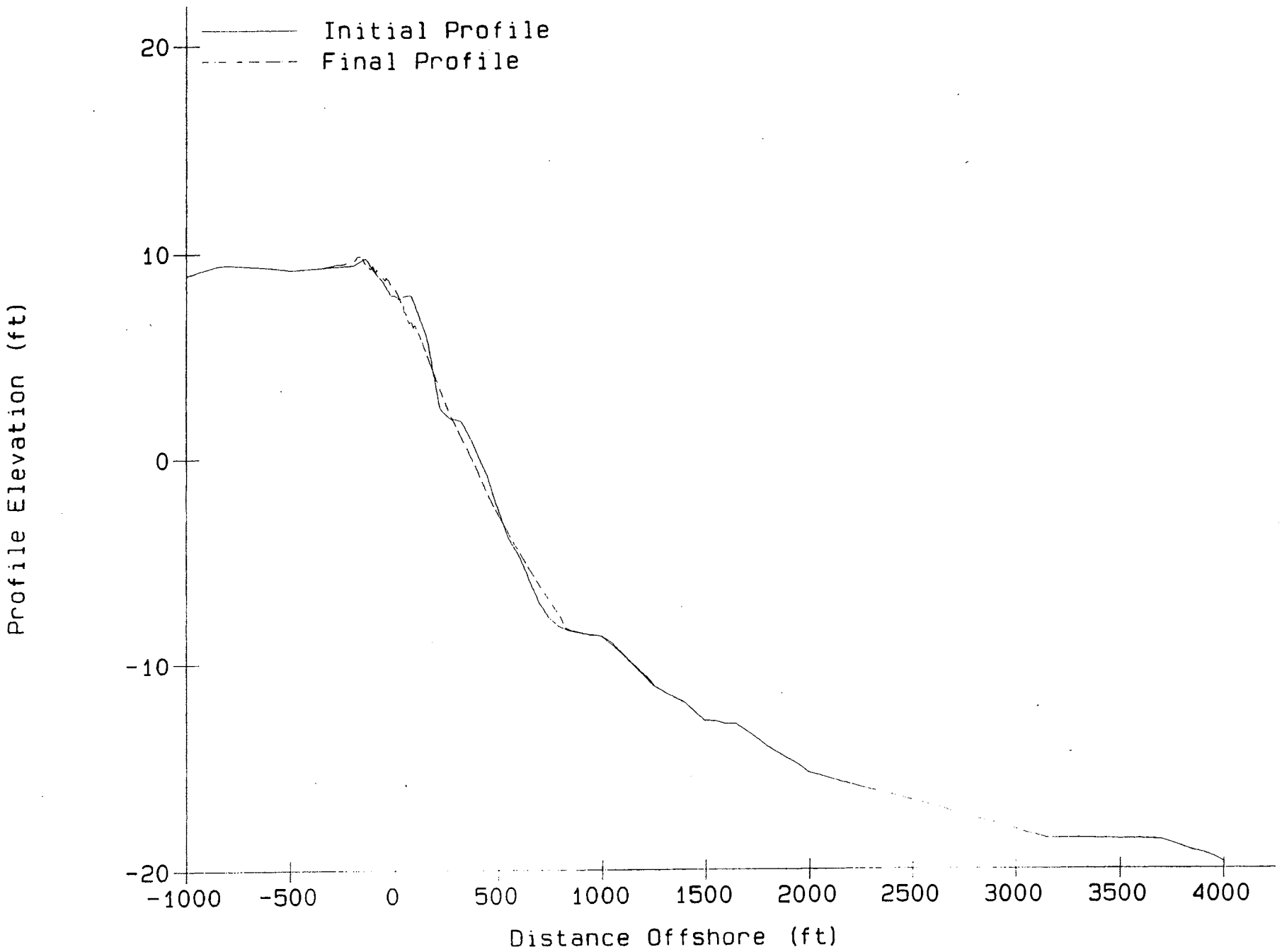

Absecon Average Profile 4: 50-yr Storm
Initial Profile
Final Profile
20
10
0
-10
-20
Profile Elevation (ft)
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
Distance Offshore (ft)

Figure 54

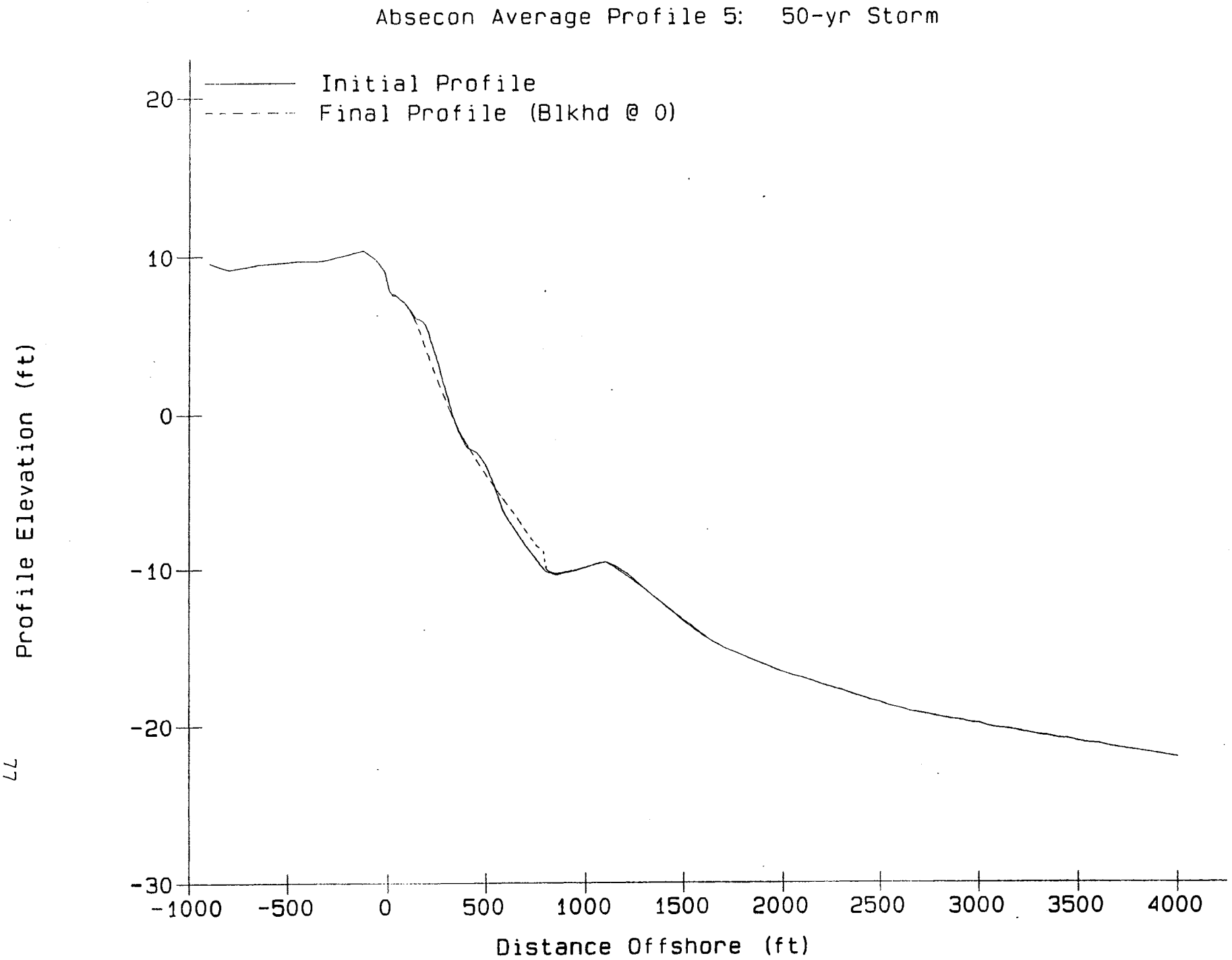

Absecon Average Profile 5: 50-yr Storm
Initial Profile
Final Profile (Blkhd @ 0)
Profile Elevation (ft)
20
10
0
-10
-20
-30
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
Distance Offshore (ft)

Figure 55

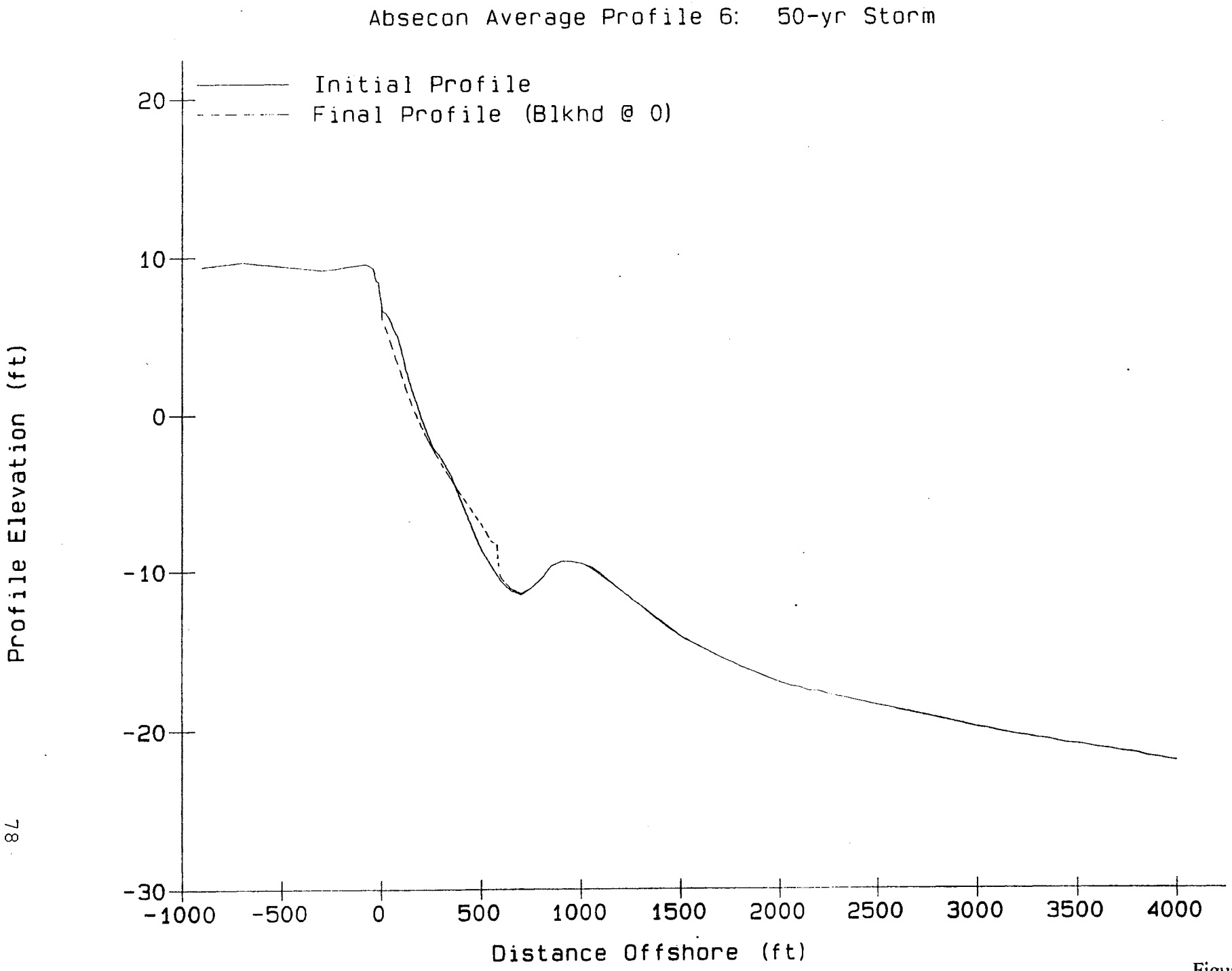

Absecon Average Profile 6: 50-yr Storm
Initial Profile
Final Profile (Blkhd @ 0)
Profile Elevation (ft)
20
10
0
-10
-20
-30
-1000
-500
0
500
1000
1500
2000
2500
3000
3500
4000
Distance Offshore (ft)

Figure 56

Table 3
Without Project Erosion Positions

SBEACH Profile	Erosion Position (ft[1/])						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
1[2/]	500	505	510	530	550	660	700
2[3/]	0	0	0	455	475	500	520
3[4/]	145	155	160	170	175	185	210
4[5/]	240	250	290	320	360	380	400
5[6/]	90	95	100	110	310	320	325
6[6/]	190	195	198	198	400	415	425

Note:
1/ Distances reported are landward erosion limits of the beach profile landward of the Reference Line.
2/ Landward edge of boardwalk located at 720 ft.
3/ Erosion for portions with geotube; landward edge of boardwalk at 360 ft truncated at 0.
4/ Unfailable seawall located at 254 ft.
5/ Landward edge of boardwalk at 295 ft.
6/ Bulkhead located at 200 ft.

Table 4
Without Project Inundation Results

WITH PROJECT STORM EROSION AND INUNDATION ANALYSIS

The "with" project analysis is conducted by evaluating the shoreline condition for Absecon Island with the project design in place. The with-project coastal processes of inundation, storm-induced erosion and wave attack were evaluated. In order to develop input for the economic benefit analysis of the with-project conditions, the improved condition alternative beachfill cross-sections were analyzed for storm-induced recession using the SBEACH model using the same climatic input as the without project condition. Seven storm events from 5 to 500-yr frequencies were run to determine storm-induced erosion positions. The distance from the economic reference line to the landward-most occurrence of the 0.1 ft of vertical recession was again used as the storm recession parameter for the modeled storm events. Seven alternative beachfill designs were analyzed for the various sections of shorelines described by profile lines 1 through 6. The results of the storm erosion analysis are presented in Tables 5 to 11. The distances reported are landward erosion limits of the beach profile landward of the reference line. For optimization purposes, Alternative DZ was run only for Atlantic City and Alternative BX was run only for Ventnor, Margate, and Longport. Tables 12 to 18 present the inundation profiles for the respective alternatives.

Table 5
Predicted Shoreline Erosion Positions
Alternative CW: 150 ft. Berm, No Dune

SBEACH Profile	Erosion Position (ft) 1/						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
1[2/]	500	505	510	530	550	660	700
2[3/]	0	0	0	0	400	490	510
3[4/]	95	140	145	155	160	165	190
4[5/]	165	215	230	260	335	345	355
5[6/]	90	95	95	110	165	170	325
6[6/]	110	135	150	165	170	180	425

Note:
1/ Distances reported are landward erosion limits of the beach profile landward of the Reference Line.
2/ Landward edge of boardwalk located at 720 ft.
3/ Erosion for portions with geotube truncated at 0; landward edge of boardwalk at 360 ft.
4/ Unfailable seawall located at 254 ft.
5/ Landward edge of boardwalk at 295 ft.
6/ Bulkhead located at 200 ft.

Table 7
Predicted Shoreline Erosion Positions
Alternative CY: 150 ft. Berm, 16 ft. Dune

SBEACH Profile	Erosion Position (ft)[1/]						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
1[2/]	500	505	510	530	550	640	690
2[3/]	0	0	0	0	0	470	500
3[4/]	65	100	105	110	150	165	180
4[5/]	125	160	170	220	300	325	335
5[6/]	80	105	110	120	165	167	170
6[6/]	90	110	115	135	160	165	170

Note:
1/ Distances reported as landward erosion limits of beach profile landward of the Reference Line.
2/ Landward edge of boardwalk located at 720 ft.
3/ Erosion for portions with geotube truncated at 0; landward edge of boardwalk at 360 ft.
4/ Unfailable seawall located at 254 ft.
5/ Landward edge of boardwalk at 295 ft.
6/ Bulkhead located at 200 ft.

Table 9
Predicted Shoreline Erosion Positions
Alternative DY: 200 ft. Berm, 16 ft. Dune

SBEACH Profile	Erosion Position (ft)[1/]						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
1[2/]	485	495	500	525	530	630	675
2[3/]	0	0	0	0	0	400	425
3[4/]	30	85	90	100	140	165	180
4[5/]	90	100	110	170	200	320	330
5[6/]	40	85	105	115	165	167	170
6[6/]	35	100	105	115	160	165	167

Note:
1/ Distances reported as landward erosion limits of beach profile landward of the Reference Line.
2/ Landward edge of boardwalk located at 720 ft.
3/ Erosion for portions with geotube truncated at 0; landward edge of boardwalk at 360 ft.
4/ Unfailable seawall located at 254 ft.
5/ Landward edge of boardwalk at 295 ft.
6/ Bulkhead located at 200 ft.

Table 11
Predicted Shoreline Erosion Positions
Alternative BX: 100 ft. Berm, 14 ft. Dune

Average Profile	Erosion Position (ft)[1/]						
	5 yr	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**200 yr**	**500 yr**
5[2/]	115	145	155	165	170	175	175
6[2/]	115	155	160	165	170	180	180

Note:
1/ Distances reported as landward erosion limits of beach profile landward of the Reference Line.
2/ Bulkhead located at 200 ft.

NUMERICAL MODELLING OF SHORELINE CHANGE

GENERAL

In recent years numerical shoreline change models have become an increasingly popular tool for investigating impacts of proposed coastal projects. Specifically, shoreline change models are ideally suited for tasks involving the analysis and evaluation of coastal projects with regard to the long-term fate of beachfills, renourishment cycles and coastal structures designed to enhance the longevity of placed beach fill material. As part of this Feasibility study, a shoreline change model has been developed which may be used for predicting relative future shoreline trends and responses along the Atlantic Ocean coastline of Absecon Island.

GENERALIZED MODEL FOR SIMULATING SHORELINE CHANGE (GENESIS)

The shoreline change model used in this study is GENESIS, developed by the U.S. Army Corps of Engineers, Coastal Engineering Research Center (Hanson and Kraus, 1989; Gravens, Kraus and Hanson, 1991). The acronym GENESIS stands for GENEralized Model for SImulating Shoreline Change and encompasses a group of programs developed for simulating wave-induced longshore transport and movement of the shoreline. GENESIS was developed to simulate long-term shoreline change on an open coast as produced by spatial and temporal changes in longshore transport (Hanson, 1987, 1989; Hanson and Kraus, 1989). Wave action is the mechanism producing longshore transport. In GENESIS, spatial and temporal differences in the transport rate may be caused by such diverse factors as irregular bottom bathymetry, wave diffraction behind structures, sources and sinks of sand, and structures such as seawalls or groins which constrain the transport.

CAPABILITIES AND LIMITATIONS OF GENESIS

GENESIS is designed to describe long-term trends of the beach plan shape change under imposed wave conditions, boundary conditions, and constraints due to coastal structures. GENESIS works best in calculating shoreline response when the change will produce a long-term trend in shoreline movement, as it progresses from one equilibrium state toward another as a result of some significant perturbation. Shoreline change models are not applicable to simulating a randomly fluctuating beach system in which no shoreline movement trend is evident. GENESIS is not applicable to calculating shoreline change in the following situations which involve shoreline change unrelated to spatial differences in wave-induced longshore sand transport: beach change inside inlets or areas dominated by tidal currents, beach change produced by wind-generated currents, storm-induced beach erosion where cross-shore sediment processes dominate the beach evolution process (this type of beach evolution is best modelled using a cross-shore transport model such as SBEACH).

GENESIS is based on the one-contour-line beach evolution concept. It is assumed that the beach profile maintains a constant equilibrium profile shape. This implies that the bottom contours are parallel and the entire profile is translated seaward or landward for an accreting or eroding shoreline, respectively. With this assumption, it is only necessary to consider the movement of one contour line. For this study, the mean high water (MHW) contour was chosen.

SEDIMENT BUDGET

A sediment budget was developed for the Atlantic Ocean coastline of New Jersey ranging from North Brigantine Island to Ocean City. The sources, sinks and volumetric rates of sand moving into and out of the region were investigated (see earlier section "Brigantine Inlet to Great Egg Harbor Inlet Sediment Budget" for further detail). The objective of the budget study was to account for the gain or loss of sediment through time by a study of the various factors that influence sediment erosion, transportation and deposition in the study area.

The modelled range of coastline consisted of seven reaches, with Reach 4 comprising Absecon Inlet, Reach 5 comprising the Atlantic Ocean coastline of Absecon Island, and Reach 6 comprising Great Egg Harbor Inlet (see Figure 18). Three components of sediment transport were analyzed in the budget study; longshore transport, beach erosion/accretion, and direct sources such as beach fills and sand bypassing. Of the three time periods detailed in the budget study, we are concerned with the most recent period, 1986 to 1993, which corresponds to the shoreline position data used in the GENESIS modelling.

At the northern end of Absecon Island, the budget study indicates gross transport rates of 170,000 cy/yr south from Absecon Inlet onto the Atlantic City beach face, and 140,000 cy/yr north from the Atlantic City beach face into Absecon Inlet for a net transport rate at the north boundary of the study area of 30,000 cy/yr moving from Absecon Inlet south onto the Atlantic City beach face. At the southern end of Absecon Island, the budget study indicates a gross transport rate of 80,000 cy/yr south from the Longport beach face into Great Egg Harbor Inlet, with no sediment moving north from Great Egg Harbor Inlet onto the Longport beach face. Thus the net transport rate at the southern boundary of the study area is 80,000 cy/yr moving south from the Longport beach face into Great Egg Harbor Inlet.

Two major beach fill projects occurred during the most recent budget study time period. From April 1 through June 21, 1986, 1,000,000 cy of fill was dredged from Absecon Inlet and placed on 9000 ft of Atlantic City shoreline, beginning at the Oriental Avenue jetty and proceeding southwestward to Arkansas Avenue, with a gap in the vicinity of Steel Pier due to ongoing construction activities. The fate of this beach fill is detailed in a report by Sorensen, Weggel and Douglass (1989) who monitored the project from August 1986 to March 1988. This fill is not included in the modelling as it occurred prior to the initial shoreline condition (see later section titled "GENESIS Calibration and Verification Strategy"). In June 1990, 250,000 cy of fill was placed on the Longport shoreline from 25th Street to the terminal groin at 11th Street. Averaging the quantities of these two fill projects over the budget study time period yields the average yearly rate of 179,000 cy indicated in the study results. The final component of the budget study indicates that during this time period, the Absecon Island shoreline accreted at an average rate of 129,000 cy/yr. As seen on Figure 18, shoreline accretion indicates material previously available for longshore transport being moved landward out of the longshore transport control volume. This is due to mechanical dune-building operations undertaken by the municipalities, which mine the beach face as a source of material.

SHORELINE POSITION DATA
REFERENCED TO PROJECT BASELINE
OCTOBER 7, 1986

MEASURED SHORELINE POSITION OF ABSECON ISLAND; CELL SPACING (DX=215. ft)
THESE DATA WERE OBTAINED FROM THE FILE: SHORL-86.ABS
STARTING AT ALONGSHORE POSITION X= 0. AND ENDING AT X=43,000

****

2502.4 2505.2 2538.6 2601.8 2664.6 2703.5 2696.0 2745.3 2806.5 2835.4
2790.6 2835.6 2876.1 2887.8 2906.5 2866.3 2899.2 2921.7 2991.5 2947.9
2901.1 2883.0 2886.2 2763.1 2772.9 2778.7 2567.9 2519.8 2476.1 2449.1
2461.4 2207.7 2083.3 2015.7 1958.8 1928.0 1900.7 1896.5 1937.1 1860.2
1753.1 1693.9 1675.1 1593.6 1516.3 1450.4 1412.9 1384.2 1361.7 1352.1
1331.7 1313.2 1288.0 1268.0 1259.3 1238.8 1217.1 1217.4 1201.7 1192.3
1167.3 1149.4 1129.9 1113.5 1112.8 1114.0 1118.5 1120.4 1094.2 1102.0
1096.3 1088.0 1088.7 1091.3 1084.3 1086.1 1058.0 1068.1 1051.3 1043.3
1026.1 988.6 982.2 969.5 941.2 954.2 928.7 947.9 931.1 922.1
901.3 888.2 875.7 896.4 881.2 864.2 880.1 869.7 873.2 867.1
867.8 843.7 889.8 868.5 833.7 795.1 795.8 777.2 760.0 743.3
721.2 707.5 706.3 705.4 693.6 698.9 668.4 693.1 691.4 674.6
677.0 685.6 687.1 695.7 700.9 698.1 711.3 716.5 722.9 726.7
748.9 752.5 759.7 752.2 738.5 768.9 828.0 857.3 853.4 851.9
843.1 836.6 847.5 868.5 891.2 910.5 919.3 946.1 973.3 988.3
1001.6 1010.3 1017.5 997.3 993.7 974.4 978.6 935.4 967.0 991.6
983.5 1010.3 1029.4 1027.8 1007.7 1043.4 1055.7 1077.6 1101.4 1111.7
1133.4 1180.0 1233.8 1250.4 1290.5 1320.4 1349.5 1342.6 1402.9 1460.7
1521.6 1570.2 1614.7 1650.0 1695.1 1735.0 1777.3 1833.7 1882.0 1931.1
2010.9 2072.7 2134.2 2199.5 2289.0 2365.5 2441.2 2302.4

Table 19

SHORELINE POSITION DATA
REFERENCED TO PROJECT BASELINE
APRIL 7, 1993

MEASURED SHORELINE POSITION OF ABSECON ISLAND; CELL SPACING (DX=215. ft)
THESE DATA WERE OBTAINED FROM THE FILE: SHORL-93.ABS
STARTING AT ALONGSHORE POSITION X= 0. AND ENDING AT X=43,000

****

2687.7 2664.1 2689.8 2743.0 2825.6 2782.3 2779.4 2810.1 2856.7 2874.1
2829.1 2861.3 2886.1 2900.9 2905.1 2870.2 2883.7 2918.4 3009.5 2963.7
2950.0 2943.8 2930.4 2817.2 2790.3 2823.7 2807.2 2570.1 2528.1 2524.9
2526.3 2263.6 2171.1 2130.8 2053.0 2004.4 1965.8 1947.8 1938.0 1911.8
1832.5 1779.5 1713.0 1640.8 1587.6 1541.3 1481.3 1424.9 1393.2 1374.1
1347.2 1306.1 1273.2 1242.4 1201.6 1187.4 1189.3 1174.6 1161.1 1157.8
1167.6 1147.1 1137.8 1125.2 1102.1 1105.9 1107.5 1103.6 1109.1 1106.2
1120.5 1123.2 1118.1 1115.3 1125.0 1097.9 1084.4 1077.1 1073.7 1062.8
1049.0 1033.4 1025.3 1007.4 994.8 981.4 991.8 969.6 973.9 966.8
950.9 932.9 933.3 924.3 921.0 924.8 918.5 911.4 931.0 903.8
888.3 872.6 859.0 849.8 846.7 814.5 803.1 796.9 791.0 792.5
763.9 746.5 714.5 681.7 663.3 671.2 669.3 673.8 674.6 684.2
687.7 691.8 707.3 721.4 742.7 753.4 755.6 768.3 783.5 782.7
799.9 785.3 772.5 774.7 777.2 780.7 790.9 805.2 816.8 815.5
813.3 820.5 828.5 850.7 866.2 878.6 889.4 908.1 918.0 931.9
928.2 963.3 974.9 973.5 960.4 934.3 949.9 949.6 948.0 958.3
967.8 987.5 1018.3 991.4 995.1 998.7 1029.8 1052.7 1072.6 1094.3
1122.7 1162.6 1195.2 1234.7 1277.9 1316.4 1353.1 1400.5 1482.7 1520.1
1551.0 1607.0 1656.5 1700.0 1754.8 1796.9 1839.1 1910.3 1970.0 2027.0
2066.8 2113.0 2167.2 2204.5 2267.6 2318.9 2391.2 2221.0

Table 21

MODEL CALIBRATION

Based upon the dates of the available shoreline position data detailed previously, there was a choice of calibrating the GENESIS model from October 7, 1986 to March 7, 1991, or from March 7, 1991 to April 7, 1993. The latter interval was chosen for two reasons: wave data for the entire period between the two sampled shorelines was available from the original hindcast, and, the two shorelines were measured at the same time of year. Thus the shoreline position data and wave record for the period from March 7, 1991 to April 7, 1993 was used in the calibration effort, and the shoreline position data and wave record for the period from October 7, 1986 to March 7, 1991 was used in the verification effort. The shoreline change occurring between March 7, 1991 and April 7, 1993 can be seen in Figure 57.

Several parameters were varied and tested during the model development. The main calibration parameters "k_1" and "k_2" were varied within the recommended ranges of $0.1 < k_1 < 1.0$ and $0.5k_1 < k_2 < 1.5k_1$ (Gravens and Kraus, 1991). In general, values at the lower end of the recommended range yielded artificially low longshore transport rates, resulting in excessive accretion in the northern project reach and excessive erosion in the southern project reach. The opposite was true for values in the higher end of the recommended range; artificially high longshore transport rates resulted in excessive erosion in the northern project and excessive accretion in the southern project reach.

Groins are specified in the model by their longshore cell location, the distance of their offshore tip from the model baseline, and their permeability, specified as a value between 0.0 and 1.0. An impermeable groin is assigned a value of 0.0, and the model only allows sand to pass over it or around the seaward end. At the opposite end of the spectrum, a groin assigned a permeability of 1.0 is treated by the model as being transparent, and has no effect on longshore transport. It was found that adjusting the value of permeability of one groin could affect large changes in the shoreline evolution in the immediate area of that groin, but that changes over a larger area required several groins in tandem to be set to one of the extremes of the permeability range. This is obviously not the case in nature due to the wide variety of construction types and conditions detailed in the structure inventory. As GENESIS does not take into account the inlet processes which occur at both ends of the study area, and the groin fields are located at the ends of the study area, it was decided to determine which "k" values produced the best shoreline agreement in the interior areas of the island (Ventnor and Margate) and then adjust groin permeabilities to replicate the shoreline at the ends of the study area. Also during model development, wave sheltering was investigated, as any possible effects due to the ebb shoal on the Brigantine side of Absecon Inlet were not accounted for in the wave hindcast. Lastly, the GENESIS model was run using its internal wave transformation model, and using the external RCPWAVE wave transformation model.

During the model development trials, it was found that using the external RCPWAVE wave transformation model resulted in better shoreline reproduction and estimates of longshore transport. RCPWAVE was used in the trial which was selected to represent the calibrated model. The k_1 and k_2 values which resulted in the best shoreline reproduction in Ventnor and Margate were 0.5 and 0.25 respectively. The calibrated model produced an average longshore transport rate of 1,200,000 cy/yr (Figure 58), which is approximately an order of magnitude

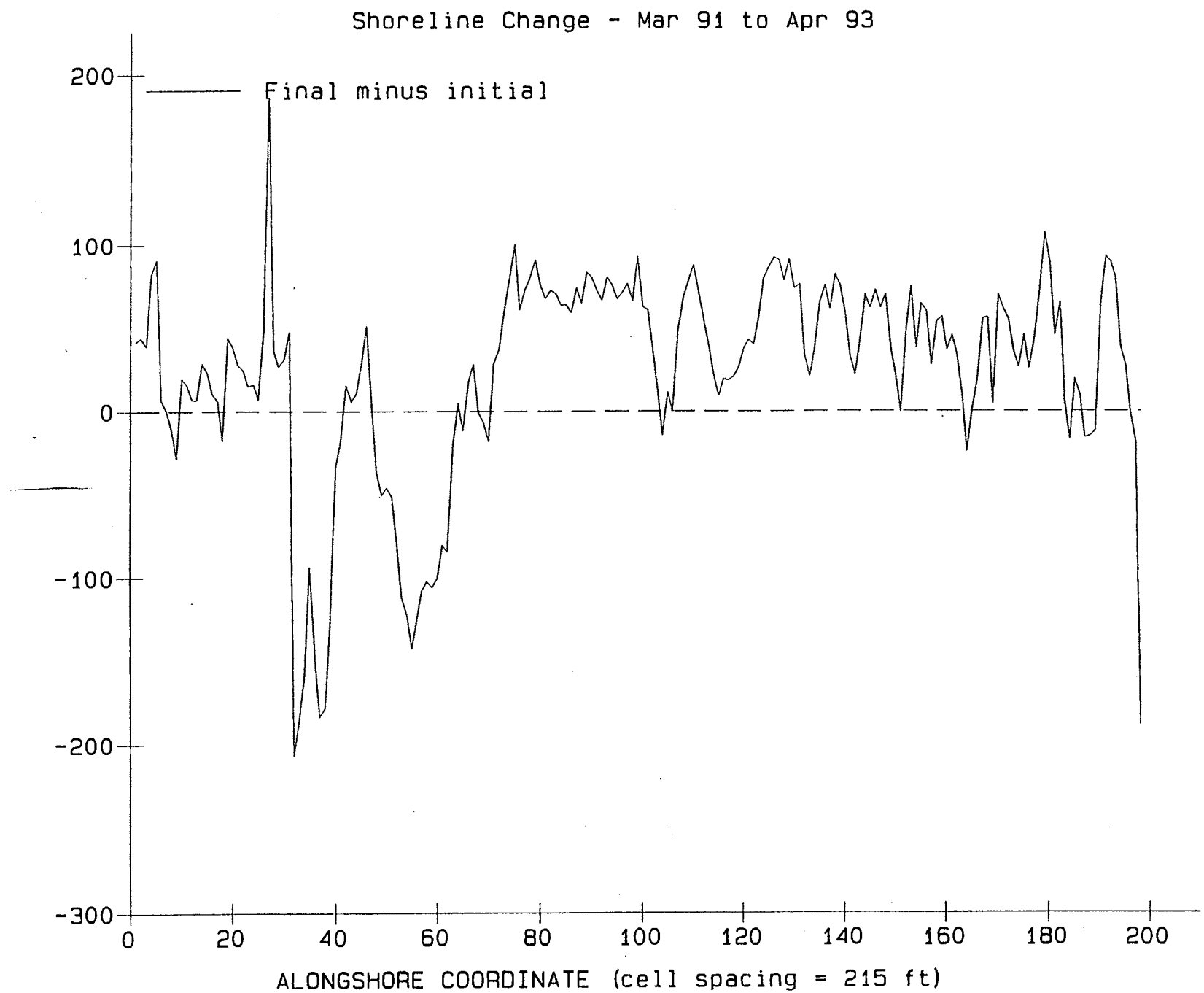

Shoreline Change - Mar 91 to Apr 93
Final minus initial
200
100
0
-100
-200
-300
SHORELINE CHANGE (ft)
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 57

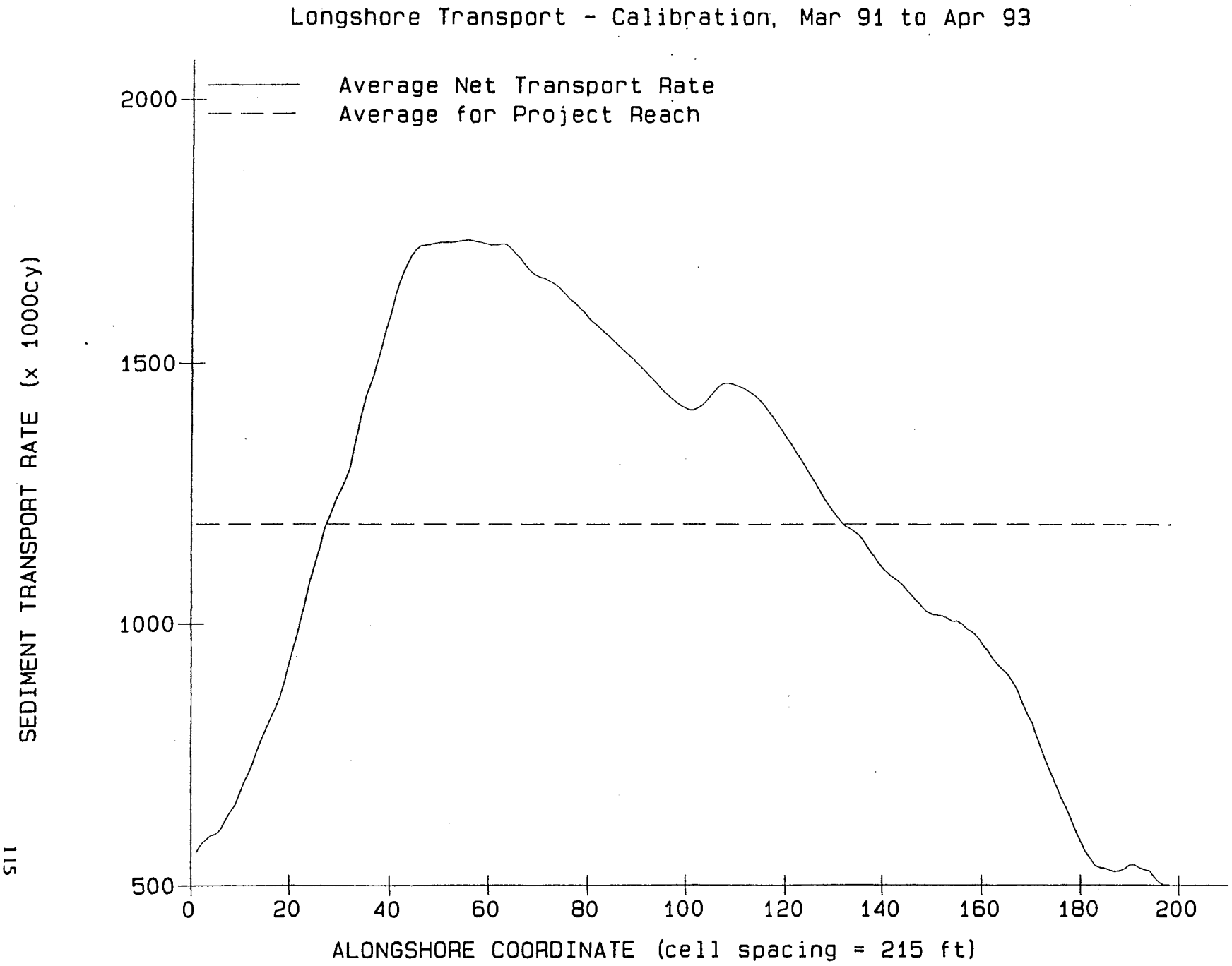

Longshore Transport - Calibration, Mar 91 to Apr 93
Average Net Transport Rate
Average for Project Reach
SEDIMENT TRANSPORT RATE (x 1000cy)
2000
1500
1000
500
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 58

higher than previous predictions shown in Table 22. SEDTRAN, a subroutine which computes the potential longshore sand transport rate for a wave record, was run on the hindcast wave record and indicated an average transport rate of 560,000 cy/yr over the record length. That the average transport rate for the entire record is several times greater than previous predictions, and the average transport rate for the calibrated model is an order of magnitude higher than previous predictions, is due to the amount of storm activity present in the wave record, specifically in the calibration time period of March 7, 1991 to April 7, 1993. The beginning years of the hindcast wave record describe mild conditions, and reveal below average transport rates, as detailed in the next section. The investigation of wave sheltering resulted in waves approaching from an angle of greater than 50 degrees being sheltered in the calibrated model. (An observer on the shore, facing seaward, would consider a wave approaching from the left to be a 90 degree wave, and a wave approaching from the right to be a -90 degree wave.) Sheltering waves above the 50 degree mark eliminates approximately 7 percent of the energy of wave spectrum.

During model development, the Ocean One shopping mall pier in Atlantic City and the Ventnor fishing pier were added to the model as permeable groins based upon results of model trials and inspection of the naturally occurring shorelines and bathymetry. The model had trouble replicating conditions in the Atlantic City groin field, particularly in the area of cells 20 through 40. This may be due to the magnitude of the natural variations which occur naturally throughout the groin field (Figure 57). All model trials showed excessive erosion just updrift of cell 115 and excessive accretion just downdrift of this cell. Indeed, this is the only area where the model results differ significantly from nature in Ventnor and Margate in the calibrated model. As this phenomenon is not witnessed in the naturally evolving shorelines, it may be due to the model's requirement that the entire project area's shoreline orientation be specified by one angle in the development of the wave record. This requirement introduces error into the modelling, as the shoreline of Absecon Island is generally concave. In addition, cell 115 may be considered the point of curvature of the island, which may be causing the unnatural shoreline evolution in this area. The difference between the GENESIS predicted April 7, 1993 shoreline, and the measured April 7, 1993 shoreline is shown in Figure 59.

MODEL VERIFICATION

The shoreline position data and wave record for the period from October 7, 1986 to March 7, 1991 were used to verify the calibrated model described above. The natural shoreline change occurring between October 7, 1986 and March 7, 1991 can be seen in Figure 60. The only difference in the model formulation was that the 250,000 cy of fill added to the Longport beach face between 11th and 25th Streets in June 1990 was input to the GENESIS model as a source of sand between cells 178 and 198.

The verification time period takes place immediately after the 1,000,000 cy fill in Atlantic City in 1986. As the natural shoreline evolution over this period shows, the southern and northern ends of the Atlantic City groin field accrete, while there is a slight erosion in the area of cells 10-20, which is a suspected nodal zone. The verification trial of the calibrated model indicates an average longshore transport rate of 40,000 cy/yr (Figure 61), which is lower than previous predictions, but is expected as this time period was known to have a mild wave climate.

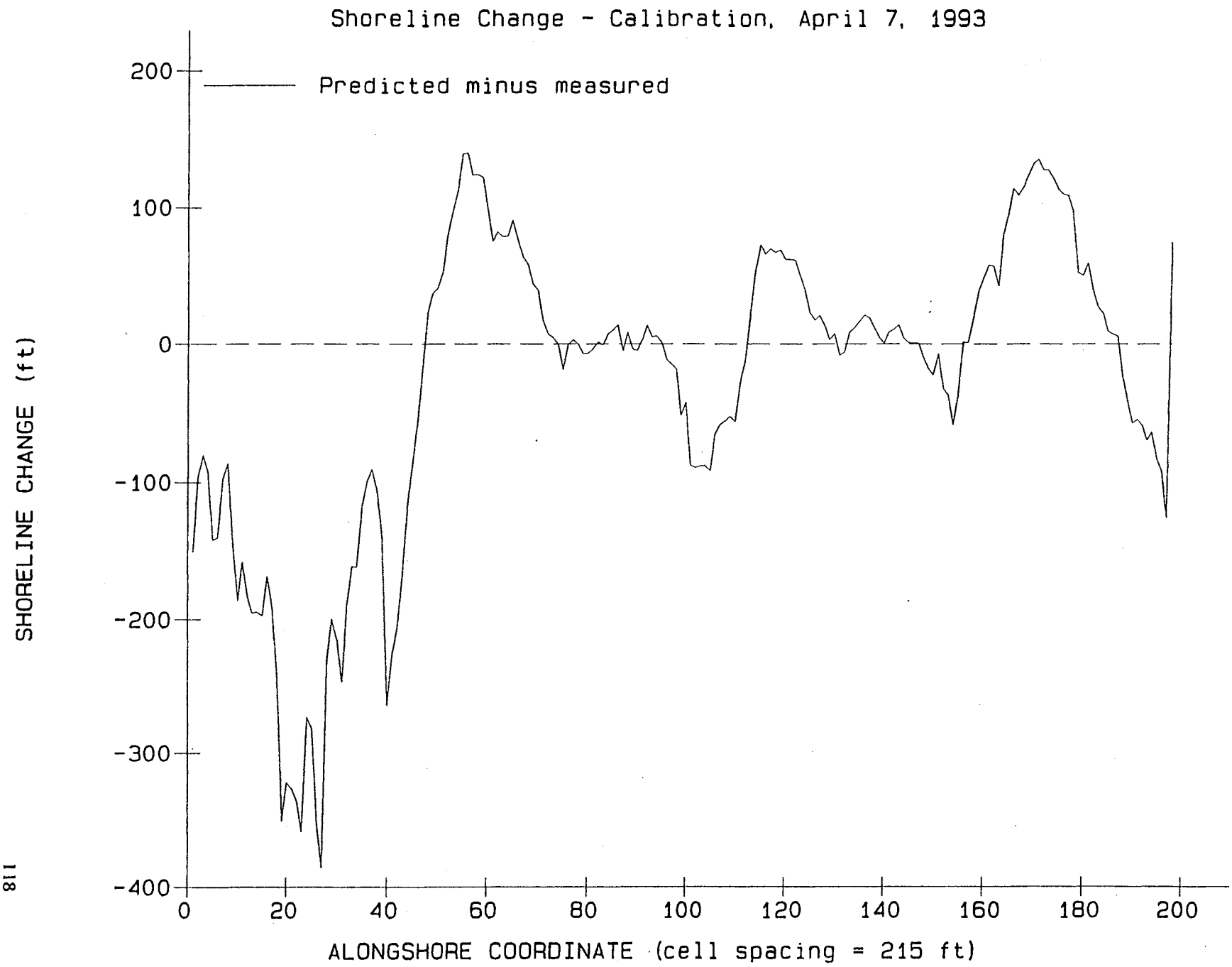

Shoreline Change - Calibration, April 7, 1993
Predicted minus measured
200
100
0
-100
-200
-300
-400
0
20
40
60
80
100
120
140
160
180
200
SHORELINE CHANGE (ft)
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 59

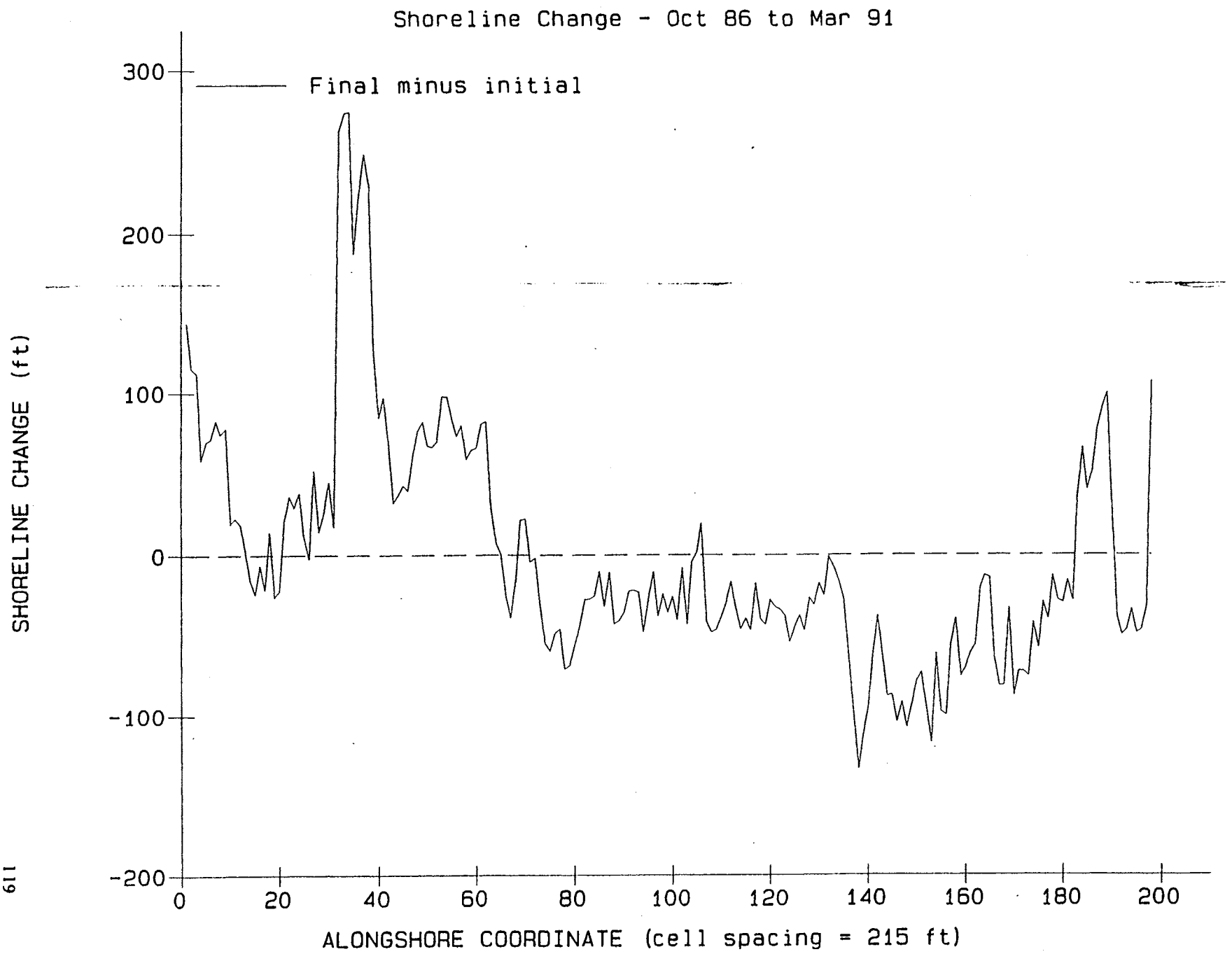

Shoreline Change - Oct 86 to Mar 91
Final minus initial
300
200
100
0
-100
-200
SHORELINE CHANGE (ft)
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 60

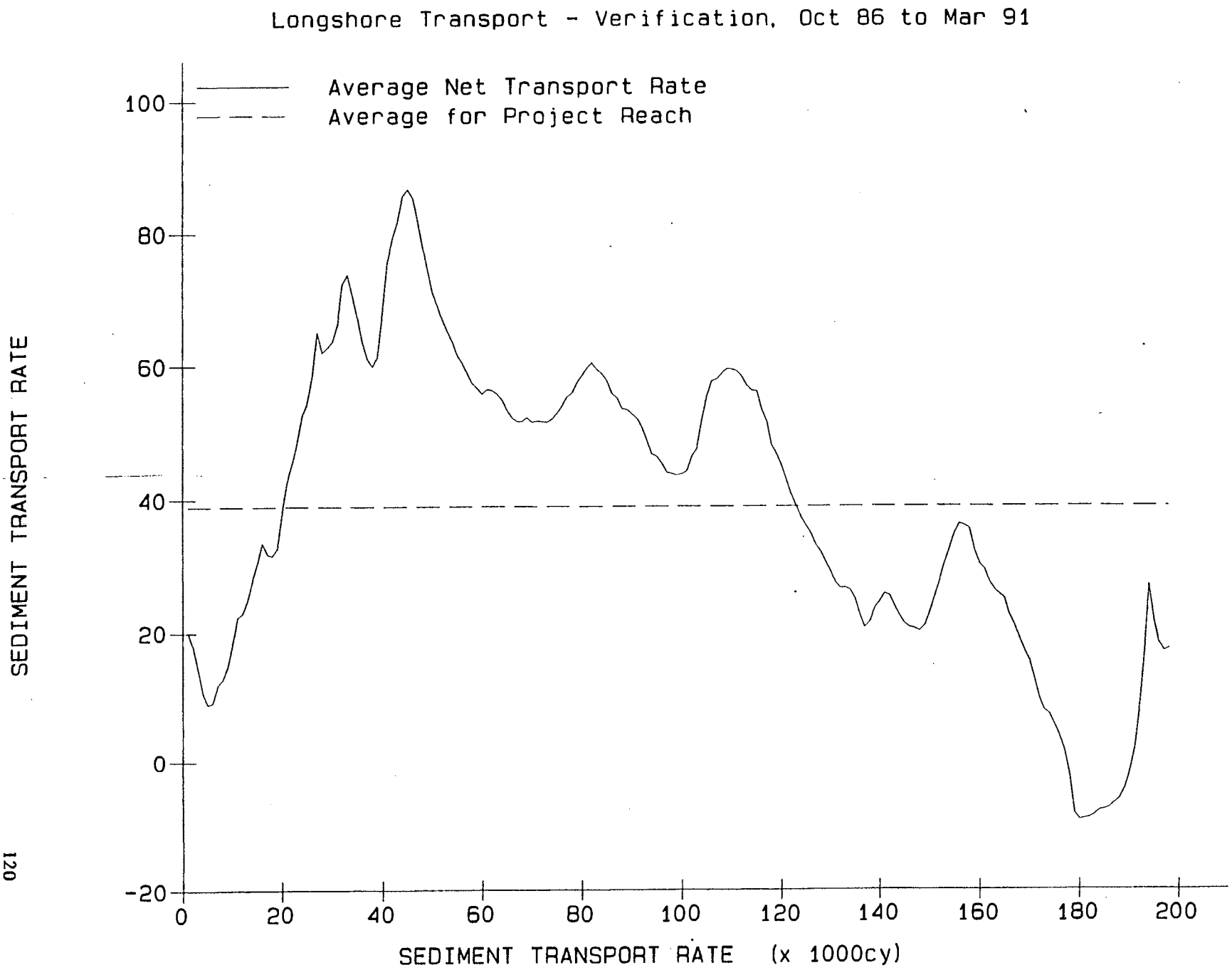

Longshore Transport - Verification, Oct 86 to Mar 91
Average Net Transport Rate
Average for Project Reach
SEDIMENT TRANSPORT RATE
100
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
SEDIMENT TRANSPORT RATE (x 1000cy)

Figure 61

The difference between the GENESIS predicted March 7, 1991 shoreline, and the measured March 7, 1991 shoreline is shown in Figure 62. Although the model has difficulty in several locations reproducing the naturally evolving shoreline, it does simulate the large-scale trends of sediment transport occurring over the island. Thus it was decided to proceed to a with project analysis to investigate relative changes in shoreline evolution for different time intervals.

WITH PROJECT

To develop estimates of renourishment rates for the selected plan for various cycle lengths, the calibrated model conditions are applied to the base year shoreline of the constructed project. Wave record lengths of one year to ten years in duration are applied to the base year shoreline to allow for economic optimization of the renourishment cycle.

The one deviation from the calibrated model is that in the analysis of the future conditions, the shoreline accretion due to mechanical dune-building operations is removed from the model as it is assumed that all beach fill activities will be a function of the chosen periodic renourishment cycle.

BASE YEAR SHORELINE

The mean high water shoreline position data based on the design template were used as a starting point in developing the base year shoreline which will occur in the year 2001. These data were then checked against the 1993 measured shoreline position data. Two reaches were discovered where the 1993 shoreline was seaward of the design template shoreline, as seen in Figure 63. In these areas (cells 1-3 and cells 68-87) the 1993 shoreline position data were substituted for the design template shoreline position data. Both of these areas are outside of the area of Atlantic City (cells 8-64) in which long-term shoreline erosion was indicated. Fill will still need to be placed in these areas to raise the berm elevation and construct the dune. The adjusted base year shoreline is shown in Figure 64.

During the period from March to June 1995, geotubes were installed, with dunes built over them, along three stretches of Atlantic City shoreline. They were placed from Vermont Avenue to Massachusetts Avenue (GENESIS cells 5-6), Martin Luther King Boulevard to Michigan Boulevard (GENESIS cells 31-36), and Mississippi Avenue to Chelsea Avenue (GENESIS cells 41-55). Sand was placed on top of the geotubes to build a dune. The landward toe of the geotube dune is located 25 feet seaward of the boardwalk, which is the structure represented in the seawall file in this region. It was determined that the landward toe of the geotube dune would limit shoreline retreat under normal conditions, thus, in the cells where geotubes were installed, the position of the shoreline retreat limiting structures is moved 25 feet seaward.

WAVE RECORD DEVELOPMENT

It was desired to determine an average condition wave record to apply to the base year shoreline to predict renourishment quantities. To accomplish this, the hindcast wave record was split into six one-year segments. For each year, the -90 to 90 degree directional spectrum was divided into 18 angle bands, each of 10 degree width. For each angle band in a given year, the number

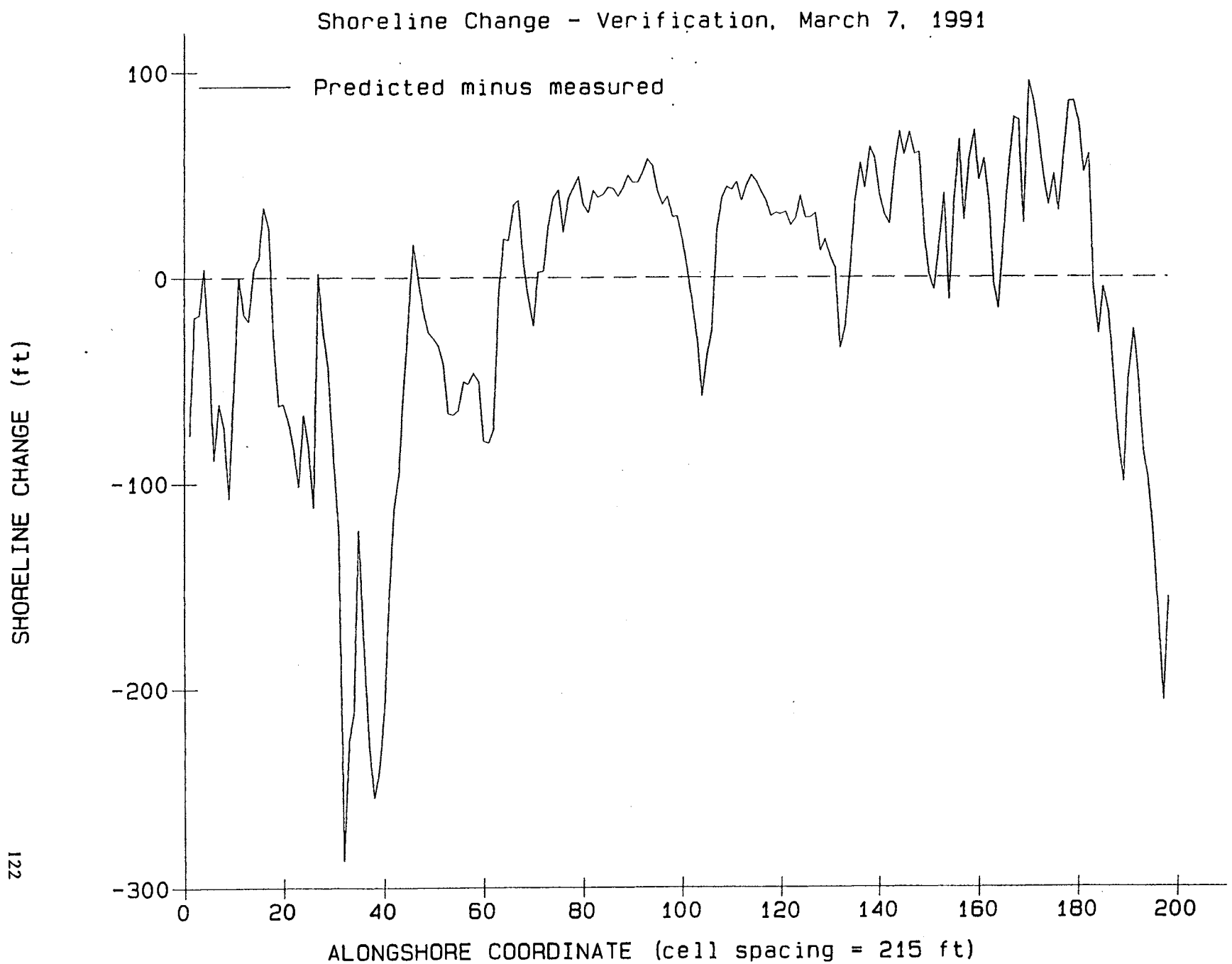

Shoreline Change - Verification, March 7, 1991
Predicted minus measured
100
0
-100
-200
-300
SHORELINE CHANGE (ft)
0
20
40
60
80
100
120
140
160
180
200
ALONGSHORE COORDINATE (cell spacing = 215 ft)

Figure 62

Color Inserts

of wave occurrences and the percentage of the spectral energy in that angle band was computed. For a given angle band, the number of occurrences for each of the six years were averaged, as were the percentages of the spectral energy. Standard deviations were also computed. If the number of occurrences or the percentage of spectral energy in an angle band in a given year fell within plus or minus one standard deviation of the average for that angle band, it was considered a hit. Values outside of a one standard deviation range of the average were considered to be a miss. The number of hits for each year was then totalled, with the year containing the most hits being considered as the most representative year of the wave record.

From this analysis (shown in Table 23), it was determined that the second year of the hindcast wave record, November 1, 1988 to October 31, 1989, was the most representative year of the six year hindcast. Thus in the with project analysis, this year's wave record was appended end to end as many as ten times to manufacture the desired lengths of wave record to be applied to the base year shoreline conditions.

MODEL OUTPUT

As the shorelines generated by the model are prone to local spikes, it was decided to first analyze the model predictions as a function of the cumulative volumetric change within each municipality's incorporated boundary. Table 24 shows that Atlantic City and Longport eroded each year, and Ventnor and Margate accreted each year. Logically, the accretion in Ventnor and Margate cannot continue indefinitely. Possible explanations of this phenomenon are: the accretion may stop or reverse if wave records of longer than ten years duration were applied to the base year conditions; representing a long period by repeating a one year representative wave record does not account for the variability of wave climates seen in nature; and one possible sink, offshore loss, is not represented by the model. If these numbers were to be used to recommend a renourishment cycle, only the losses in Atlantic City and Longport should be considered. The amount of fill needed to renourish the Atlantic City and Longport shorelines should not be reduced by the amount of accretion occurring in Ventnor and Margate. However, the values reported by the model based on the predicted shoreline were roughly 15 to 20% of the historical estimates of renourishment requirements (Table 24).

When the model predicted shorelines are examined on a cell by cell basis, it is seen that each municipality has areas of erosion and areas of accretion. Thus, it was deemed as too broad a generalization to state that Ventnor and Margate continually accrete and do not require renourishment. Investigating the minimum (farthest landward retreat) shoreline computed by GENESIS allows a more conservative view of the model output. In this scenario, shown in Table 25, the predicted volumetric changes within municipal boundaries are in much better agreement with the historical predictions.

GROINS

Additional groins were added to the base year model to investigate if their sand trapping capability could reduce the required renourishment rates sufficiently to offset their cost. The area to the south of the existing Atlantic City groin field was the site of this investigation. In an attempt to smooth and stabilize the shoreline in this area, 100 feet was removed from the

Representative Wave Conditions

Degree Band		1988	In Range?	1989	In Range?	1990	In Range?	1991	In Range?	1992	In Range?	1993	In Range?	Avg	Std	Avg+Std	Avg-Std
-90 to -80	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
-80 to -70	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
-70 to -60	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
-60 to -50	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
-50 to -40	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
-40 to -30	#	0		4		4		2	Y	2	Y	2	Y	2.3	1.4	3.7	0.9
	E	0		0.5	Y	0.6		0.3	Y	0.6		0.2	Y	0.37	0.22	0.59	0.16
-30 to -20	#	26		11	Y	18	Y	15	Y	7	Y	5		13.7	7.1	20.8	6.6
	E	1.8	Y	1	Y	2.1		1.4	Y	1	Y	0.5		1.3	0.54	1.84	0.76
-20 to -10	#	89	Y	18	Y	107	Y	198		10	Y	16	Y	73	67.4	140.4	5.6
	E	3.9	Y	1.1	Y	3.4	Y	5.5		0.9	Y	1	Y	2.63	1.75	4.38	0.88
-10 to 0	#	632	Y	1116	Y	1931		720	Y	798	Y	275		912	518.7	1430.7	393.3
	E	24.1	Y	28.6	Y	57.9		18.2	Y	22.6	Y	7.2		26.43	15.56	41.99	10.87
0 to 10	#	472	Y	979		378	Y	304	Y	333	Y	1070		589.3	313.2	902.5	276.1
	E	11.5	Y	32.5		13.8	Y	9	Y	6.7		33.1		17.77	10.85	28.62	6.92
10 to 20	#	501	Y	391	Y	308	Y	1525		243	Y	728	Y	616	435.3	1051.3	180.7
	E	7.8	Y	13.5	Y	10.8	Y	52.8		7.4	Y	23.7	Y	19.33	15.92	35.25	3.41
20 to 30	#	811		189	Y	99	Y	98	Y	452	Y	393	Y	340.3	250.5	590.8	89.8
	E	8.6	Y	7.8	Y	4.8		6	Y	12.9		14		9.02	3.38	12.4	5.64
30 to 40	#	95	Y	85	Y	34	Y	30	Y	586		190	Y	170	193.4	363.3	-23.4
	E	4	Y	3.2	Y	2.5	Y	2	Y	27.2		10	Y	8.15	8.92	17.07	-0.77
40 to 50	#	139	Y	101	Y	10	Y	13	Y	380		63	Y	117.7	125.9	243.6	-8.2
	E	14.8		8.2	Y	0.6		1.2	Y	13.2		4.1	Y	7.02	5.53	12.55	1.49
50 to 60	#	131		22	Y	31	Y	15		117	Y	101	Y	69.5	47.9	117.4	21.6
	E	11.9		2.7		3.6	Y	3.6	Y	7.5	Y	6.2	Y	5.92	3.15	9.07	2.77
60 to 70	#	27	Y	4	Y	0	Y	0	Y	0	Y	74		17.5	27	44.5	-9.5
	E	11.7		1.1	Y	0	Y	0	Y	0	Y	0.1	Y	2.15	4.29	6.44	-2.14
70 to 80	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
80 to 90	#	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	E	0	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0	0	0	0
	HITS	28		32		29		31		29		28					

# = No. of occurences in angle band
E = % of energy in angle band

Table 23

Absecon Island Volumetric Change
Predicted vs. Historical Rates
(cubic yards)

Cycle	Atlantic City	Ventnor	Margate	Longport	TOTAL	HISTORICAL
1 year	-25,000	15,000	20,000	-25,000	50,000	400,000
2 year	-40,000	45,000	30,000	-75,000	125,000	800,000
3 year	-55,000	65,000	40,000	-130,000	185,000	1,200,000
4 year	-70,000	85,000	55,000	-185,000	255,000	1,600,000
5 year	-85,000	100,000	75,000	-245,000	330,000	2,000,000
6 year	-100,000	110,000	100,000	-310,000	410,000	2,400,000
7 year	-115,000	125,000	120,000	-375,000	490,000	2,800,000
8 year	-125,000	135,000	145,000	-430,000	555,000	3,200,000
9 year	-145,000	145,000	170,000	-485,000	630,000	3,600,000
10 year	-160,000	160,000	200,000	-535,000	695,000	4,000,000

"Total" refers to the volume of sand lost from the Atlantic Ocean coastline of Atlantic City and Longport

"Historical" refers to the historical estimate based on long-term erosion, storms and sea-level rise for the Atlantic Ocean coastline of Absecon Island

Table 24

Absecon Island Volumetric Change
Based on Landward-most Shoreline Retreat
Predicted vs. Historical Rates
(cubic yards)

Cycle	Atlantic City	Ventnor	Margate	Longport	TOTAL	HISTORICAL
1 year	-255,000	-135,000	-255,000	-185,000	830,000	400,000
2 year	-330,000	-160,000	-270,000	-265,000	1,025,000	800,000
3 year	-390,000	-170,000	-275,000	-355,000	1,190,000	1,200,000
4 year	-445,000	-180,000	-280,000	-445,000	1,350,000	1,600,000
5 year	-490,000	-185,000	-280,000	-540,000	1,495,000	2,000,000
6 year	-540,000	-190,000	-280,000	-640,000	1,650,000	2,400,000
7 year	-585,000	-190,000	-280,000	-730,000	1,785,000	2,800,000
8 year	-635,000	-190,000	-280,000	-810,000	1,915,000	3,200,000
9 year	-680,000	-190,000	-280,000	-885,000	2,035,000	3,600,000
10 year	-725,000	-190,000	-280,000	-950,000	2,145,000	4,000,000

"Total" refers to the volume of sand lost from the Atlantic Ocean coastline of all four municipalities

"Historical" refers to the historical estimate based on long-term erosion, storms and sea-level rise for the Atlantic Ocean coastline of Absecon Island

Table 25

seaward end of the groin at Martin Luther King Boulevard (GENESIS cell 32), and four groins were added to the south: Ohio Avenue (GENESIS cell 35) extending 300 feet seaward of the MHW shoreline, Georgia Avenue (GENESIS cell 43) extending 200 feet seaward of the MHW shoreline, Texas Avenue (GENESIS cell) extending 100 feet seaward of the MHW shoreline, and Brighton Avenue (GENESIS cell 52) also extending 100 feet seaward of the MHW shoreline.

The model results indicate that any benefit due to the amount of sand trapped by the groins will be offset due to a roughly equal amount of starvation occurring immediately downdrift of the groin field. The presence of the additional groins does not affect change in the renourishment rate predictions outside of Atlantic City. Table 26 compares the Atlantic City renourishment rate predictions for the with project scenario with and without the additional groins. The permeability value assigned to the new groins was consistent with values assigned to existing groins in the calibrated model. As newly constructed groins may be less permeable, a lower permeability value was assigned to the new groins, and the model was run again. The increased amount of sand trapped by the groins was offset by an increased amount of starvation downstream of the groin field, thus it was concluded that new groin construction for the purpose of lowering the required renourishment rates was not economically justified.

RENOURISHMENT RATES

Sorensen, Weggel and Douglass (1989) studied the most recent Atlantic City beach fill in 1986 and Everts et al. (1974) studied the 1963 and 1970 fills. Everts et al. (1974) conclude that most sand is lost to the offshore region during the period from September through March, thus placing the fill material in the spring will maximize its residence time on the beach face. Everts et al. (1974) also find that the rate of loss of fill material is proportional to the quantity placed at one time, and thus recommend placing smaller volumes on a more frequent basis to maximize overall residence time. Sorensen, Weggel and Douglass (1989) also recommend frequent placement of small volumes, with the renourishment cycle in the two to four year range.

Thus, based on model results, historical predictions, and past experiences in Atlantic City and elsewhere, a three year renourishment cycle, with a total quantity of 1,190,000 cy (1,666,000 cy when multiplying by the 1.4 overfill ratio) for the Absecon Island shoreline is recommended. Further. it is recommended that the fill be placed in the spring to maximize residence time.

ATLANTIC CITY NOURISHMENT REQUIREMENTS
WITH AND WITHOUT ADDITIONAL GROINS

Cycle	w/o Groins	w/ Groins	Volume Saved
1 year	260,000	270,000	(10,000)
2 year	330,000	350,000	(20,000)
3 year	390,000	400,000	(10,000)
4 year	440,000	450,000	(10,000)
5 year	490,000	490,000	0
6 year	540,000	520,000	20,000
7 year	590,000	560,000	30,000
8 year	630,000	590,000	40,000
9 year	680,000	620,000	60,000
10 year	730,000	650,000	80,000

Table 26

SECTION 3

SURVEYING AND MAPPING REQUIREMENTS

Survey data used for the Feasibility Study was collected between 1993 &1994 at Longport, Ventnor, Margate and Atlantic City. The spacing between the survey lines varies from 1,000 to 3,000 feet. Each profile was extended landward using 1993 digital photogrammetry elevations.

Data collected for the study mapping effort include the following: aerial photography, first floor elevations of all structures in the first block fronting the ocean, elevations and locations of all shore protection structures, streets and street names, spot elevations and contours at 2' intervals throughout the study area. Computer programs used to read and store the mapping include AutoCAD and Map and Imaging Processing System (MIPS), which is a program used for Geographic Information Systems (GIS).

Mapping developed for this Feasibility Study is sufficient for the plans and specs phase, but new survey data will be required. Beach Profile surveys every 200 feet starting from the bulkheads in Ventnor, Margate and Longport and from the seaward edge of the boardwalk in Atlantic City to beyond the depth of closure will be necessary to accurately determine quantities in developing the plans and specifications. These beach profiles should also include profiles of all groins in the study area, and will include the entire oceanfront of Absecon Island from the Oriental Avenue Jetty to the terminal groin in Longport.

SECTION 4

GEOTECHNICAL INVESTIGATION

Geotechnical Appendix
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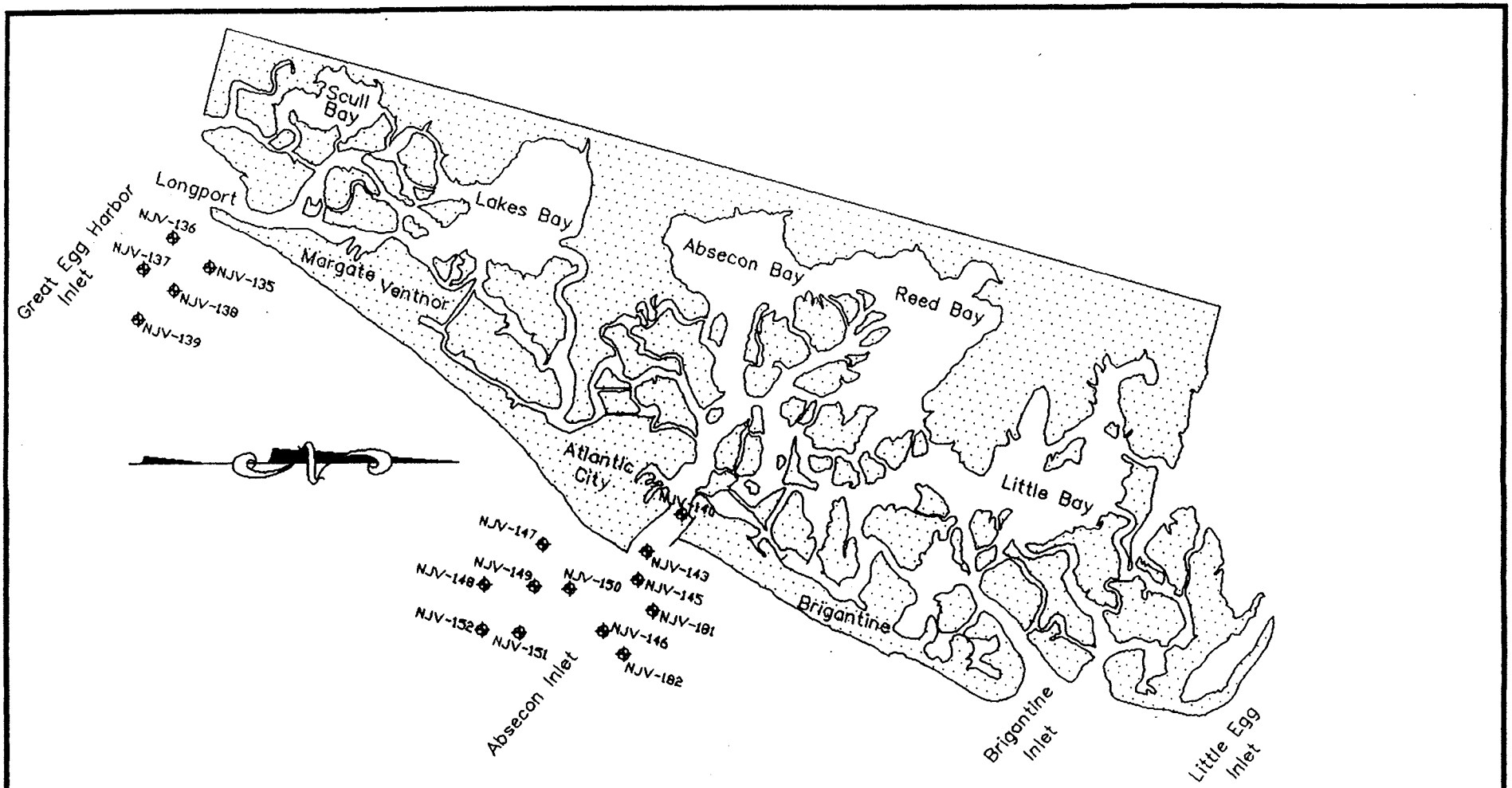
Section 2 (page 134..... Native Beach Material Analysis

Section 3 (page 146)..... Borrow Area Suitability Analysis

Section 1
Borrow Area Investigation

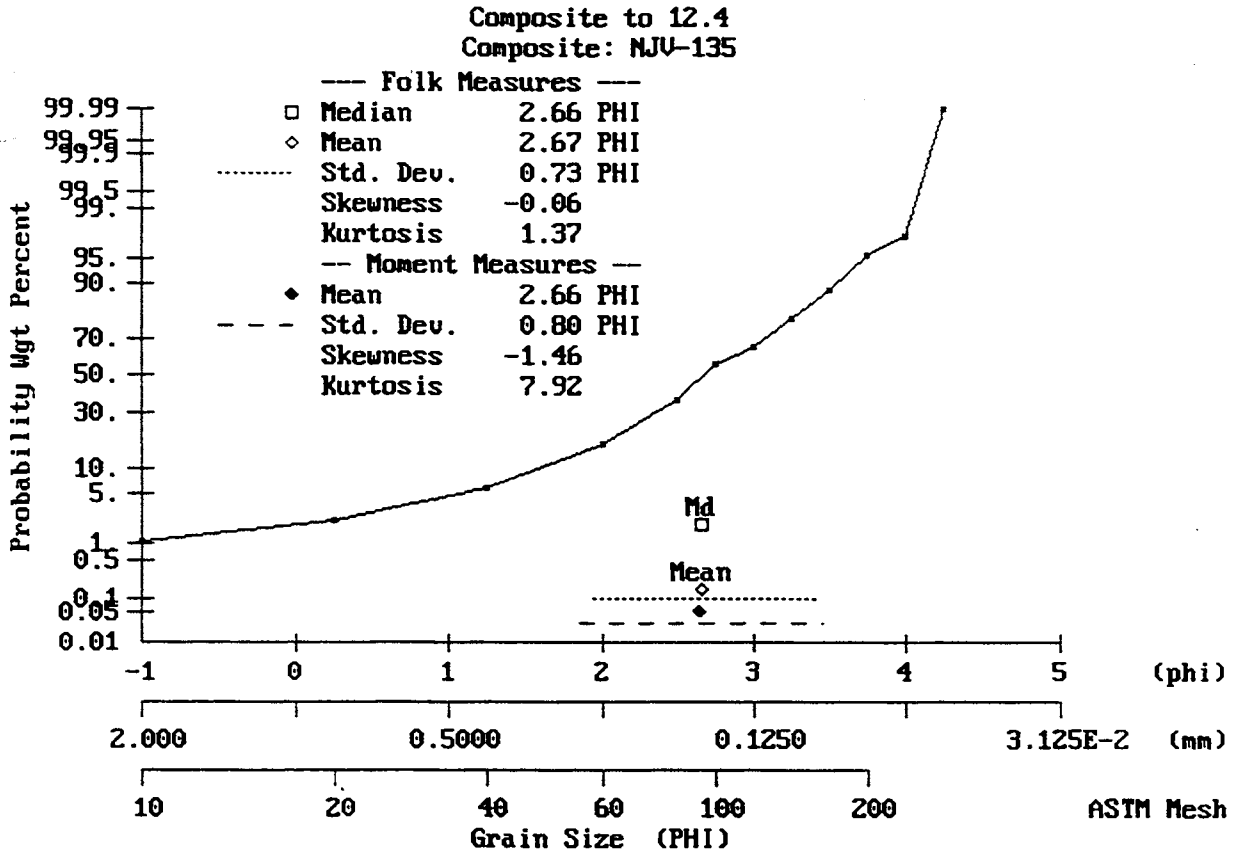


DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
VIBROCORE LOCATION PLAN

NTS

FIGURE 1C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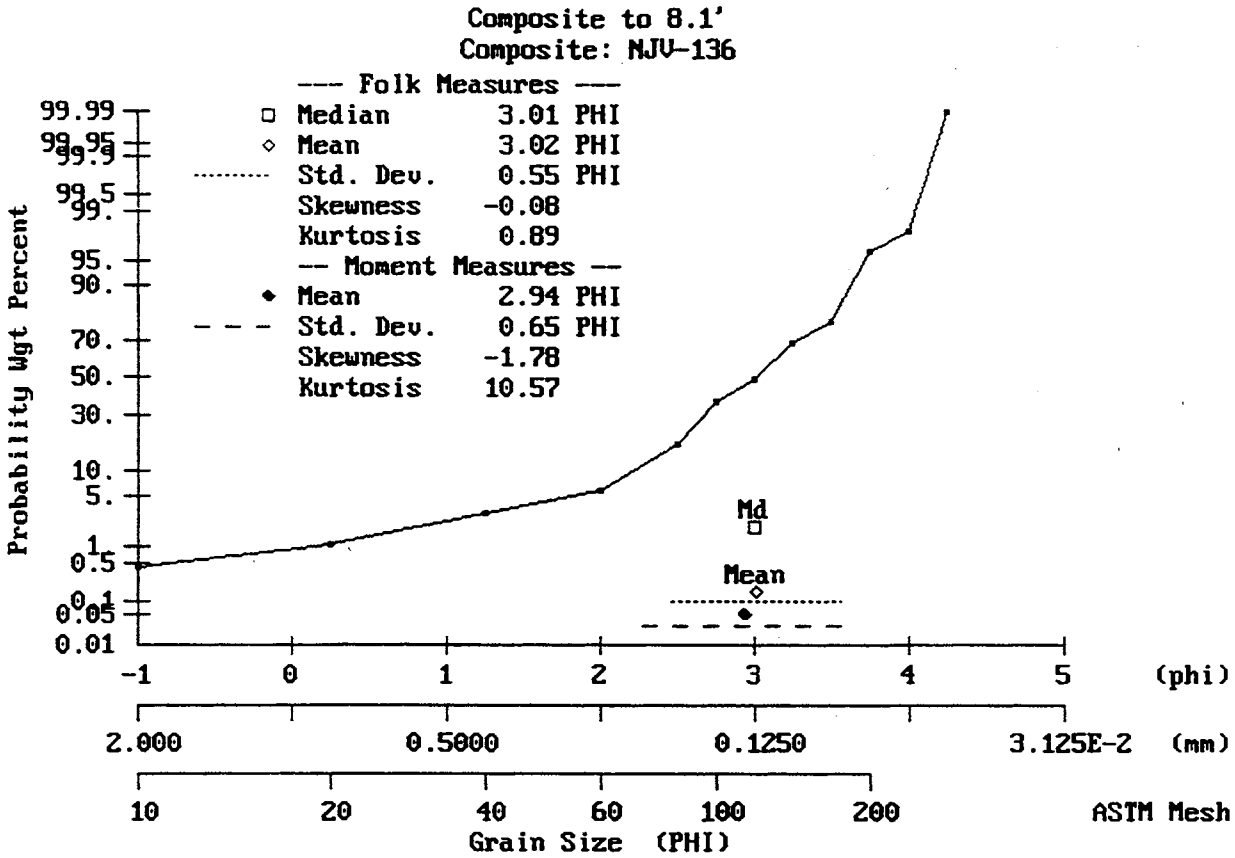
Median 2.66 PHI
Mean 2.67 PHI
Std. Dev. 0.73 PHI
Skewness -0.06
Kurtosis 1.37
-- Moment Measures --
Mean 2.66 PHI
Std. Dev. 0.80 PHI
Skewness -1.46
Kurtosis 7.92
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1.
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)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Median 3.01 PHI
Mean 3.02 PHI
Std. Dev. 0.55 PHI
Skewness -0.08
Kurtosis 0.89
-- Moment Measures --
Mean 2.94 PHI
Std. Dev. 0.65 PHI
Skewness -1.78
Kurtosis 10.57
Probability Wgt Percent
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99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
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3.125E-2
(mm)
10
20
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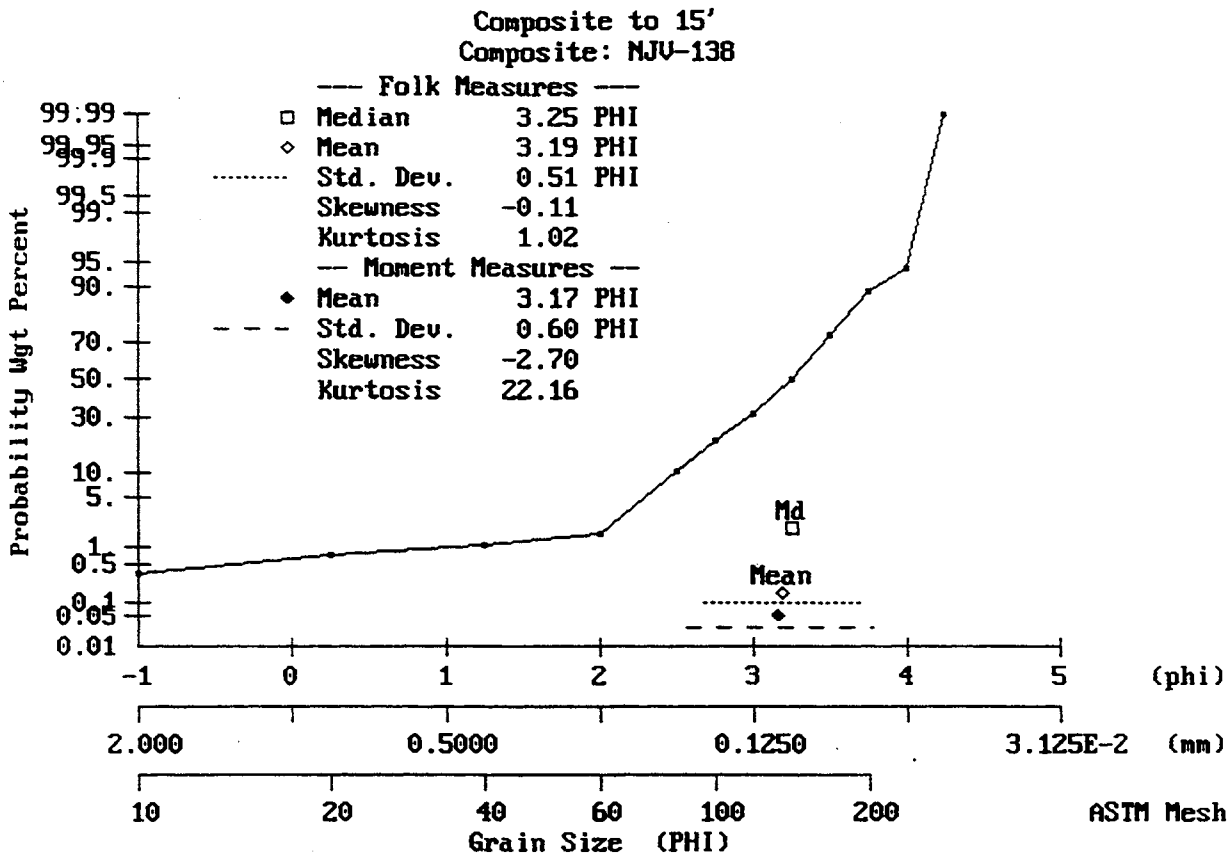
60
100
200
ASTM Mesh
Grain Size (PHI)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--- Folk Measures ---
Median 3.25 PHI
Mean 3.19 PHI
Std. Dev. 0.51 PHI
Skewness -0.11
Kurtosis 1.02
-- Moment Measures --
Mean 3.17 PHI
Std. Dev. 0.60 PHI
Skewness -2.70
Kurtosis 22.16
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
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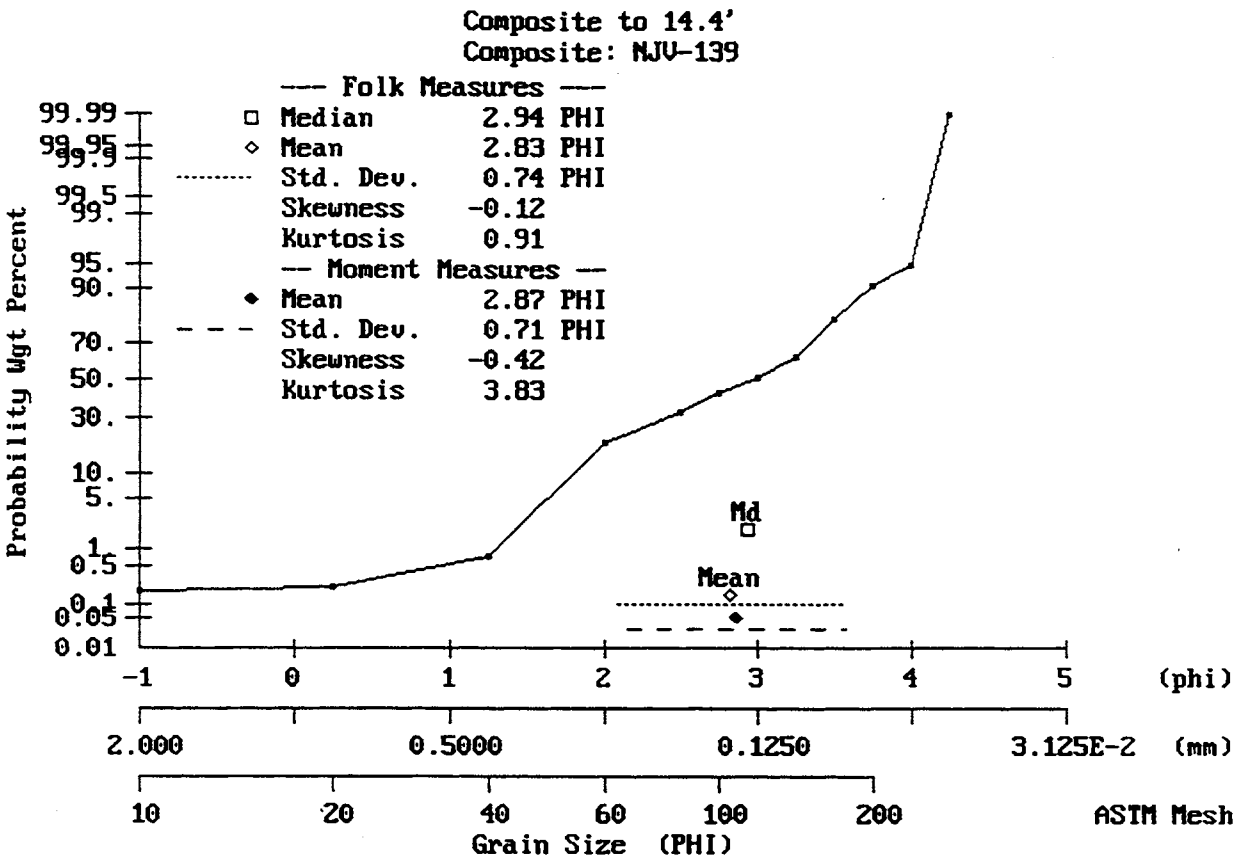
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)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Composite: NJV-139
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Median 2.94 PHI
Mean 2.83 PHI
Std. Dev. 0.74 PHI
Skewness -0.12
Kurtosis 0.91
-- Moment Measures --
Mean 2.87 PHI
Std. Dev. 0.71 PHI
Skewness -0.42
Kurtosis 3.83
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
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(mm)
10
20
40
60
100
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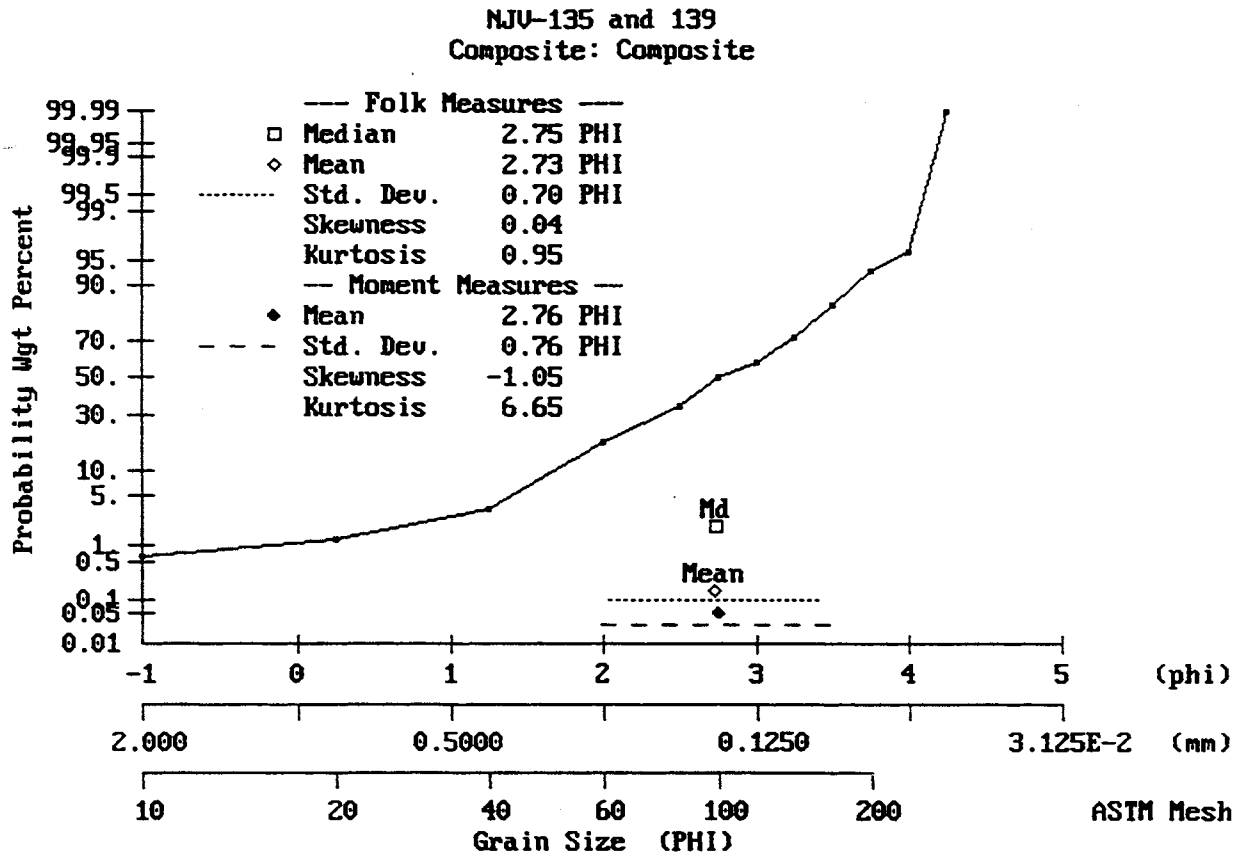
ASTM Mesh
Grain Size (PHI)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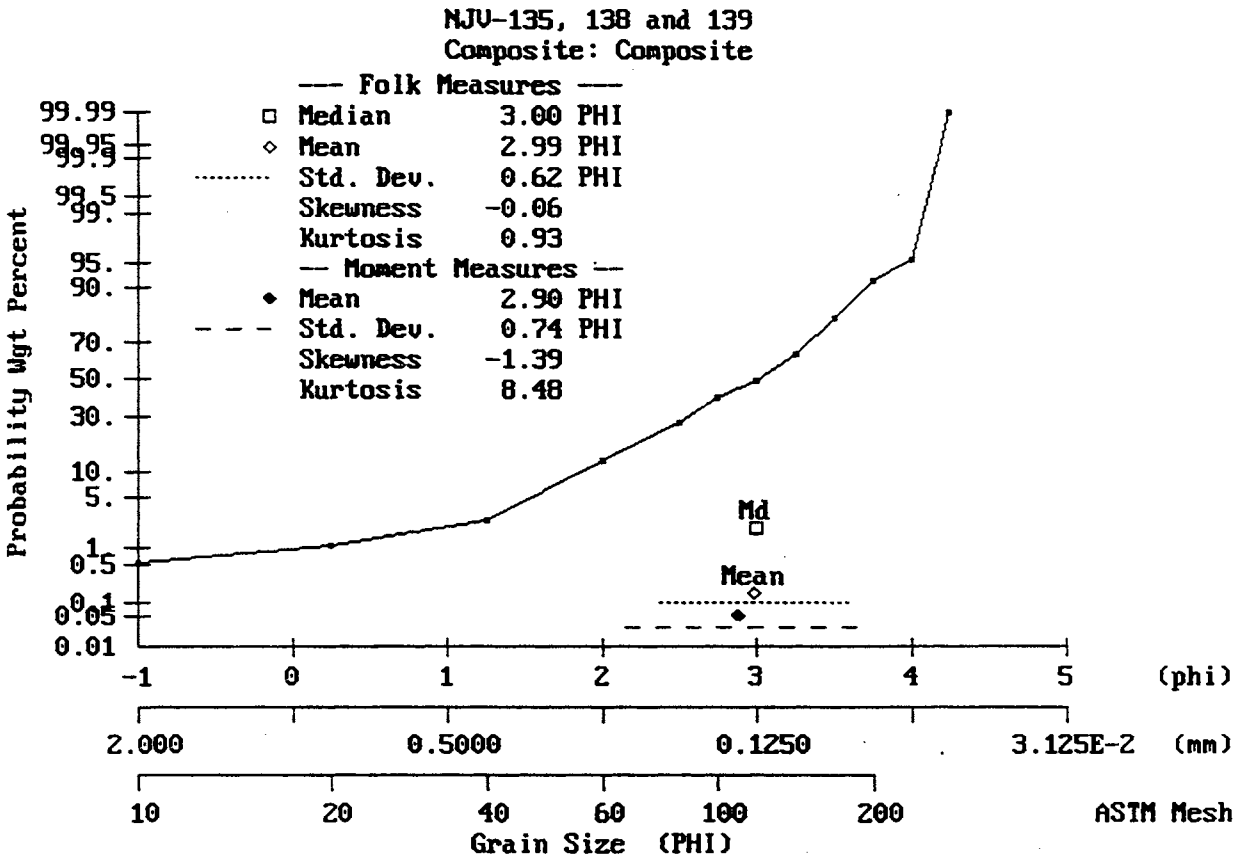
Kurtosis 0.95
-- Moment Measures --
Mean 2.76 PHI
Std. Dev. 0.76 PHI
Skewness -1.05
Kurtosis 6.65
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)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Mean 2.99 PHI
Std. Dev. 0.62 PHI
Skewness -0.06
Kurtosis 0.93
-- Moment Measures --
Mean 2.90 PHI
Std. Dev. 0.74 PHI
Skewness -1.39
Kurtosis 8.48
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
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3
4
5
(phi)
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(mm)
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100
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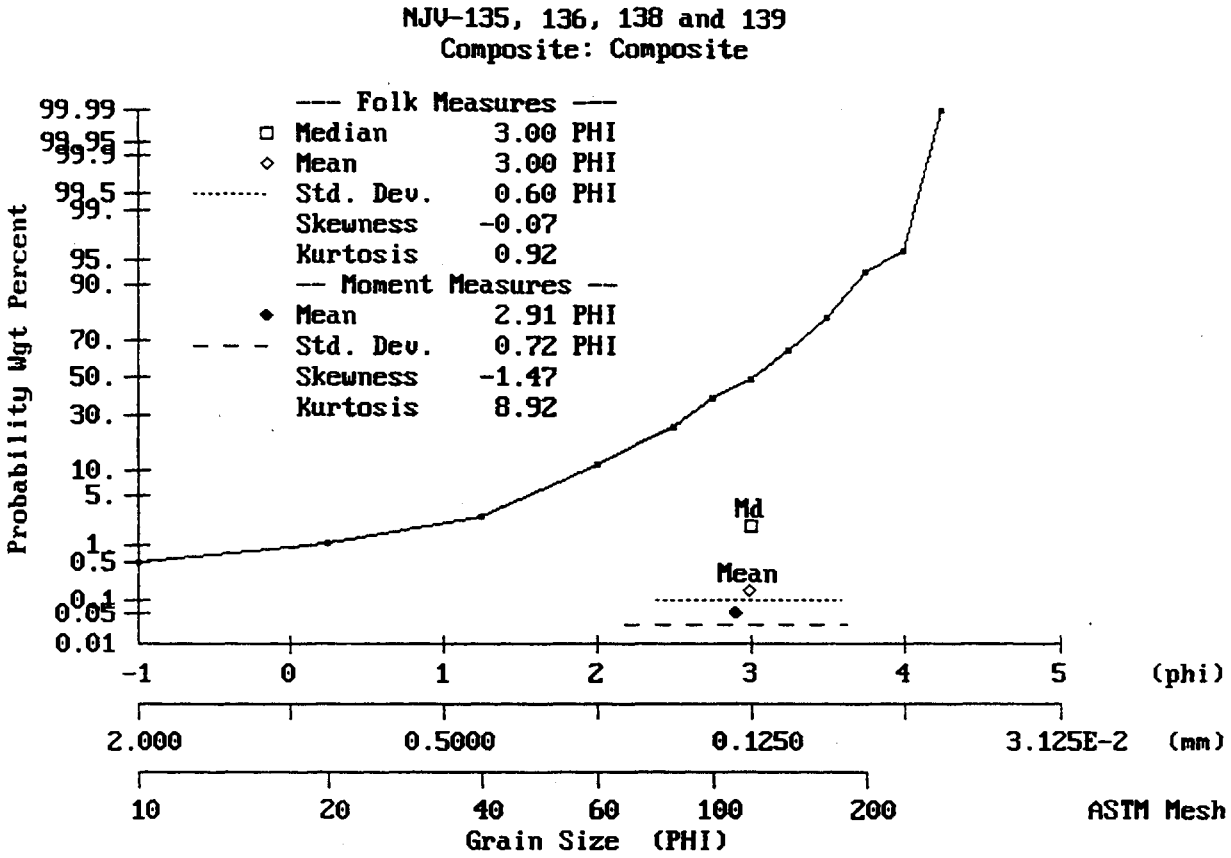
ASTM Mesh
Grain Size (PHI)


NJV-135, 136, 138 and 139
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--- Folk Measures ---
Median 3.00 PHI
Mean 3.00 PHI
Std. Dev. 0.60 PHI
Skewness -0.07
Kurtosis 0.92
-- Moment Measures --
Mean 2.91 PHI
Std. Dev. 0.72 PHI
Skewness -1.47
Kurtosis 8.92
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1.
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)

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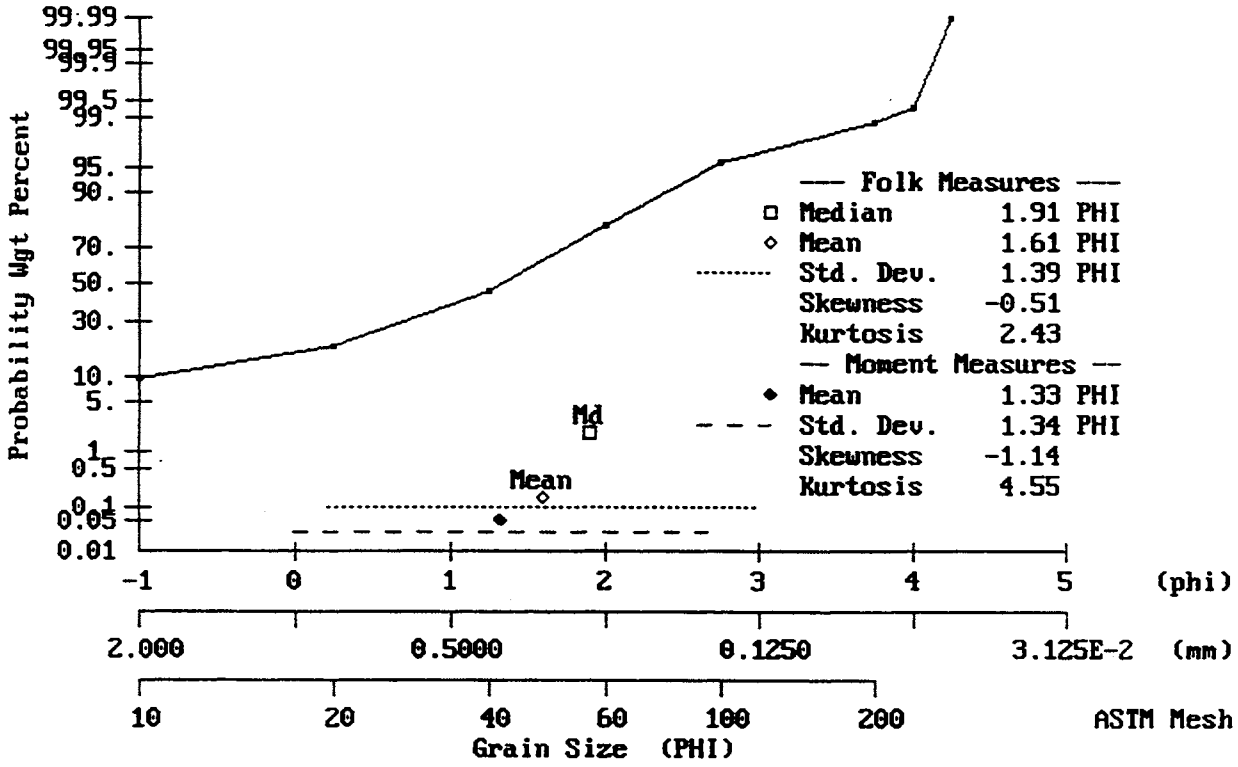
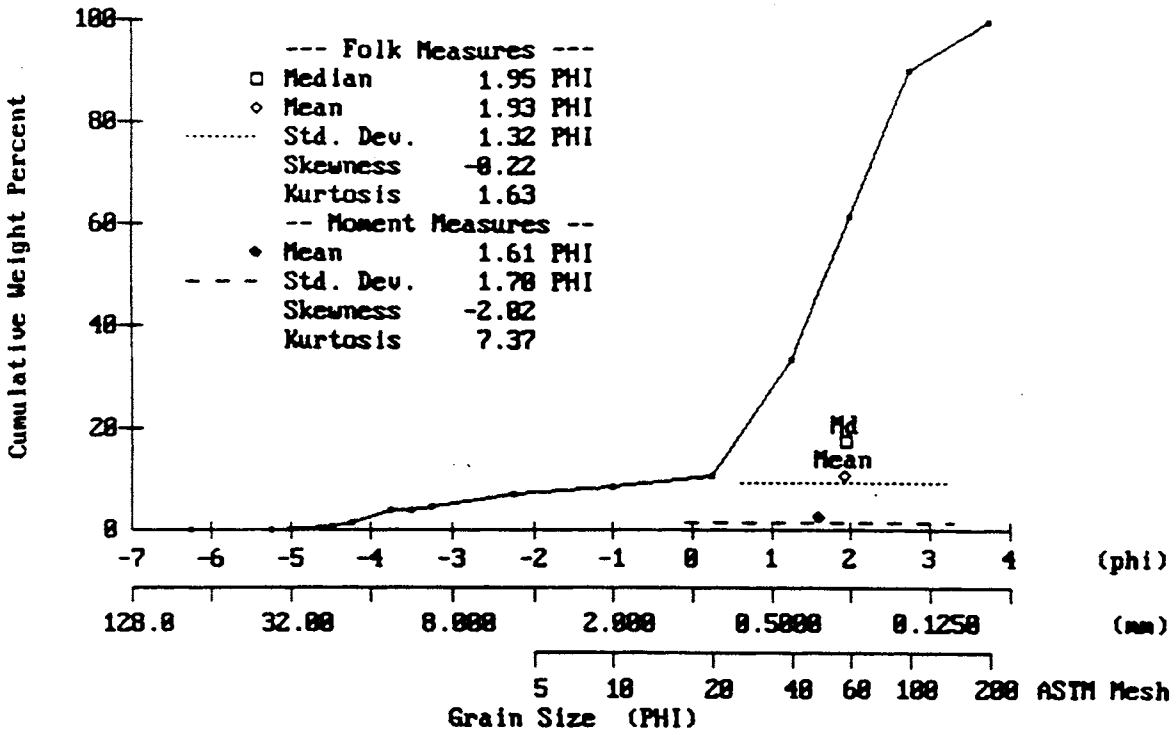
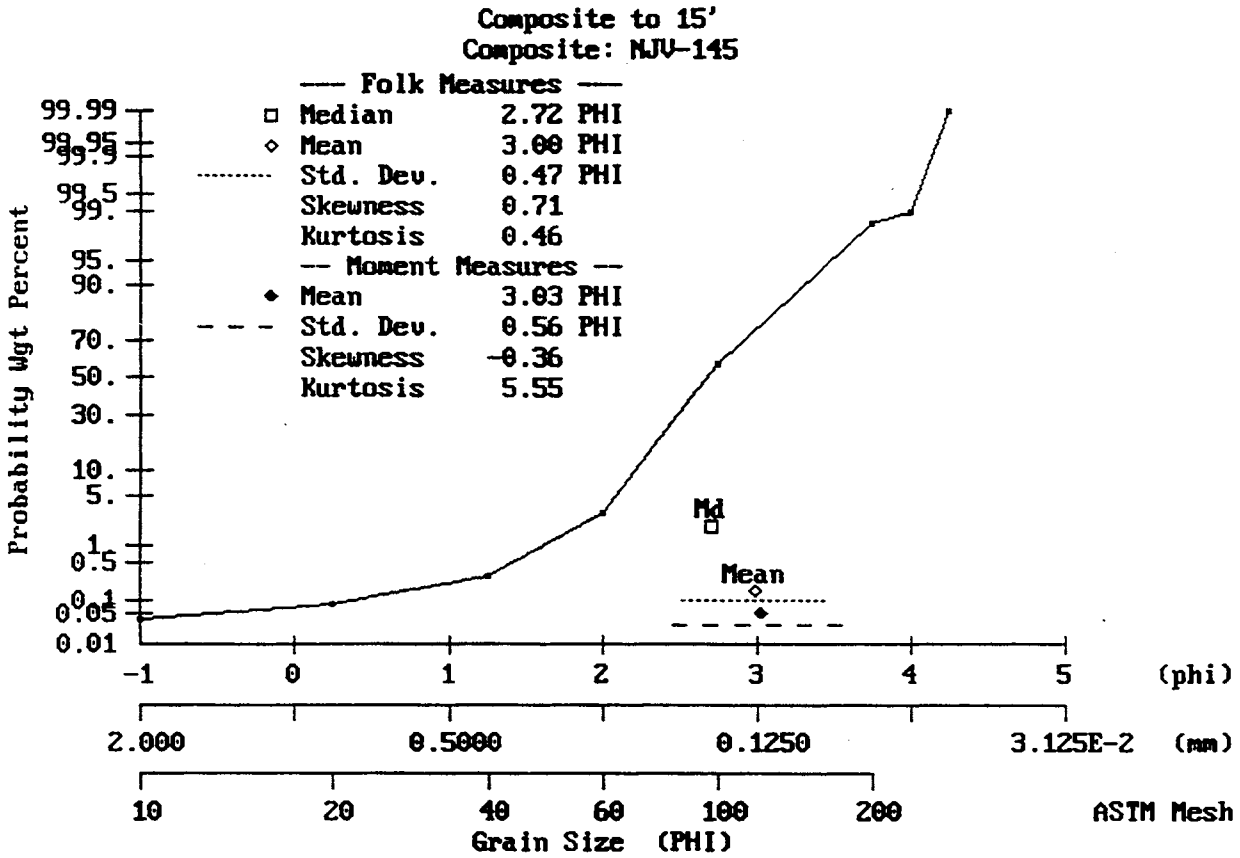
Composite: NJV-140



MJV-143
Composite: MJV-143

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Composite: NJV-145
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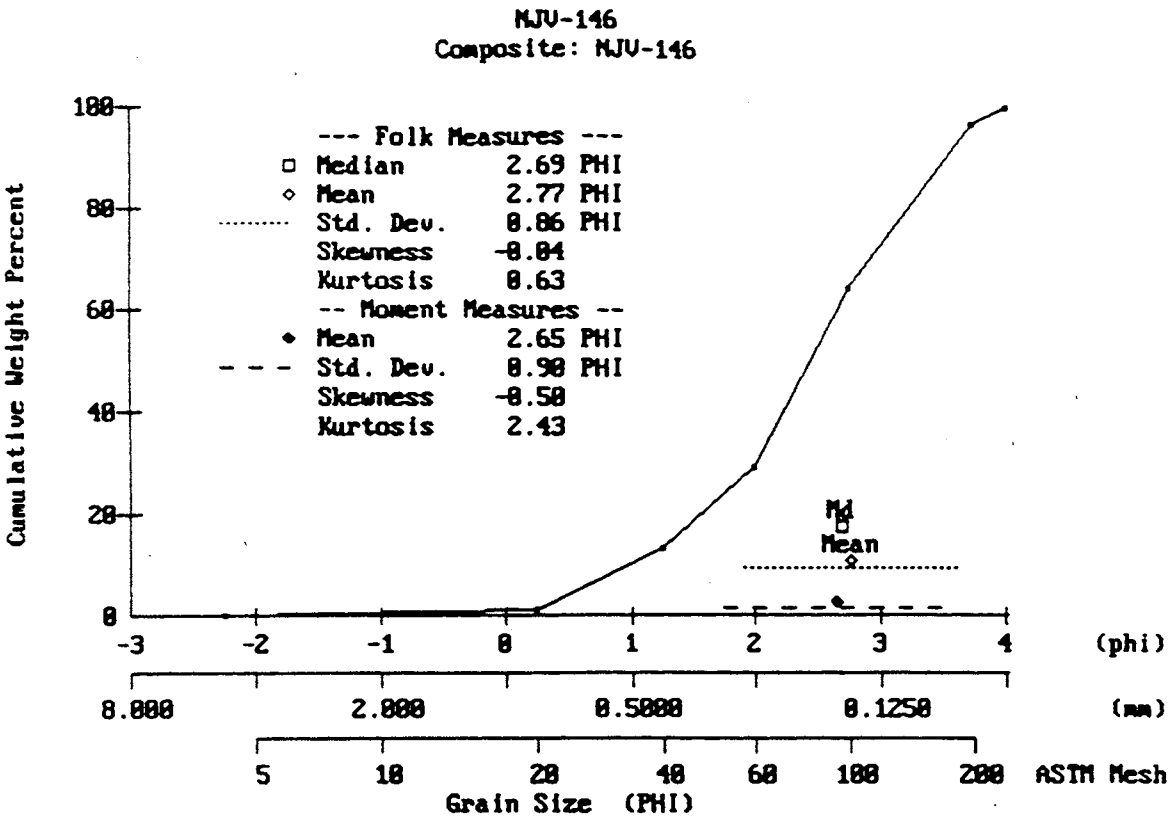
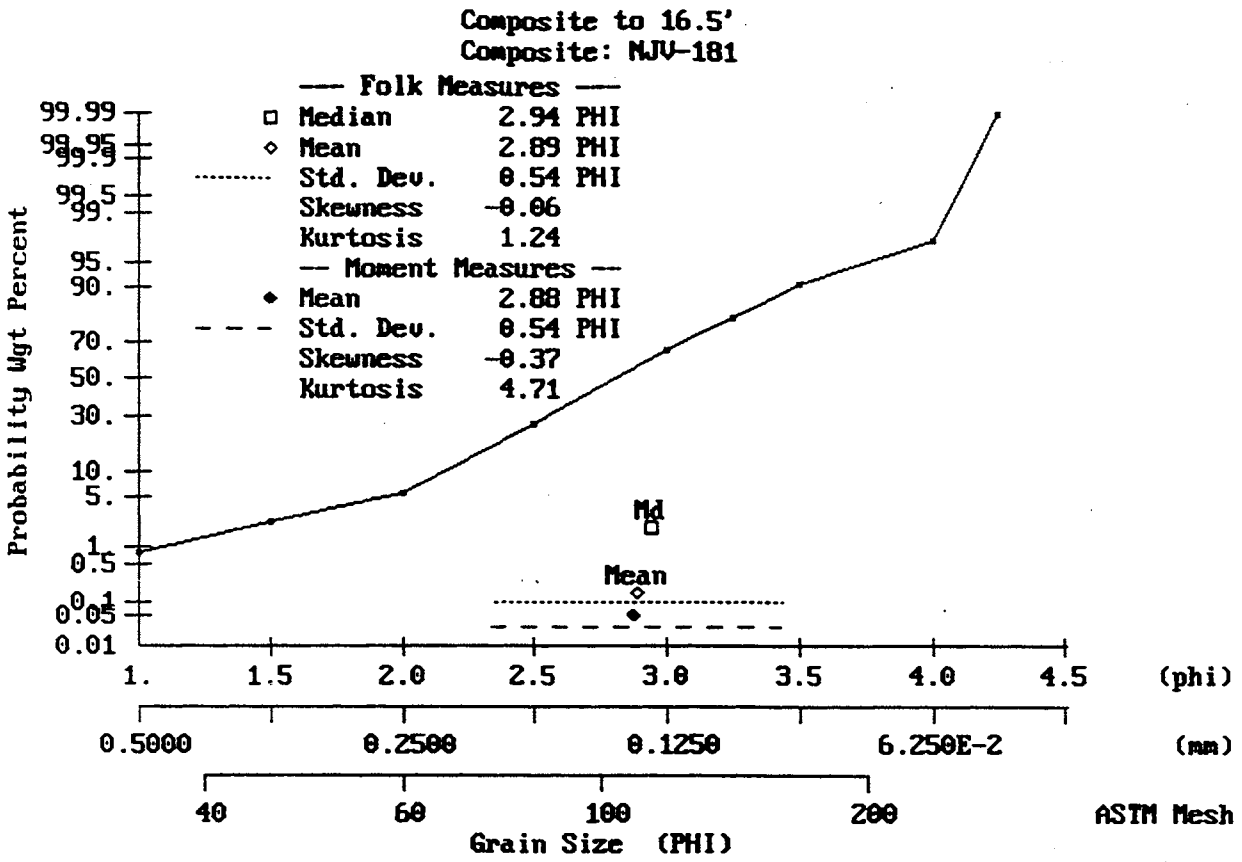
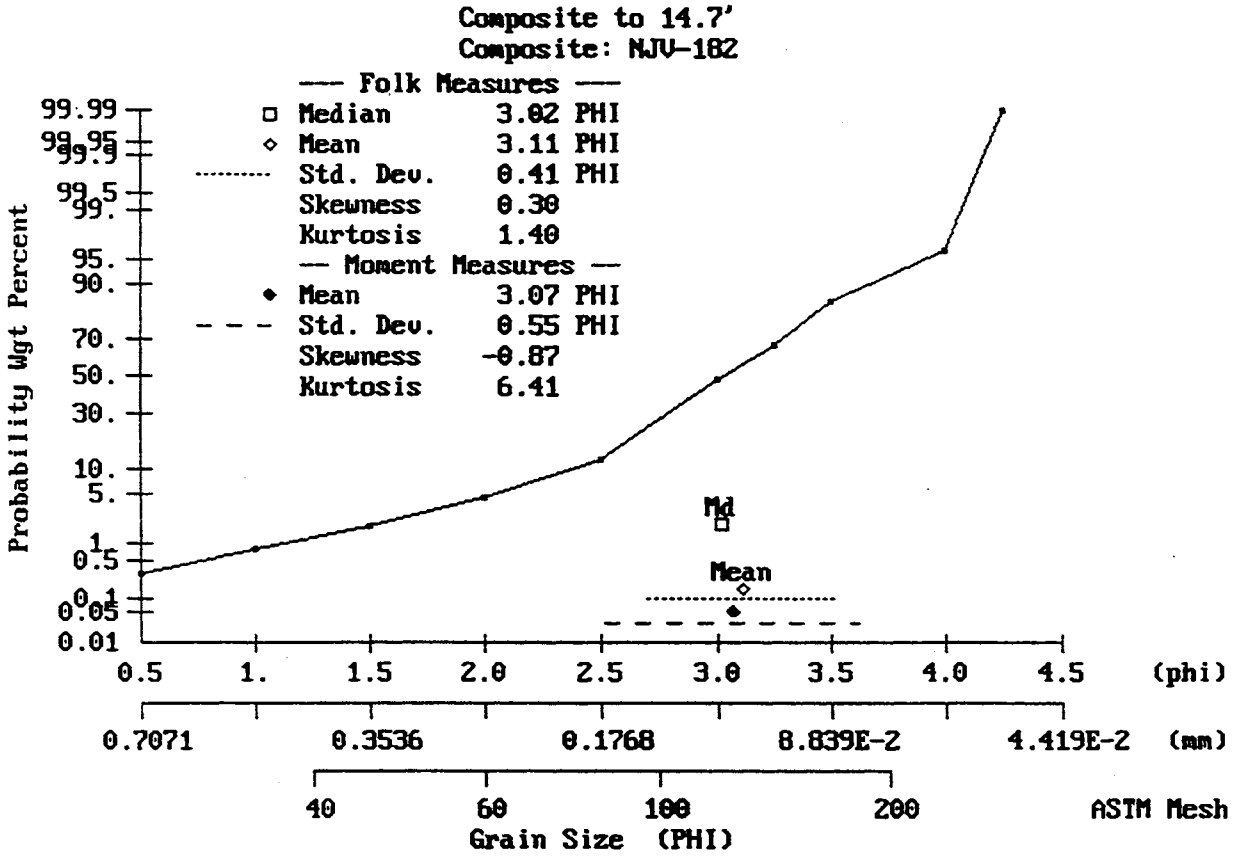
Std. Dev. 0.47 PHI
Skewness 0.71
Kurtosis 0.46
-- Moment Measures --
Mean 3.03 PHI
Std. Dev. 0.56 PHI
Skewness -0.36
Kurtosis 5.55
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)

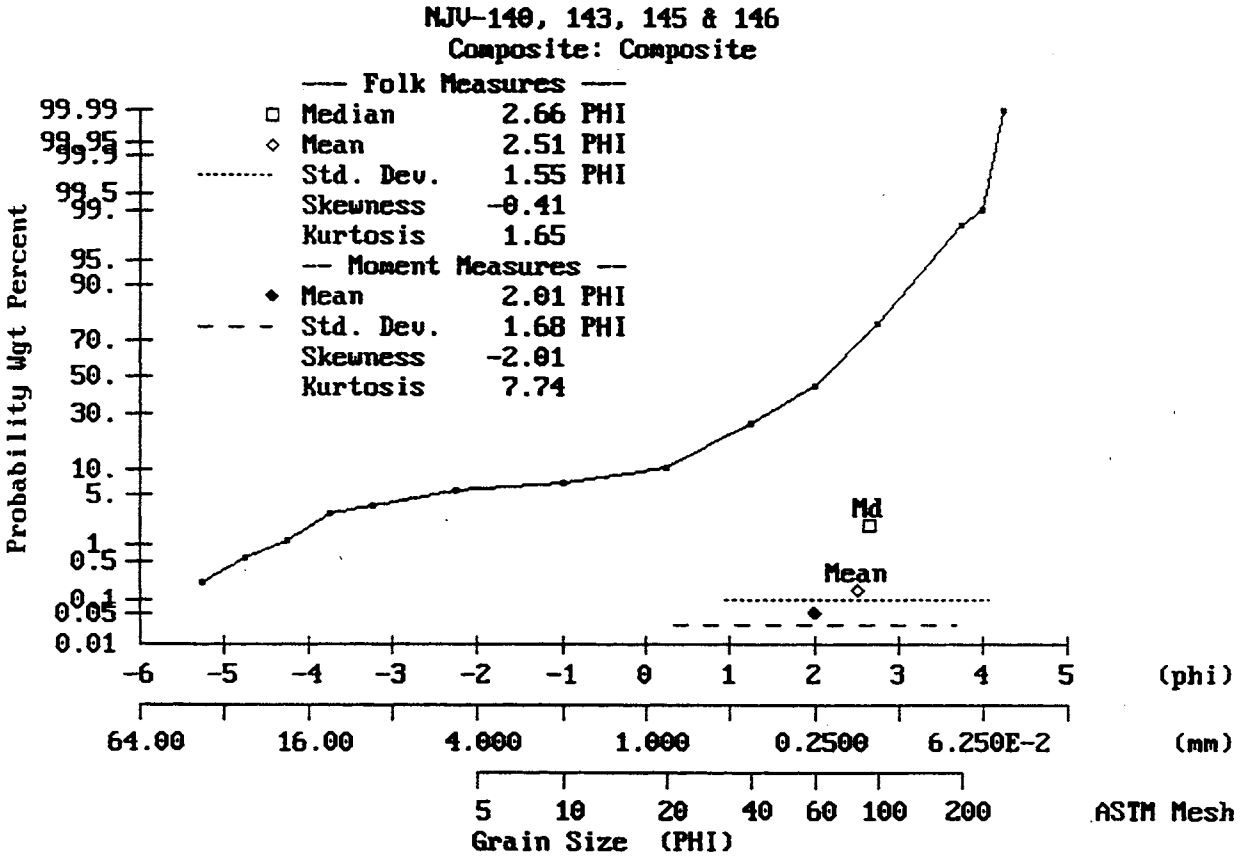
137


MJV-146
Composite: MJV-146
--- Folk Measures ---
Median 2.69 PHI
Mean 2.77 PHI
Std. Dev. 0.86 PHI
Skewness -0.04
Kurtosis 0.63
-- Moment Measures --
Mean 2.65 PHI
Std. Dev. 0.90 PHI
Skewness -0.50
Kurtosis 2.43
Cumulative Weight Percent
100
80
60
40
20
0
Md
Mean
-3
-2
-1
0
1
2
3
4
(phi)
8.000
2.000
0.5000
0.1250
(mm)
5
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)

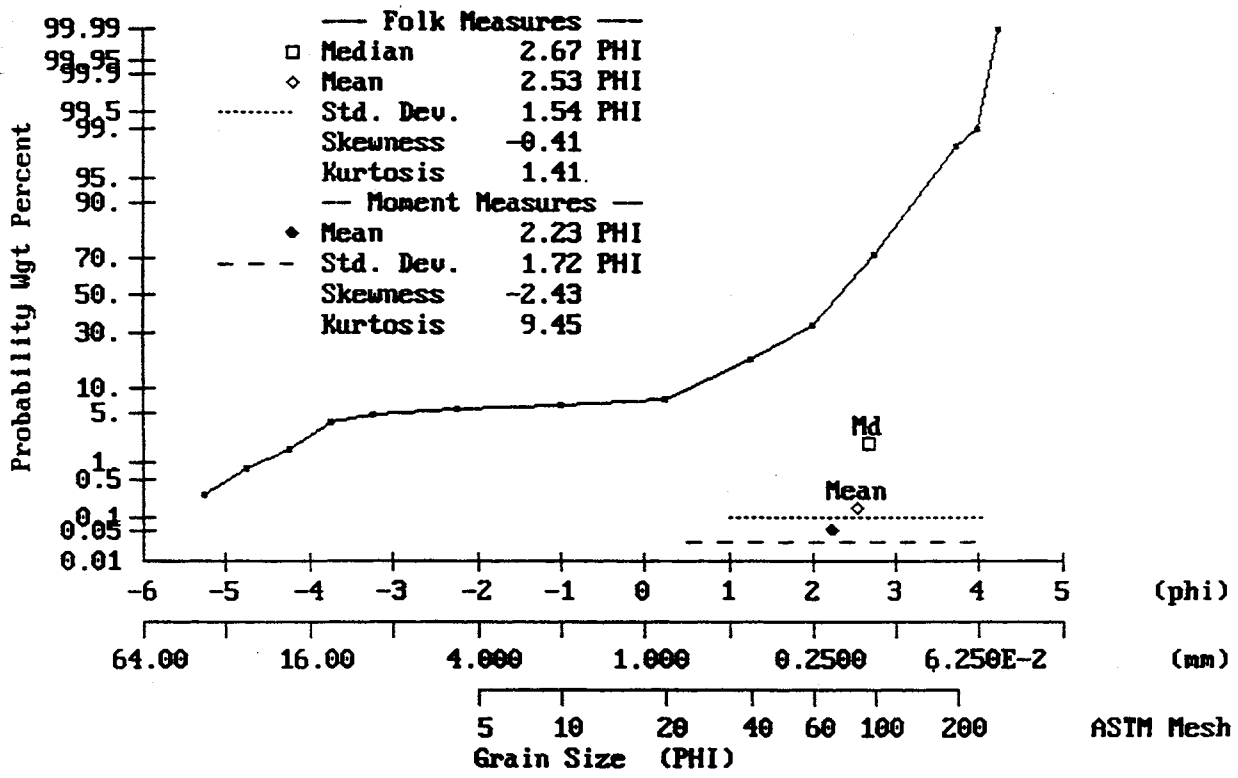

Composite to 16.5'
Composite: MJV-181
— Folk Measures —
Median 2.94 PHI
Mean 2.89 PHI
Std. Dev. 0.54 PHI
Skewness -0.06
Kurtosis 1.24
— Moment Measures —
Mean 2.88 PHI
Std. Dev. 0.54 PHI
Skewness -0.37
Kurtosis 4.71
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1.
0.5
0.1
0.05
0.01
Md
Mean
1.
1.5
2.0
2.5
3.0
3.5
4.0
4.5
(phi)
0.5000
0.2500
0.1250
6.250E-2
(mm)
40
60
100
200
ASTM Mesh
Grain Size (PHI)

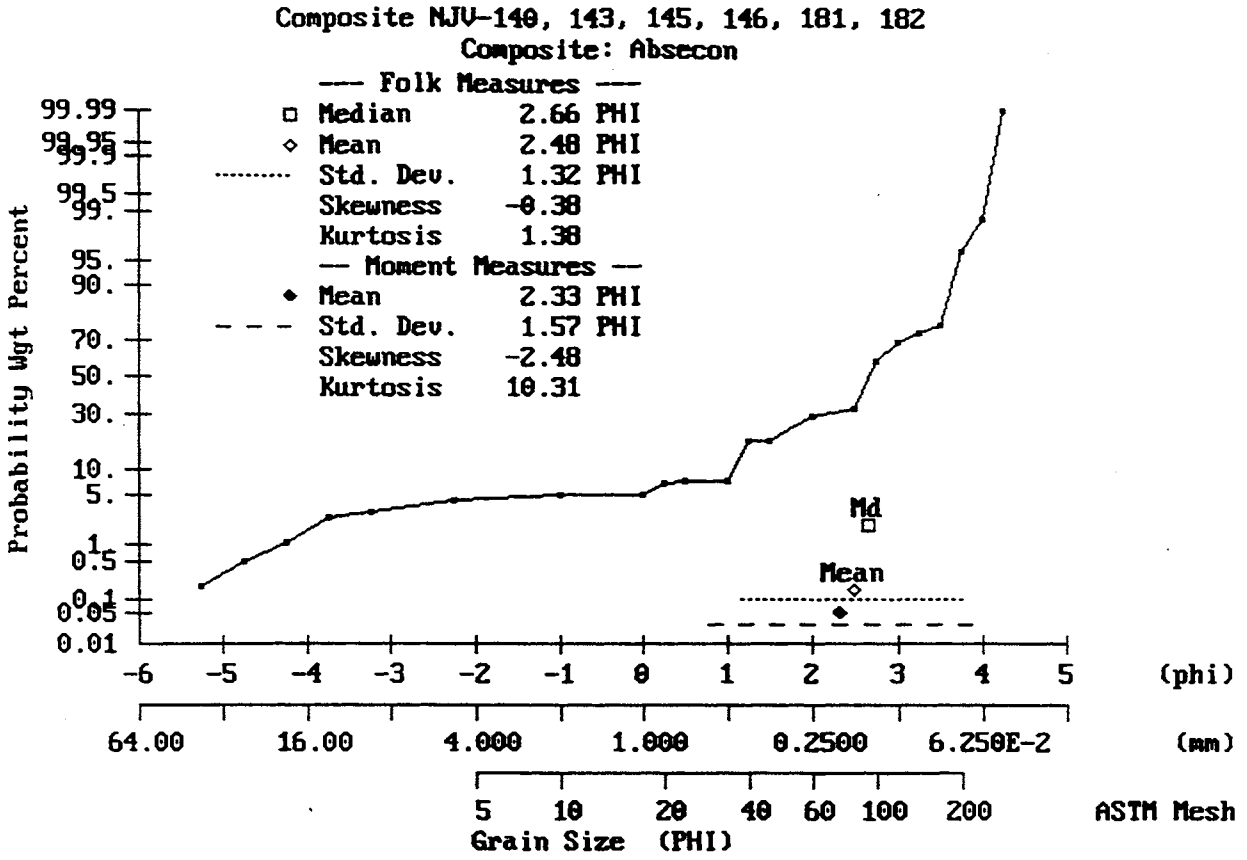
139


Composite to 14.7'
Composite: NJV-182
— Folk Measures —
Median 3.02 PHI
Mean 3.11 PHI
Std. Dev. 0.41 PHI
Skewness 0.30
Kurtosis 1.40
— Moment Measures —
Mean 3.07 PHI
Std. Dev. 0.55 PHI
Skewness -0.87
Kurtosis 6.41
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 4.5 (phi)
0.7071 0.3536 0.1768 8.839E-2 4.419E-2 (mm)
40 60 100 200 ASTM Mesh
Grain Size (PHI)


NJV-140, 143, 145 & 146
Composite: Composite
--- Folk Measures ---
Median 2.66 PHI
Mean 2.51 PHI
Std. Dev. 1.55 PHI
Skewness -0.41
Kurtosis 1.65
-- Moment Measures --
Mean 2.01 PHI
Std. Dev. 1.68 PHI
Skewness -2.01
Kurtosis 7.74
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 (phi)
64.00 16.00 4.000 1.000 0.2500 6.250E-2 (mm)
5 10 20 40 60 100 200 ASTM Mesh
Grain Size (PHI)

NJV-143, 145 & 146
Composite: Composite

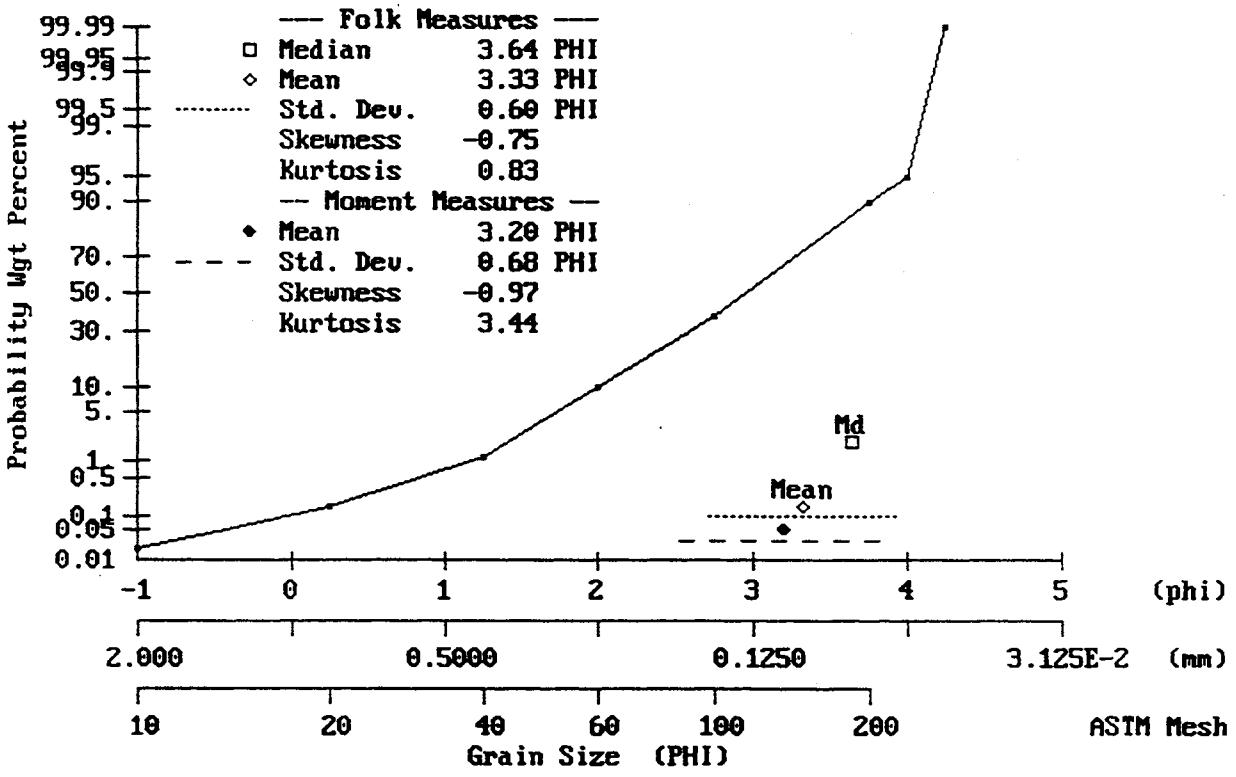



Composite NJV-140, 143, 145, 146, 181, 182
Composite: Absecon
--- Folk Measures ---
Median 2.66 PHI
Mean 2.48 PHI
Std. Dev. 1.32 PHI
Skewness -0.38
Kurtosis 1.38
-- Moment Measures --
Mean 2.33 PHI
Std. Dev. 1.57 PHI
Skewness -2.48
Kurtosis 10.31
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 (phi)
64.00 16.00 4.000 1.000 0.2500 6.250E-2 (mm)
5 10 20 40 60 100 200 ASTM Mesh
Grain Size (PHI)

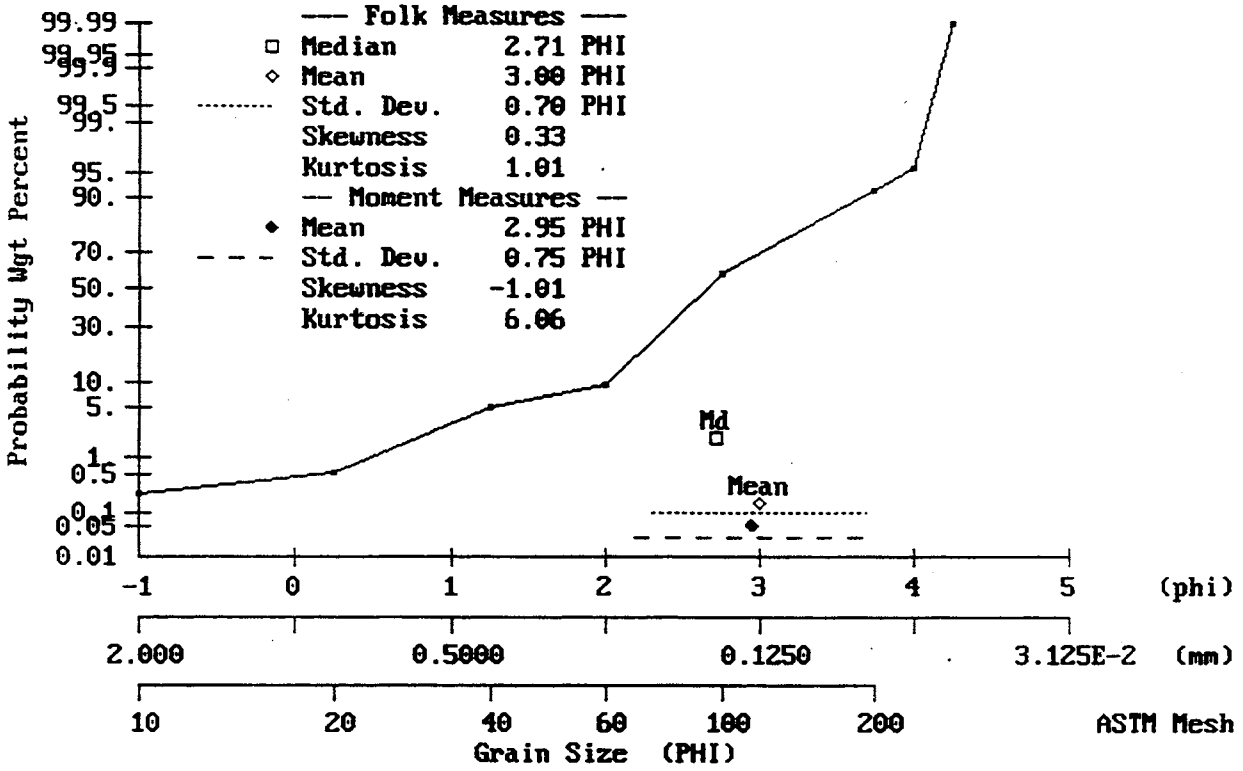
19

143

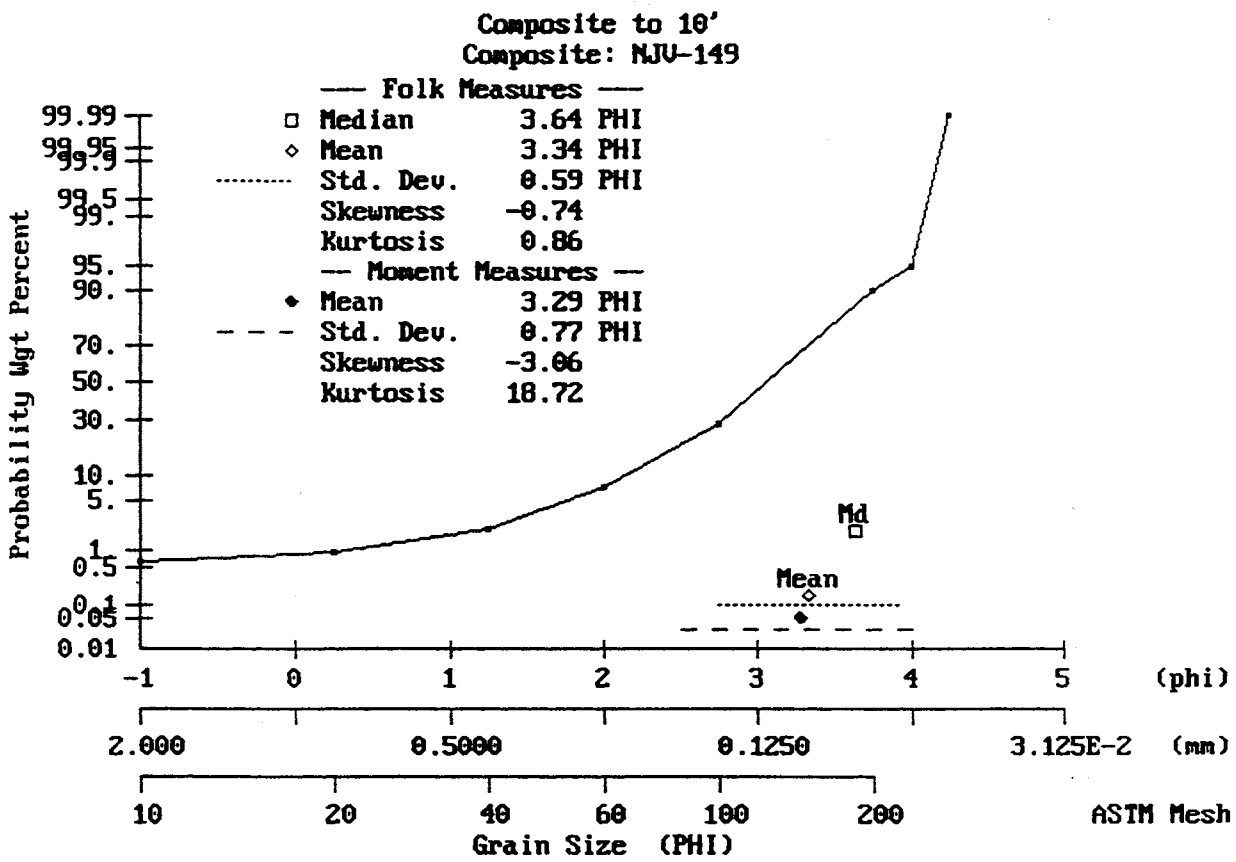
Composite to 10'
Composite: NJV-147

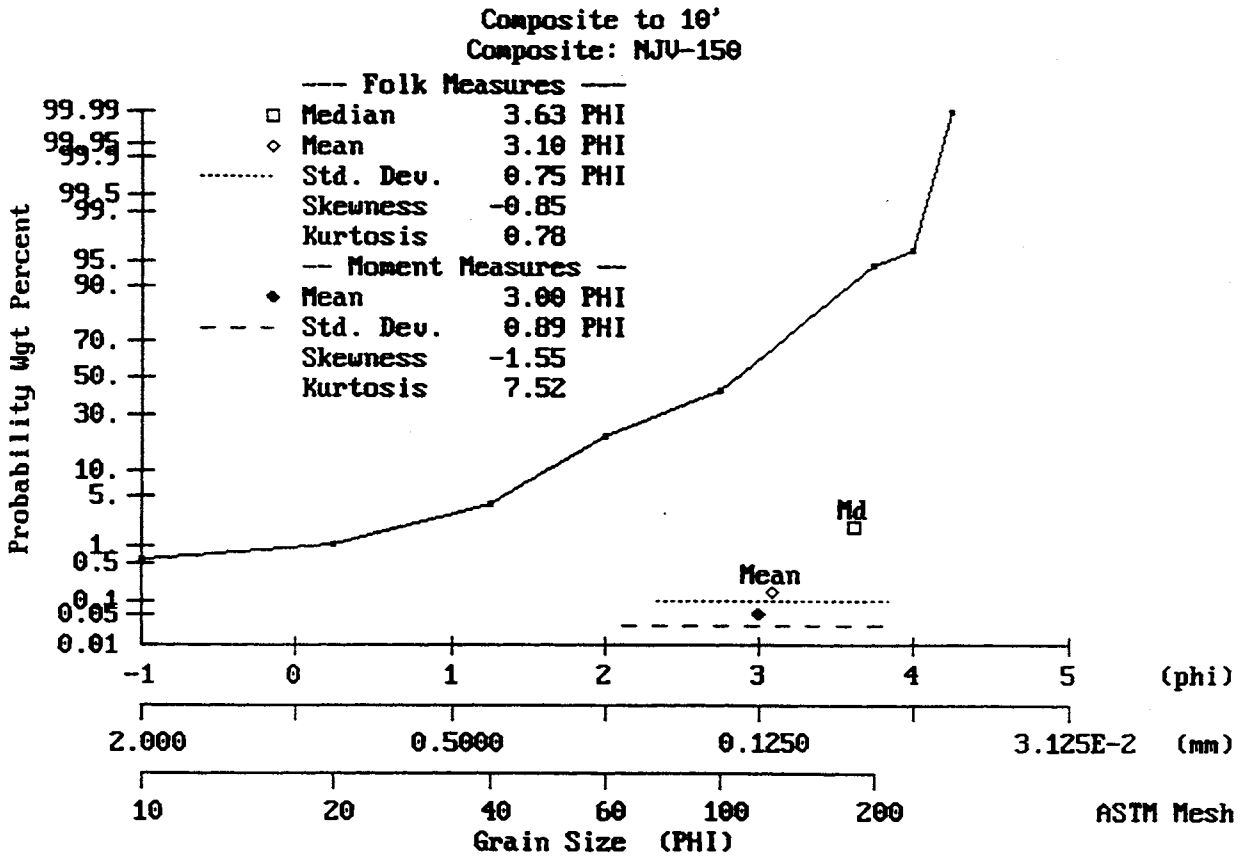


Composite to 17.4'
Composite: NJV-148

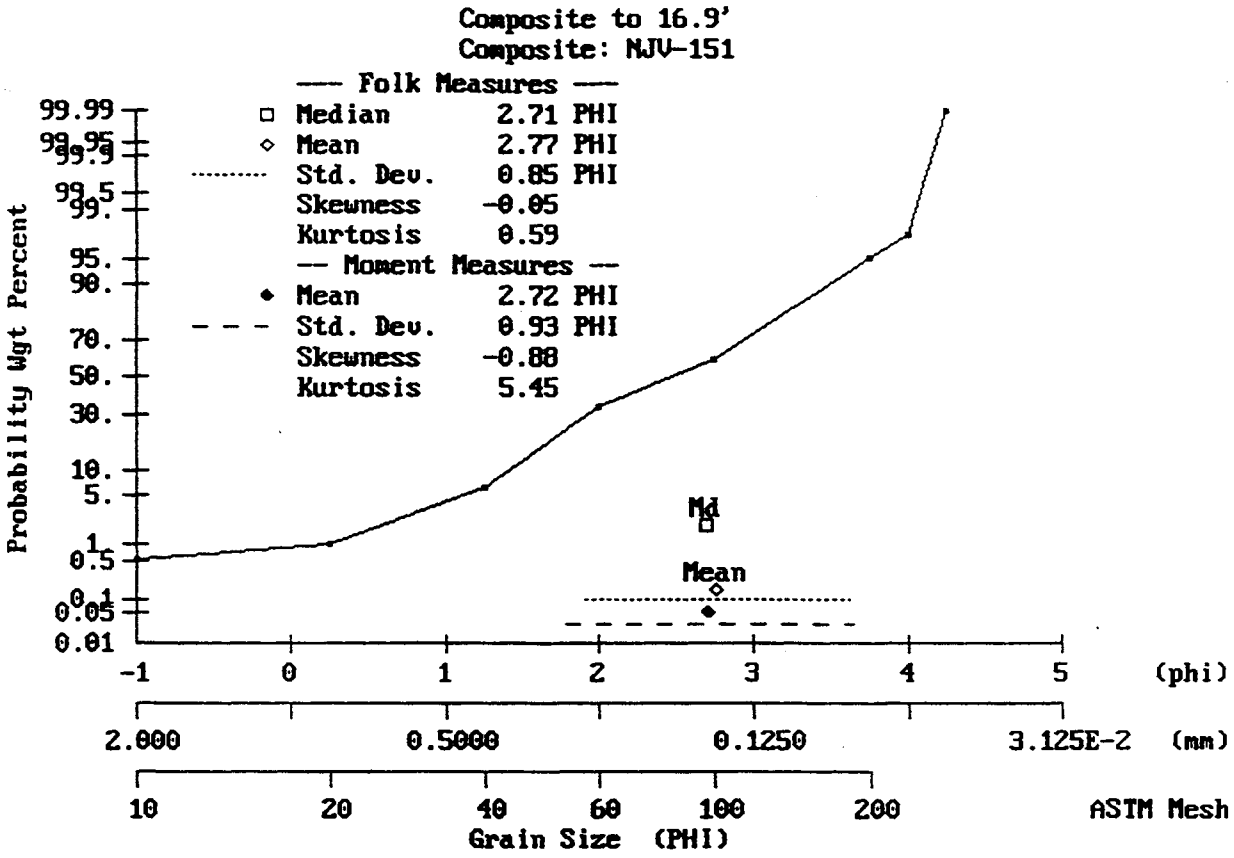


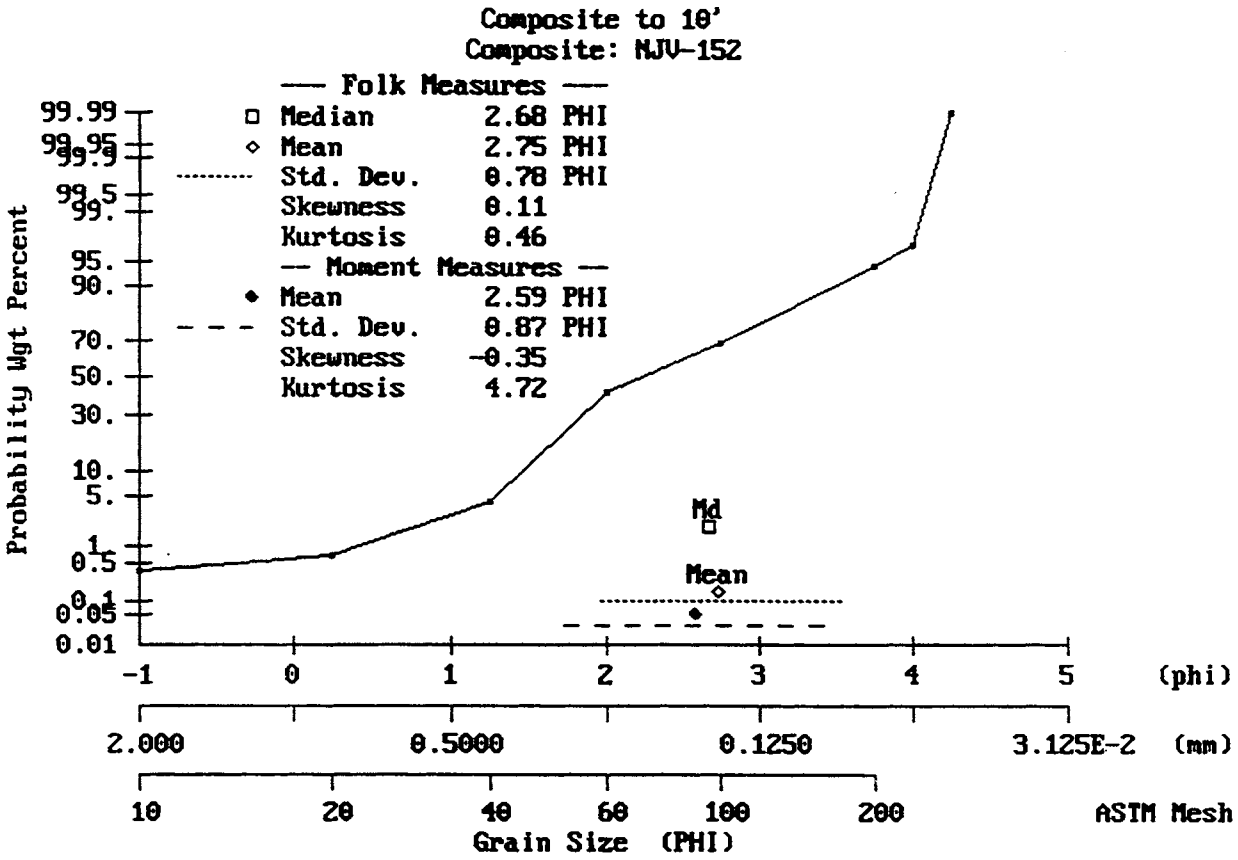
21


Composite to 10'
Composite: NJV-149
— Folk Measures —
Median 3.64 PHI
Mean 3.34 PHI
Std. Dev. 0.59 PHI
Skewness -0.74
Kurtosis 0.86
— Moment Measures —
Mean 3.29 PHI
Std. Dev. 0.77 PHI
Skewness -3.06
Kurtosis 18.72
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)


Composite to 10'
Composite: MJV-150
--- Folk Measures ---
Median 3.63 PHI
Mean 3.10 PHI
Std. Dev. 0.75 PHI
Skewness -0.85
Kurtosis 0.78
-- Moment Measures --
Mean 3.00 PHI
Std. Dev. 0.89 PHI
Skewness -1.55
Kurtosis 7.52
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)

141

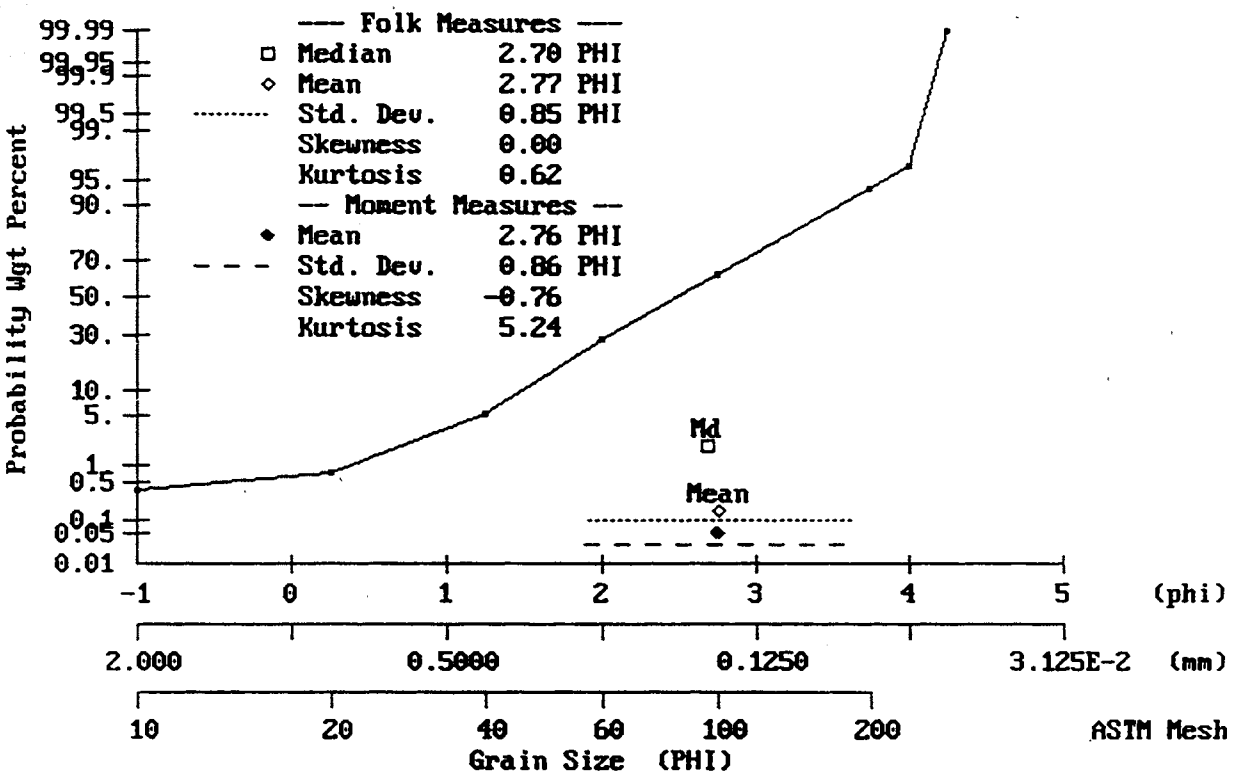

Composite to 16.9'
Composite: NJV-151
— Folk Measures —
Median 2.71 PHI
Mean 2.77 PHI
Std. Dev. 0.85 PHI
Skewness -0.05
Kurtosis 0.59
— Moment Measures —
Mean 2.72 PHI
Std. Dev. 0.93 PHI
Skewness -0.88
Kurtosis 5.45
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1.
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)


Composite to 10'
Composite: NJV-152
— Folk Measures —
Median 2.68 PHI
Mean 2.75 PHI
Std. Dev. 0.78 PHI
Skewness 0.11
Kurtosis 0.46
— Moment Measures —
Mean 2.59 PHI
Std. Dev. 0.87 PHI
Skewness -0.35
Kurtosis 4.72
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
-1
0
1
2
3
4
5
(phi)
2.000
0.5000
0.1250
3.125E-2
(mm)
10
20
40
60
100
200
ASTM Mesh
Grain Size (PHI)

25

149

NJV-148, 151 & 152
Composite: Composite



DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-135*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/862*
Boring Depth (ft): *14.00*	Elevation:	Work order: *7185*
Datum: Notes. *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev (feet)	Depth (feet)	Legend	Material Description	Comments
0				
	1			(A) SA 1.1/1.3'
	2		TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM),	
	3		AT 0.7 - 0.8'.	
	4			(B) MA 4.1/4.4'

-5	5			
	6		LT. GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL AND SHELL FRAGMENTS.	
	7			(C) SA 6.8/7.3

	8			
	9			
-10	10			
	11			(D) SA 10.5/10.8'
			TAN AND LT. GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL GRAVEL SIZES AT 11.6 - 12.4'	
	12			
	13			(E) MA 13.0/13.3'
	14		---	
-15	15			
	16			
	17			
	18			
	19			
-20				

27

Date: 07/22/94 LABORATORY LOG AND SAMPLE DATUM Sheet

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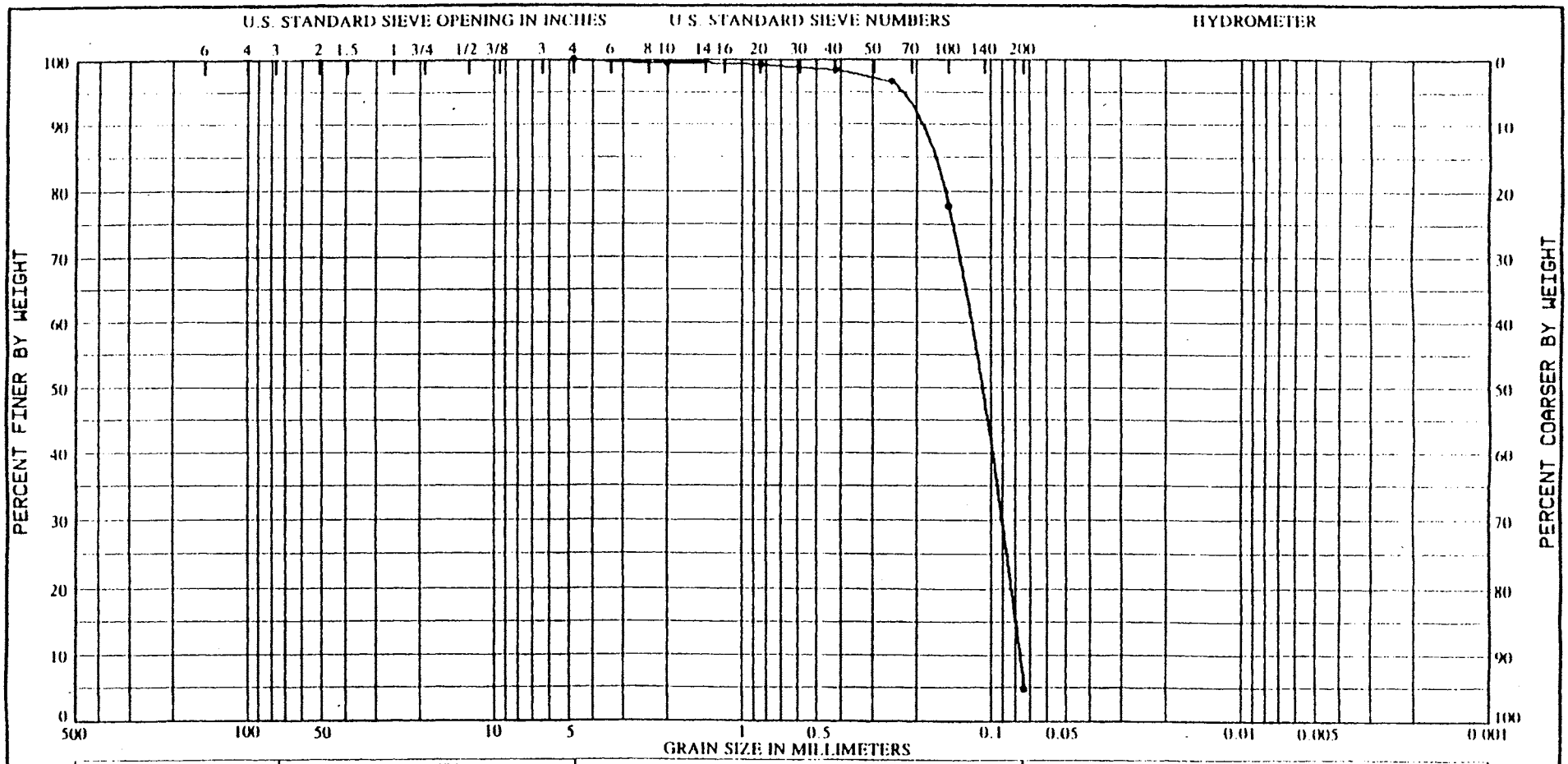
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No	Elev.	Classification	Nat w%	LL	PL	PI
	-1.1 / -1.3'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

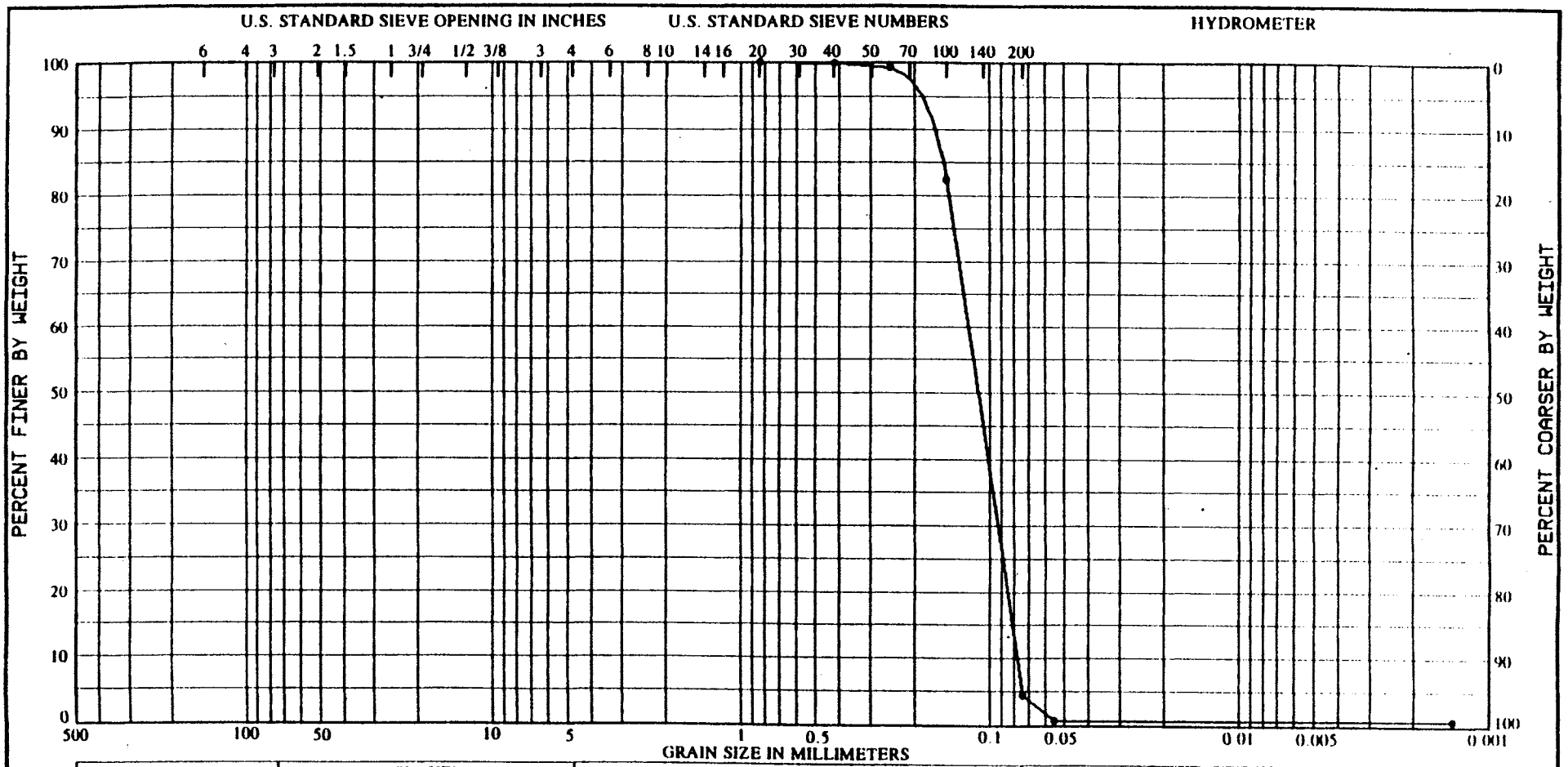
Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/862A
Boring No: NJV-135
Date: 06/13/94

GRADATION CURVES

F-12

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

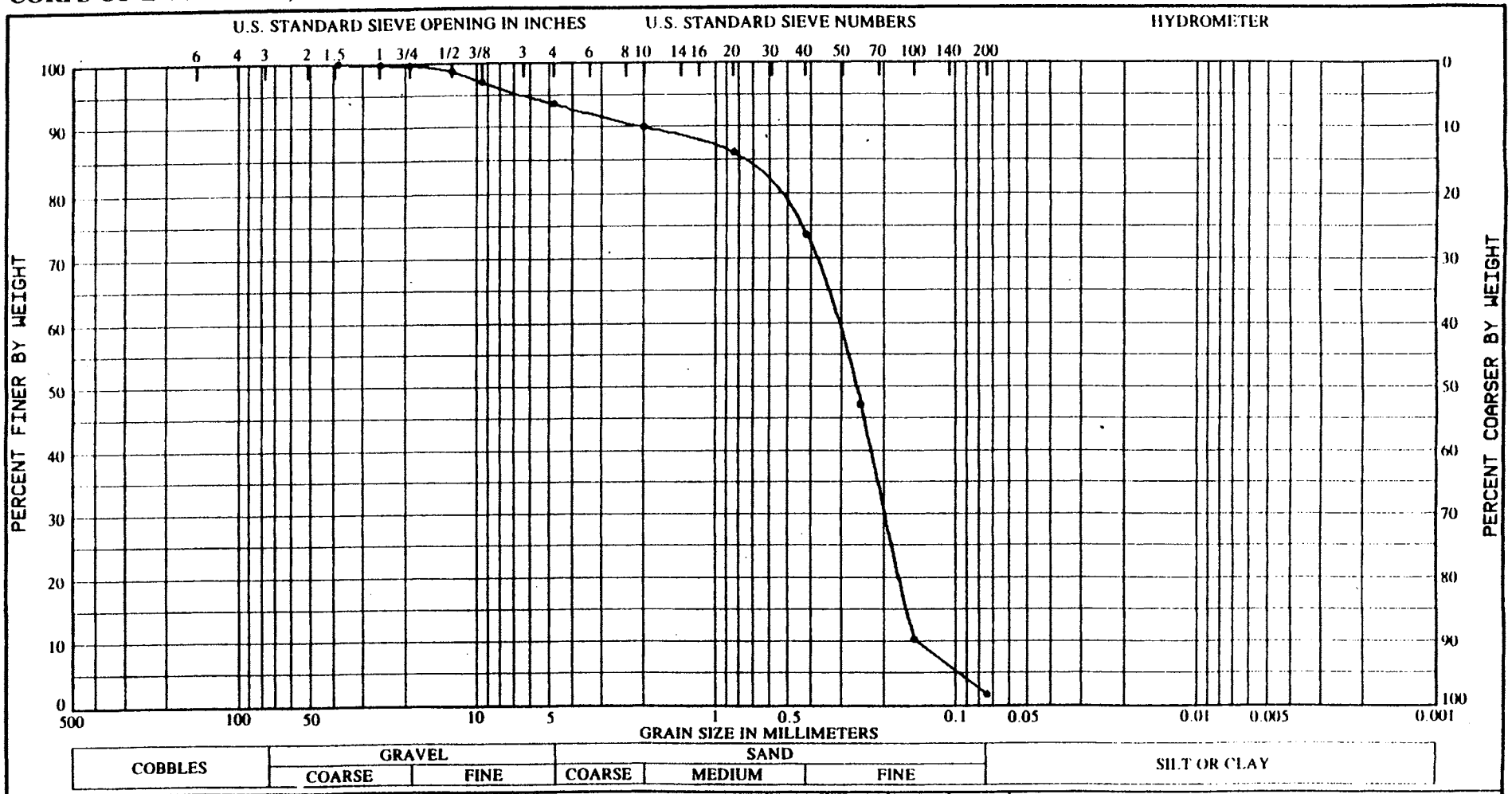
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-13.0 / -13.3'	(VISUAL) TAN AND LT. GRAY, POORLY GRADED SAND (SP)				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/862E
Boring No NJV-135
Date 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-6.8 / -7.3'	(VISUAL) LT. GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL AND ATRACE OF MICA.				

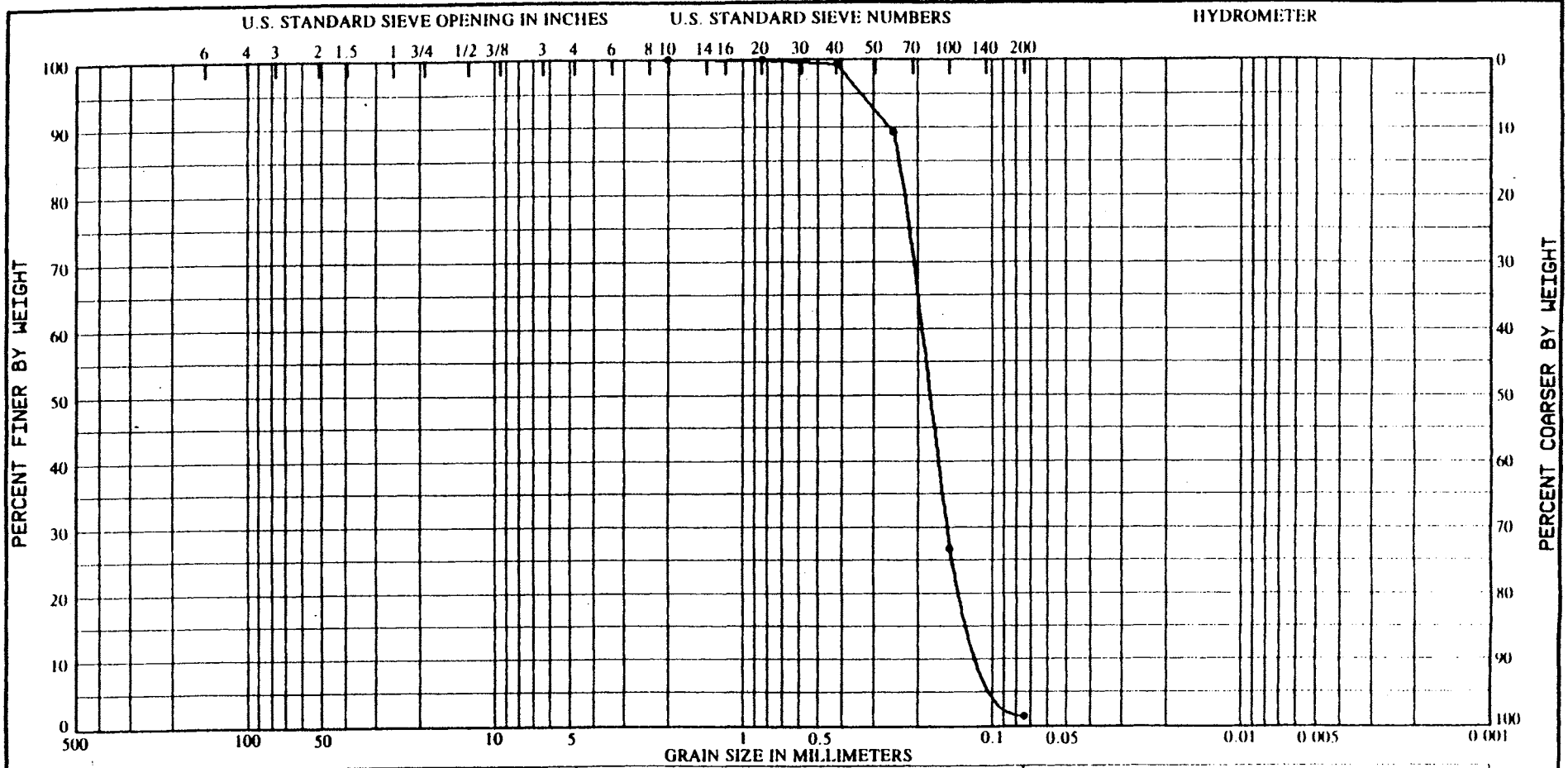
Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/862C
Boring No: NJV-135
Date: 06/13/94

GRADATION CURVES

155

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-10.5 / -10.8'	(VISUAL) TAN AND LT. GRAY, POORLY GRADED SAND (SP).				

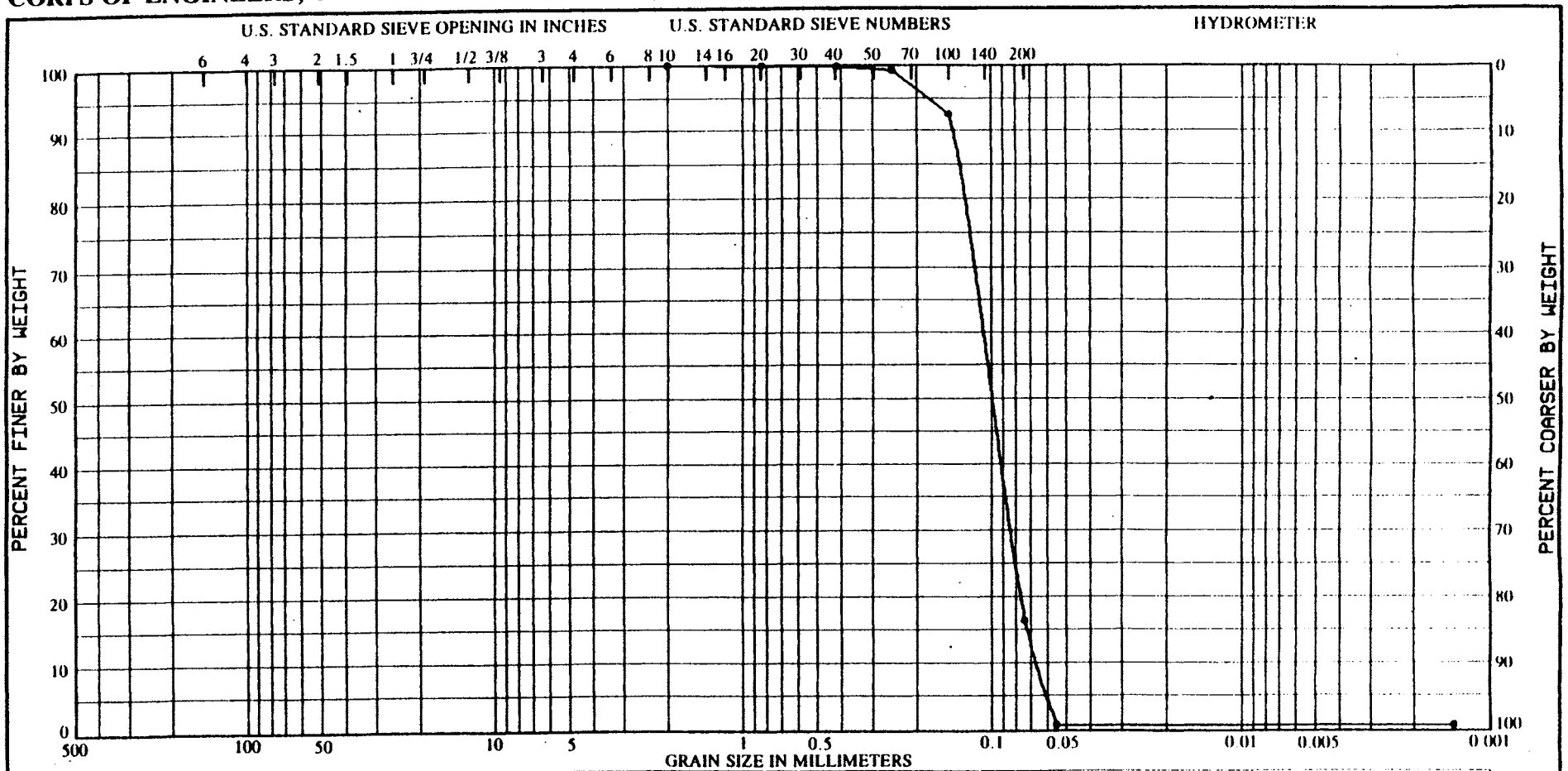
Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/862D
Boring No: NJV-135
Date: 06/13/94

GRADATION CURVES

3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-4.1 / -4.4'	(VISUAL) TAN AND GRAY, SILTY SAND (SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/862B
Boring No NJV-135
Date 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No.	*NJV-136*
Location: *OFFSHORE OF NEW JERSEY*		Lab No.	*184/863*
Boring Depth (ft): *19.00*	Elevation:	Work order:	*7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition:	*NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1			
	2			
	3			(A) SA 2.6/2.9'
	4		TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM).	
-5	5			
	6			(B) SA 6.2/6.4'
	7			
	8		TAN, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL FRAGMENTS.	(C) SA 7.5/8.1' (D) MA 8.2/8.5'
	9		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF SHELL FRAGMENTS.	
-10	10		TAN, POORLY GRADED SILTY SAND (SP-SM).	
	11			
	12			
	13			(E) SA 12.6/12.9'
	14			
-15	15		TAN AND GRAY, POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL SIZE SHELL AT 11.2/11.6'.	
	16			
	17			(F) SA 16.3/16.5'
	18			
	19			
-20				

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Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No of

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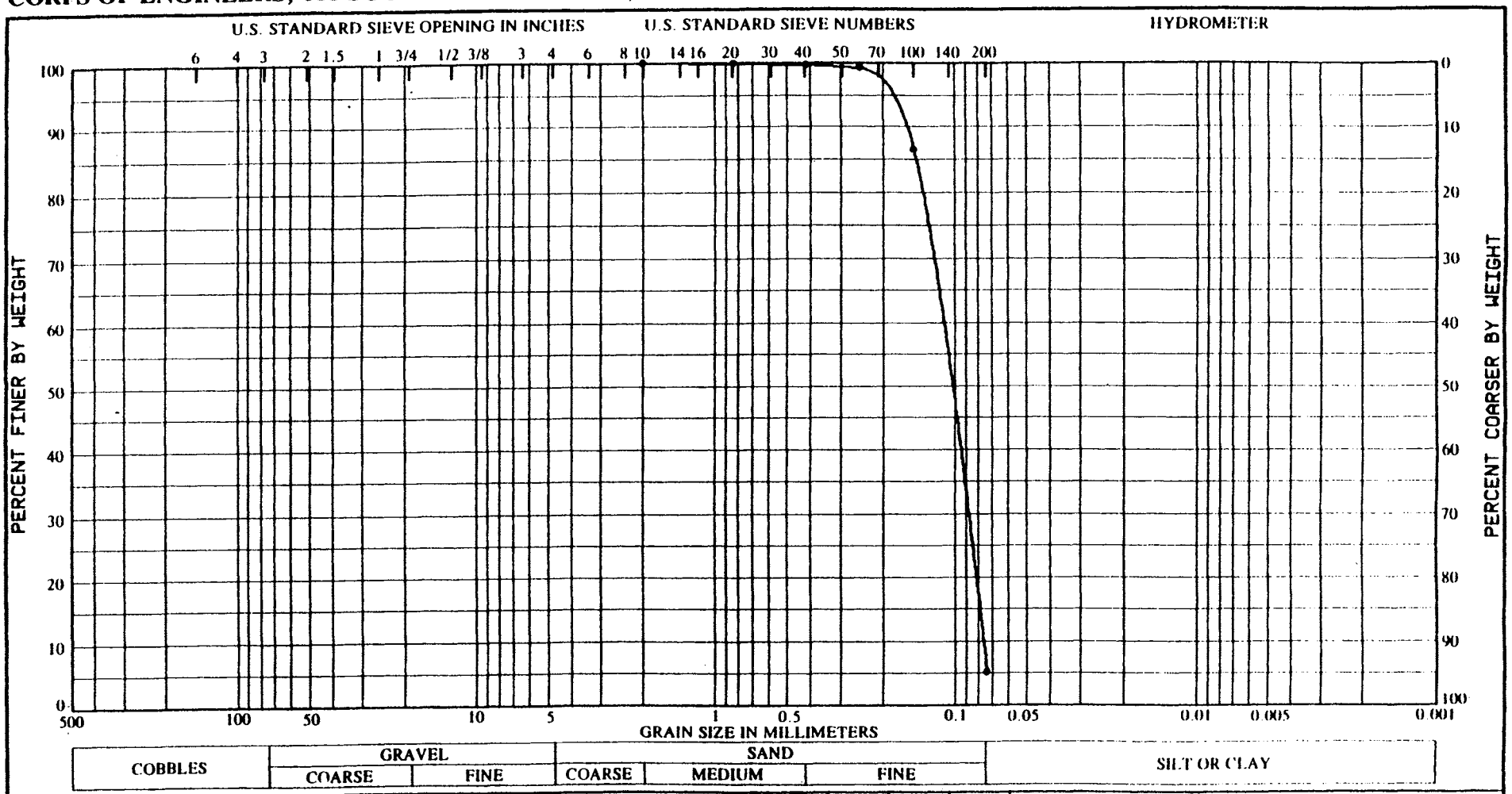
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

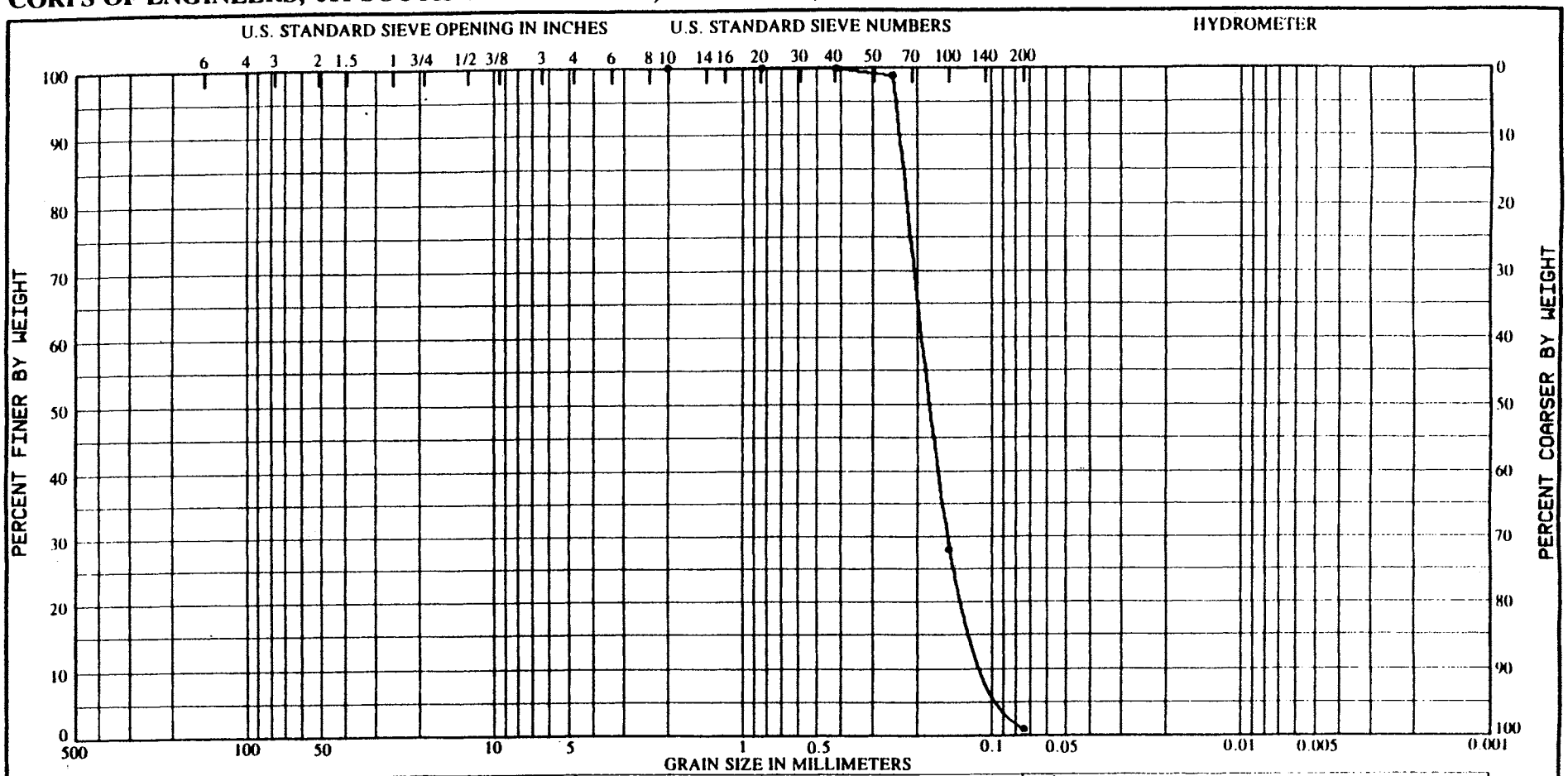
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-2.6 / -2.9'	(VISUAL) TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/863A
Boring No NJV-136
Date 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

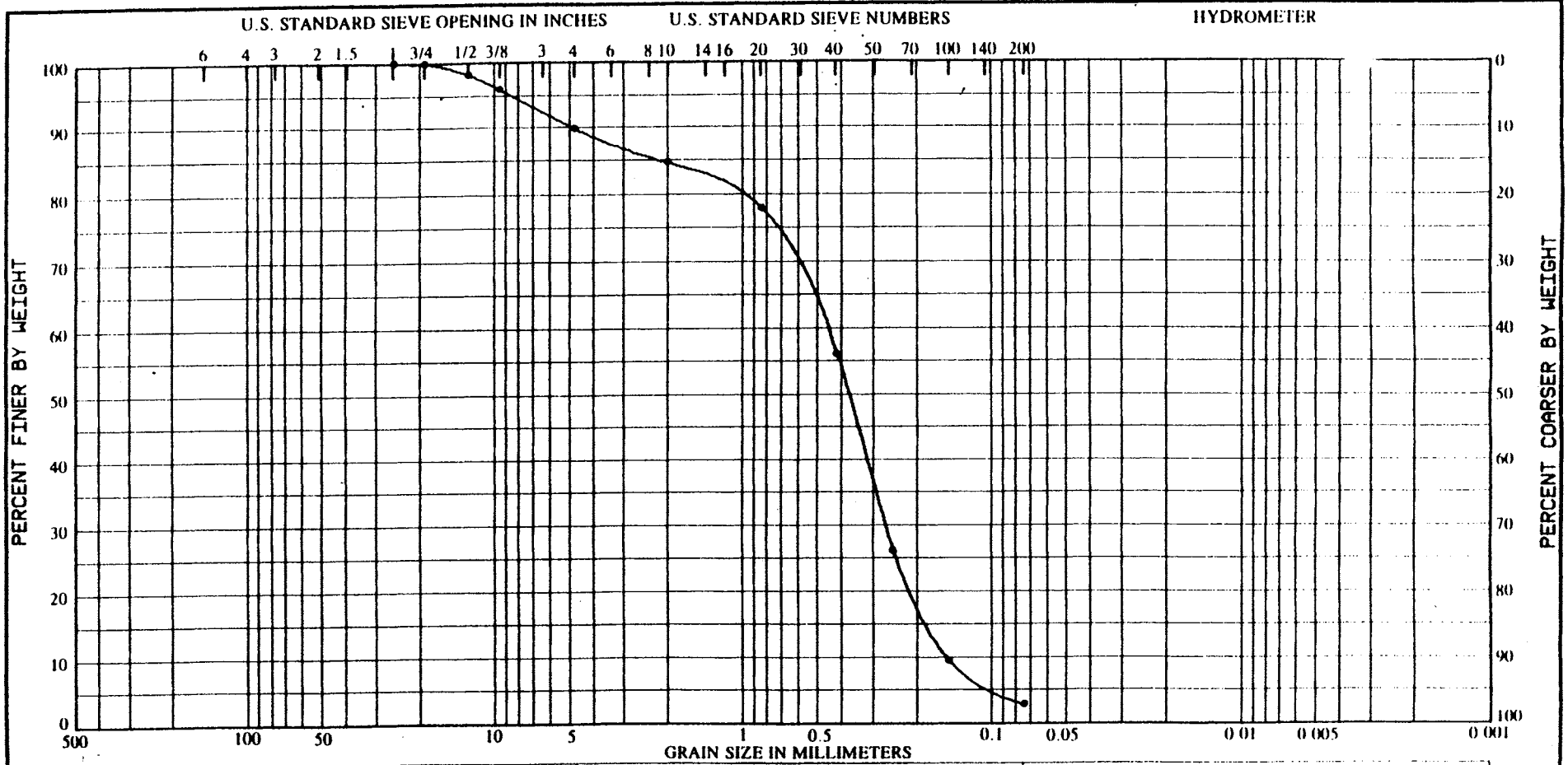
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-6.2 / -6.4'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/863B
Boring No NJV-136
Date 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-7.5 / -8.1'	(VISUAL) TAN, POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/863C
Boring No NJV-136
Date 06/13/94

GRADATION CURVES

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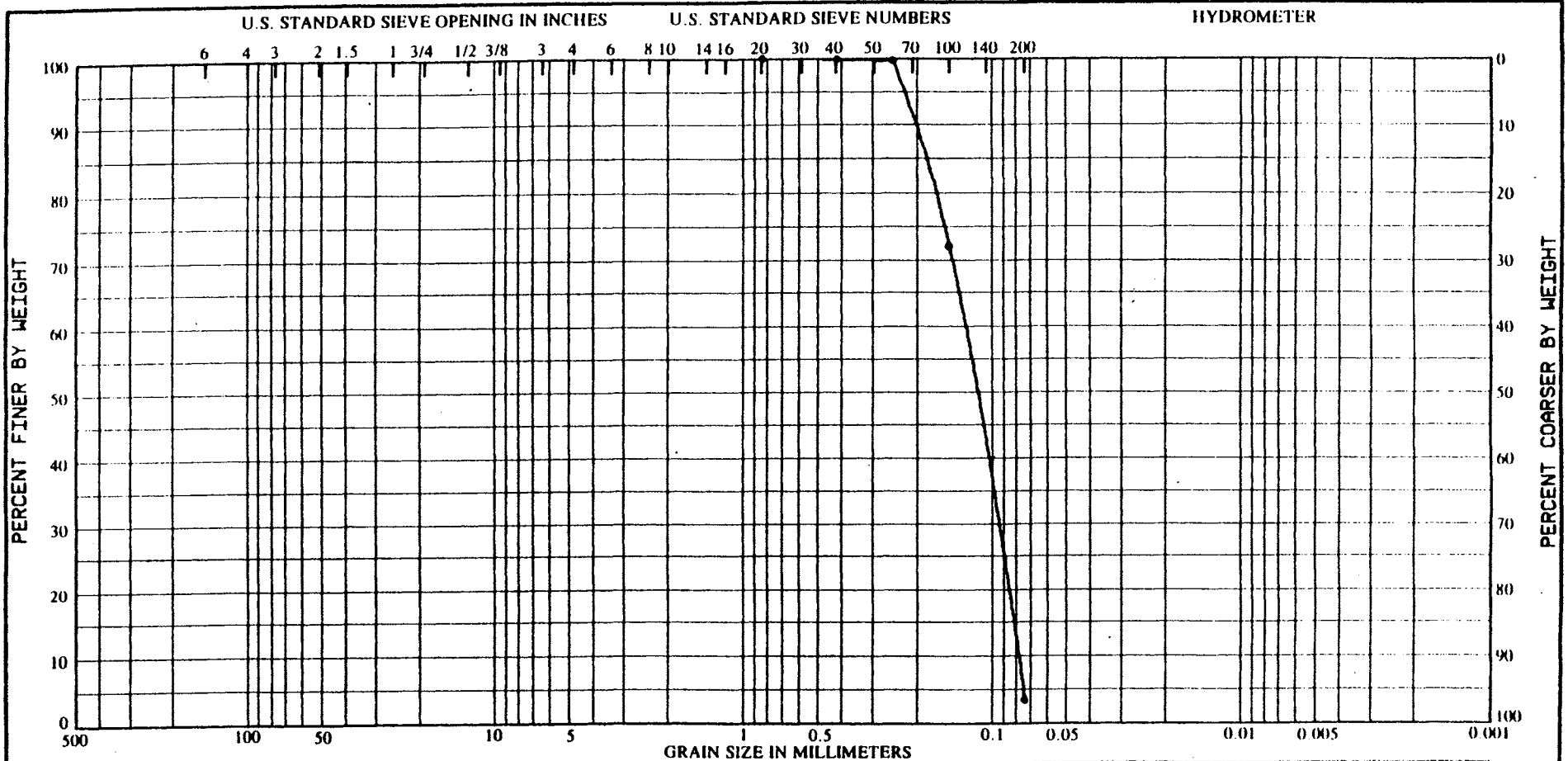
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



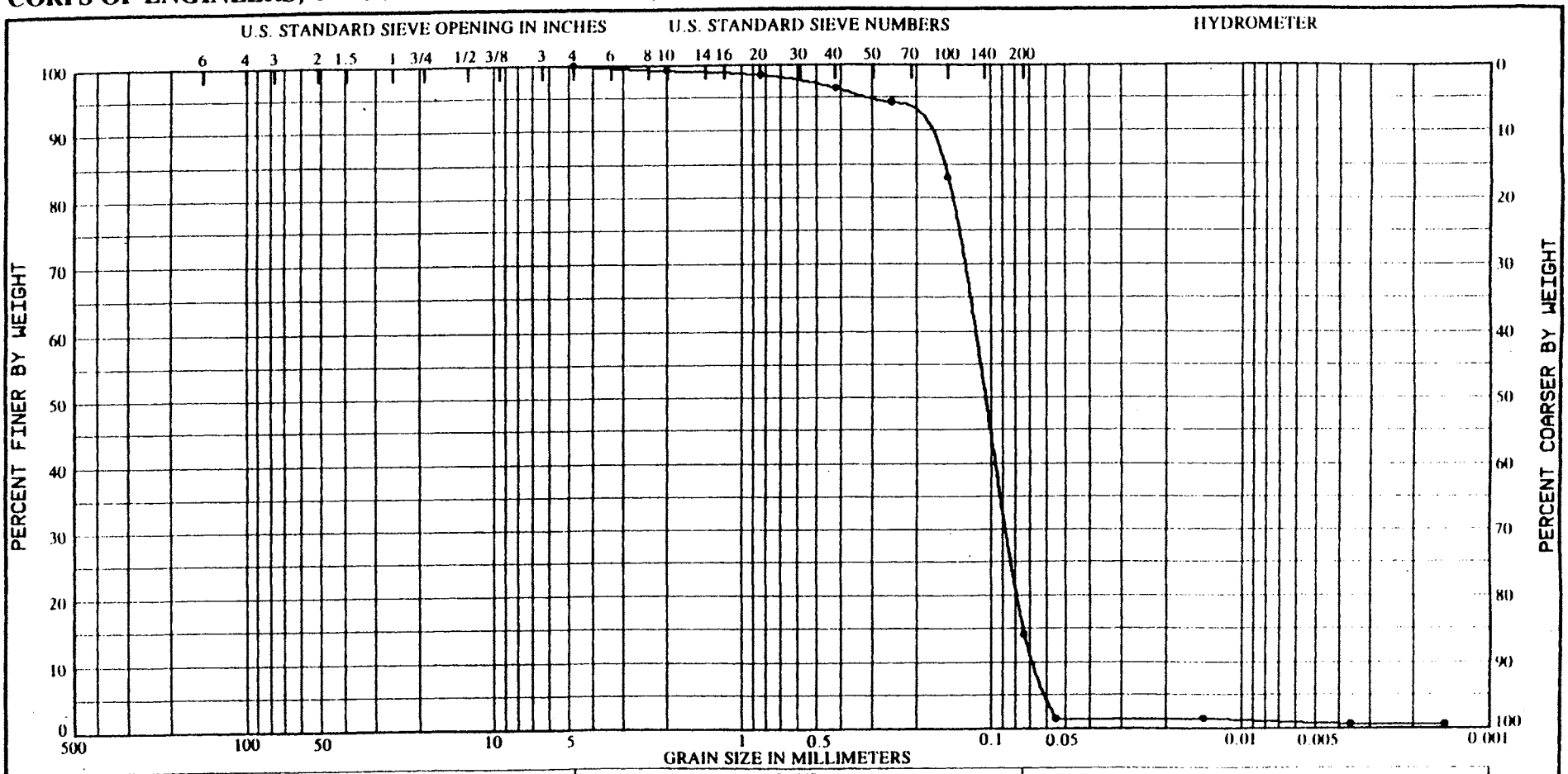
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-12.6 / -12.9'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/863E
Boring No: NJV-136
Date: 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

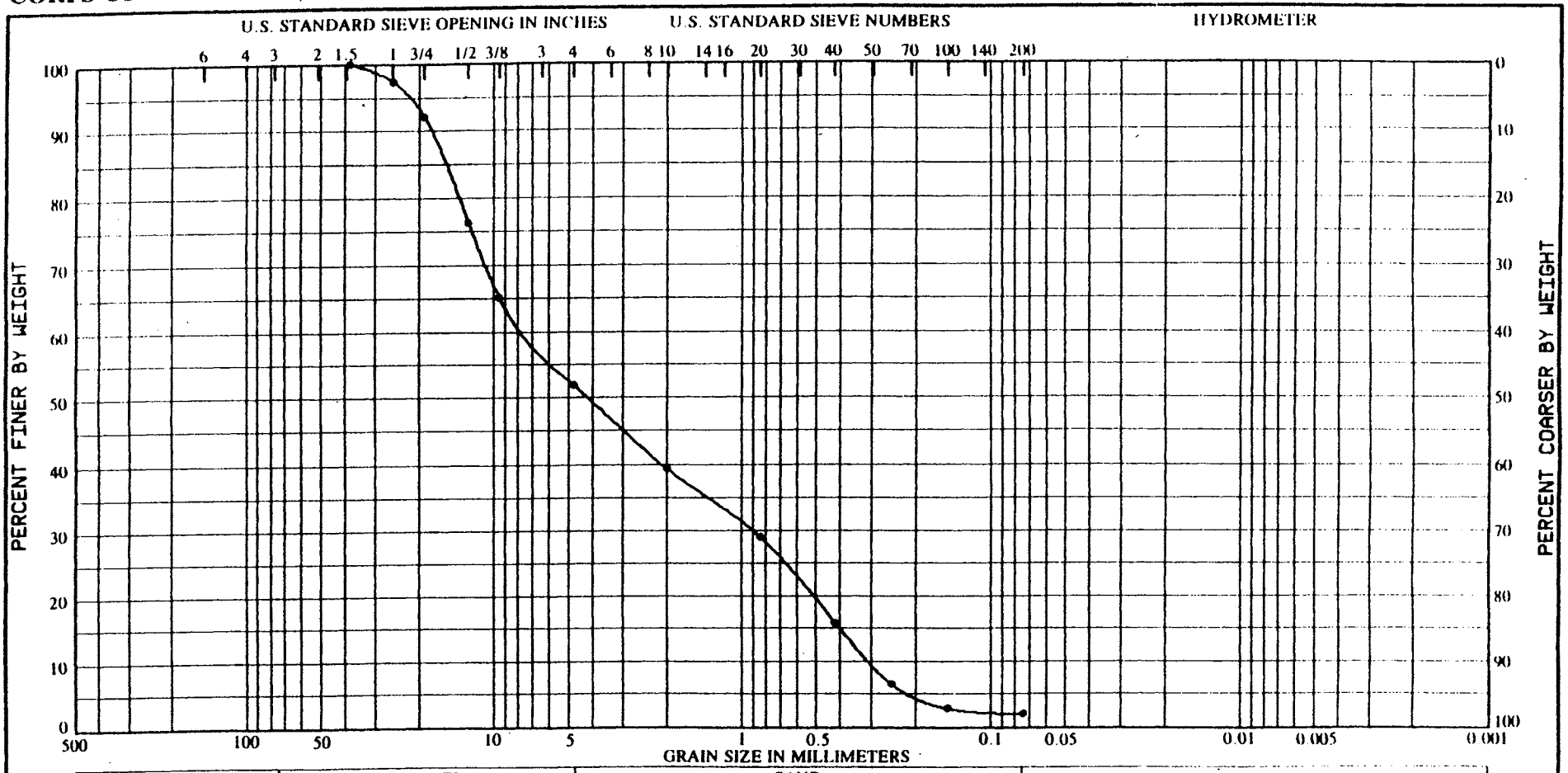
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-8.2 / -8.5'	(VISUAL) GRAY, SILTY SAND (SM), WITH A TRACE OF MICA.				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/863D
Boring No: NJV-136
Date: 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



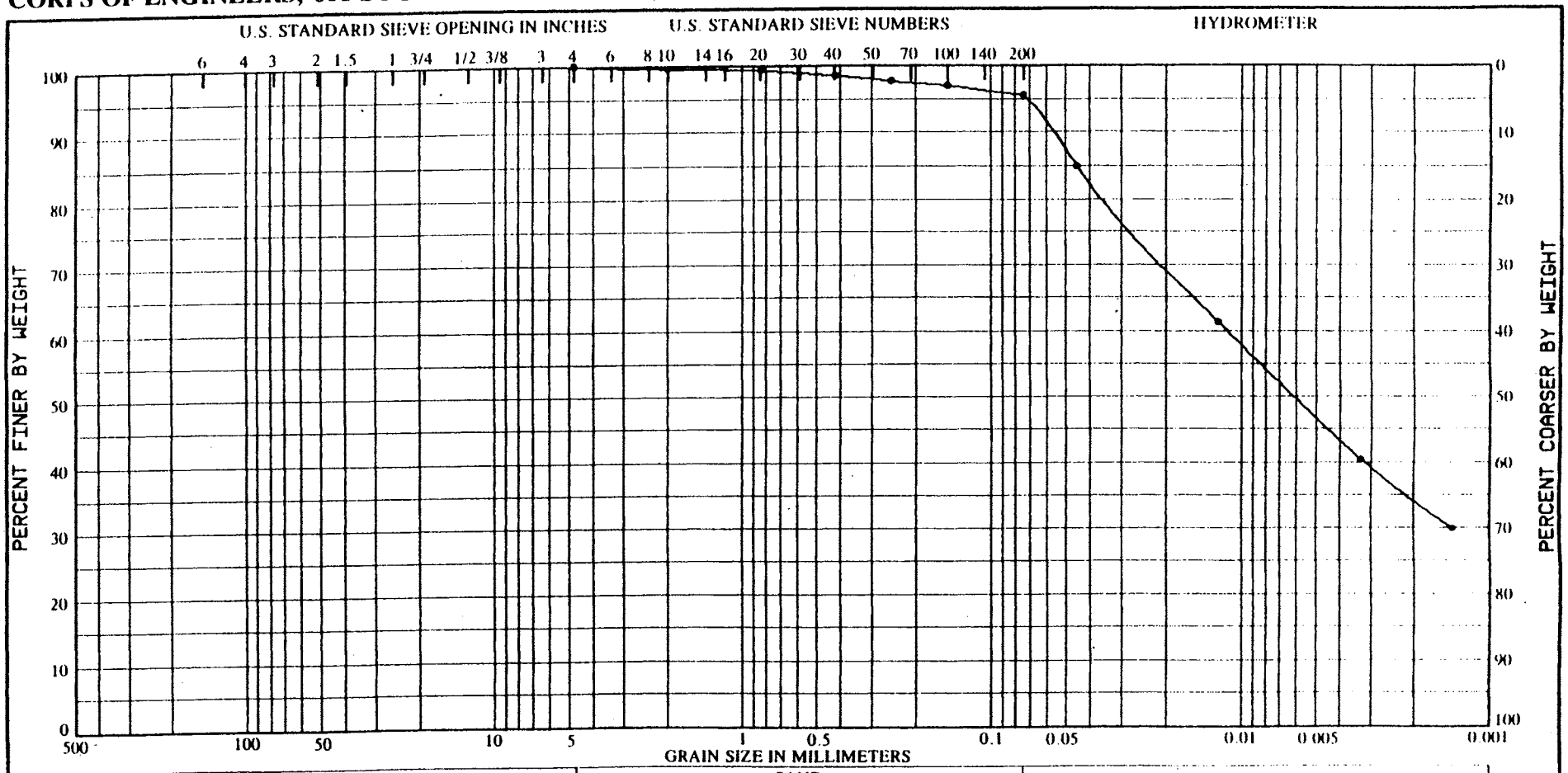
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-17.4 / -18.1'	(VISUAL) TAN, POORLY GRADED GRAVEL (GP), WITH SOME SAND SIZES.				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/864B
Boring No NJV-137
Date 07/22/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-15.1 / -15.5'	(VISUAL) DK. GRAY, FAT CLAY (CH), WITH A TRACE OF SAND SIZES AND ORGANIC MATTER.				

GRADATION CURVES

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/864A
Boring No: NJV-137
Date: 07/20/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-137*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/864*
Boring Depth (ft): *19.00*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1			
	2			
	3			
	4			
-5	5			
	6			
	7			
	8			
	9			
-10	10			
	11			
	12			
	13			
	14		----------	
-15	15		DK. GRAY, FAT CLAY (CH).	(A) MA 15.1/15.5'
	16			
	17		----------	
	18		TAN, POORLY GRADED GRAVEL (GP), WITH SOME SAND SIZES.	(B) SA 17.4/18.1'
	19		----------	
-20				

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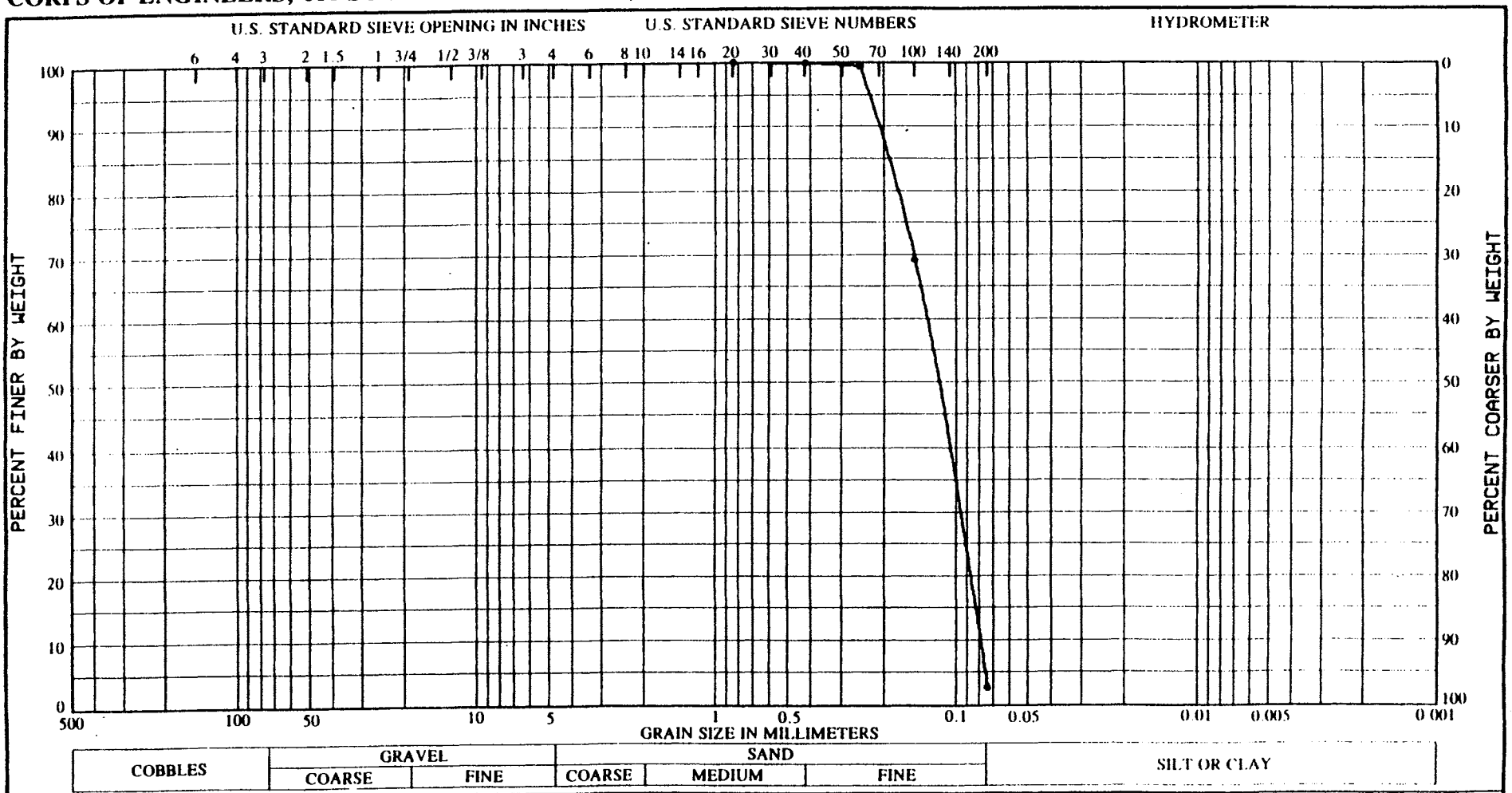
Date: *07/22/94*

LABORATORY LOG AND SAMPLE DATUM

Sheet No

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-16.3 / -16.5'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY

Lab No 184/863F

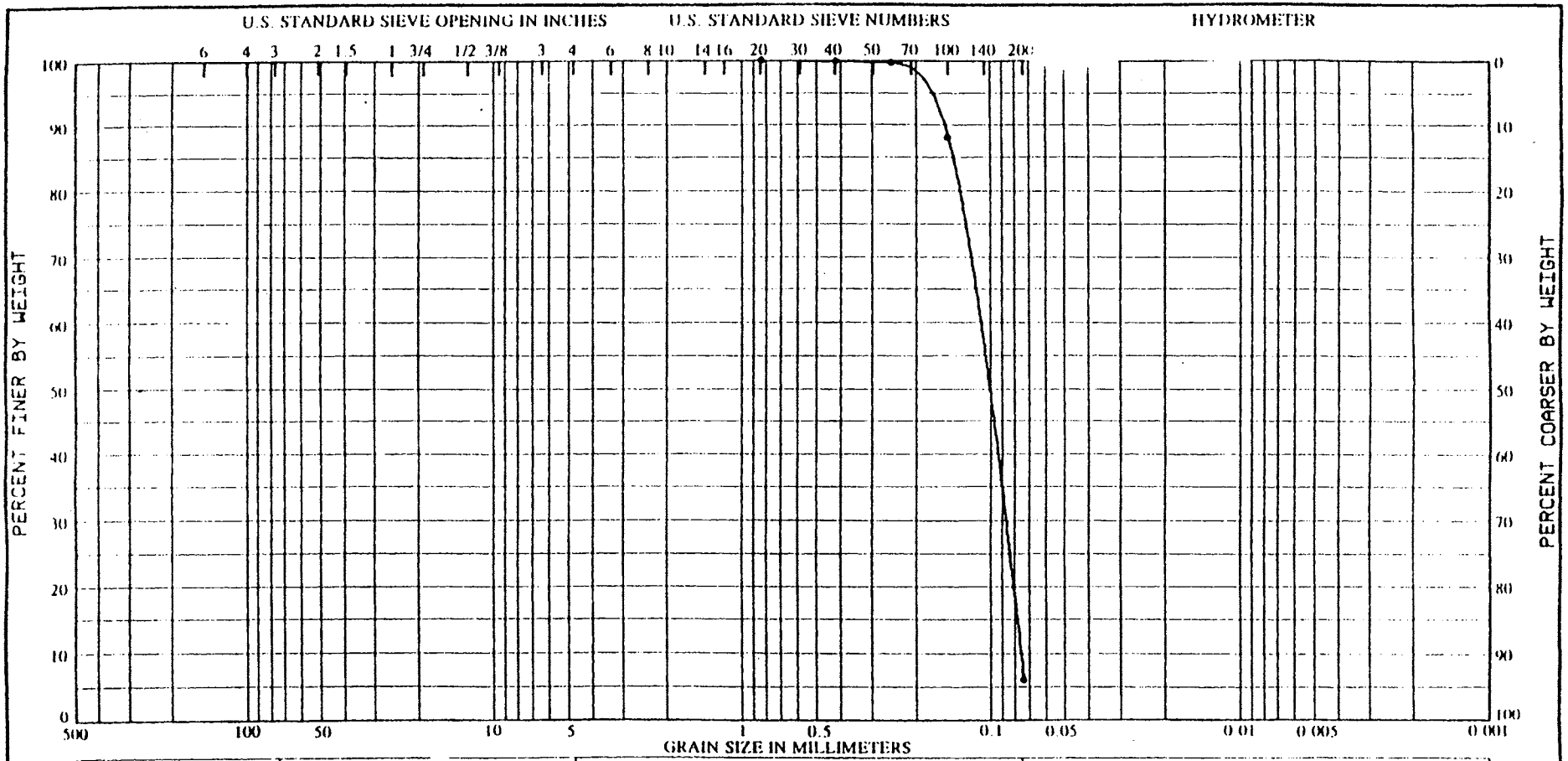
Boring No NJV-136

Date 06/13/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	L.L.	P.L.	P.I.
	-2.9 / -3.2'	(VISUAL) GRAY AND TAN, POORLY GRADED SILTY SAND (SP-SM).				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/865A
Boring No: NJV-138
Date: 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*	Boring No. *NJV-138*
Location: *OFFSHORE OF NEW JERSEY*	Lab No. *184/865*
Boring Depth (ft): *18.80* Elevation:	Work order: *7185*
Datum Notes: *See grain size data on enclosed gradation curves.*	Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Legend	Material Description	Comments
0				
	1			
	2			
	3			(A) SA 2.9/3.2'
	4			
-5	5			
	6			
	7		GRAY AND TAN, POORLY GRADED SILTY SAND (SP-SM), WITH OCCASIONAL TRACE OF SHELL FRAGMENTS AND FRAGMENTS OF 1.0/2.2'.	(B) MA 6.9/7.2'
	8			
	9			
-10	10			
	11			
	12			
	13			(C) SA 12.8/13.1'
	14			
-15	15		LT GRAY AND GRAY, LAYERED POORLY GRADED SILTY SAND (SP-SM) AND LEAN CLAY (CL).	
	16			
	17		LT. GRAY, POORLY GRADED SILTY SAND (SP-SM).	(D) SA 17.0/17.3'
	18			
	19		LT GRAY, LAYERED POORLY GRADED SILTY SAND (SP-SM), AND LEAN CLAY (CL).	
-20				

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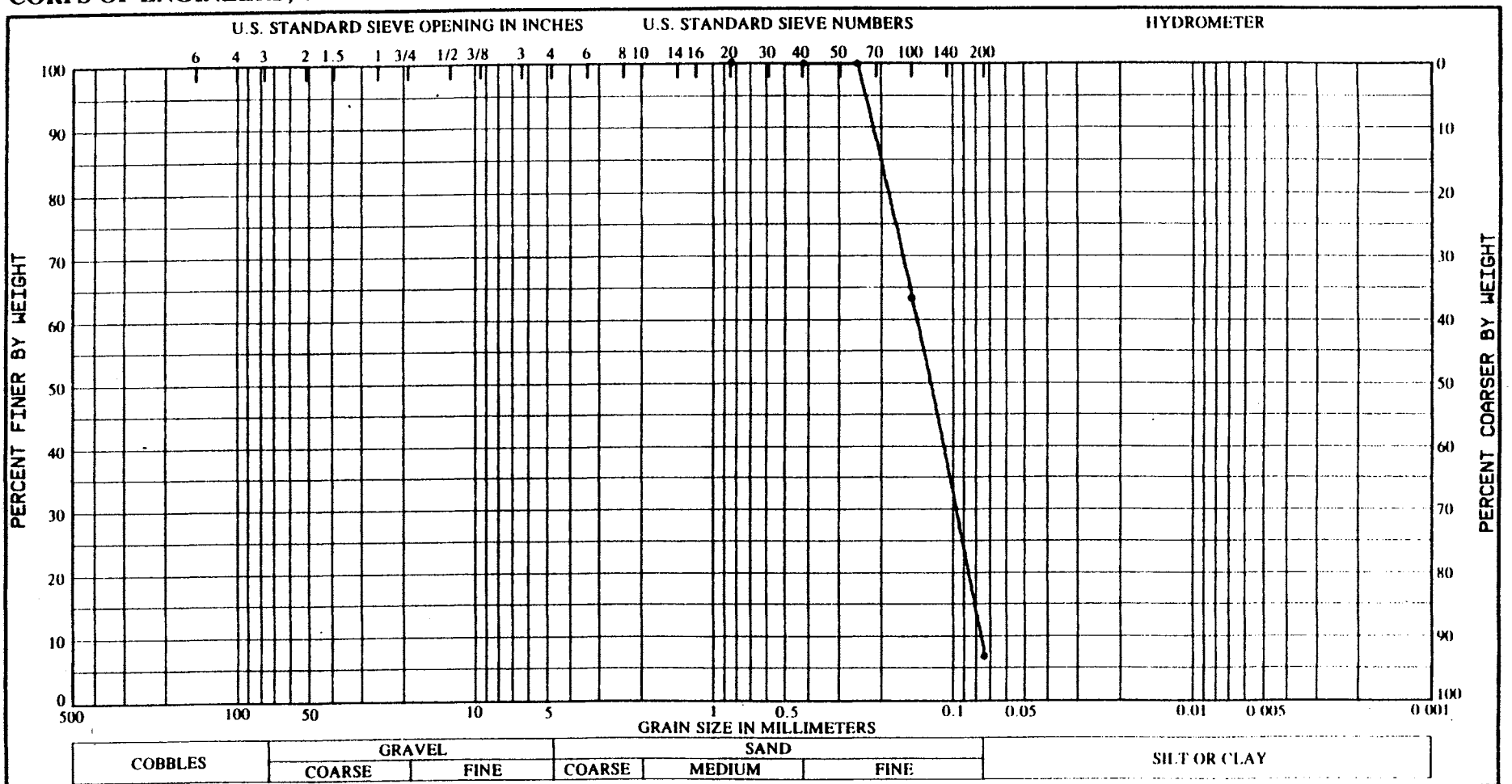
Date: 07/22/94 LABORATORY LOG AND SAMPLE DATUM Sheet No

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



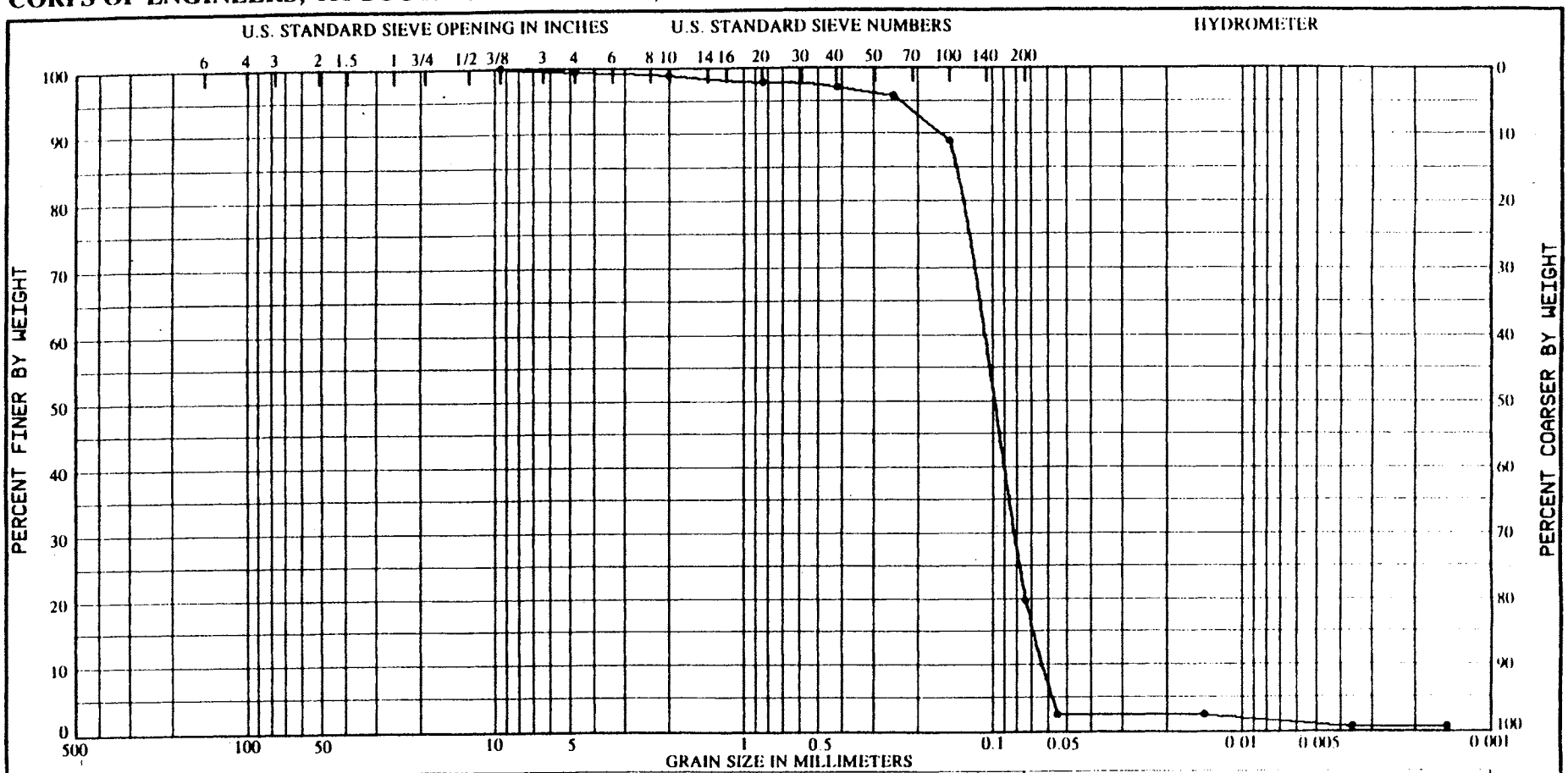
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-12.8 / -13.1'	(VISUAL) GRAY AND TAN, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/865C
Boring No NJV-138
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-6.9 / -7.2'	(VISUAL) GRAY AND TAN, SILTY SAND (SM), WITH A TRACE OF SHELL FRAGMENTS.				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/865B
Boring No NJV-138
Date 06/14/94

GRADATION CURVES

9h

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-139*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/866*
Boring Depth (ft): *16.40*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1		TAN, POORLY GRADED SAND (SP).	(A) SA 1.3/1.6'
	2			
	3		GRAY, POORLY GRADED SILTY SAND (SP-SM).	
	4			
-5	5		GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL FRAGMENTS.	(B) SA 5.1/5.4'
	6			
	7		GRAY, SILTY SAND (SM), WITH PLASTIC FINES.	(C) MA 6.4/6.7'
	8		GRAY, POORLY GRADED SILTY SAND (SP-SM).	
	9			(D) SA 9.0/9.3'
-10	10		TAN, POORLY GRADED SAND (SP).	
	11			
	12		GRAY, POORLY GRADED SILTY SAND (SP-SM).	(E) MA 12.0/12.3'
	13			(F) SA 13.3/13.6'
	14		TAN, POORLY GRADED SAND (SP), WITH 14.2'.	
-15	15			(G) MA 15.1/15.4'
	16		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH TRACE OF SHELL FRAGMENTS BOTTOM 0.4' OF SAMPLE.	
	17			
	18			
	19			
-20				

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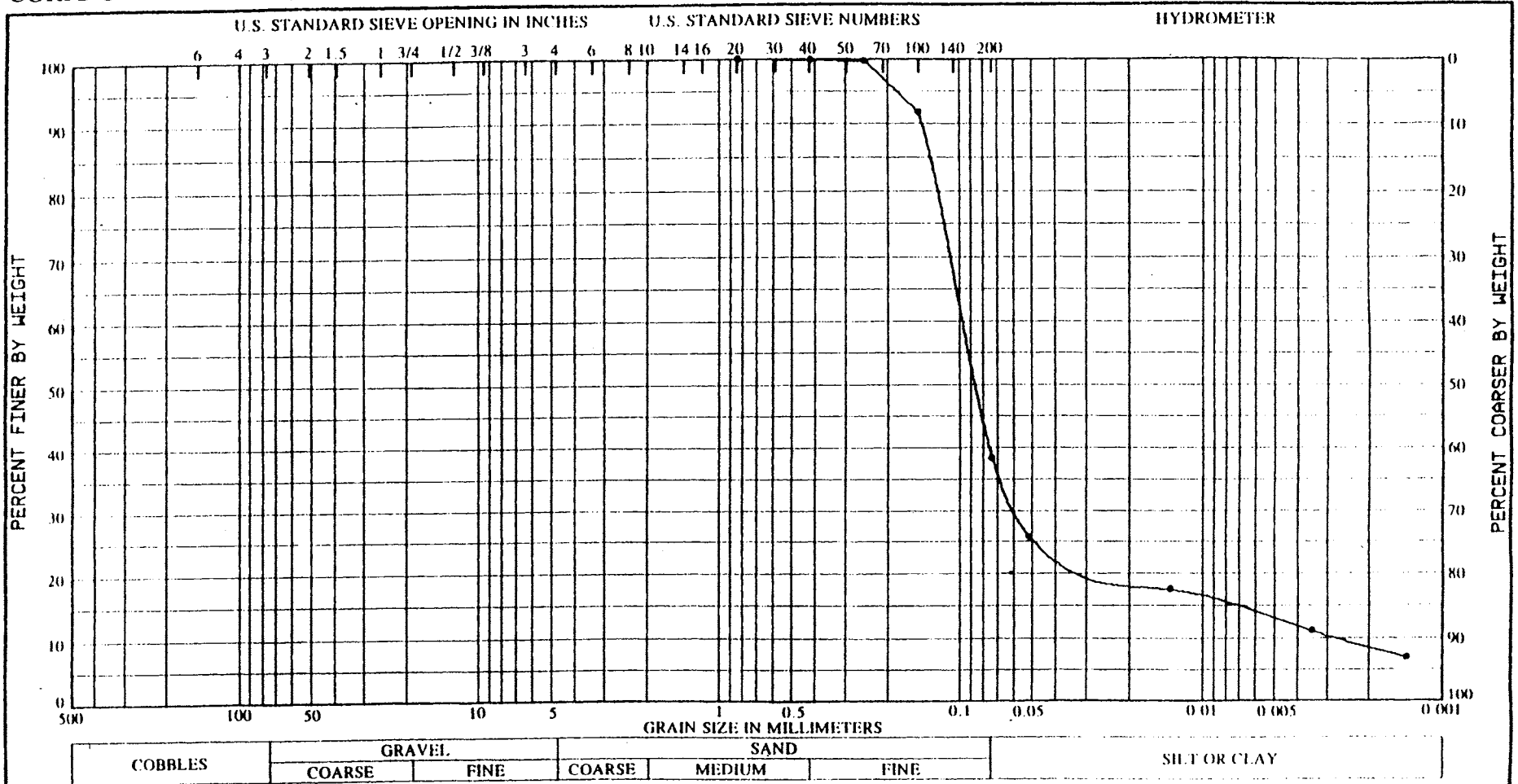
Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



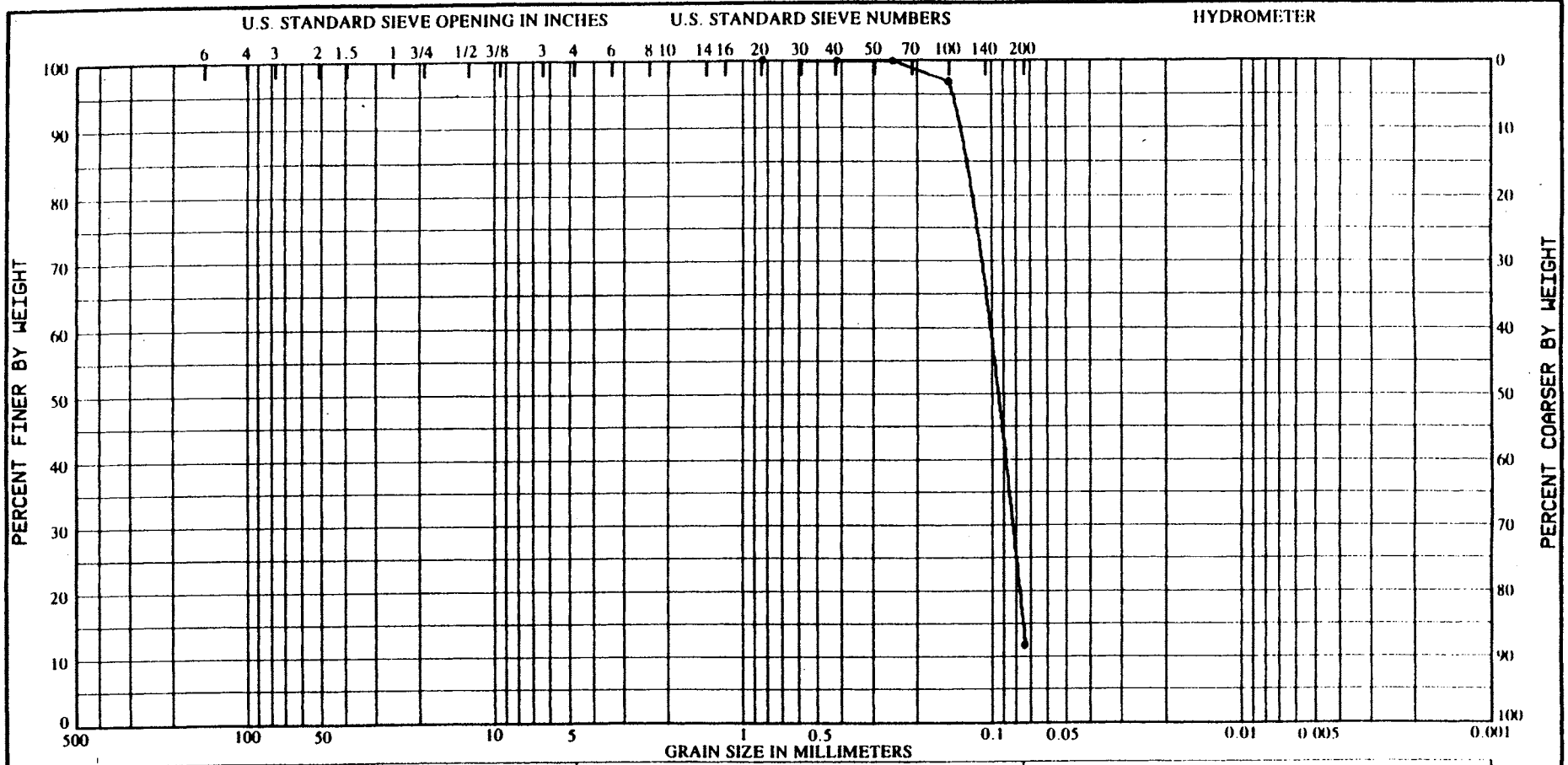
Sample No	Elev.	Classification	Nat w%	LL	PL	PI
	-17.0 / -17.3'	(VISUAL) LT. GRAY, SILTY SAND (SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/865D
Boring No NJV-138
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



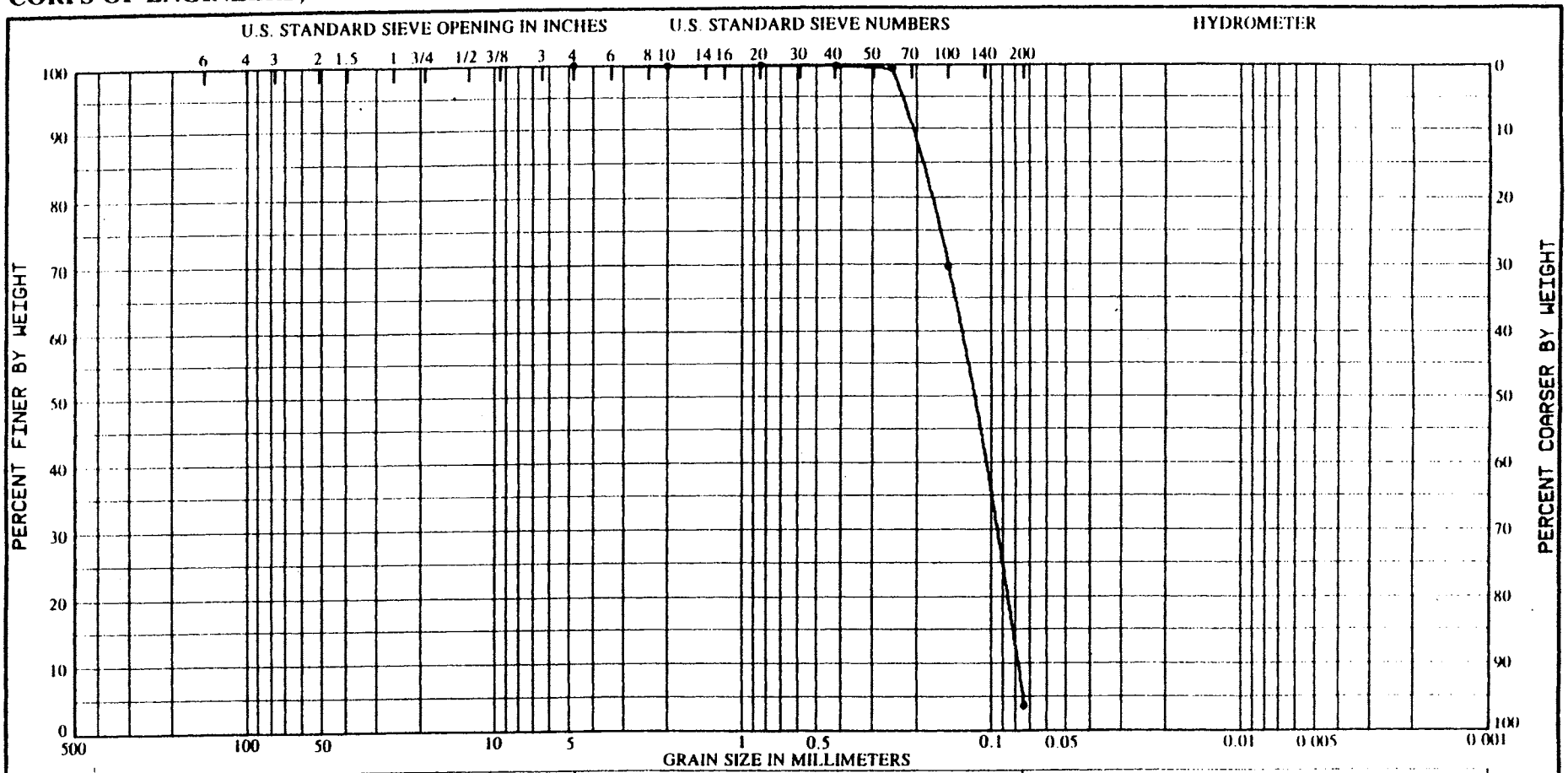
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-5.1 / -5.4'	(VISUAL) GRAY, POORLY GRADED SILTY SAND				
		(SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No. 184/866B
Boring No. NJV-139
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

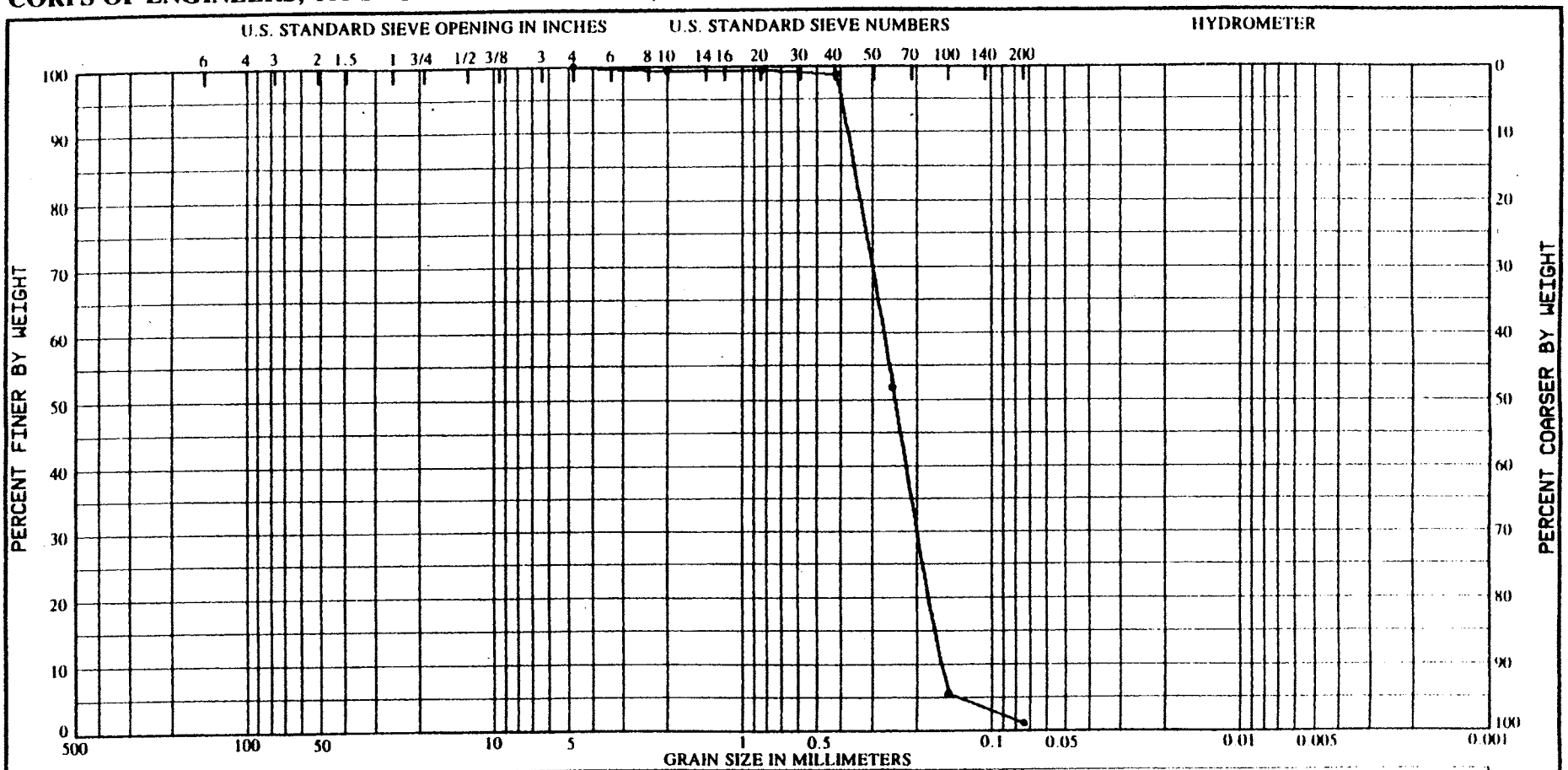
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-1.3 / -1.6'	(VISUAL) TAN, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/866A
Boring No NJV-139
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-9.0 / -9.3'	(VISUAL) TAN, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/866D
Boring No NJV-139
Date 06/14/94

GRADATION CURVES

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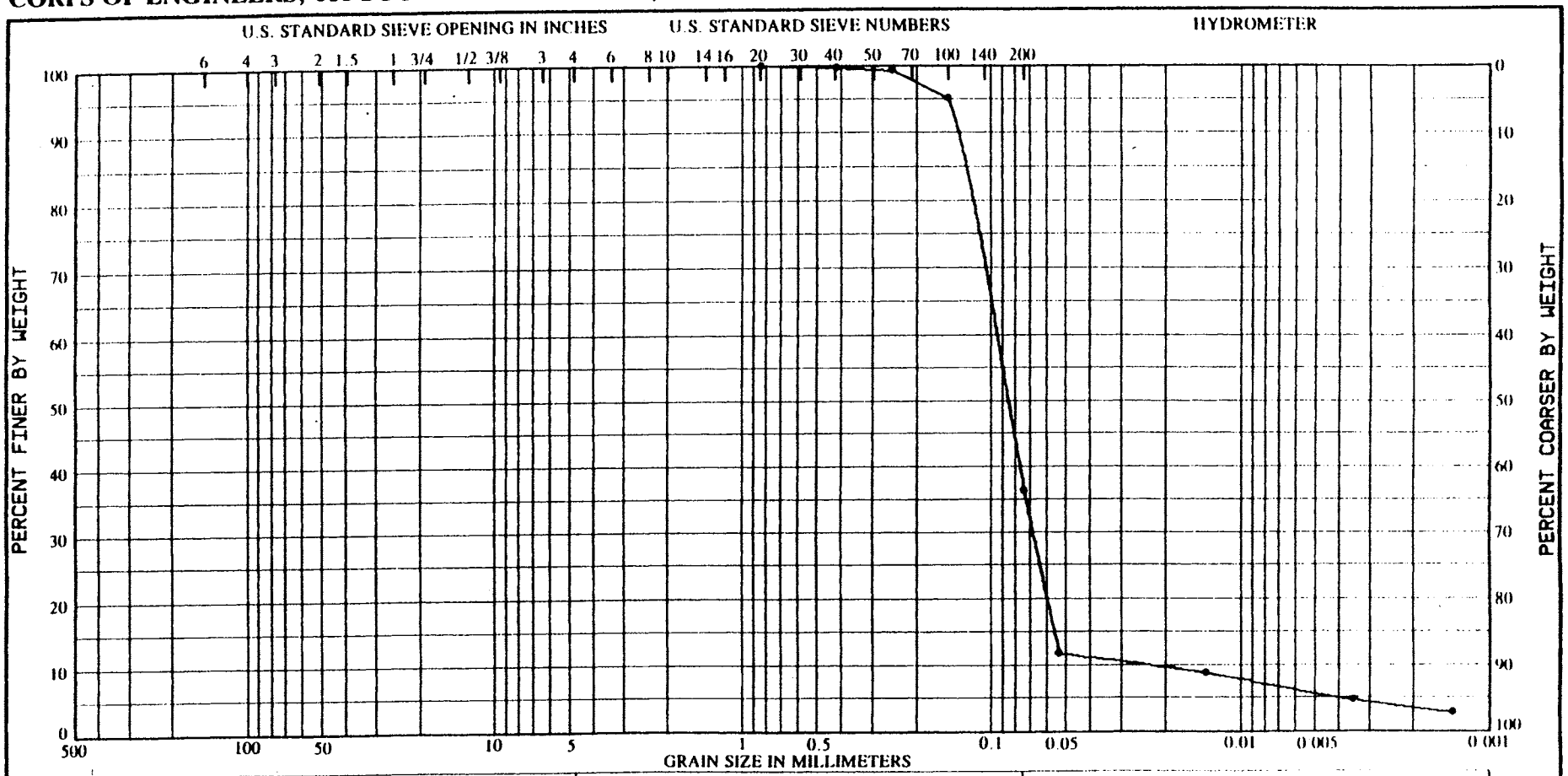
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

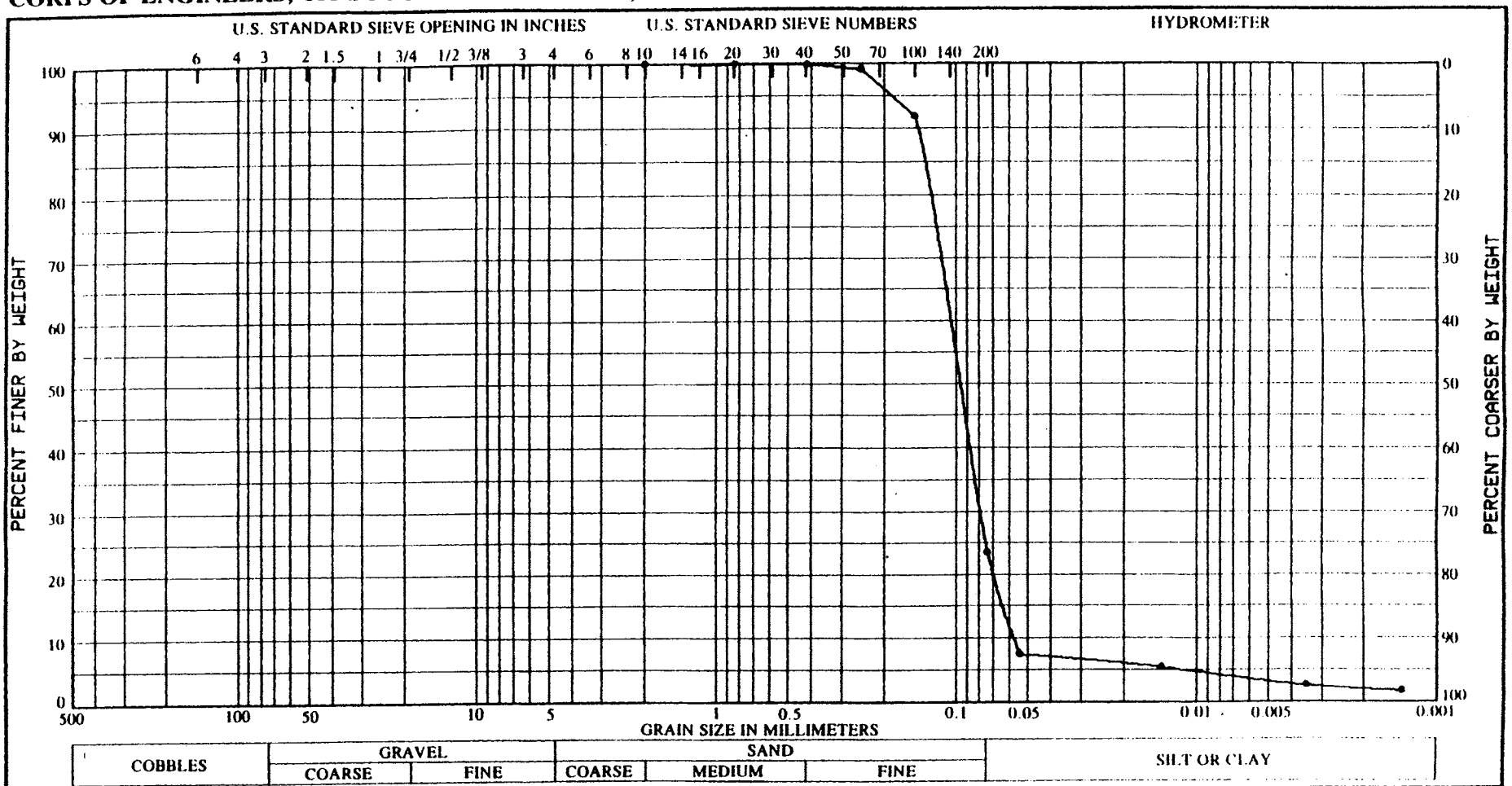
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-6.4 / -6.7'	(VISUAL) GRAY, SILTY SAND (SM), WITH A TRACE OF MICA.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/866C
Boring No NJV-139
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

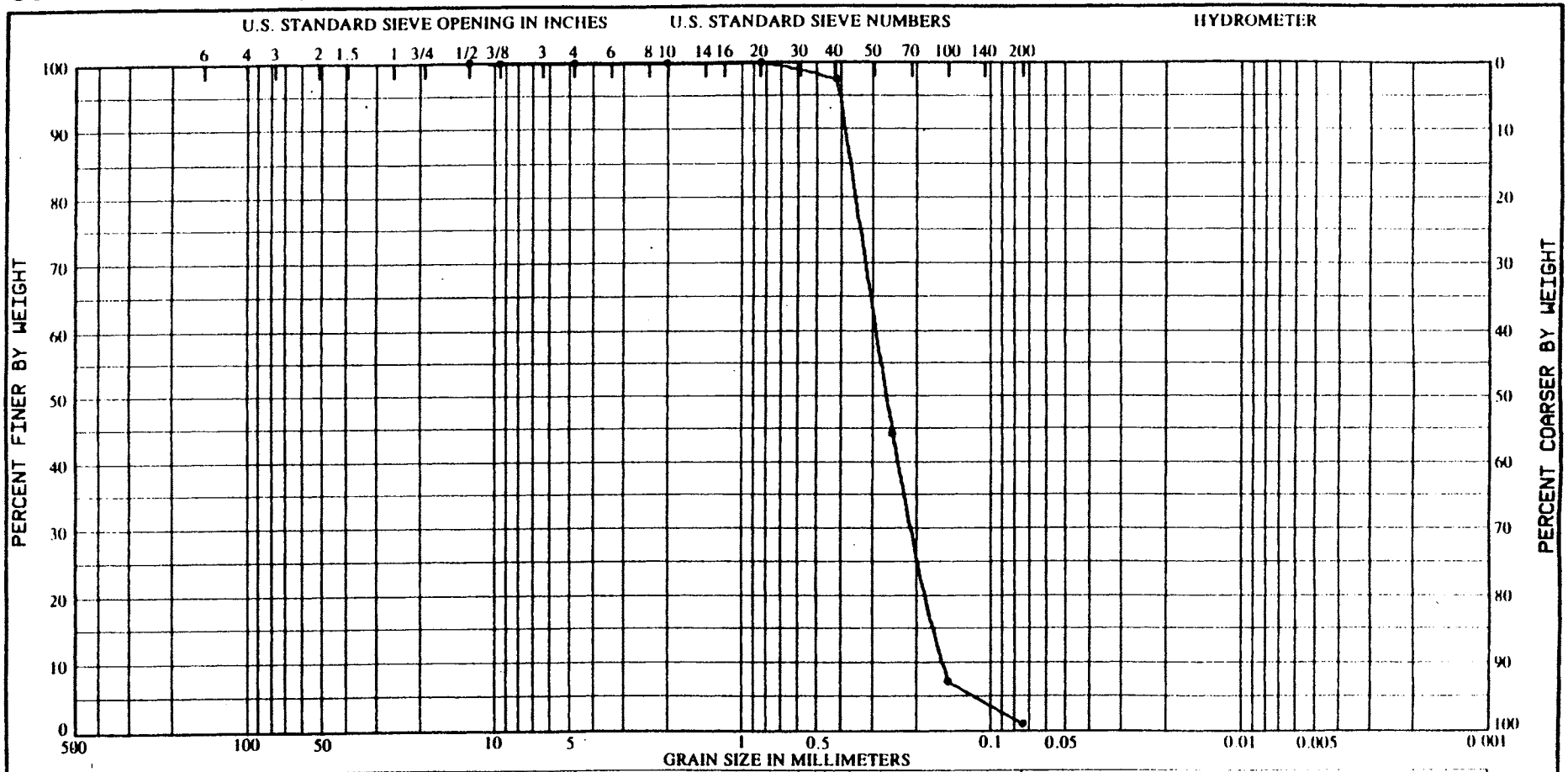
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-12.0 / -12.3'	(VISUAL) GRAY, SILTY SAND (SM), WITH A TRACE OF MICA.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/866E
Boring No NJV-139
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-13.3 / -13.6'	(VISUAL) TAN, POORLY GRADED SAND (SP).				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No. 184/866F
Boring No. NJV-139
Date 06/14/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-140*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/867*
Boring Depth (ft): *13.50*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1		TAN, POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL SIZE SHELL FRAGMENTS AND ORGANIC MATTER.	(A) SA 0.8/1.3'
	2			
	3		LT. GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL FRAGMENTS.	(B) SA 3.3/3.6'
	4			
-5	5		POCKET OF BLACK, ORGANIC MATTER.	
	6			
	7			
	8		TAN AND GRAY, POORLY GRADED SAND (SP) TO POORLY GRADED SILTY SAND (SP-SM), WITH POCKET OF SHELL FRAGMENTS AT 7.1/7.3'.	(C) SA 8.0/8.3'
	9			
-10	10			
	11		TAN, POORLY GRADED SAND (SP), WITH SOME GRAVEL SIZES.	(D) SA 10.2/10.6'
	12			(E) SA 11.8/12.3'
	13		LT. GRAY AND TAN, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL +2" SIZES AND A TRACE OF GRAVEL.	
	14			
-15	15			
	16			
	17			
	18			
	19			
-20				

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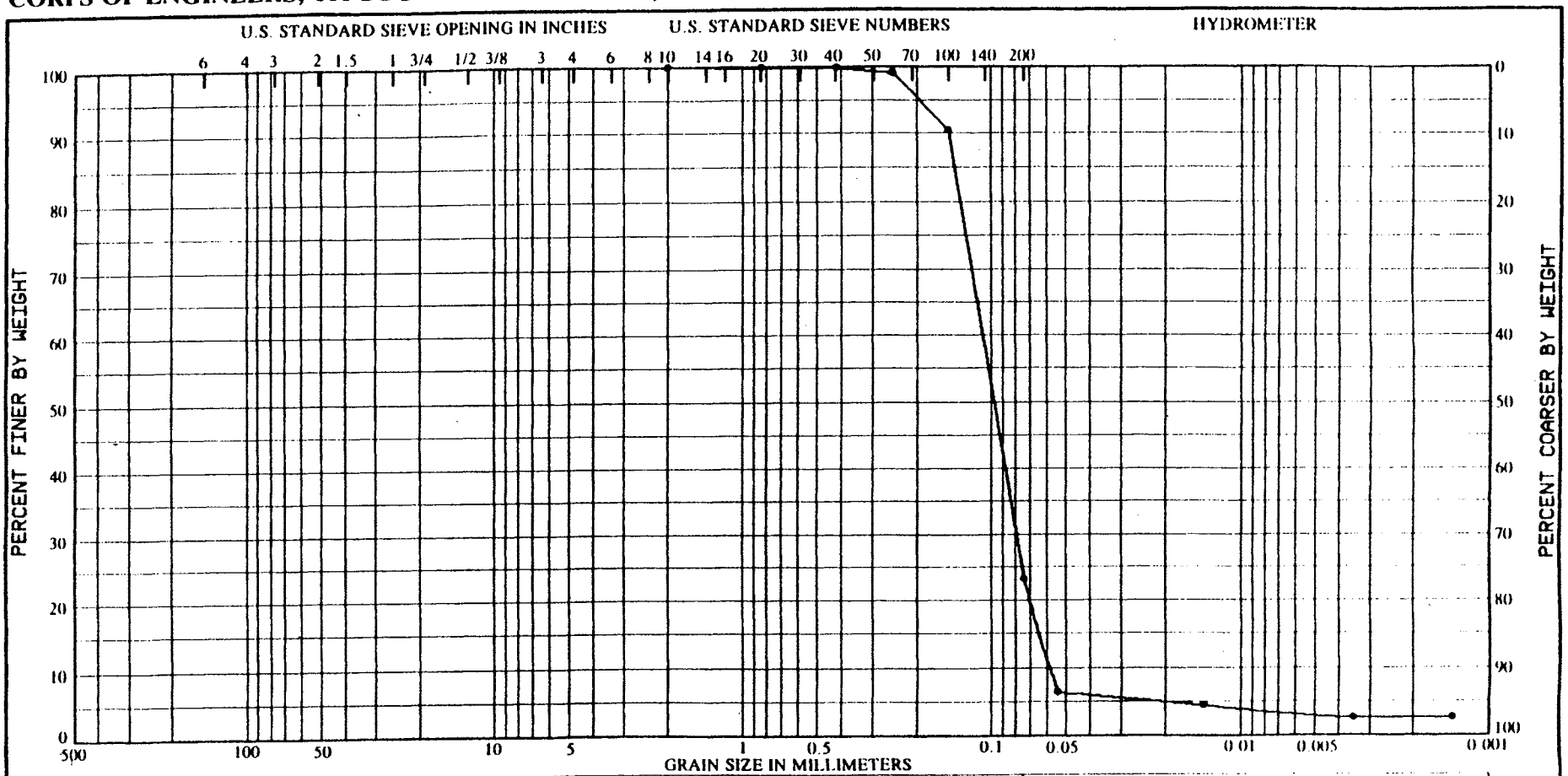
Date: *07/22/94*

LABORATORY LOG AND SAMPLE DATUM

Sheet 1 of 1

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

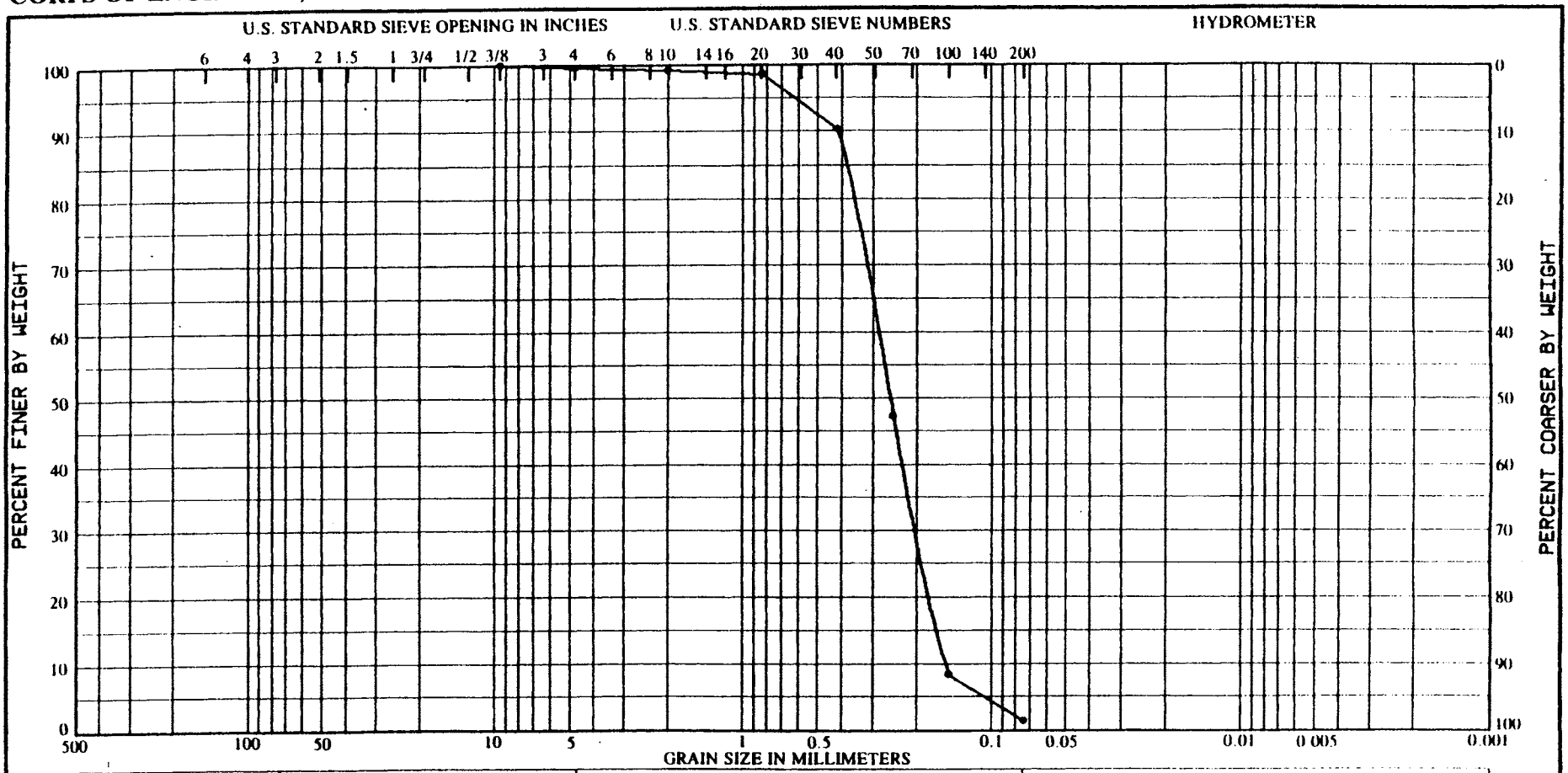
Sample No.	Elev.	Classification	Nat w%	L.L.	P.I.	PI
	-15.1 / -15.4'	(VISUAL) GRAY, SILTY SAND (SM).				

Project: VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No: 184/866G
Boring No: NJV-139
Date: 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PI.	PI
	-3.3 / -3.6'	(VISUAL) LT. GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/8678
Boring No NJV-140
Date 06/14/94

GRADATION CURVES

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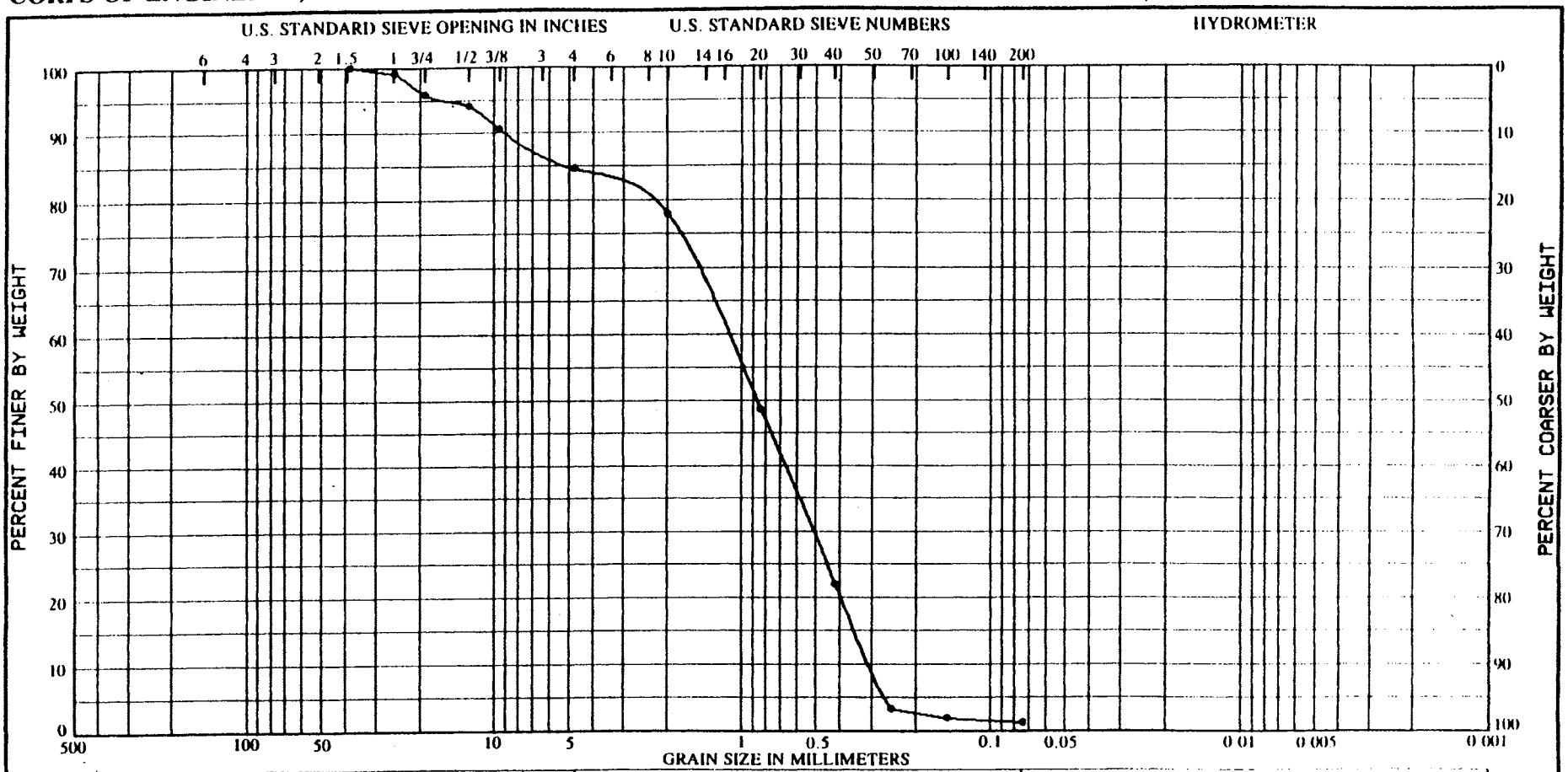
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



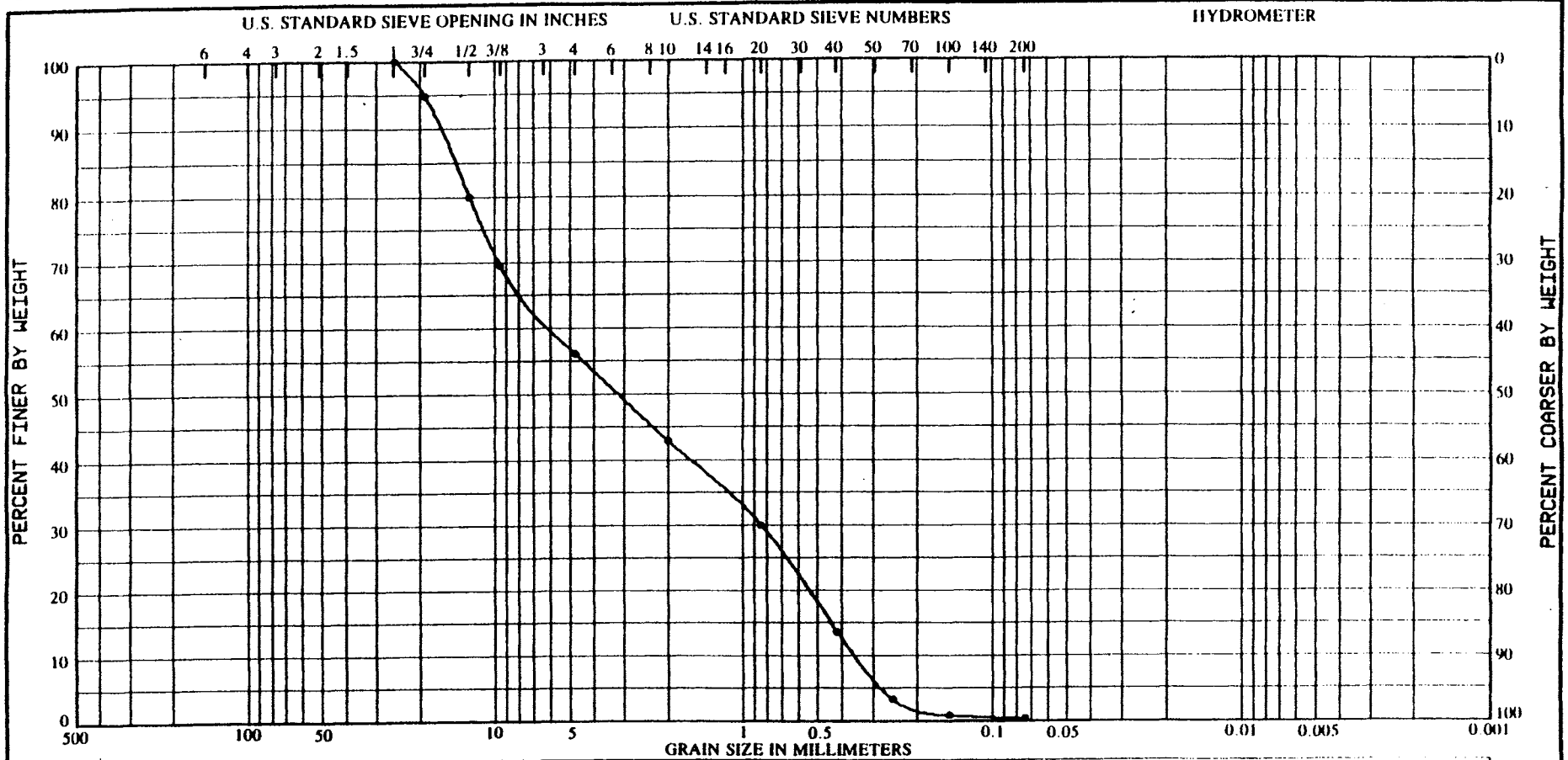
Sample No.	Elev.	Classification	Nat w%	LL	PI	PI
	-0.8 / -1.3'	(VISUAL) TAN, POORLY GRADED SAND (SP),				
		WITH A LITTLE GRAVEL SIZE SHELL.				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/867A
Boring No NJV-140
Date 06/14/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-10.2 / -10.6'	(VISUAL) TAN, GRAVELY POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/867D
Boring No NJV-140
Date 06/14/94

GRADATION CURVES

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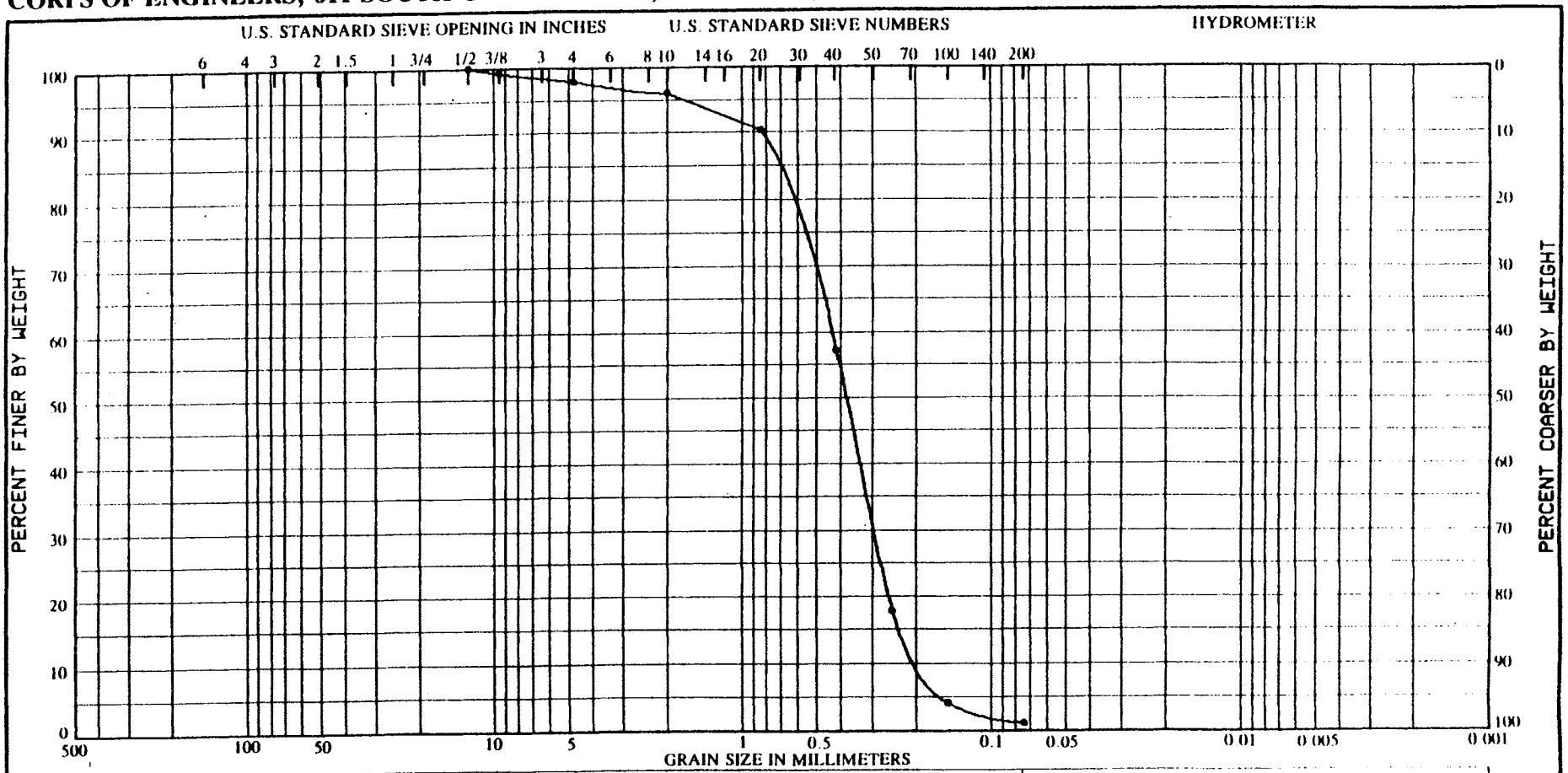
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

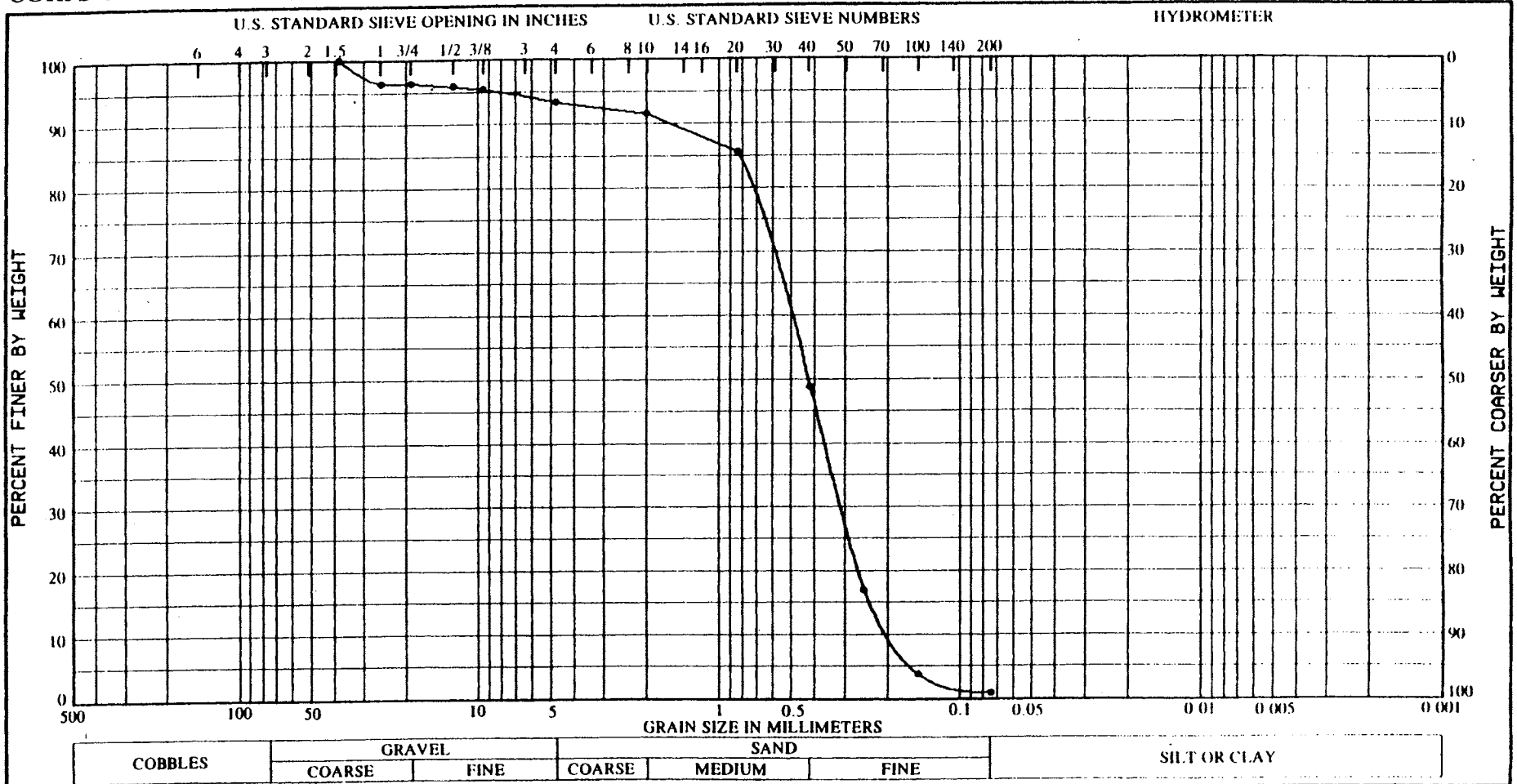
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-8.0 / -8.3'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/867C
Boring No NJV-140
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-11.8 / -12.3'	(VISUAL) LT. GRAY AND TAN, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/867E
Boring No NJV-140
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-143*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/868*
Boring Depth (ft): *18.50*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1			(A) SA 1.2/1.8'
	2			(B) SA 2.1/2.3'
	3			
	4		TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF SHELL FRAGMENTS TO 1.5" AT 0.6/2.0'.	
-5	5			
	6			
	7			
	8		----------	
	9			
-10	10			
	11		TAN AND GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL FRAGMENTS.	(C) SA 11.0/11.4'
	12			
	13			
	14		----------	
-15	15			(D) SA 15.0/15.8'
	16		TAN, GRAVELLY POORLY GRADED SAND (SP).	
	17		----------	(E) MA 17.0/17.2'
	18		GRAY, INORGANIC SILT LOW LL (ML).	
	19		----------	
-20				

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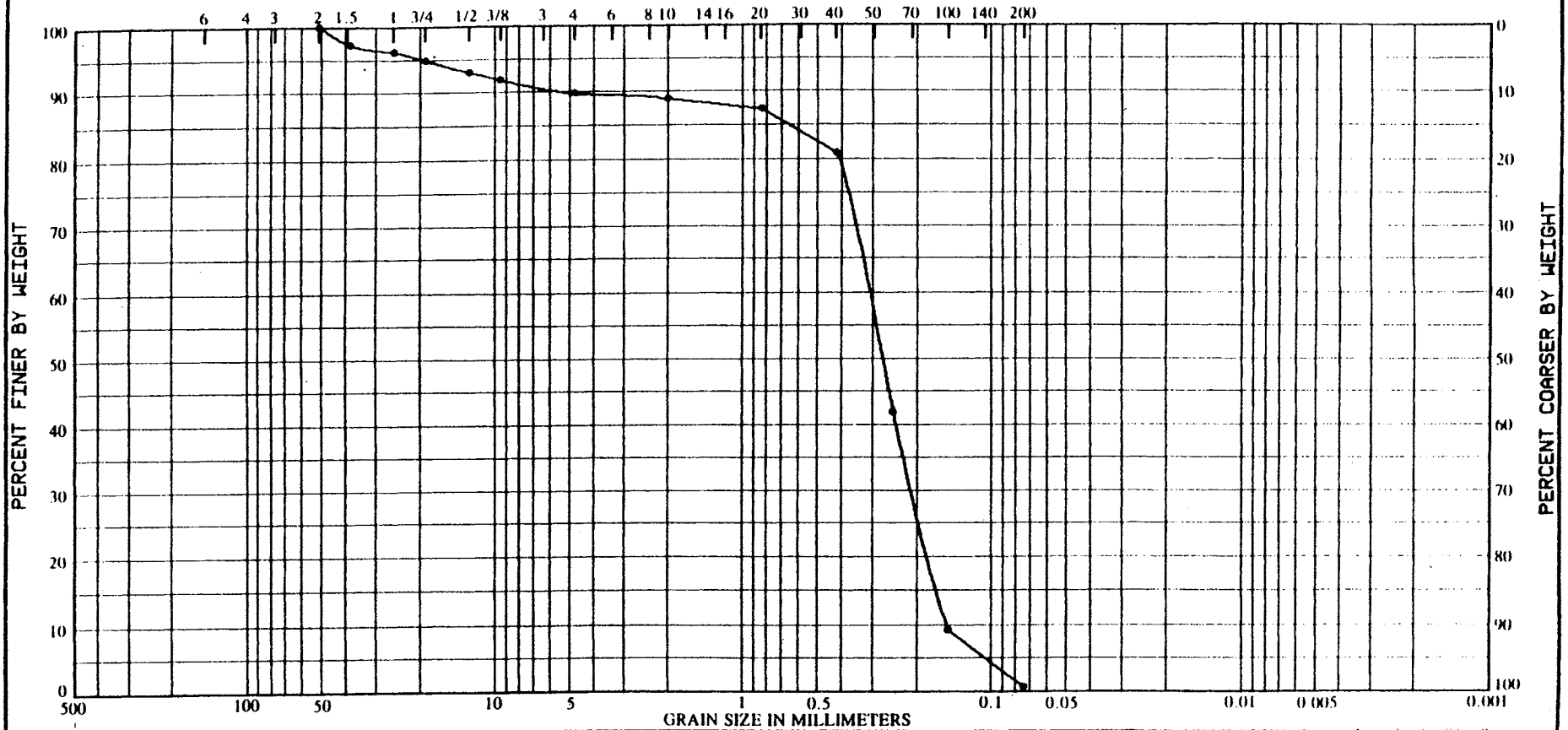
Date: *07/22/94* **LABORATORY LOG AND SAMPLE DATUM** Sheet No. of

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	L.L.	P.L.	P.I.
	-1.2 / -1.8'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/868A
Boring No NJV-143
Date 06/14/94

GRADATION CURVES

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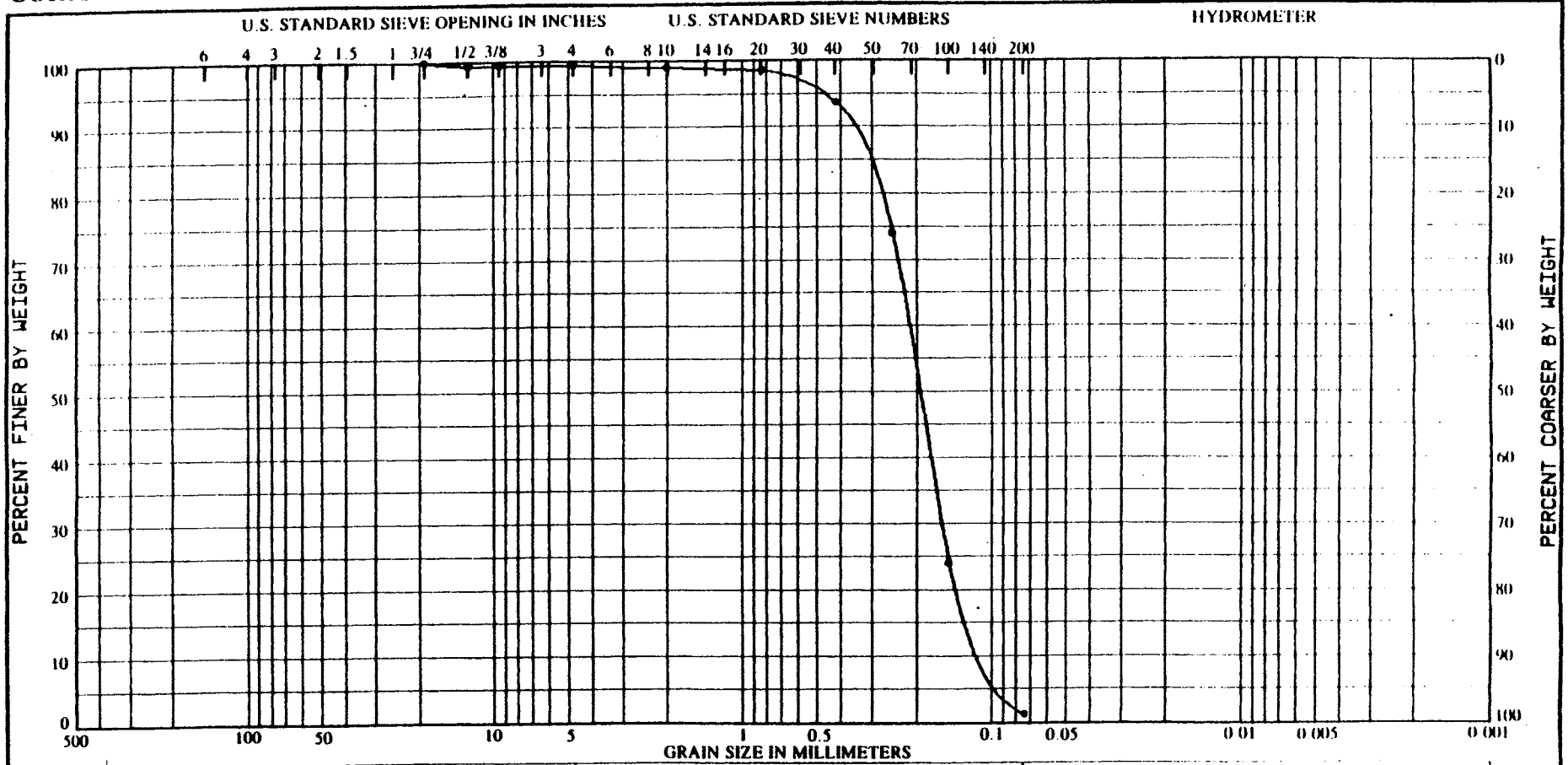
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



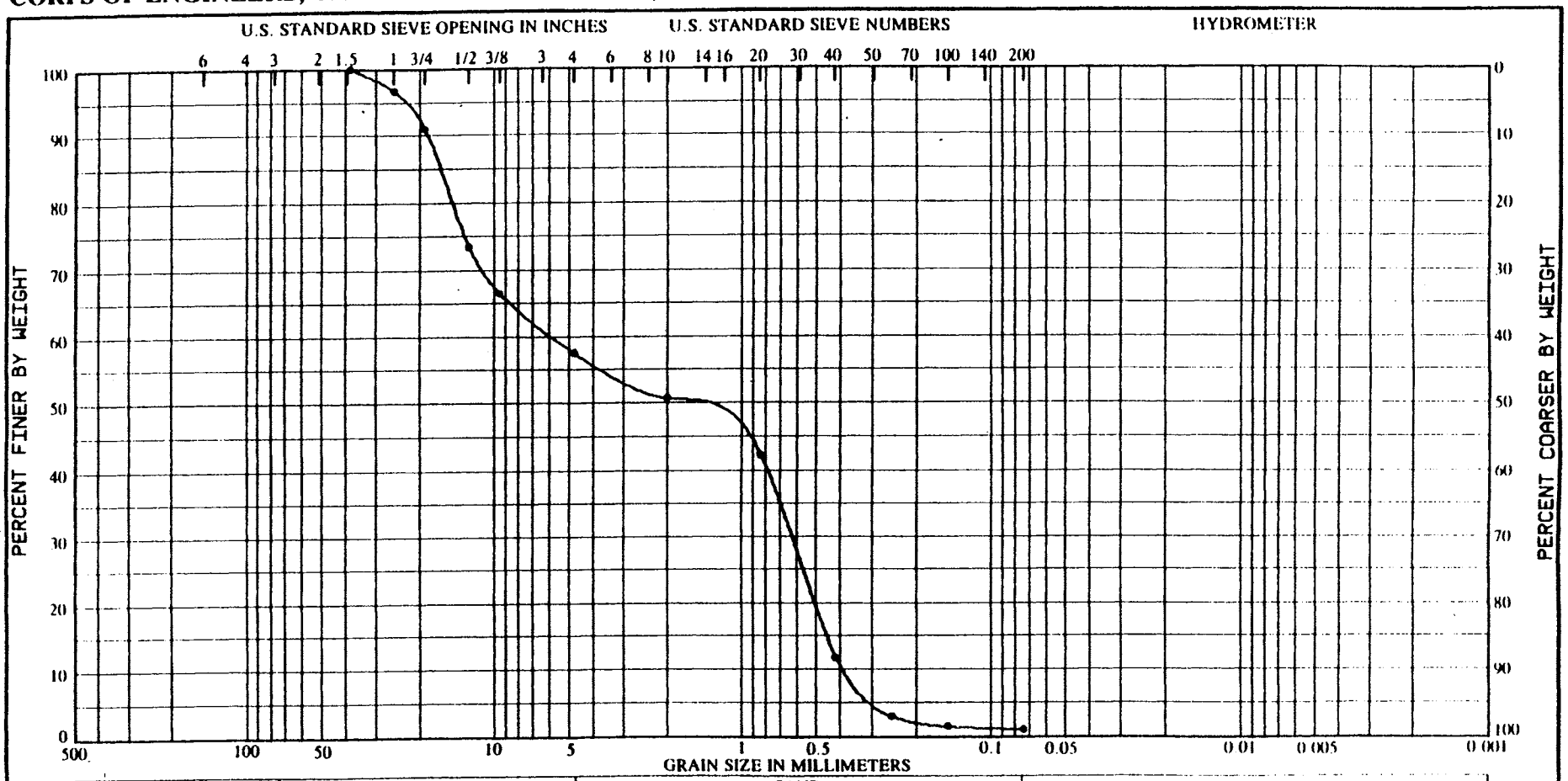
Sample No.	Elev.	Classification	Nat w%	L.L.	PL	PI
	-2.1 / -2.3'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL FRAGMENTS.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/868B
Boring No NJV-143
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



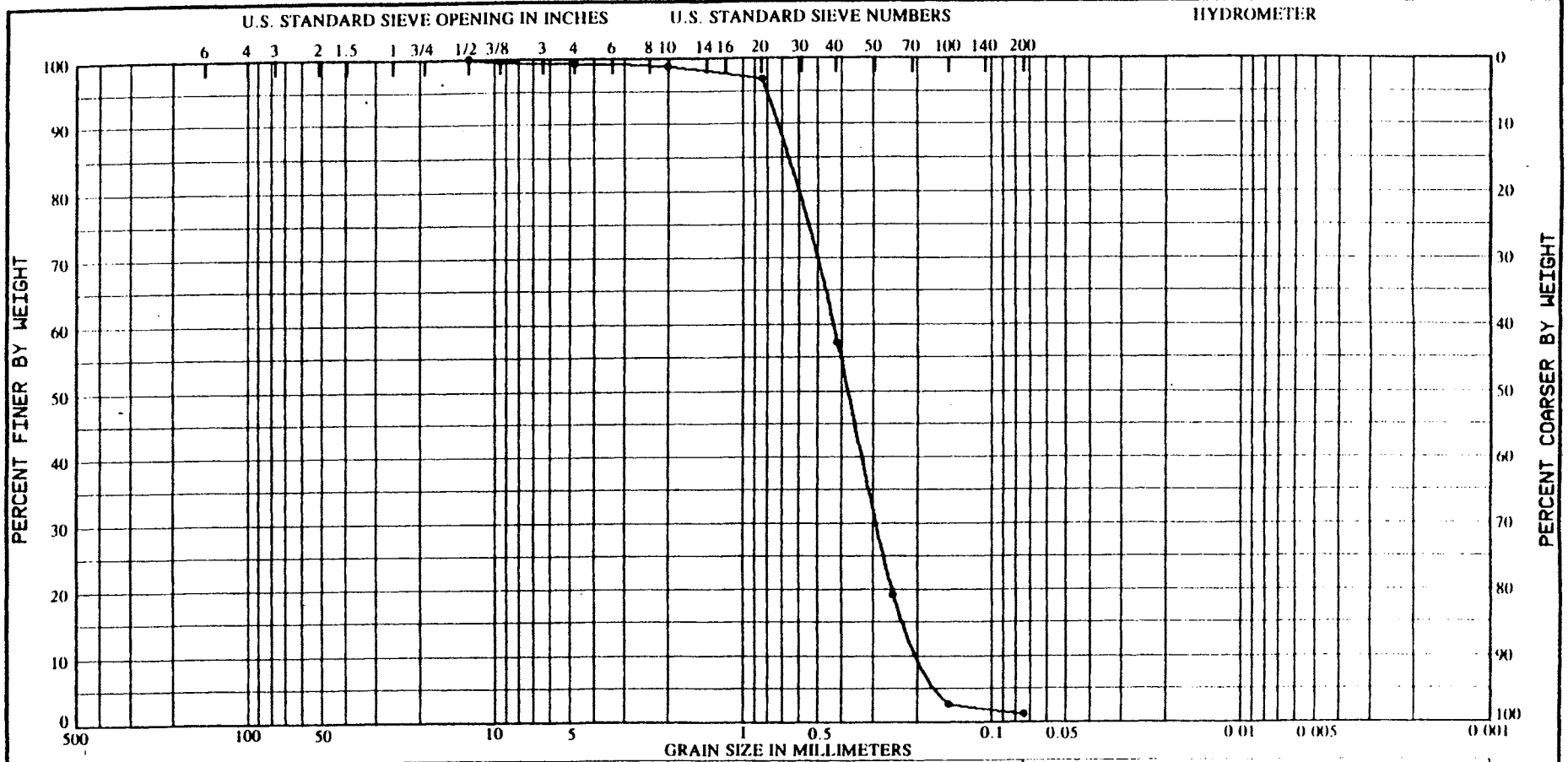
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-15.0 / -15.8'	(VISUAL) TAN, GRAVELY POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL SIZE SHELL.				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/868D
Boring No: NJV-143
Date: 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-11.0 / -11.4'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL FRAGMENTS.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/868C
Boring No NJV-143
Date 06/14/94

GRADATION CURVES

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DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-144*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/869*
Boring Depth (ft): *16.50*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1		TAN, POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL AND GRAVEL SIZE SHELL FRAGMENTS.	(A) SA 0.5'1.0'
	2		----------	
	3			(B) MA 3.2/3.5'
	4		GRAY, SILTY SAND (SM), WITH A TRACE OF SHELL FRAGMENTS.	
-5	5			
	6			
	7		----------	
	8			(C) MA 8.0/8.3'
	9			
-10	10		GRAY, SILTY SAND (SM), WITH PLASTIC FINES AND A TRACE OF SHELL FRAGMENTS.	
	11			
	12		----------	(D) MA 12.0/12.3'
	13		GRAY, INORGANIC SILT LOW LL (ML), WITH A TRACE OF SHELL FRAGMENTS.	
	14		----------	
-15	15			(E) MA 15.3/15.7'
	16		GRAY, SILTY SAND (SM), WITH PLASTIC FINES AND A TRACE OF SHELL FRAGMENTS.	
	17		----------	
	18			
	19			
-20				

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Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No

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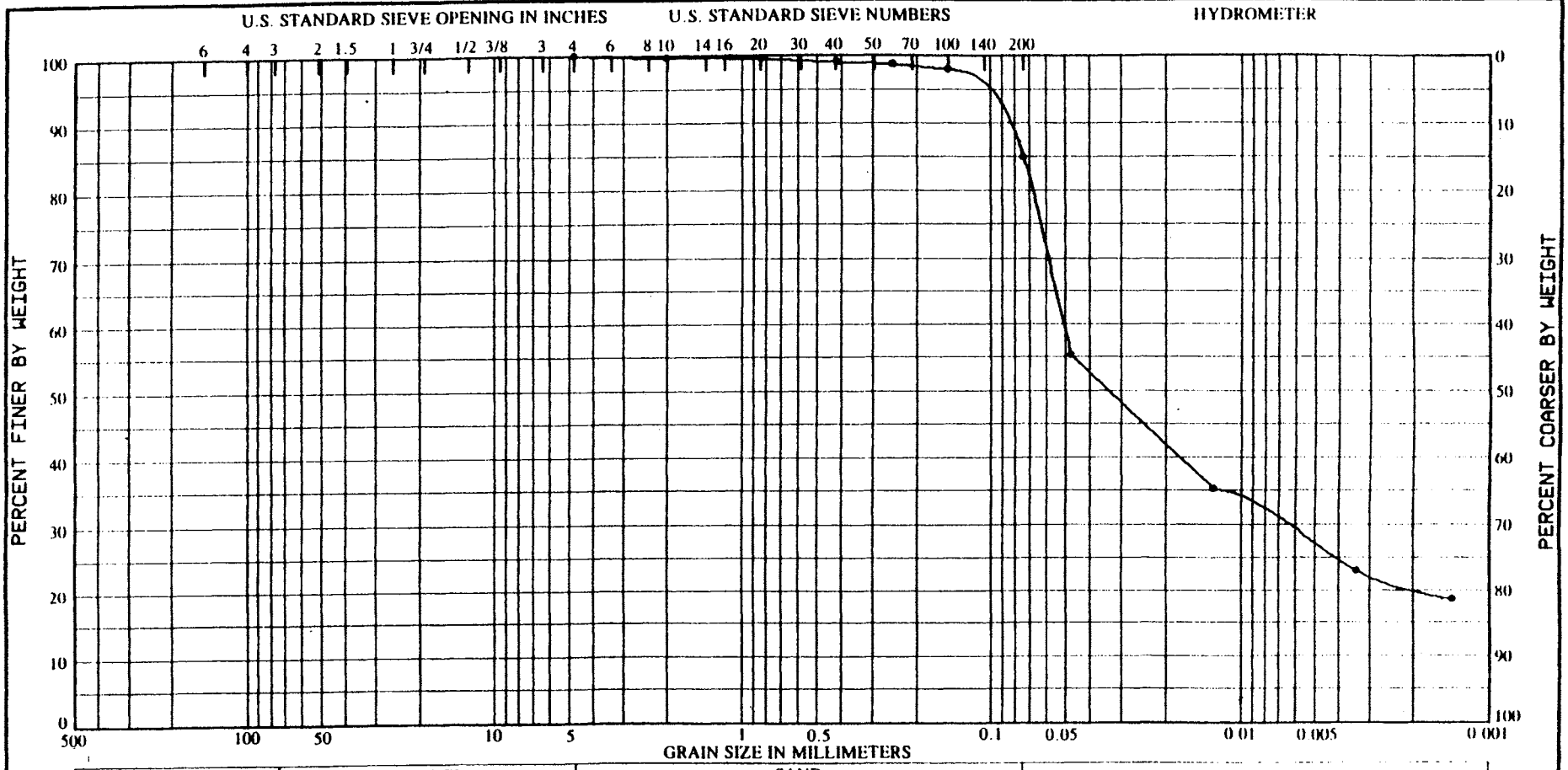
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



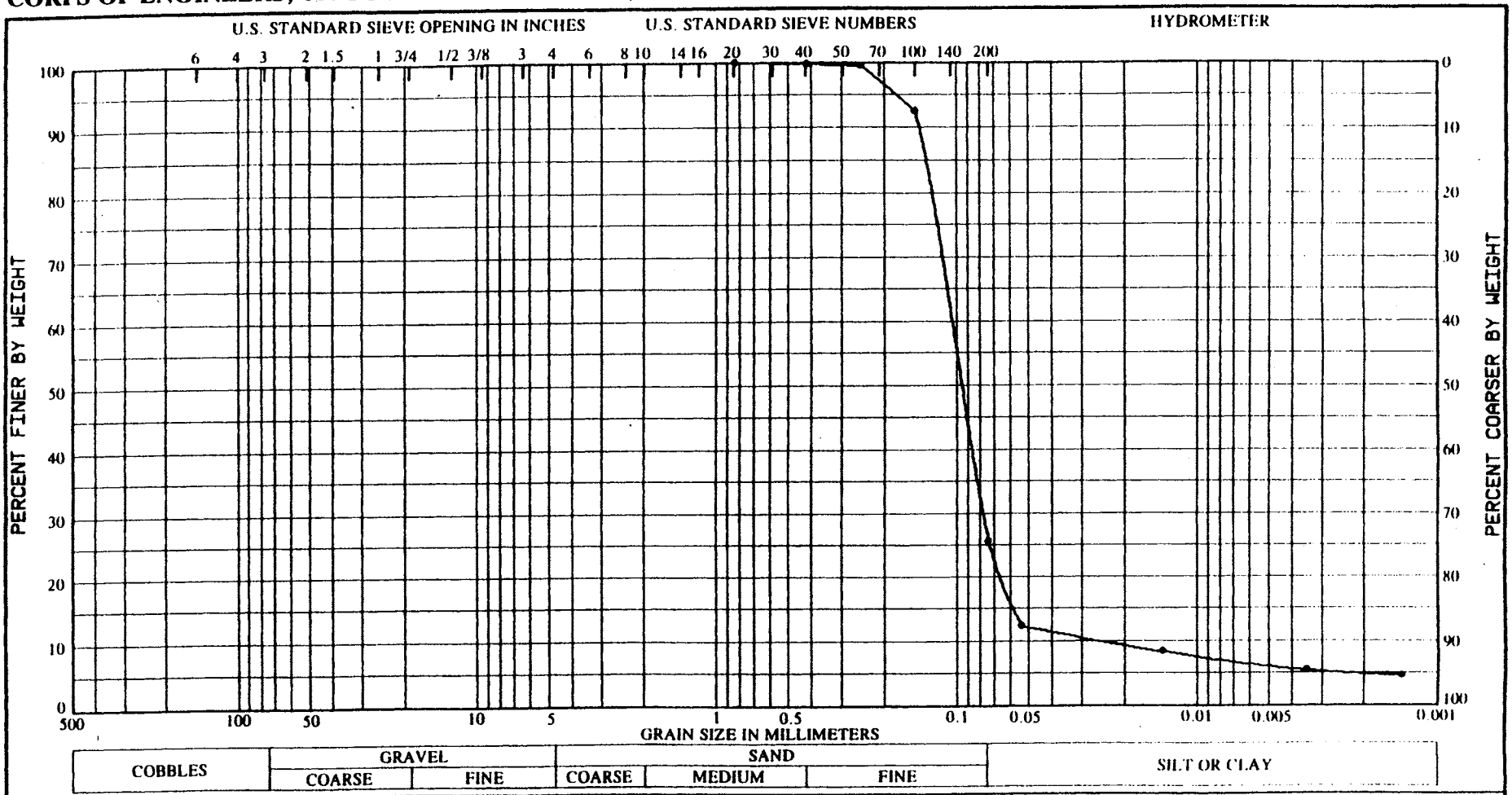
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-17.0 / -17.2'	(VISUAL) GRAY INORGANIC SILT LOW LL (ML), WITH A LITTLE SAND SIZES AND A TRACE OF MICA.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/868E
Boring No NJV-143
Date 06/14/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-3.2 / -3.5'	(VISUAL) GRAY, SILTY SAND (SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/869B
Boring No NJV-144
Date 06/23/94

GRADATION CURVES

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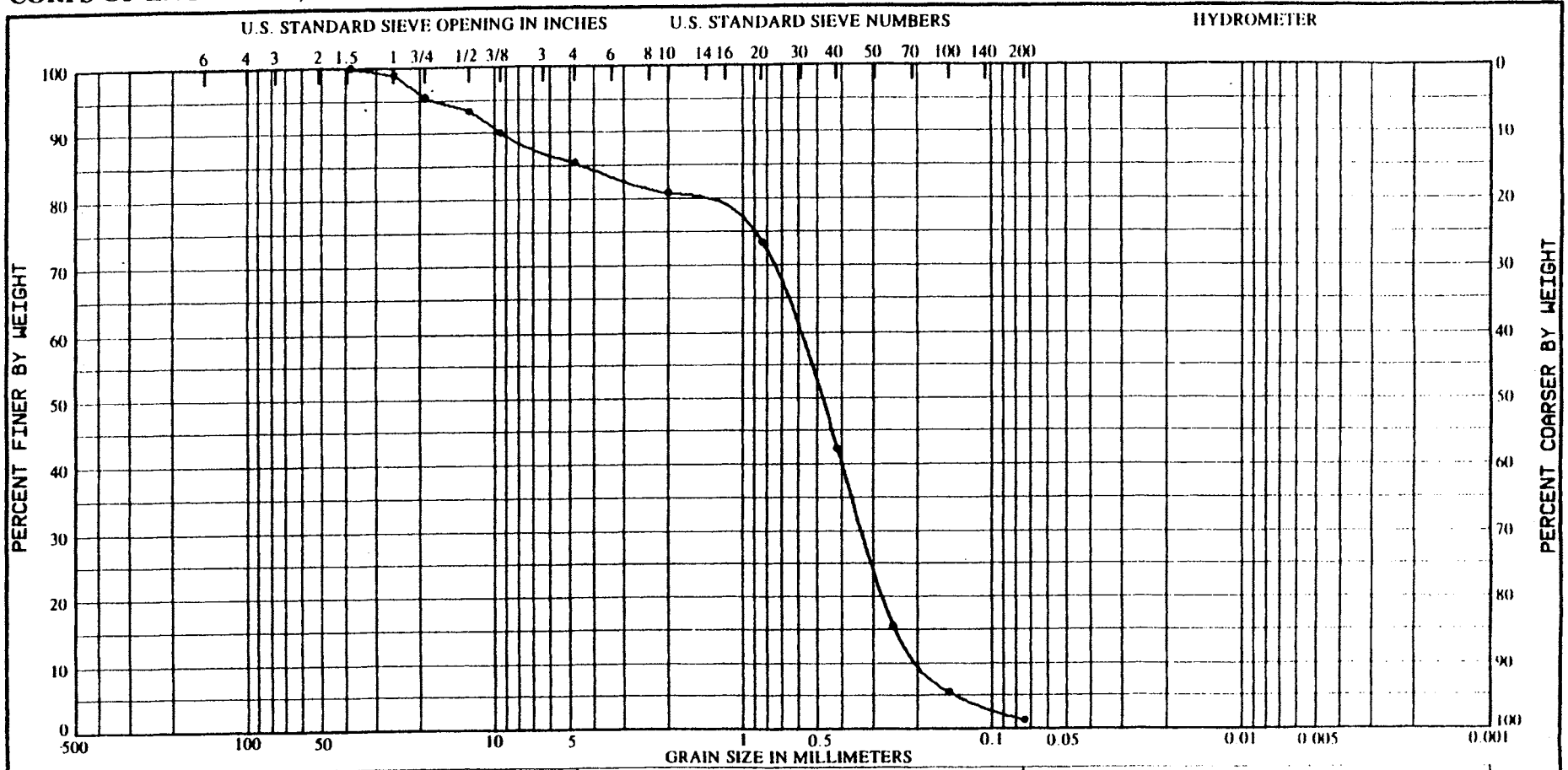
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



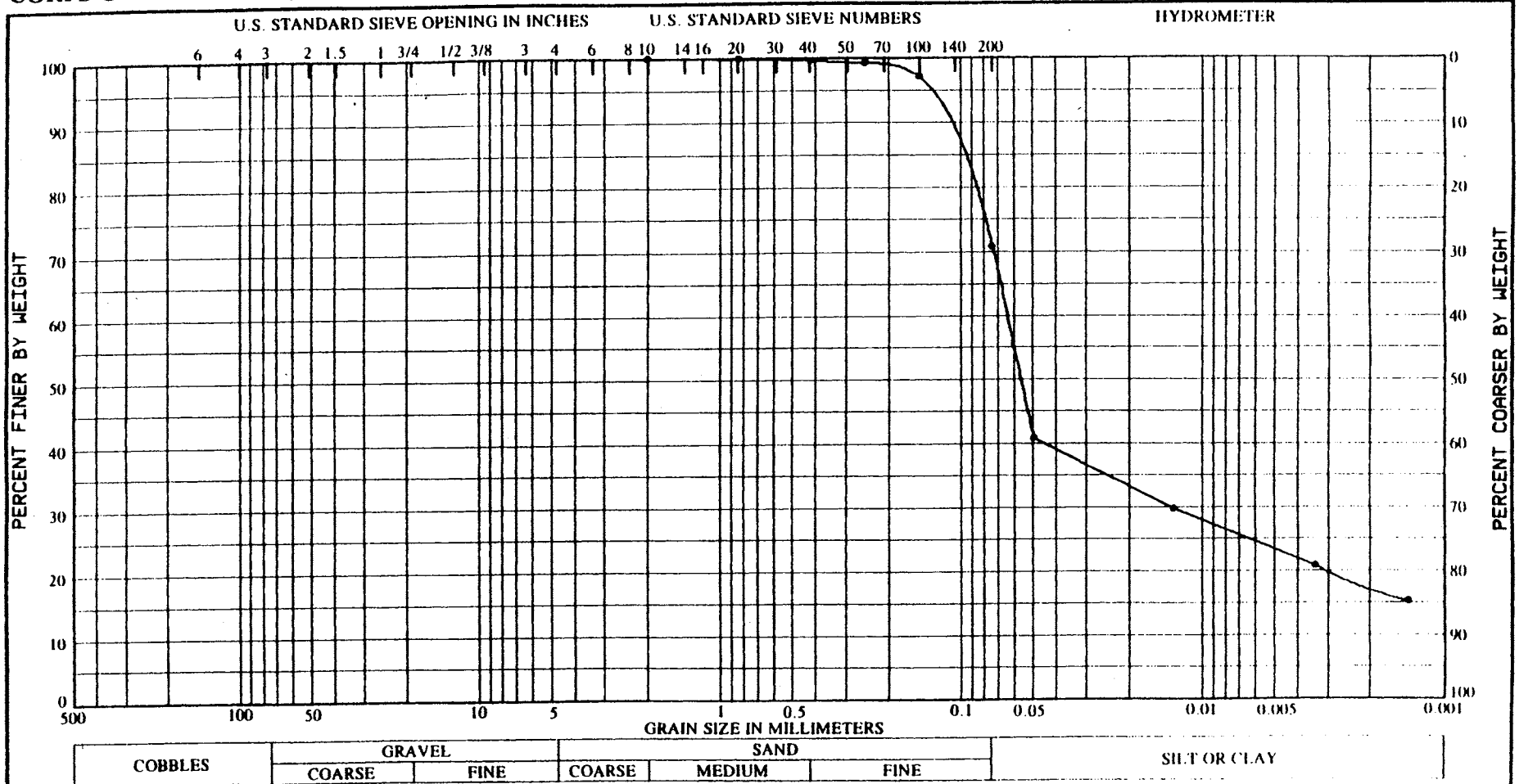
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-0.5 / -1.0'	(VISUAL) TAN, POORLY GRADED SAND (SP), WITH A LITTLE GRAVEL SIZE SHELL AND A TRACE OF MICA.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/869A
Boring No NJV-144
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



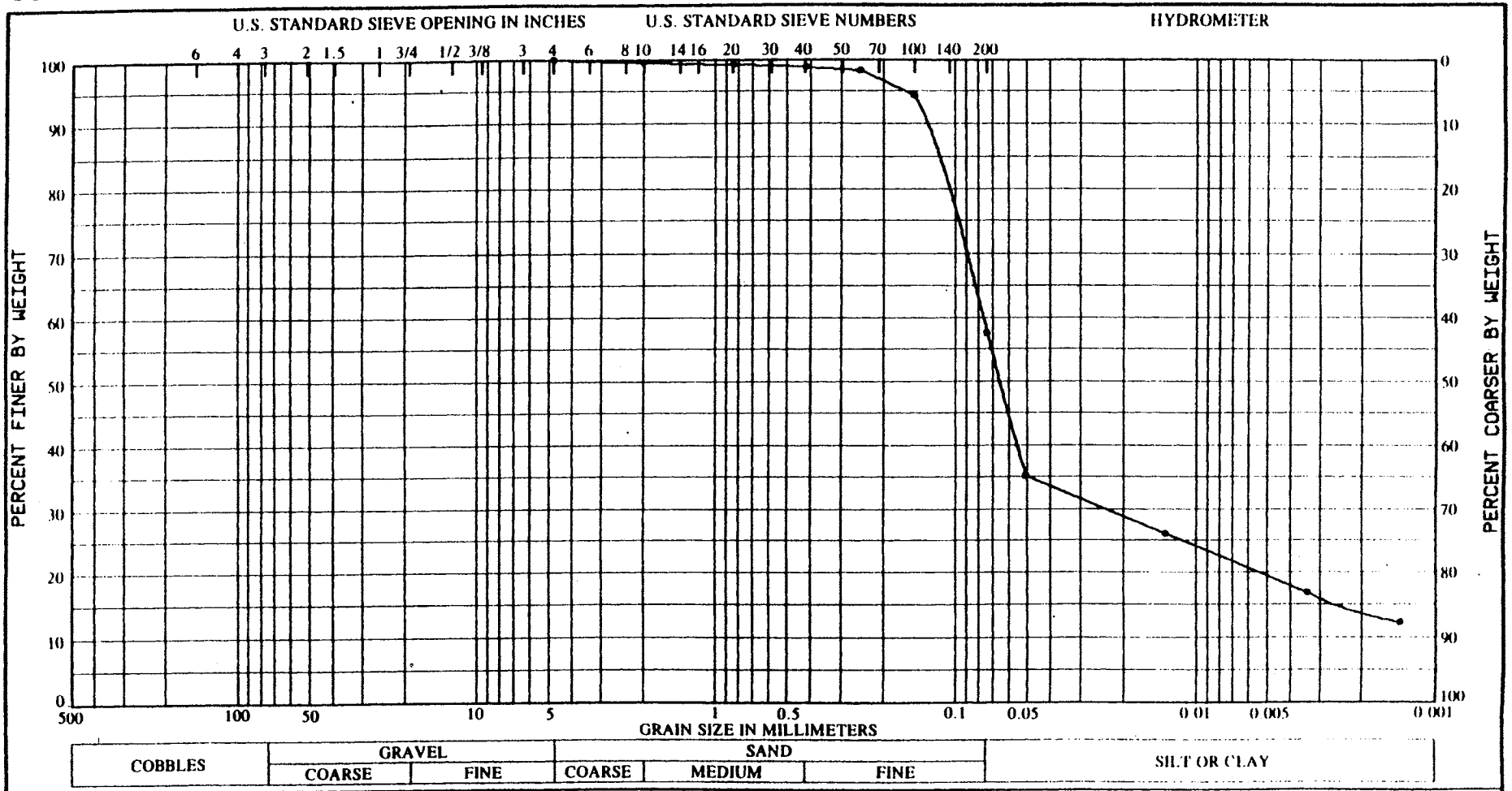
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-8.0 / -8.3'	(VISUAL) GRAY, INORGANIC SILT LOW LL (ML), WITH SOME SAND SIZES.				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/869C
Boring No NJV-144
Date 06/23/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



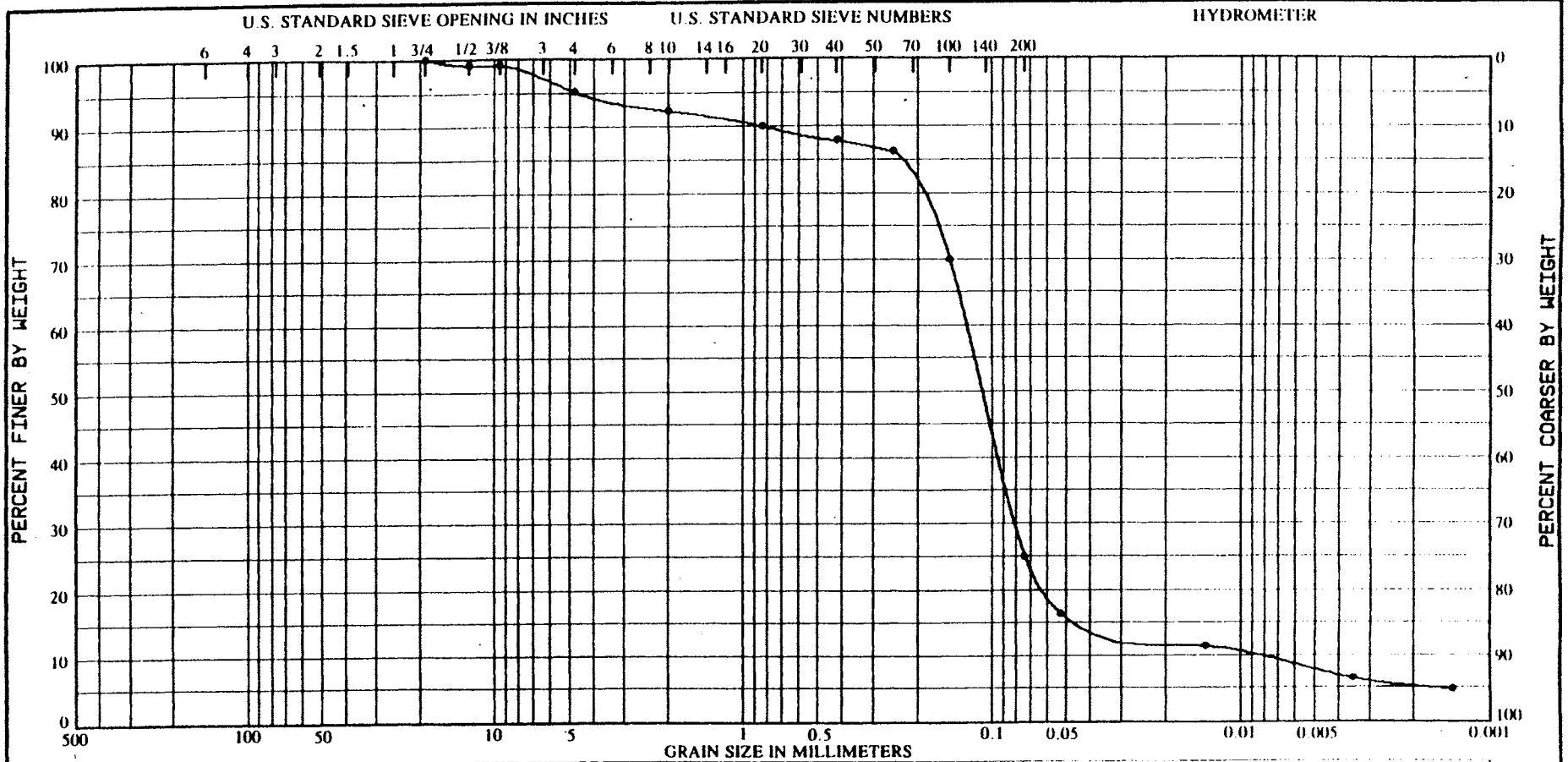
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-12.0 / -12.3'	(VISUAL) GRAY, SANDY INORGANIC SILT LOW LL (ML), WITH A TRACE OF MICA.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/869D
Boring No NJV-144
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-15.3 / -15.7'	(VISUAL) GRAY, SILTY SAND (SM), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/869E
Boring No NJV-144
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-145*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/870*
Boring Depth (ft): *20.60*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1			
	2			
	3			(A) SA 2.9/3.2'
	4			
-5	5			
	6			
	7			
	8			(B) SA 7.5/7.7'
	9			
-10	10		TAN AND GRAY, POORLY GRADED SAND (SP), WITH A SLIGHT TRACE OF SHELL FRAGMENTS.	
	11			
	12			
	13			(C) SA 12.9/13.2'
	14			
-15	15			
	16			
	17			
	18			(D) MA 18.1/18.4'
	19			
-20				

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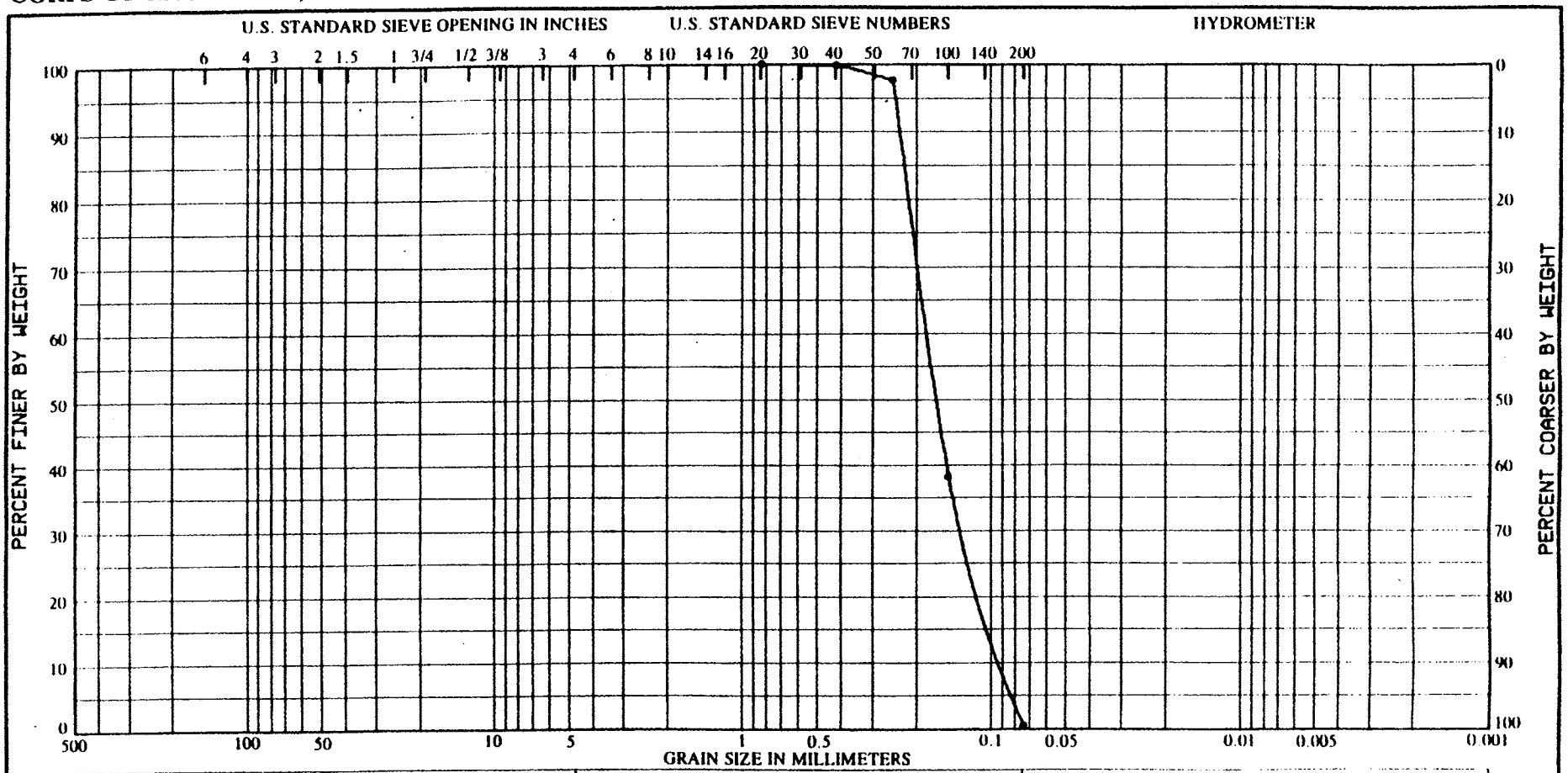
Date: *07/22/94* **LABORATORY LOG AND SAMPLE DATUM** Sheet No. 1 of 1

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

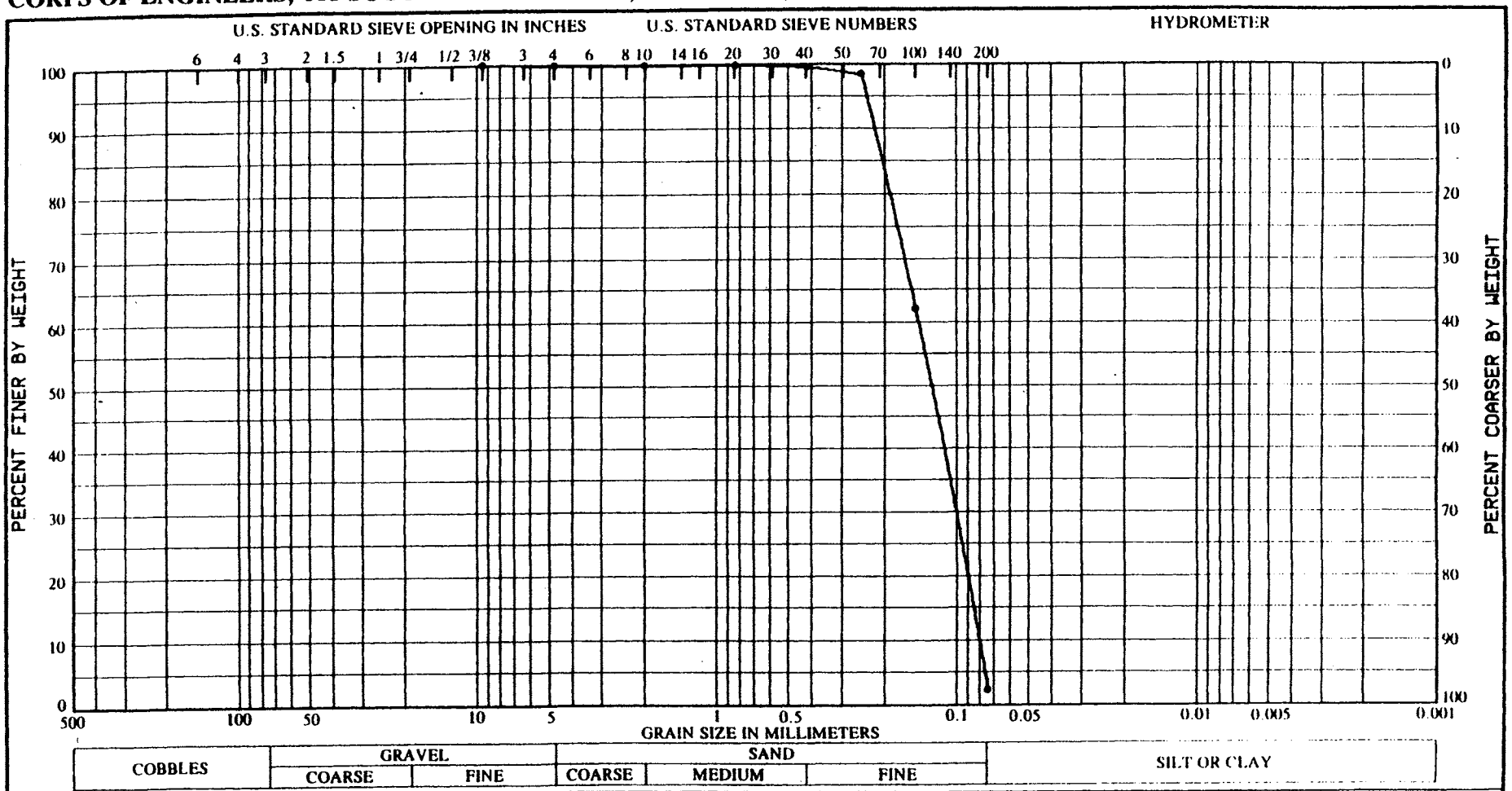
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-2.9 / -3.2'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/870A
Boring No NJV-145
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



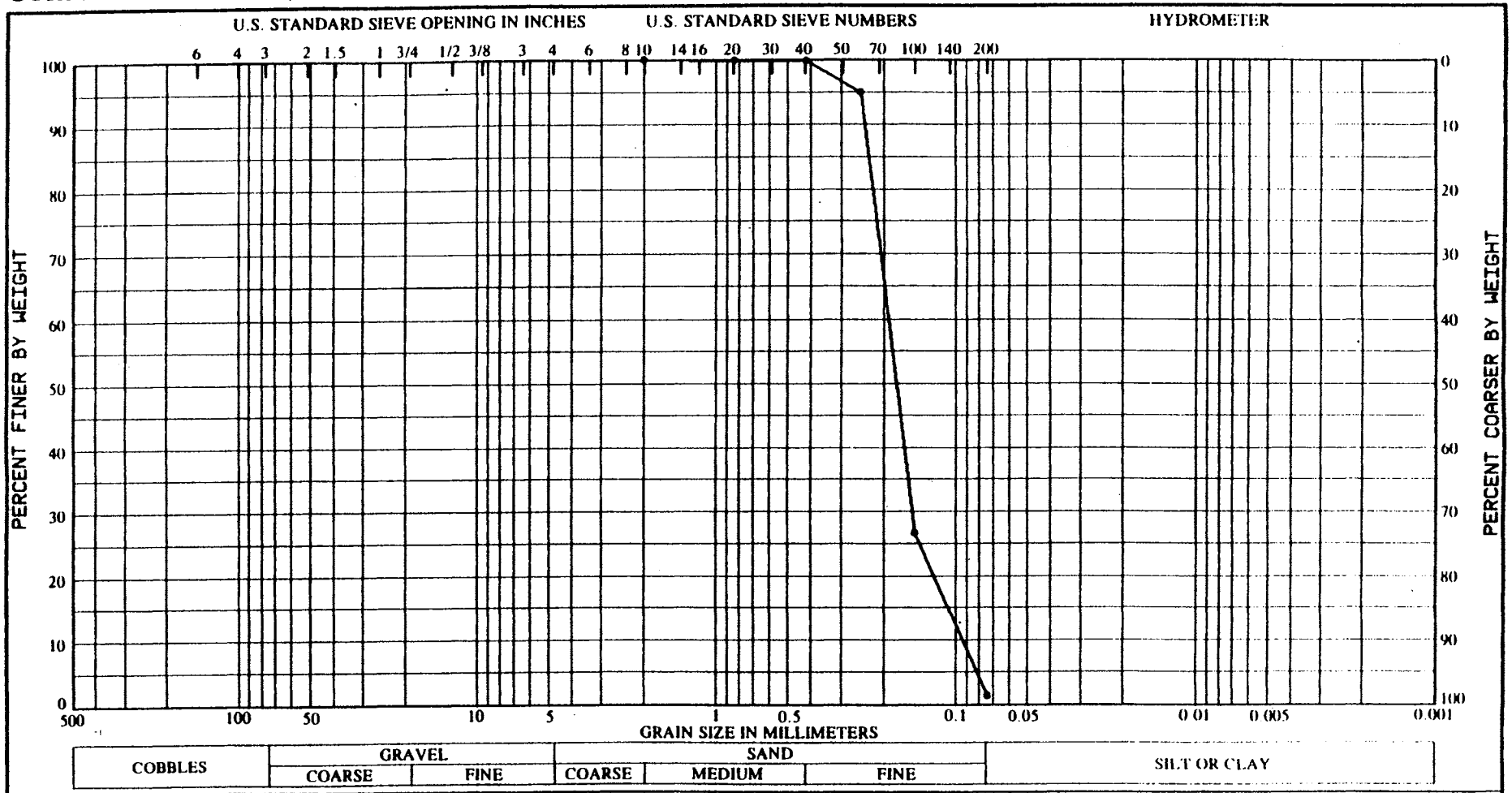
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-7.5 / -7.7'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/870B
Boring No NJV-145
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



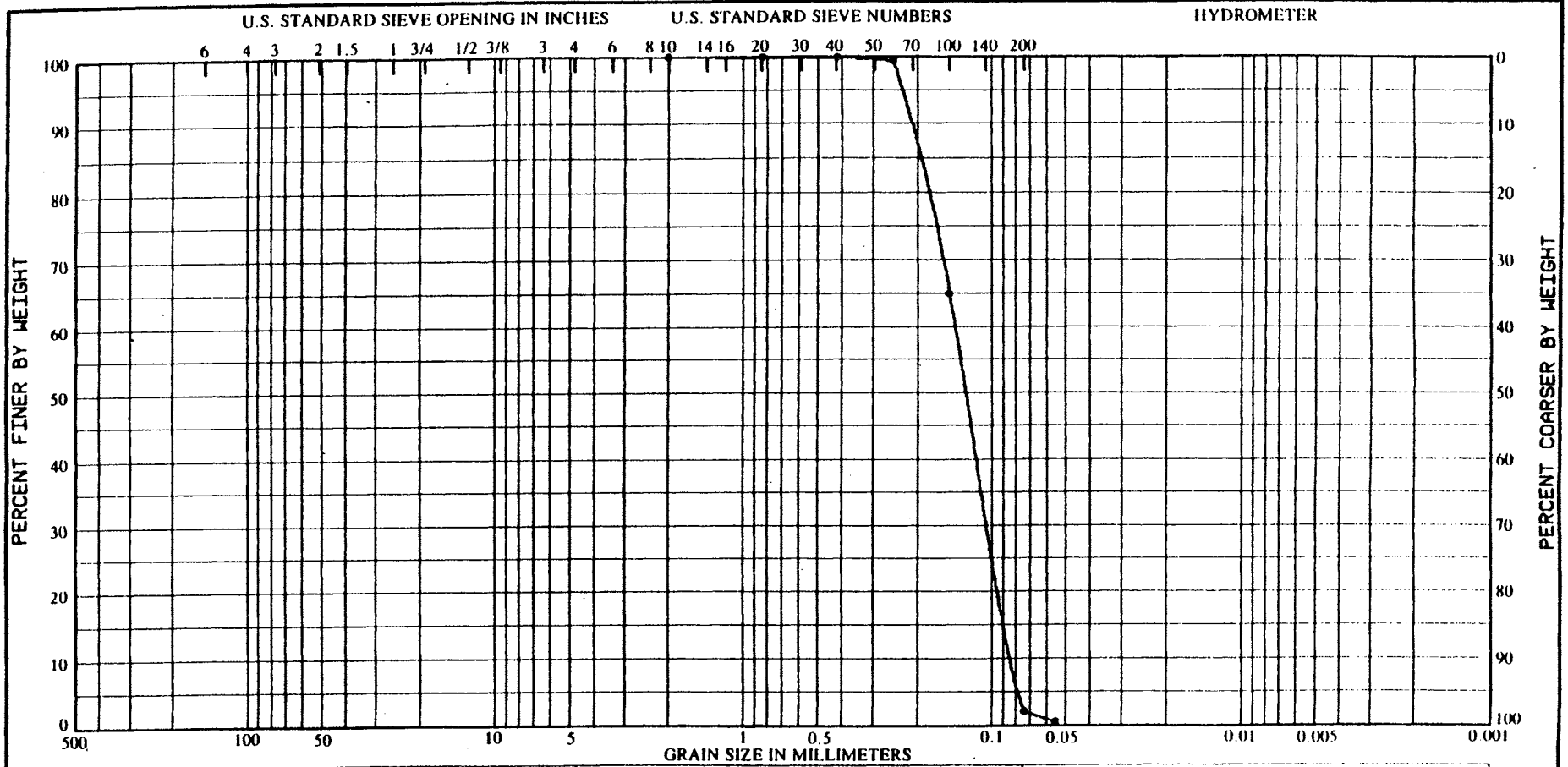
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-12.9 / -13.2'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/870C
Boring No NJV-145
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-18.1 / -18.4'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/870D
Boring No NJV-145
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-146*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/871*
Boring Depth (ft): *15.50*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1			(A) SA 1.3/1.7'
	2			
	3		TAN AND GRAY, POORLY GRADED SAND (SP), WITH OCCASIONAL SHELL AND SHELL FRAGMENTS GRAVEL SIZES.	
	4			
-5	5			
	6		----------	
	7			(B) SA 6.4/6.7'
	8		GRAY, SILTY SAND (SM), WITH A TRACE OF SHELL FRAGMENTS.	(C) MA 7.8/8.0'
	9		----------	
-10	10		TAN AND GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL FRAGMENTS.	
	11		----------	(D) SA 10.8/11.0'
	12			(E) MA 12.1/12.3'
	13		GRAY, FAT CLAY (CH), WITH A TRACE OF SAND.	
	14			
-15	15		----------	
	16			
	17			
	18			
	19			
-20				

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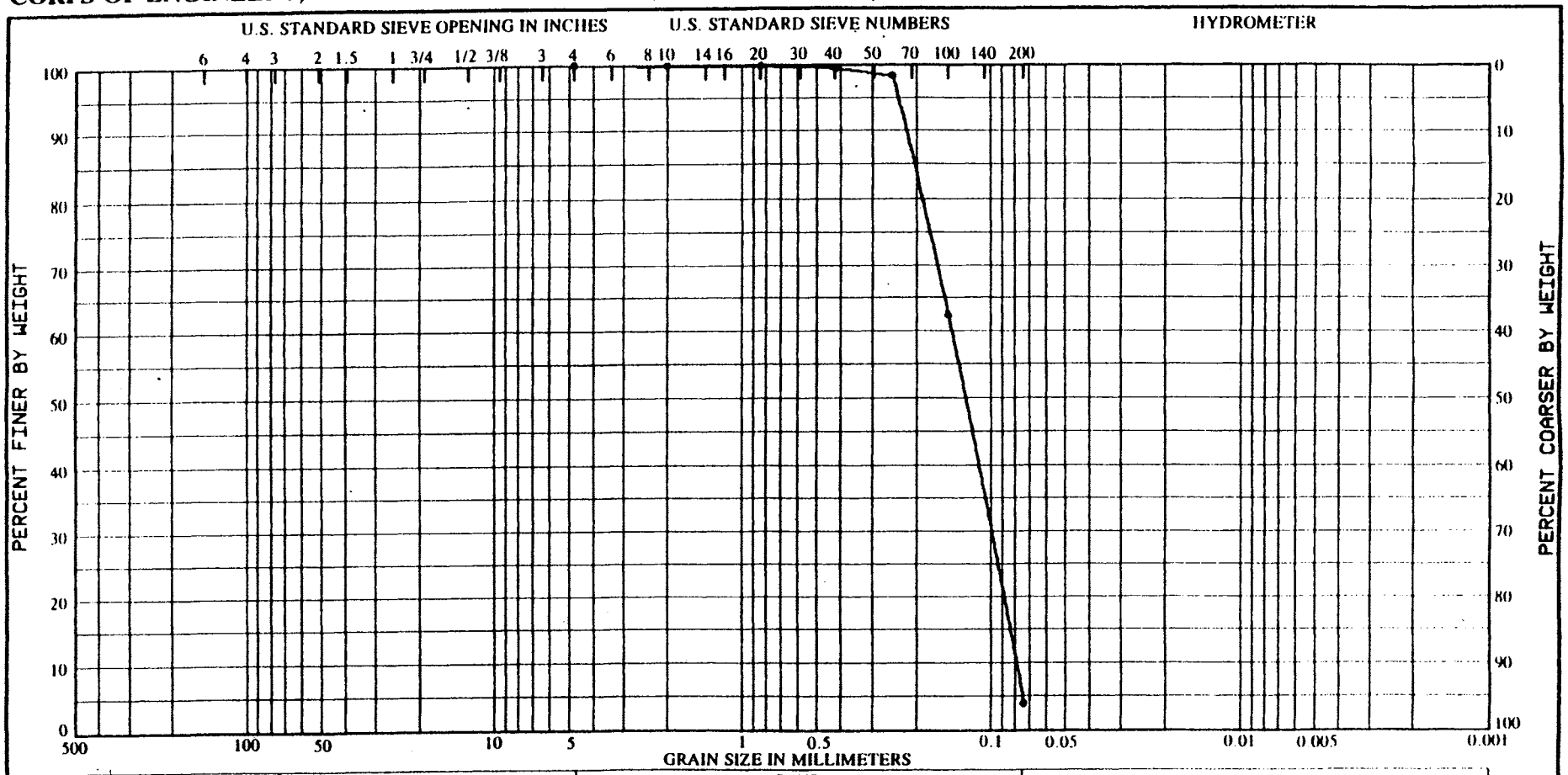
Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



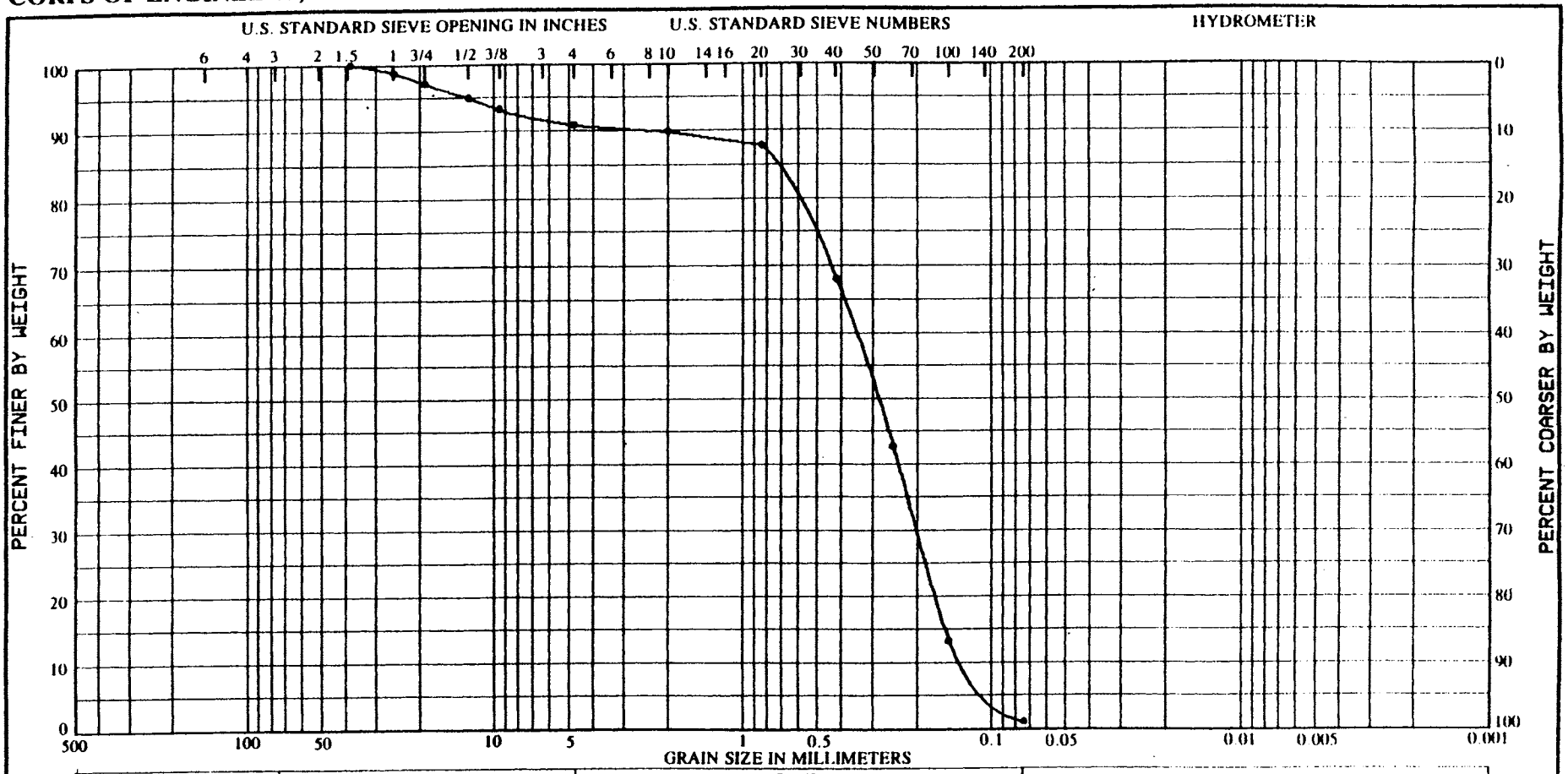
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-6.4 / -6.7'	(VISUAL) GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No. 184/871B
Boring No NJV-146
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

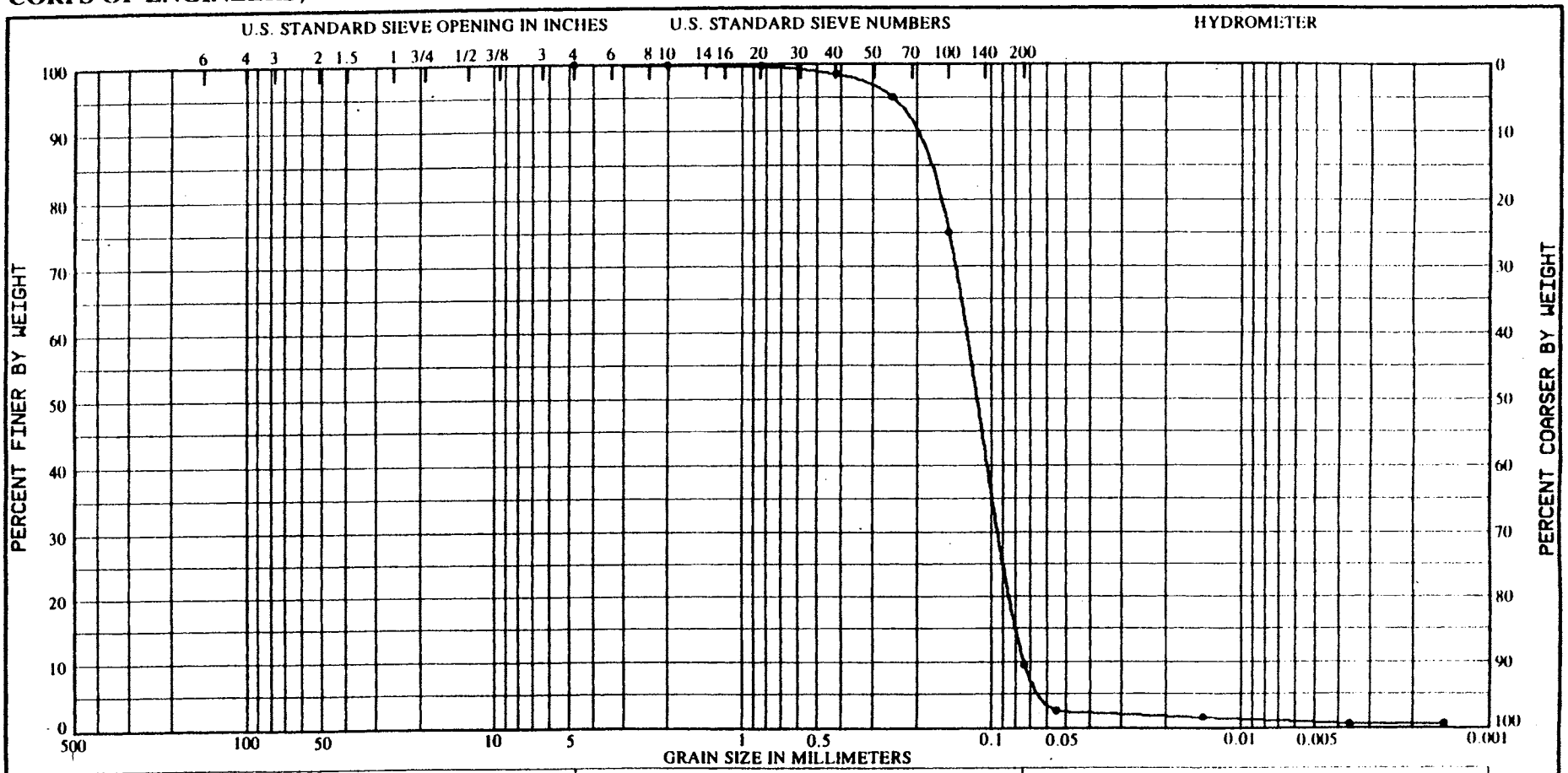
Sample No.	Elev.	Classification	Nat w %	LL	PL	PI
	-1.3 / -1.7'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/871A
Boring No NJV-146
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

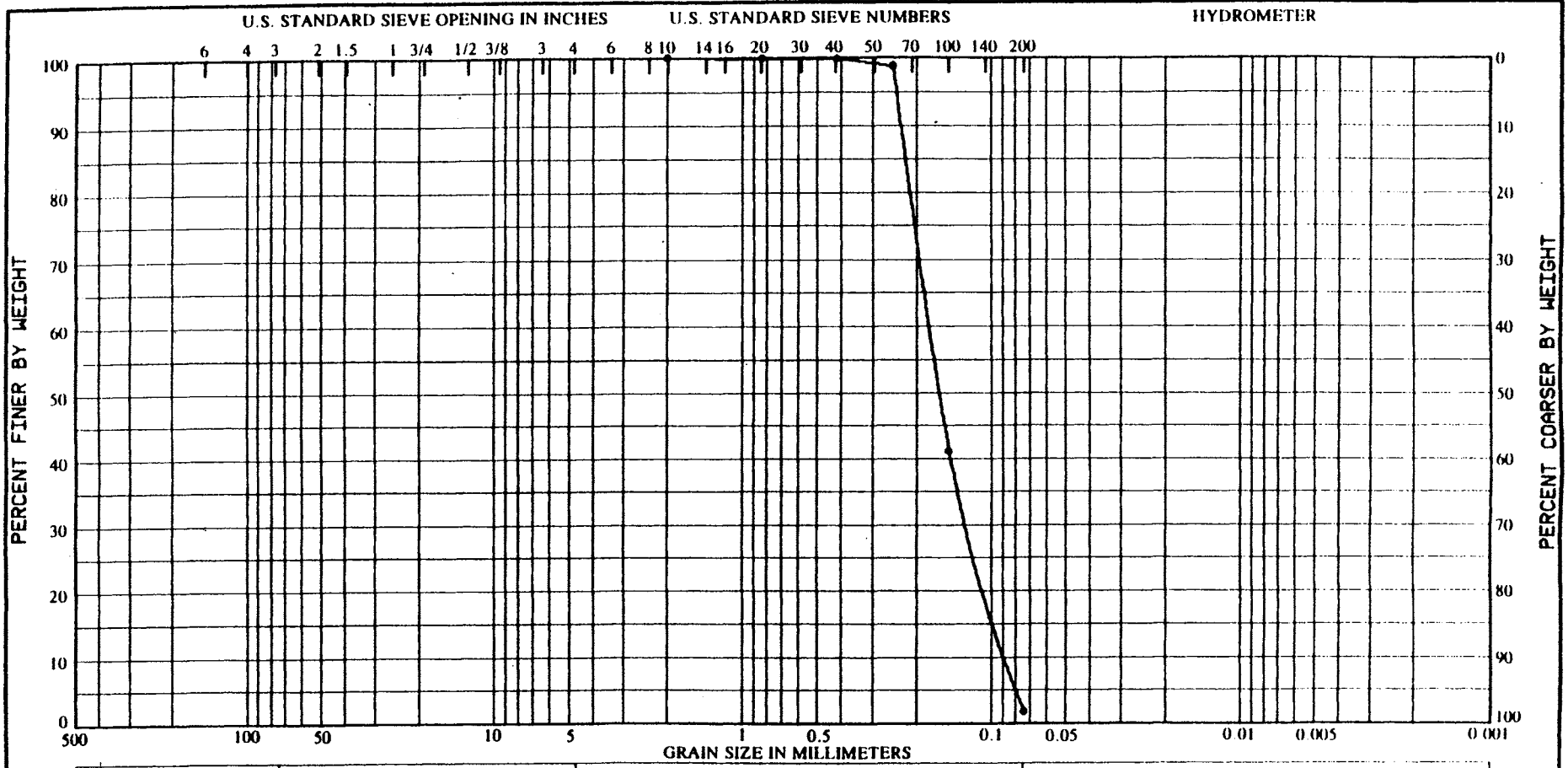
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-7.8 / -8.0'	(VISUAL) GRAY, POORLY GRADED SILTY SAND				
		(SP-SM), WITH A TRACE OF MICA.				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/871C
Boring No NJV-146
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



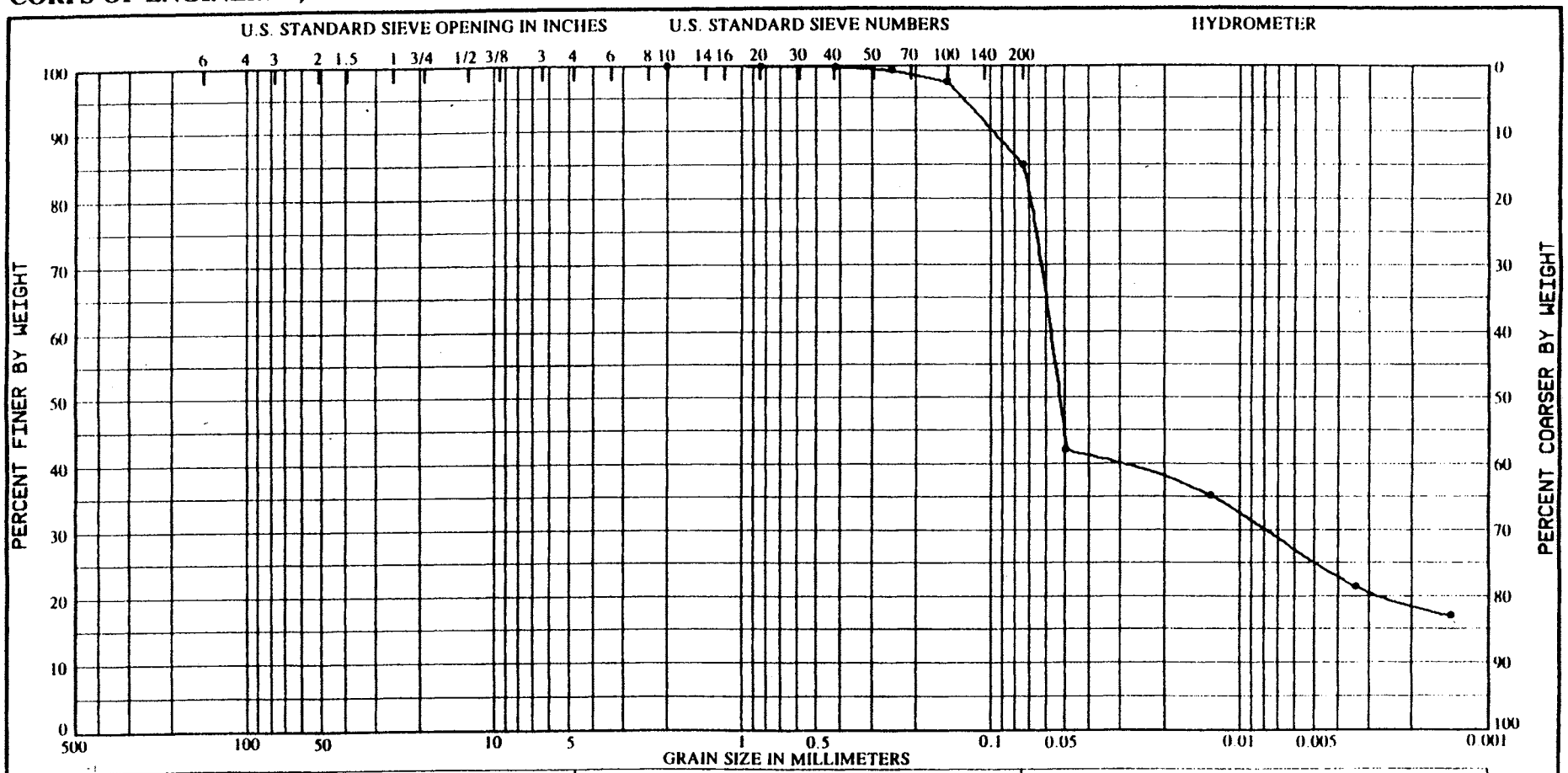
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-10.8 / -11.0'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/871D
Boring No: NJV-146
Date: 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-12.1 / -12.3'	(VISUAL) GRAY, FAT CLAY (CH), WITH A LITTLE SAND SIZES.				

GRADATION CURVES

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/871E
Boring No: NJV-146
Date: 06/23/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No. *NJV-147*
Location: *OFFSHORE OF NEW JERSEY*		Lab No. *184/872*
Boring Depth (ft): *17.50*	Elevation:	Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition: *NAPEN-94-612*

Elev (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1		TAN AND GRAY, POORLY GRADED SAND (SP).	
	2			(A) SA 1.5/1.8'

	3			
	4			
-5	5			
	6		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF SHELL FRAGMENTS.	(B) MA 5.9/6.1'
	7			
	8			
	9			
-10	10			
	11			(C) SA 10.6/10.9'
	12			

	13			
	14			
				(D) SA 14.3/14.6'
-15	15		GRAY AND TAN, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF SHELL FRAGMENTS.	
	16			
	17			(E) SA 16.8/17.0'

	18			
	19			
-20				

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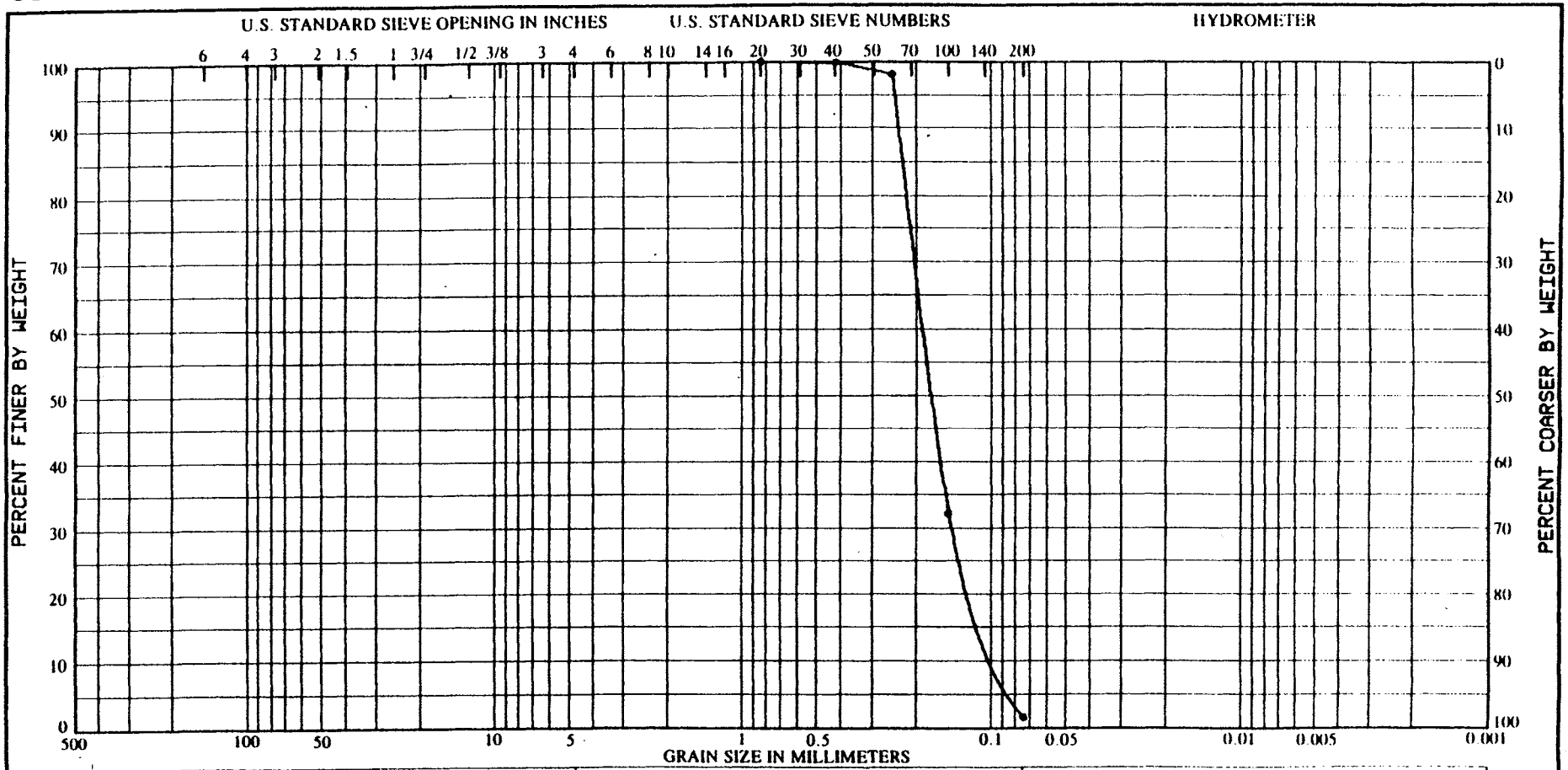
Date: *07/22/94*

LABORATORY LOG AND SAMPLE DATUM

Sheet No. of

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



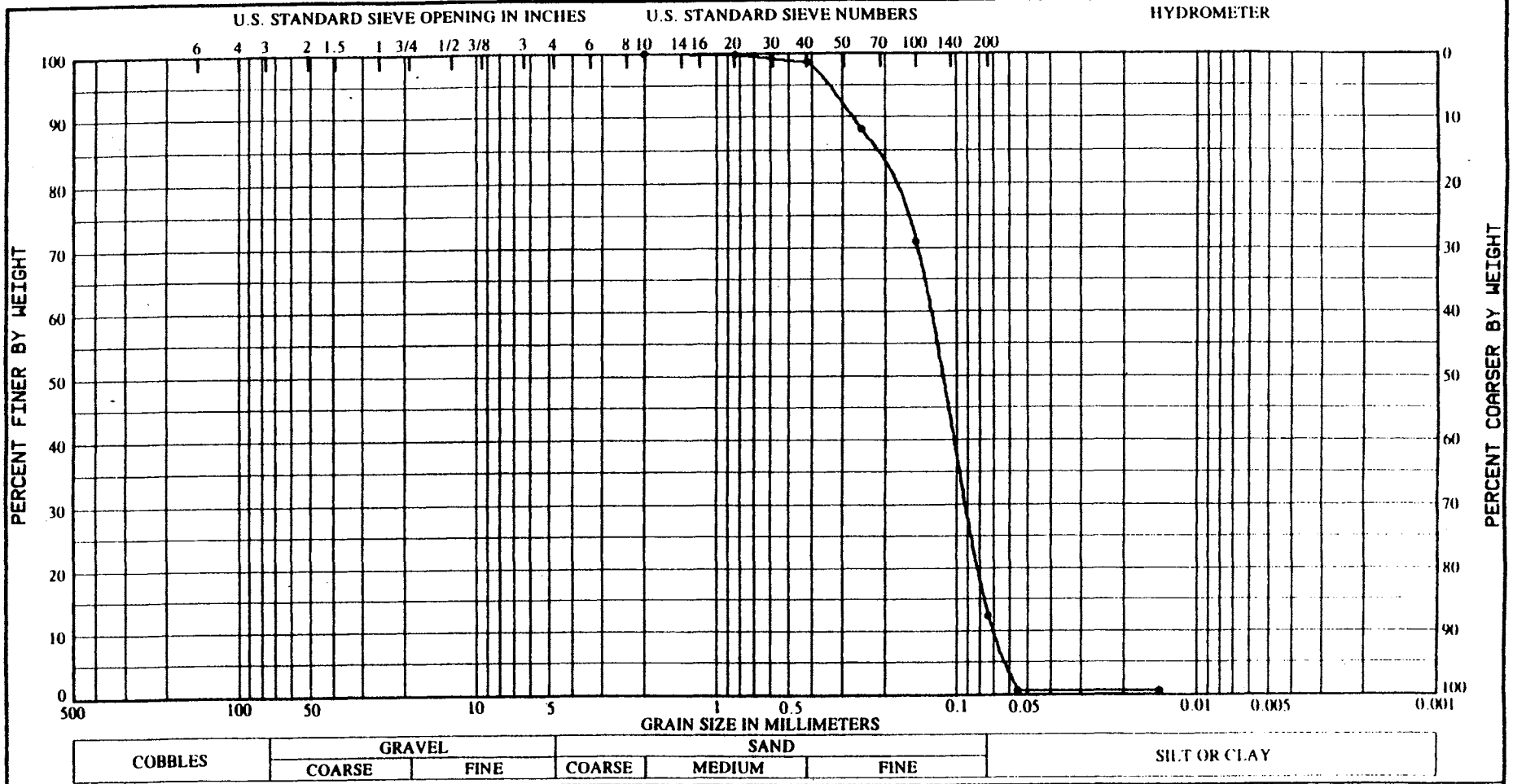
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-1.5 / -1.8'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/872A
Boring No NJV-147
Date 06/23/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-5.9 / -6.1'	(VISUAL) GRAY, SILTY SAND (SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/872B
Boring No NJV-147
Date 06/23/94

GRADATION CURVES

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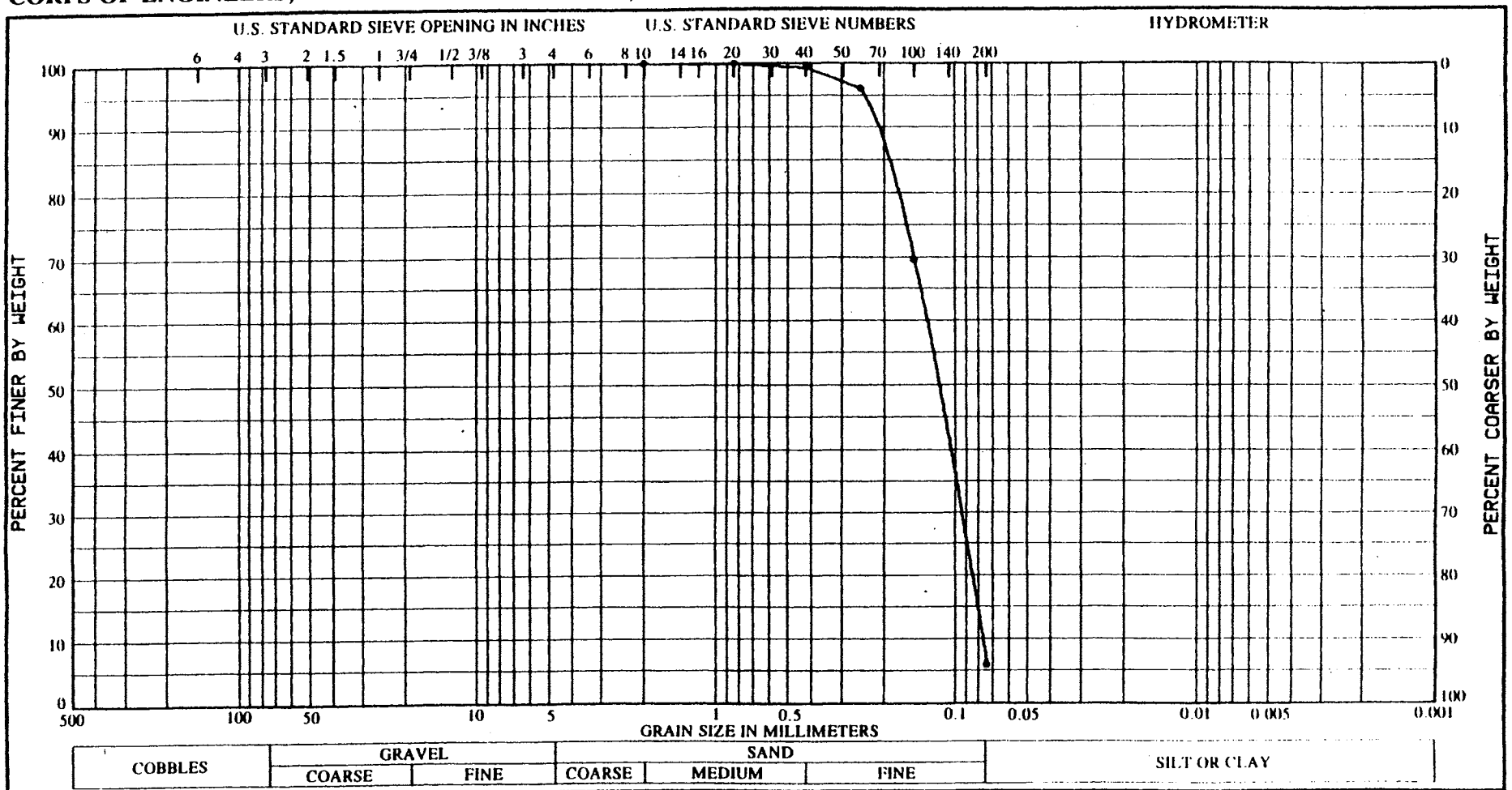
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-14.3 / -14.6'	(VISUAL) GRAY AND TAN, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY

Lab No 184/872D

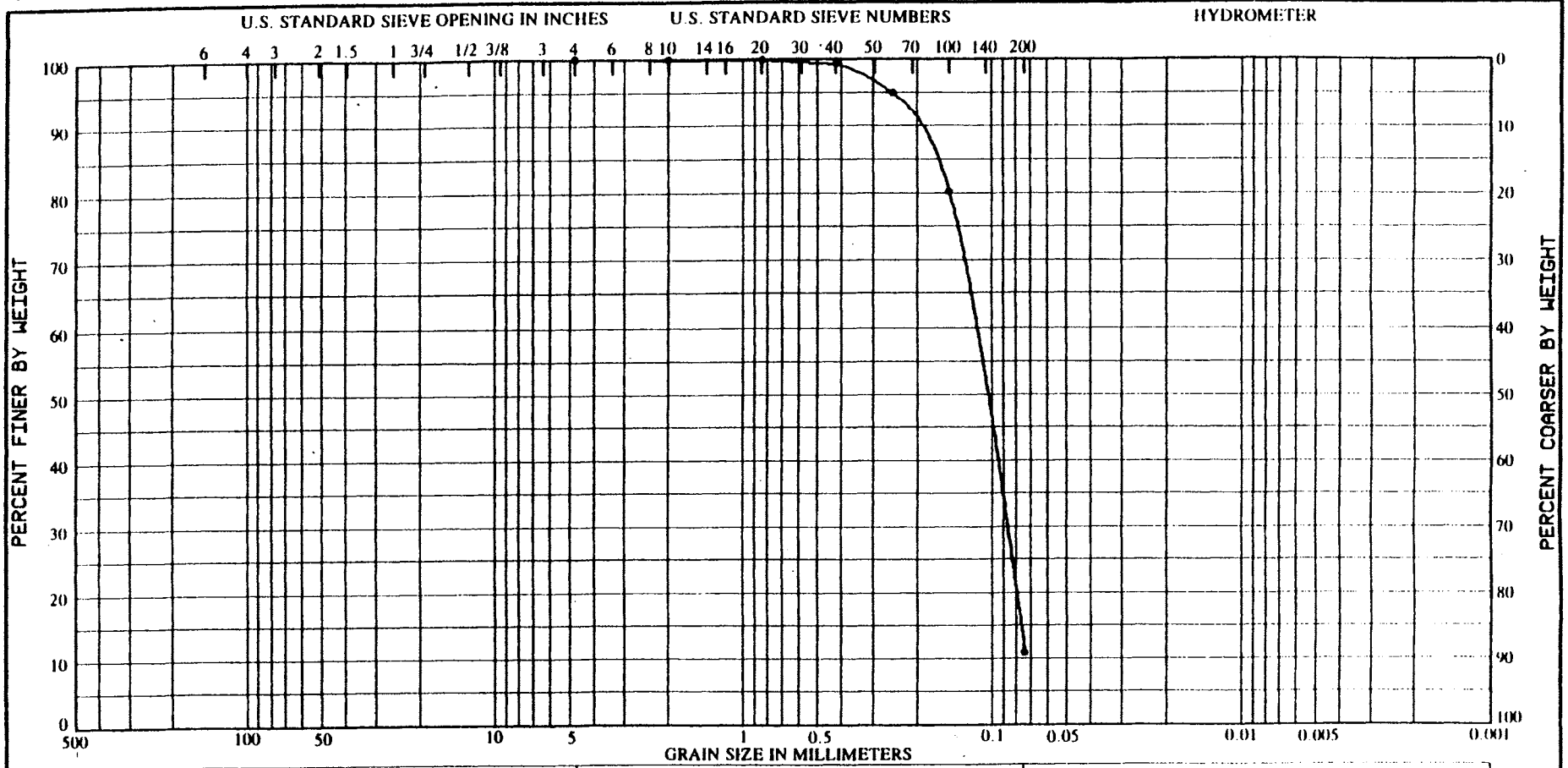
Boring No NJV-147

Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	L.L.	P.L.	P.I
	-10.6 / -10.9'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/872C
Boring No NJV-147
Date 06/23/94

GRADATION CURVES

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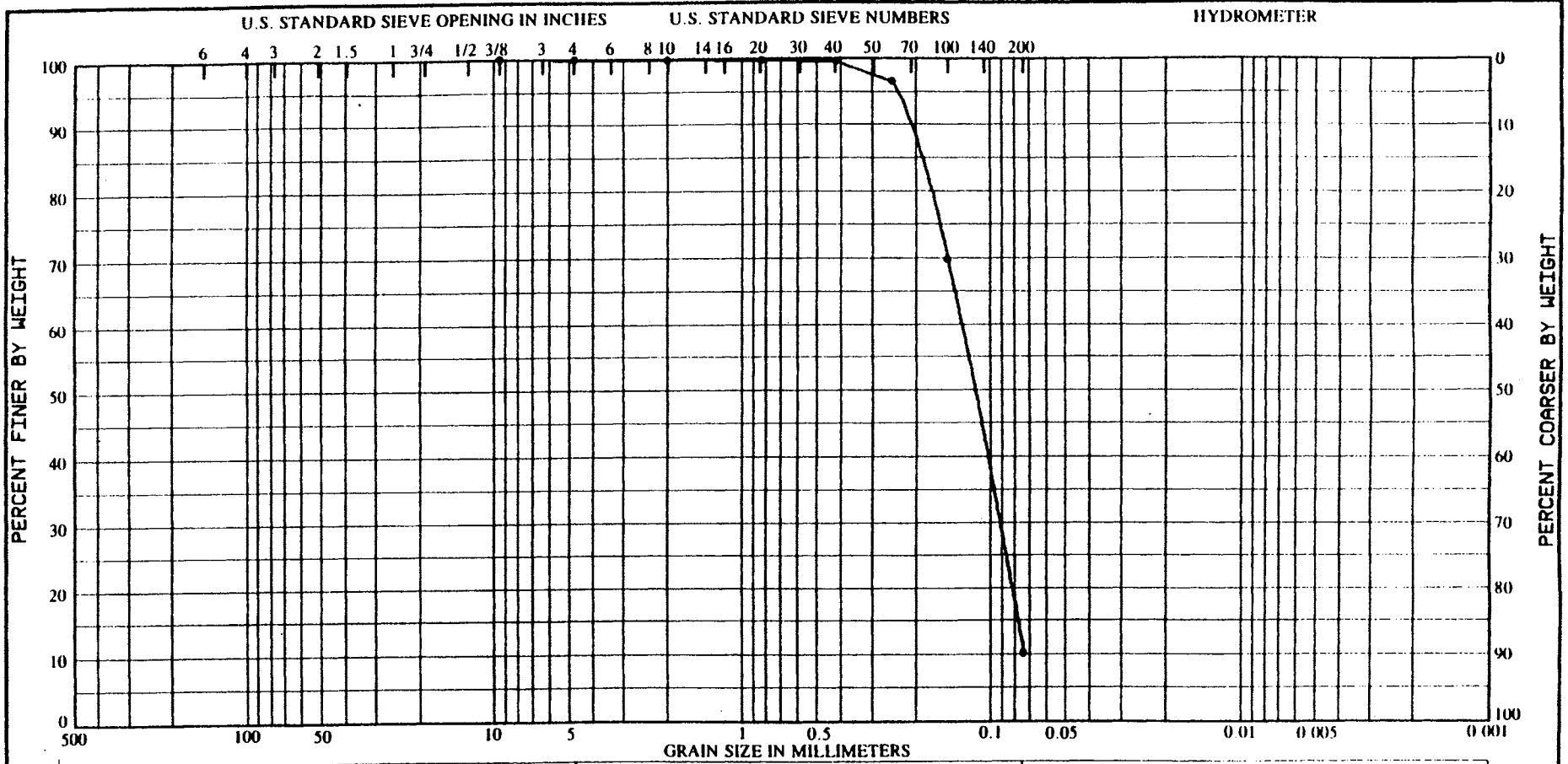
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	L.L.	PL	PI
	-16.8 / -17.0'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/872E
Boring No NJV-147
Date 06/23/94

GRADATION CURVES

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DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*			Boring No. *NJV-148*
Location: *OFFSHORE OF NEW JERSEY*			Lab No. *184/873*
Boring Depth (ft): *17.40*	Elevation:		Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*			Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0			GRAY, SILTY SAND (SM).	(A) SA 0.3/0.5'
	1		BLACK, SANDY INORGANIC SILT HIGH LL (MH).	(B) MA 0.8/1.1'
	2		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH POCKETS OF (SM), WITH PLASTIC FINES.	(C) MA 2.2/2.5'
	3		TAN, CLAYEY SAND (SC).	
	4			
-5	5		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF SHELL FRAGMENTS.	
	6			
	7			(D) SA 6.6/6.8'
	8			
	9			
-10	10			
	11			
	12		GRAY, POORLY GRADED SILTY SAND (SP-SM).	(E) SA 11.5/11.7'
	13			
	14			
-15	15			(F) SA 15.2/15.4'
	16			
	17			
	18			
	19			
-20				

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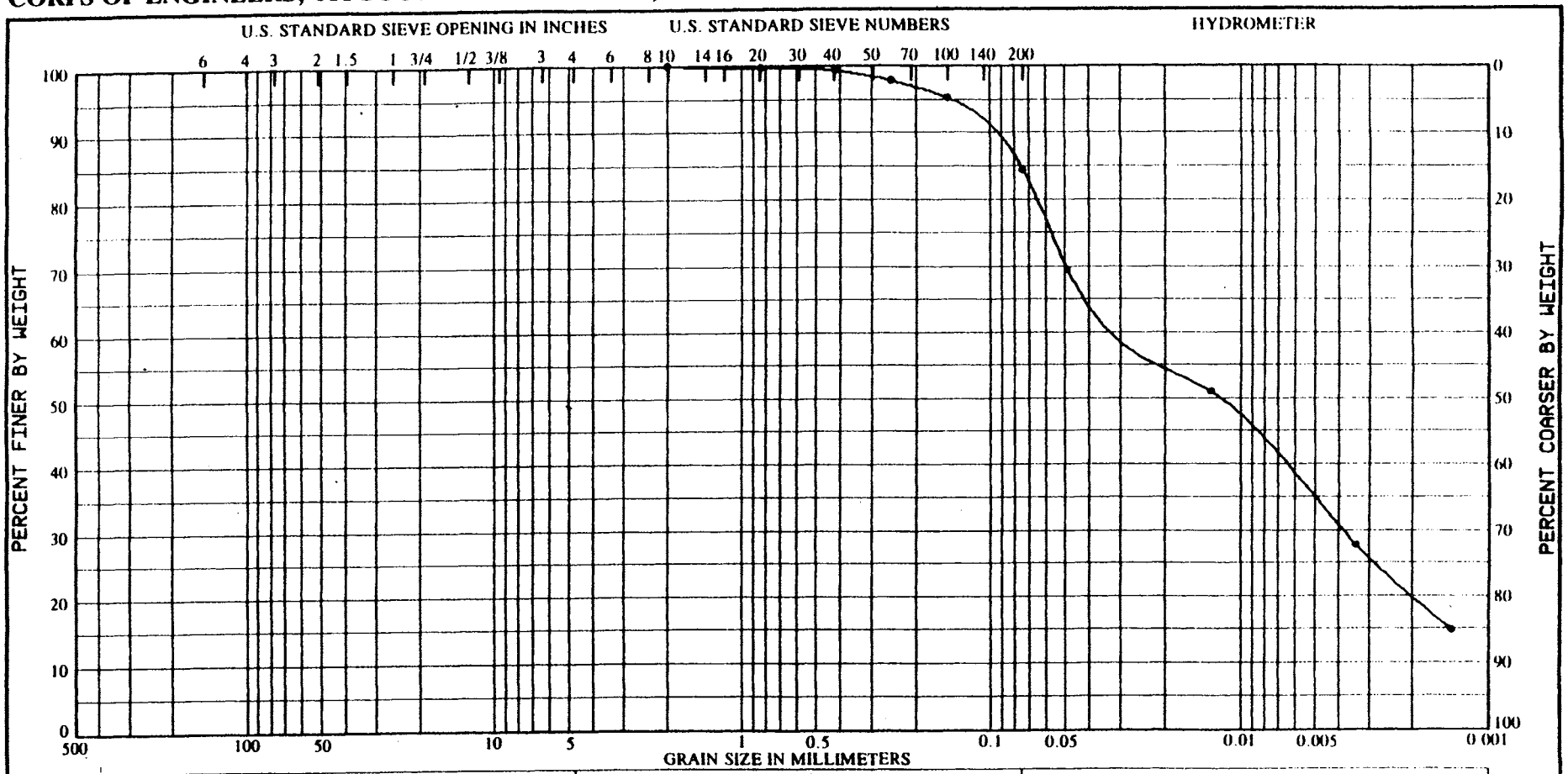
Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No. 5

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-0.8 / -1.1'	(VISUAL) GRAY, INORGANIC SILT HIGH LL (MH), WITH A LITTLE SAND SIZES AND A TRACE OF ORGANICS.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY

Lab No. 184/873B

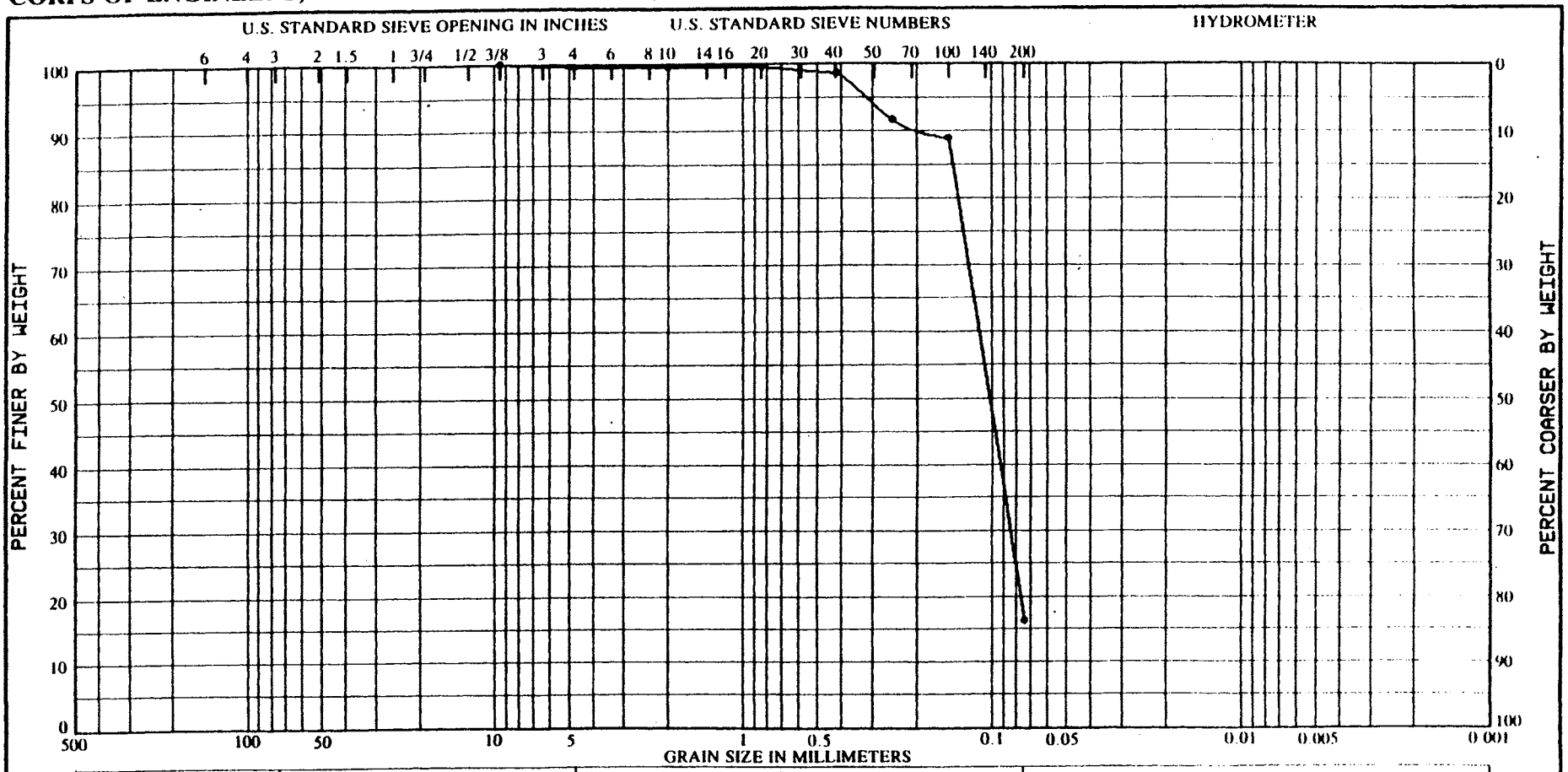
Boring No. NJV-148

Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

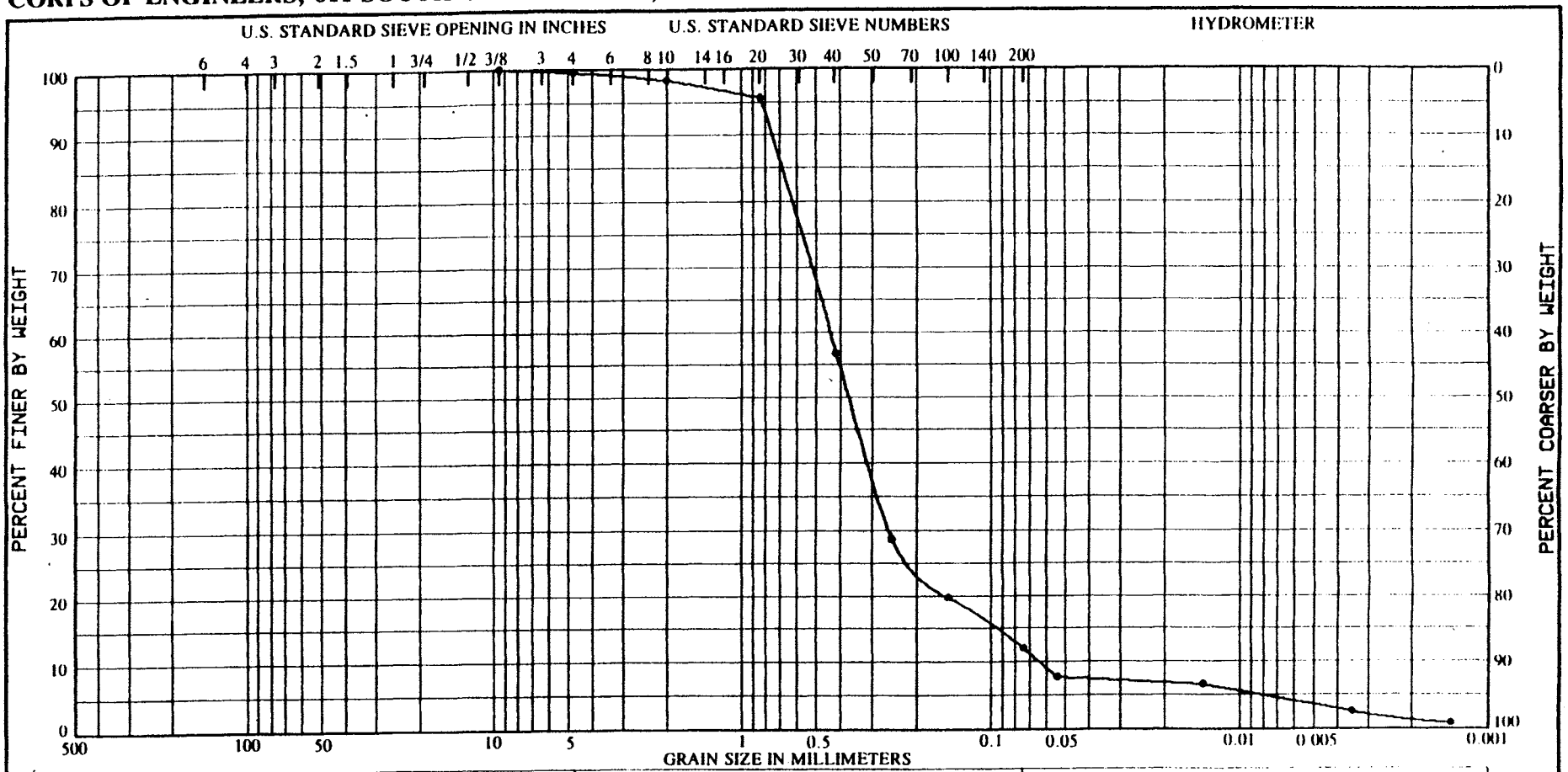
Sample No.	Elev.	Classification	Nat w%	L.L	P.I.	PI
	-0.3 / -0.5'	(VISUAL) GRAY, SILTY SAND (SM), WITH A TRACE OF MICA.				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/873A
Boring No: NJV-148
Date: 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-2.2 / -2.5'	(VISUAL) GRAY, POORLY GRADED SILTY SAND				
		(SP-SM), WITH A TRACE OF SHELL FRAGMENTS.				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/873C
Boring No NJV-148
Date 06/23/94

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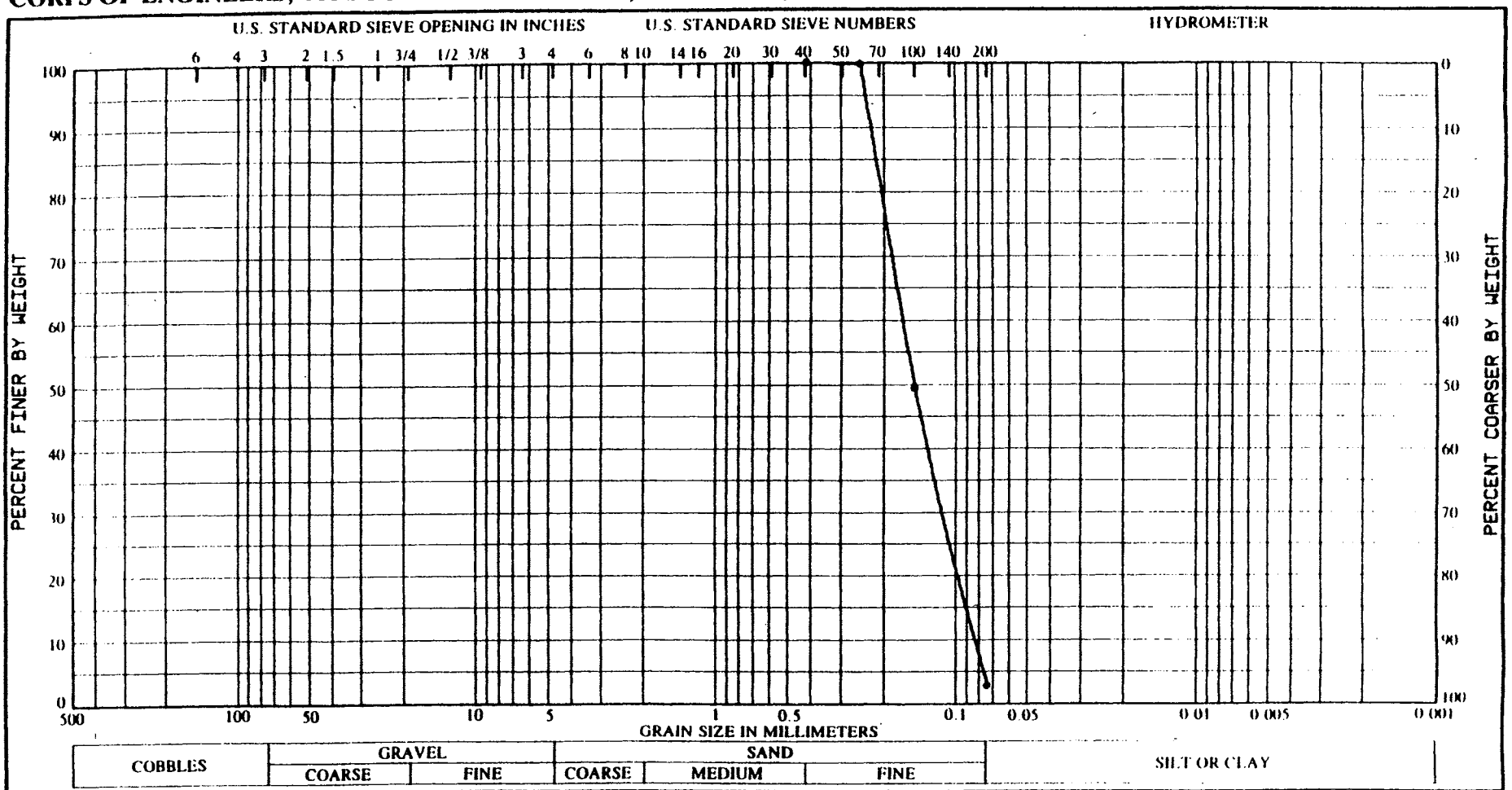
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No	Elev	Classification	Nat w %	LL	PL	PI
	-6.6 / -6.8'	(VISUAL) GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/8730
Boring No NJV-148
Date 06/23/94

GRADATION CURVES

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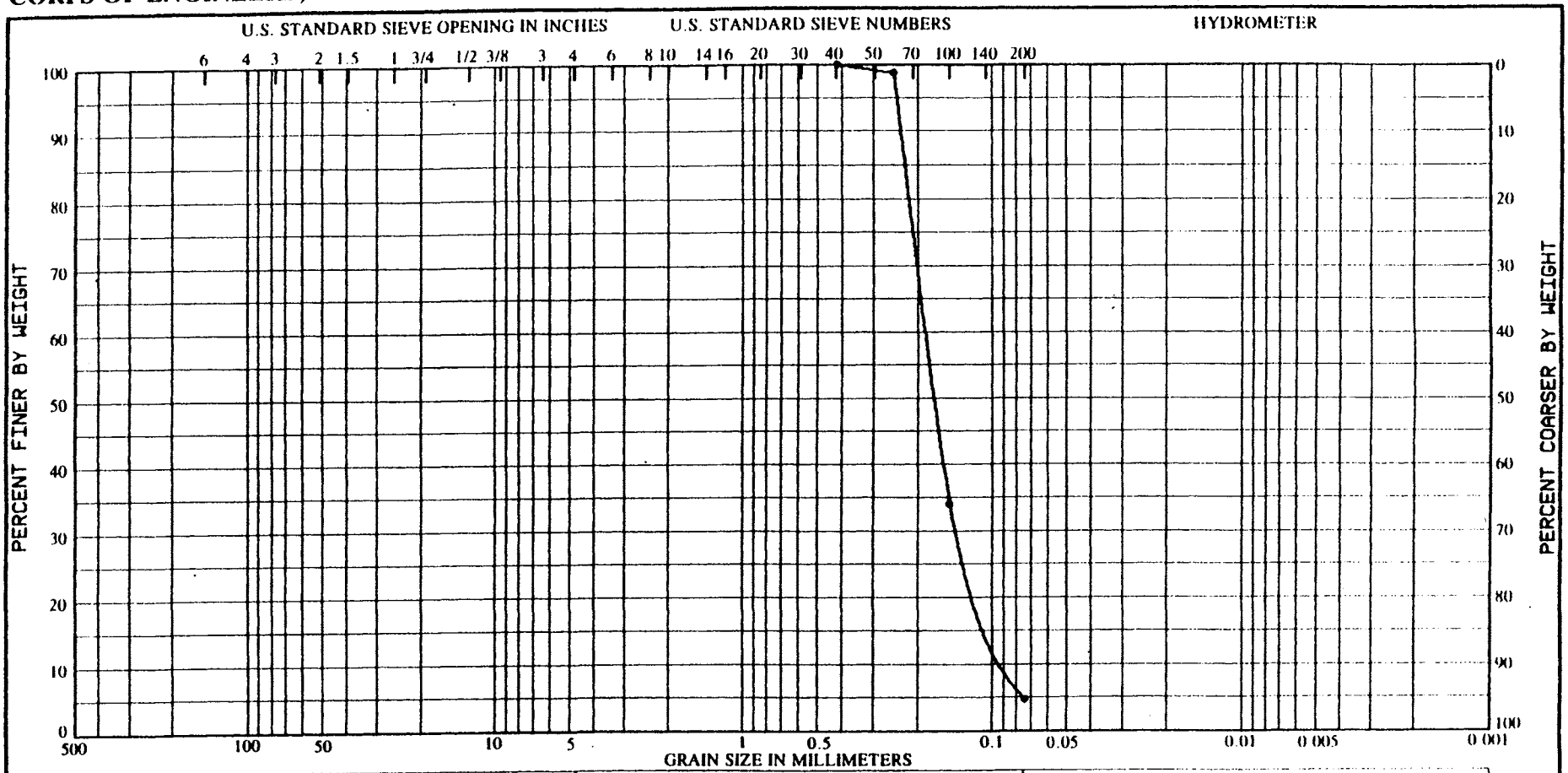
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



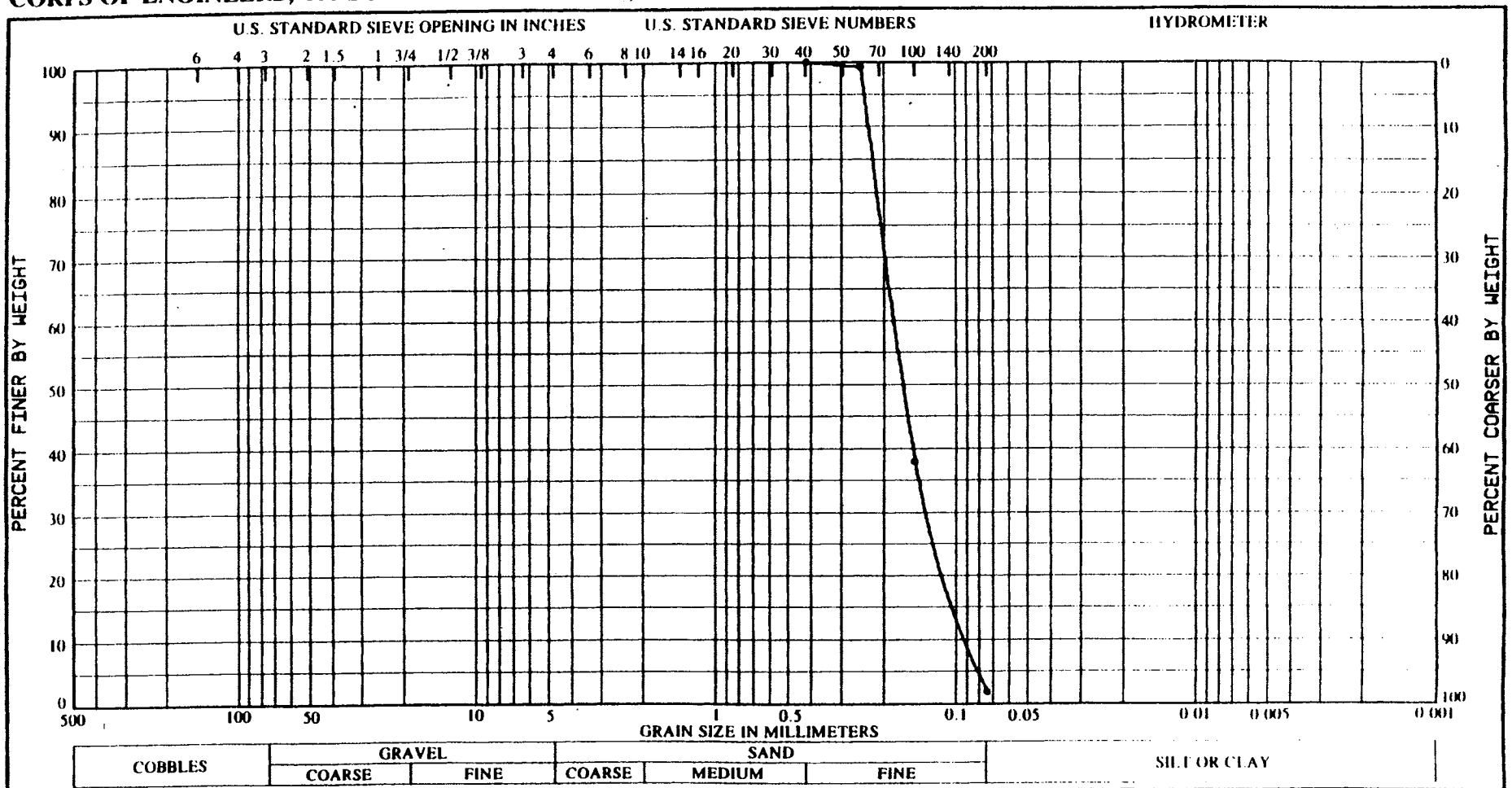
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-11.5 / -11.7'	(VISUAL) GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/873E
Boring No NJV-148
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	L.L.	Pl.	PI
	-15.2 / -15.4'	(VISUAL) GRAY, POORLY GRADED SAND (SP).				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/873F
Boring No NJV-148
Date 06/23/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*			Boring No. *NJV-149*
Location: *OFFSHORE OF NEW JERSEY*			Lab No. *184-874*
Boring Depth (ft): *16.30*	Elevation:		Work order: *7185*
Datum/Notes: *See grain size data on enclosed gradation curves.*			Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1			(A) SA 1.1/1.3'
	2		TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM).	
	3		----------	
	4			(B) MA 3.8/4.1'
-5	5		GRAY, SILTY SAND (SM).	
	6		----------	
	7		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF SHELL FRAGMENTS GRAVEL SIZES.	(C) SA 7.3/7.6'
	8		----------	
	9		GRAYISH TAN, POORLY GRADED SILTY SAND (SP-SM).	
-10	10		----------	
	11			
	12			
	13		GRAY, POORLY GRADED SILTY SAND (SP-SM).	(D) SA 12.9/13.1'
	14			
-15	15			
	16		----------	
	17			
	18			
	19			
-20				

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Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No. of

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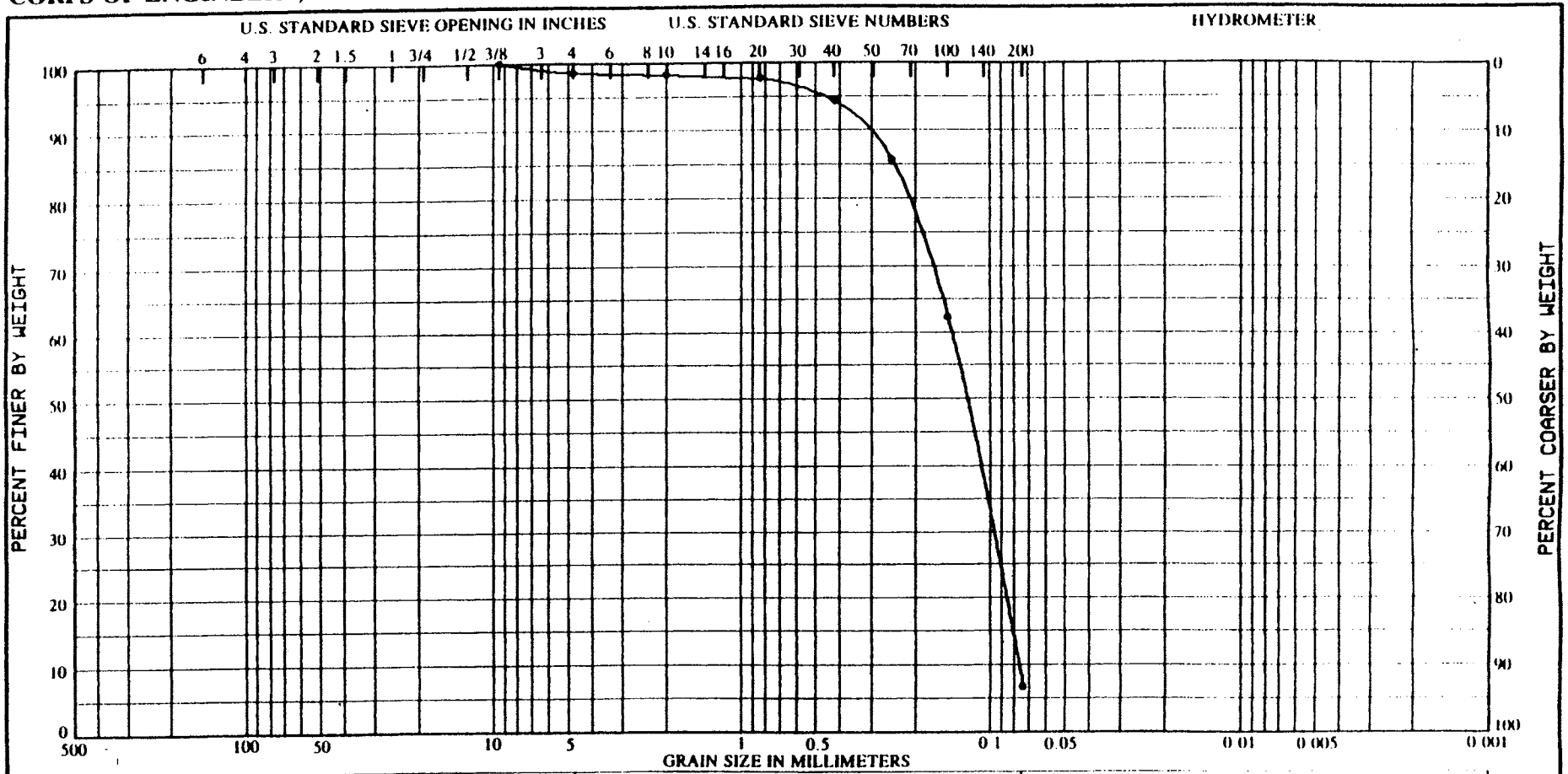
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-1.1 / -1.3'	(VISUAL) TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/874A
Boring No: NJV-149
Date: 06/23/94

GRADATION CURVES

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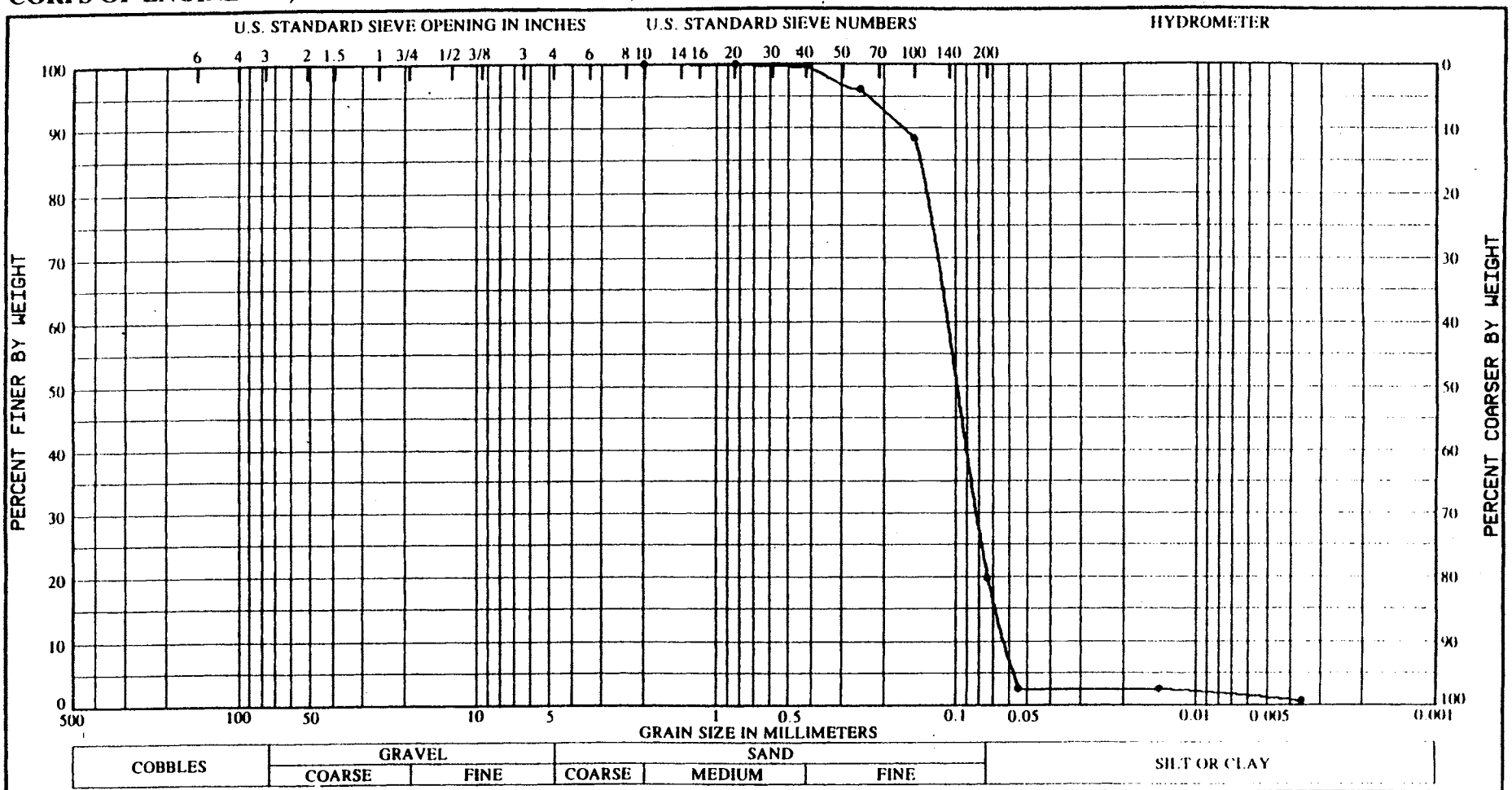
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



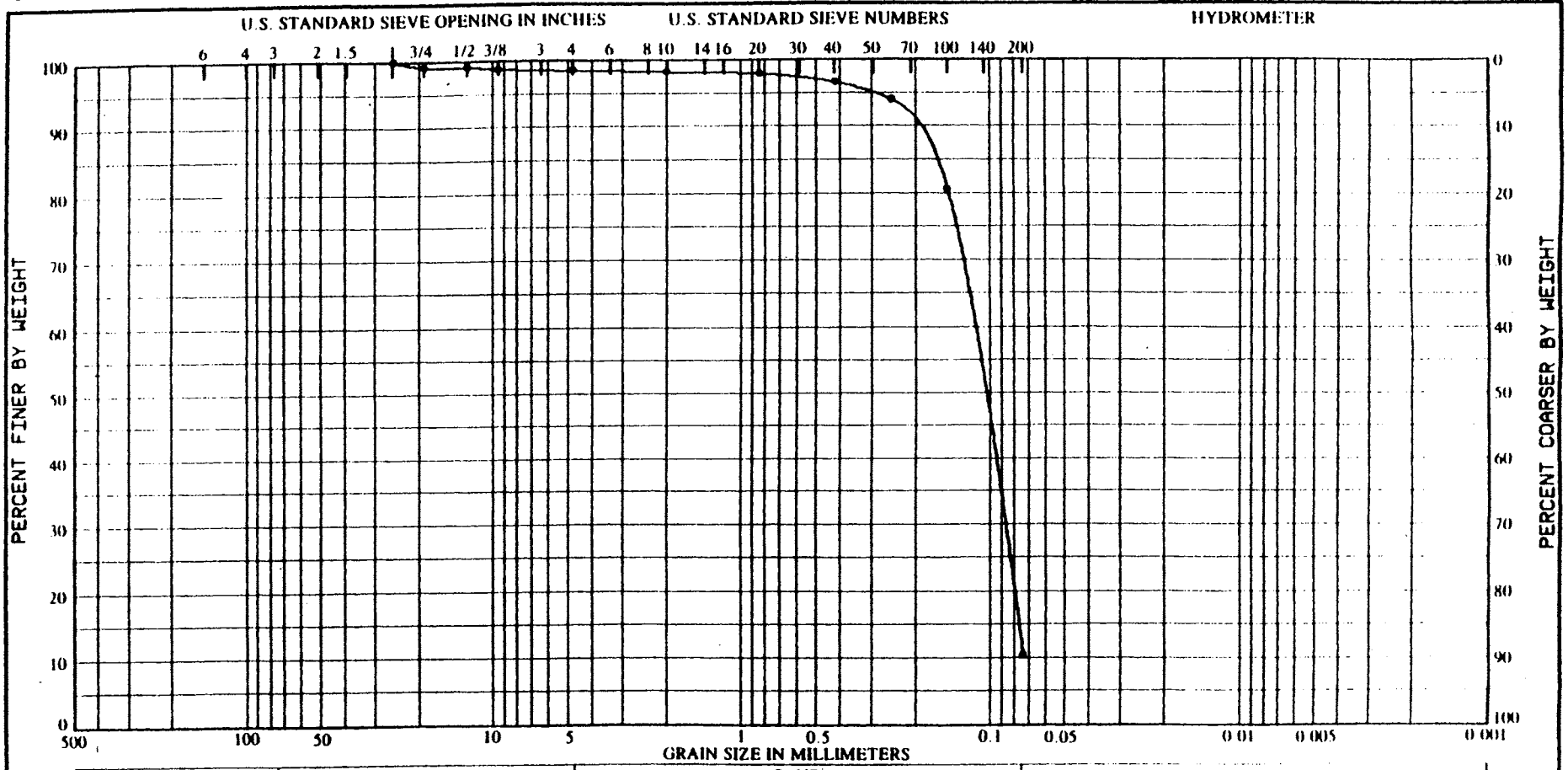
Sample No.	Elev.	Classification	Nat w%	L.L.	PL	PI
	-3.8 / -4.1'	(VISUAL) GRAY, SILTY SAND (SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/874B
Boring No NJV-149
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



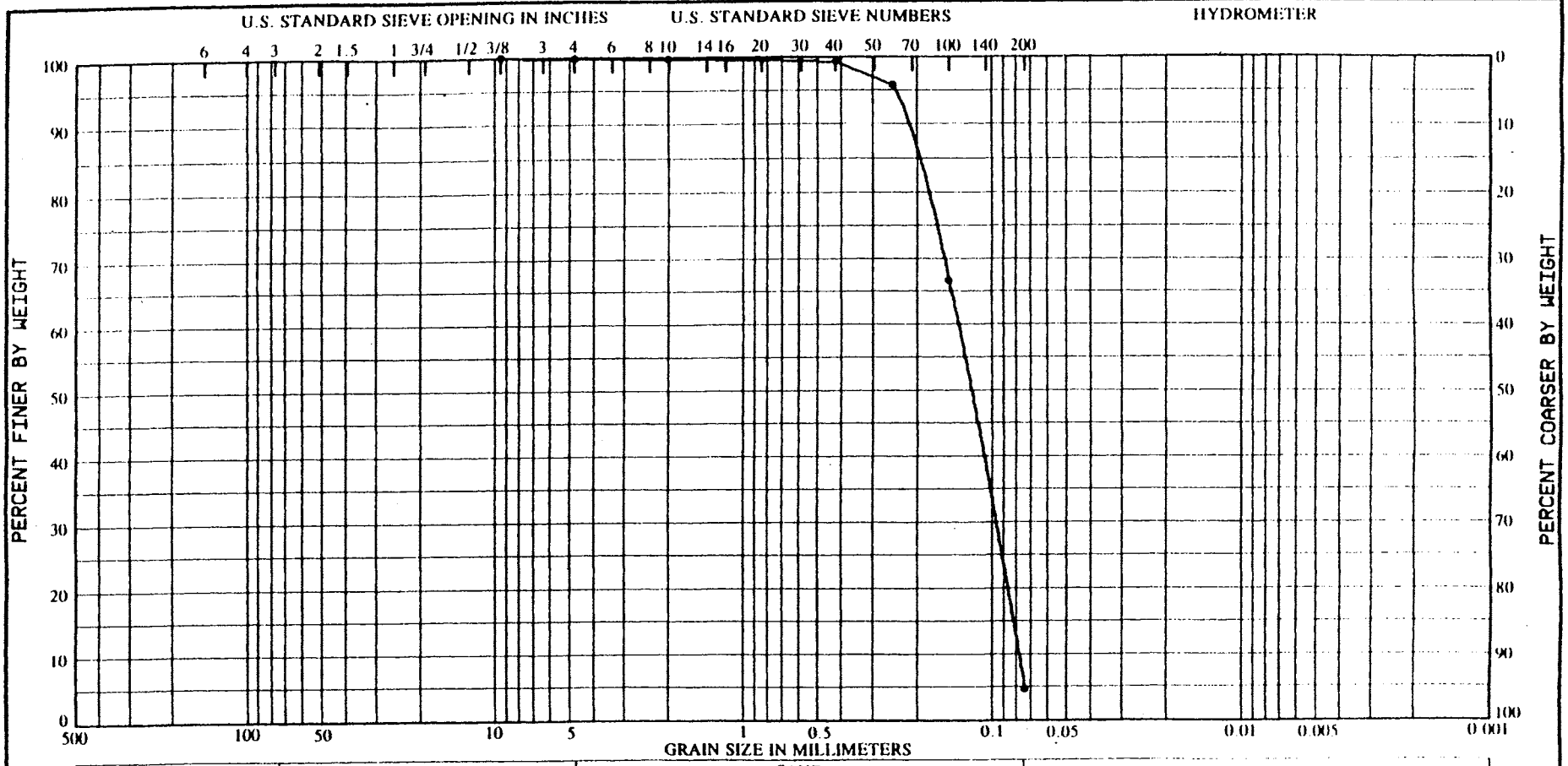
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-7.3 / -7.6'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF GRAVEL AND SAND SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/874C
Boring No NJV-149
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No	Elev.	Classification	Nat w%	LL	PL	PI
	-12.9 / -13.1'	(VISUAL) GRAY, POORLY GRADED SAND (SP).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/874D
Boring No NJV-149
Date 06/23/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No.	*NJV-150*
Location: *OFFSHORE OF NEW JERSEY*		Lab No.	*184-875*
Boring Depth (ft): *14.40*	Elevation:	Work order:	*7185*
Datum: Notes: *See grain size data on enclosed gradation curves.*		Requisition:	*NAPEN-94-612*

Elev (feet)	Depth (feet)	Leg-end	Material Description	Comments
0				
	1		TAN, POORLY GRADED SAND (SP).	
	2			(A) SA 1.6/1.9'
	3		----------	
	4			(B) SA 4.0/4.3'
-5	5			
	6			
	7			
	8			(C) SA 7.5/7.8'
	9		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH OCCASIONAL POCKETS OF SHELL FRAGMENTS.	
-10	10			
	11			
	12			(D) SA 11.6/11.9'
	13			
	14		----------	
-15	15			
	16			
	17			
	18			
	19			
-20				

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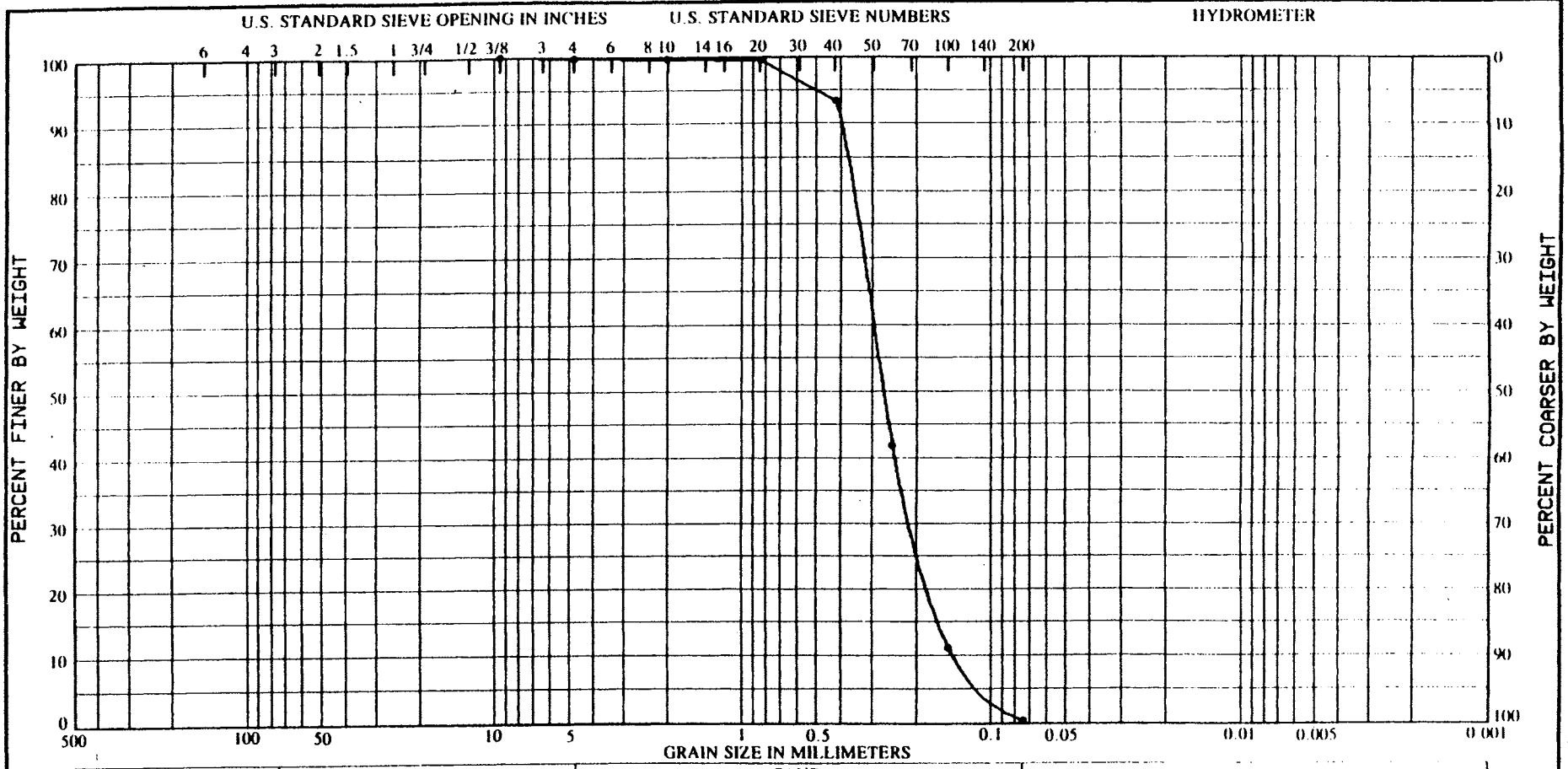
Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet 1 of 1

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

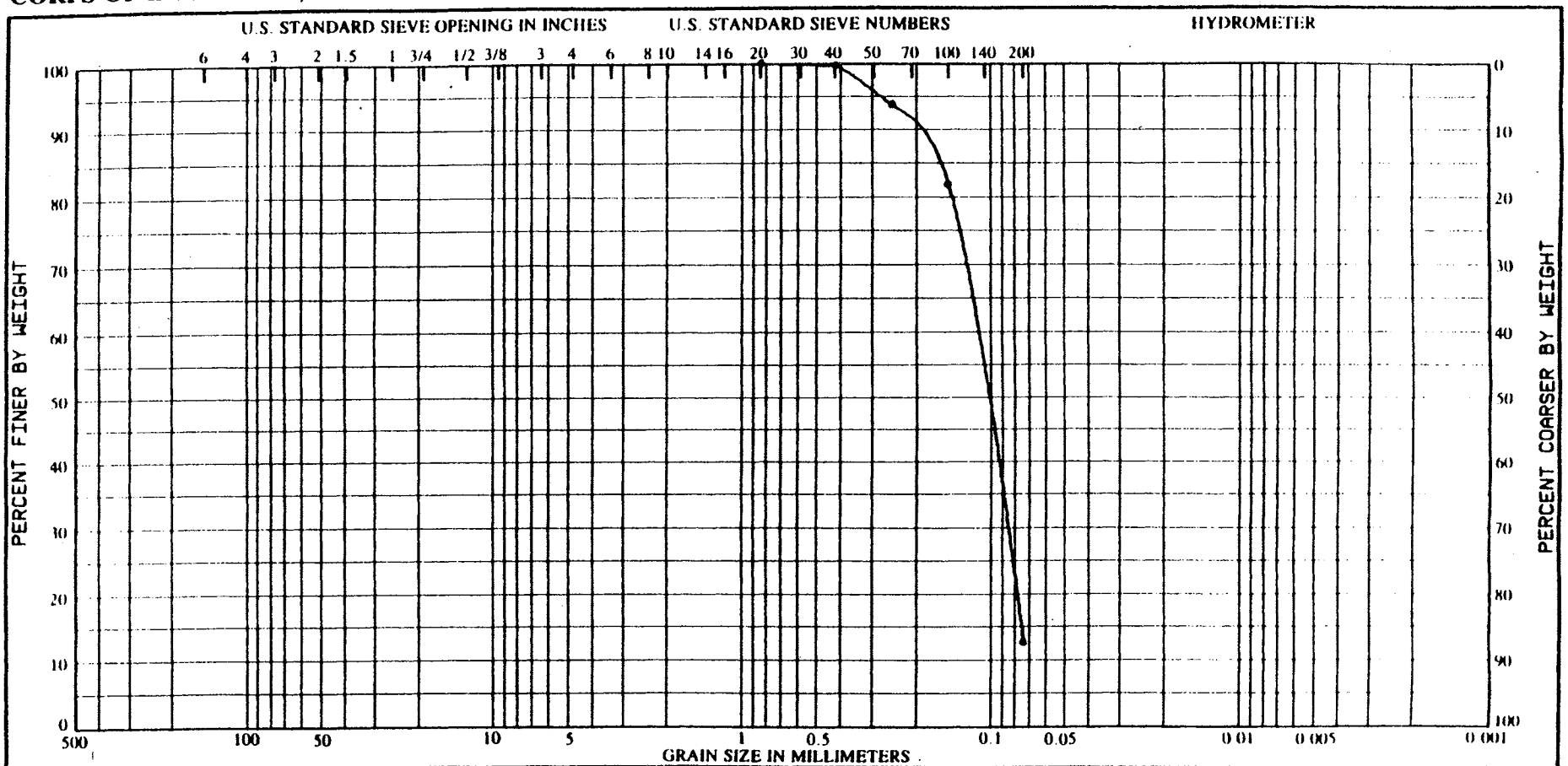
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-1.6 / -1.9'	(VISUAL) TAN, POORLY GRADED SAND (SP).				

GRADATION CURVES

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/875A
Boring No: NJV-150
Date: 06/24/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PI	PI
	-4.0 / -4.3'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/875B
Boring No NJV-150
Date 06/24/94

GRADATION CURVES

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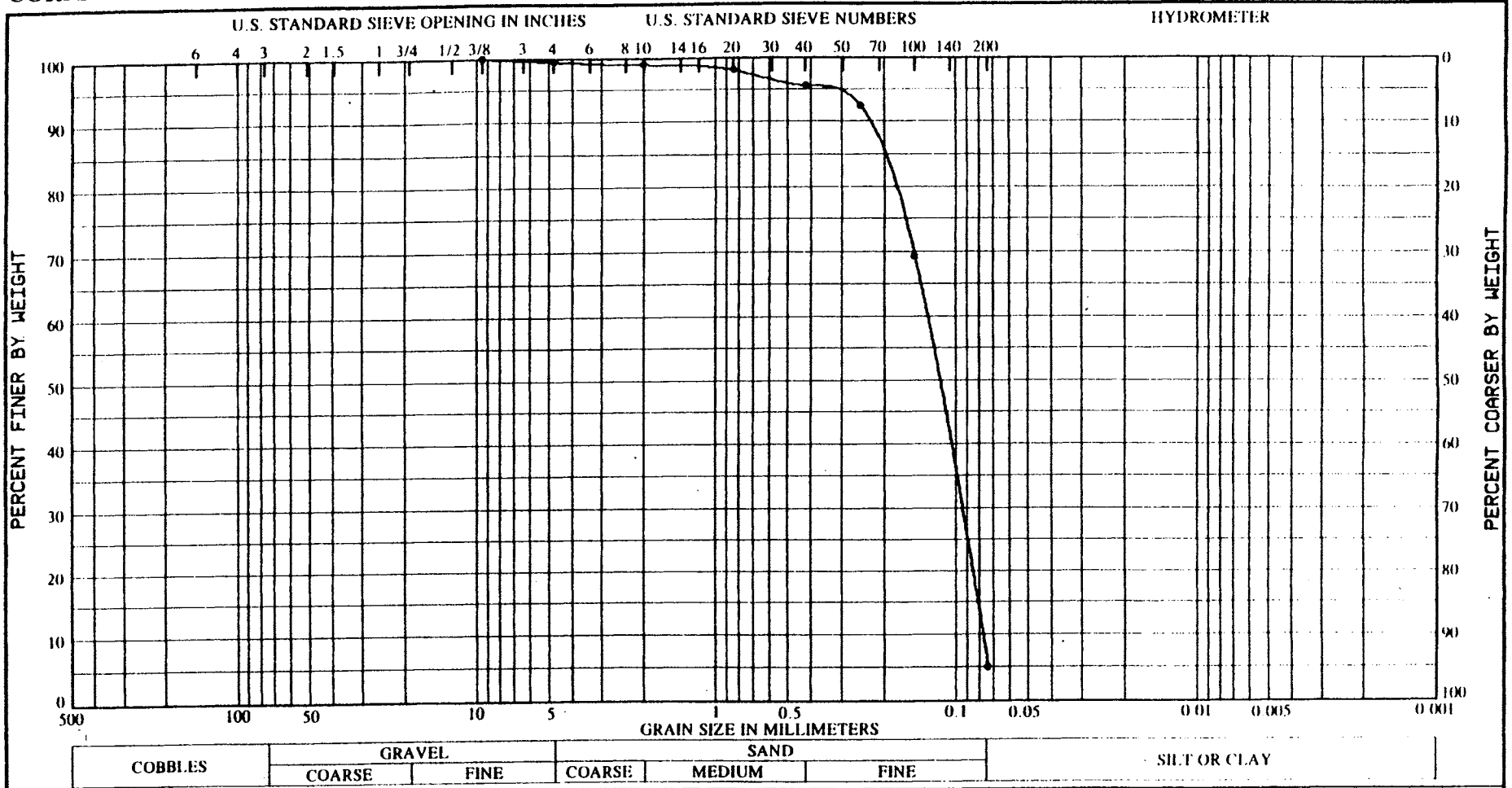
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



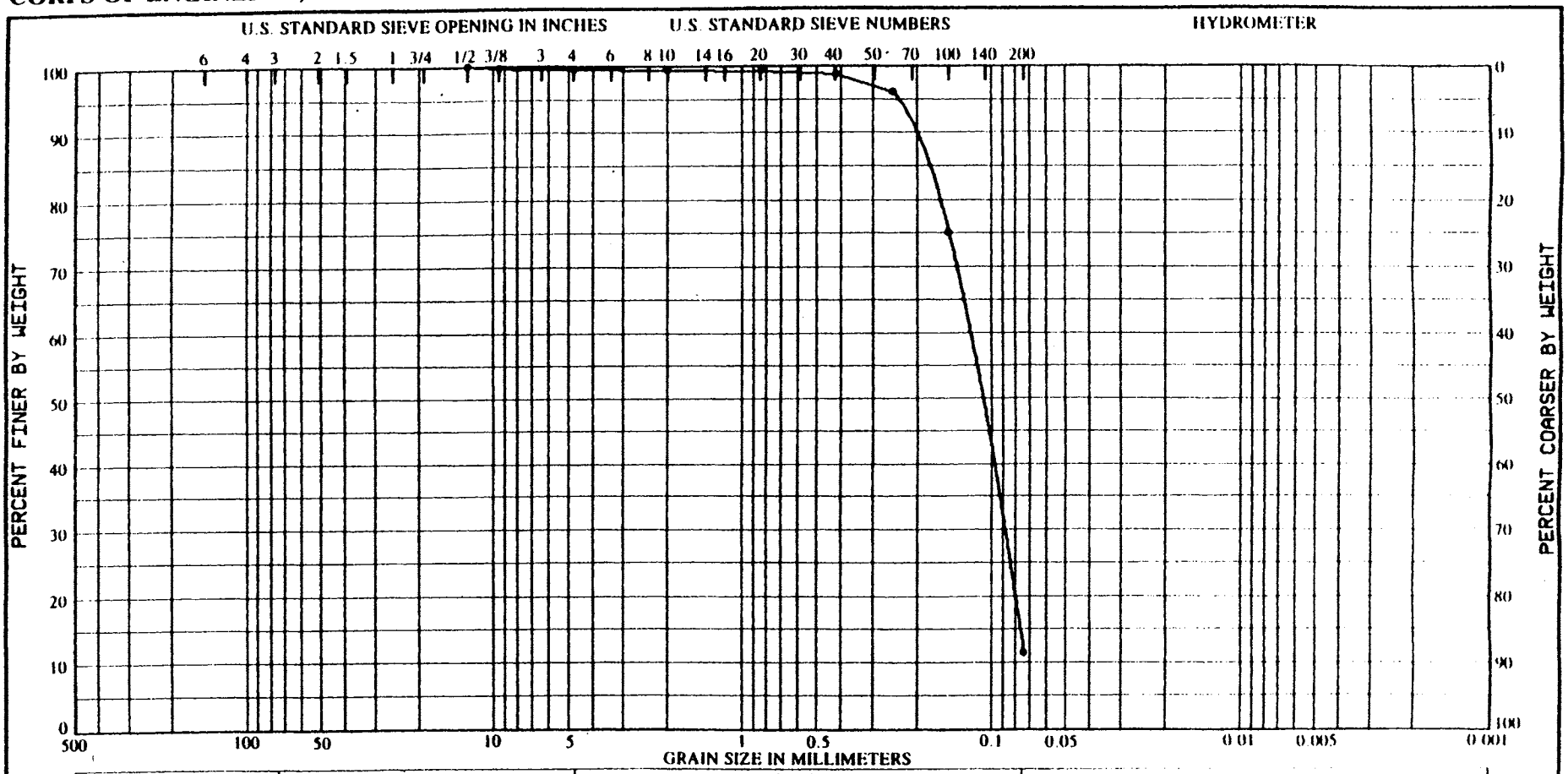
Sample No.	Elev.	Classification	Nat w%	L.L.	Pl.	Pl
	-7.5 / -7.8'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/875C
Boring No NJV-150
Date 06/24/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	L.L.	PL	PI
	-11.6 / -11.9'	(VISUAL) GRAY, POORLY GRADED SILTY SAND				
		(SP-SM), WITH A TRACE OF GRAVEL SIZE SHELL.				

GRADATION CURVES

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/875D
Boring No NJV-150
Date 06/24/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*			Boring No. *NJV-151*
Location: *OFFSHORE OF NEW JERSEY*			Lab No. *184-876*
Boring Depth (ft): *16.90*	Elevation:		Work order: *7185*
Datum: Notes: *See grain size data on enclosed gradation curves.*			Requisition: *NAPEN-94-612*

Elev. (feet)	Depth (feet)	Legend	Material Description	Comments
0				
	1			(A) SA 1.2/1.4'
	2		TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH POCKETS OF TAN (SP).	
	3			
	4			
-5	5		----------	
			DK. GRAY, SILTY SAND (SM), WITH ORGANIC MATTER.	
	6		----------	
			TAN, POORLY GRADED SAND (SP).	
	7		----------	(B) MA 6.8/7.1'
			DK. GRAY, SILTY SAND (SM), WITH PLASTIC FINES.	
	8		----------	
	9			
-10	10			
	11			(C) SA 11.2/11.5'
	12		GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF SHELL FRAGMENTS.	
	13			
	14			(D) SA 14.2/14.5'
-15	15			
	16			
	17		----------	
	18			
	19			
-20				

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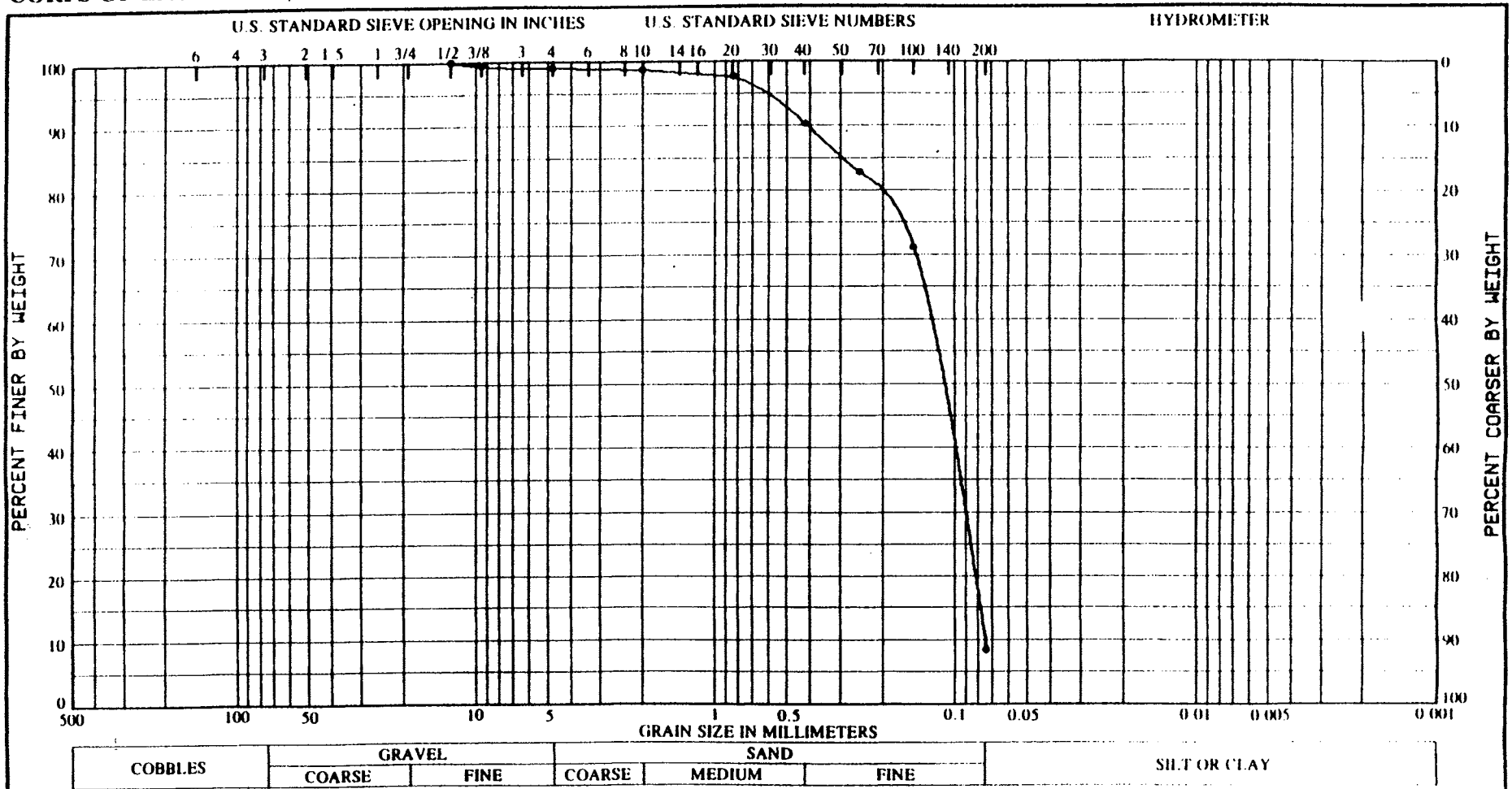
Date: *07/22/94* LABORATORY LOG AND SAMPLE DATUM Sheet No. 1 of 1

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-1.2 / -1.4'	(VISUAL) TAN AND GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/876A
Boring No NJV-151
Date 06/24/94

GRADATION CURVES

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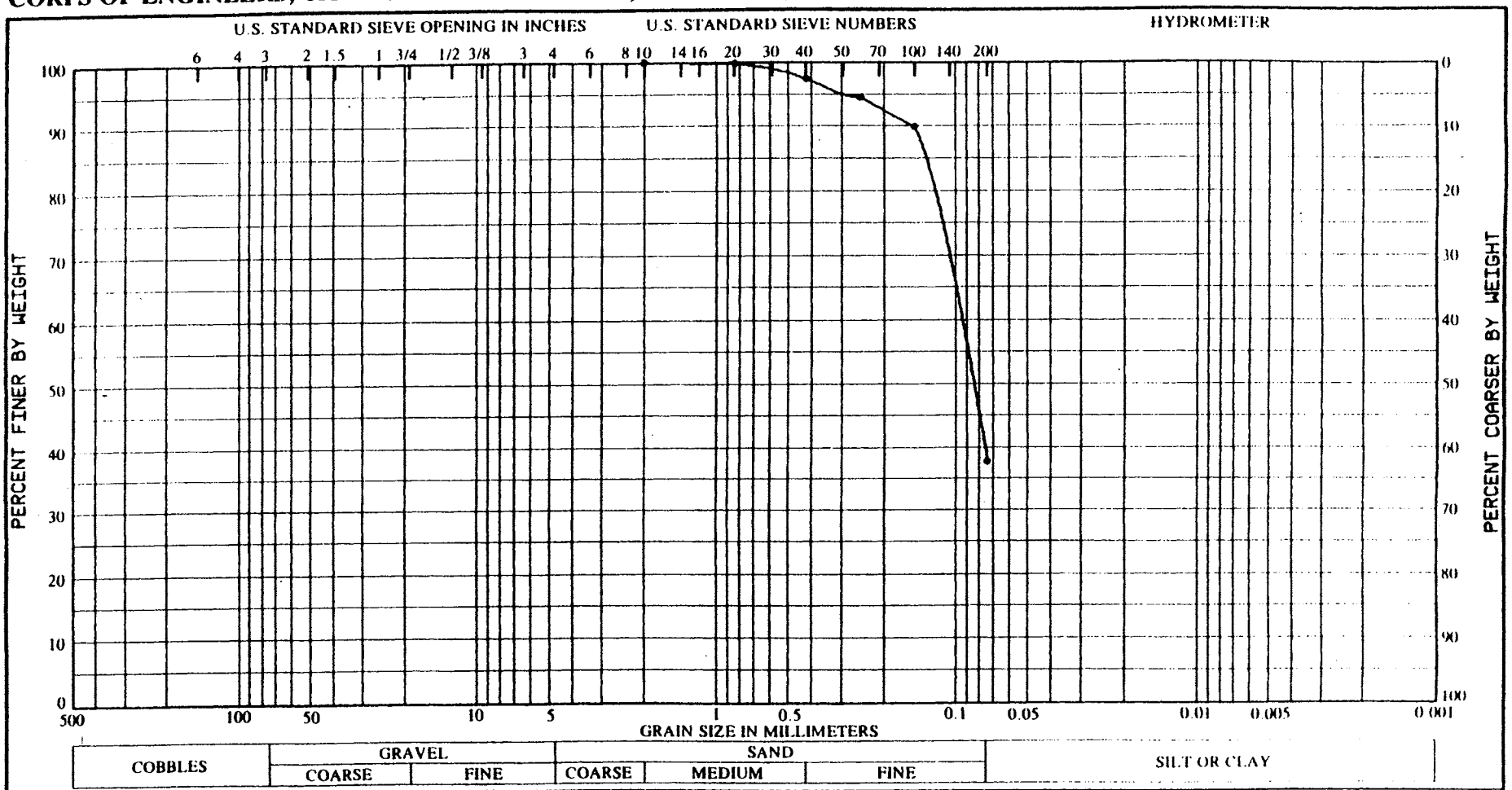
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



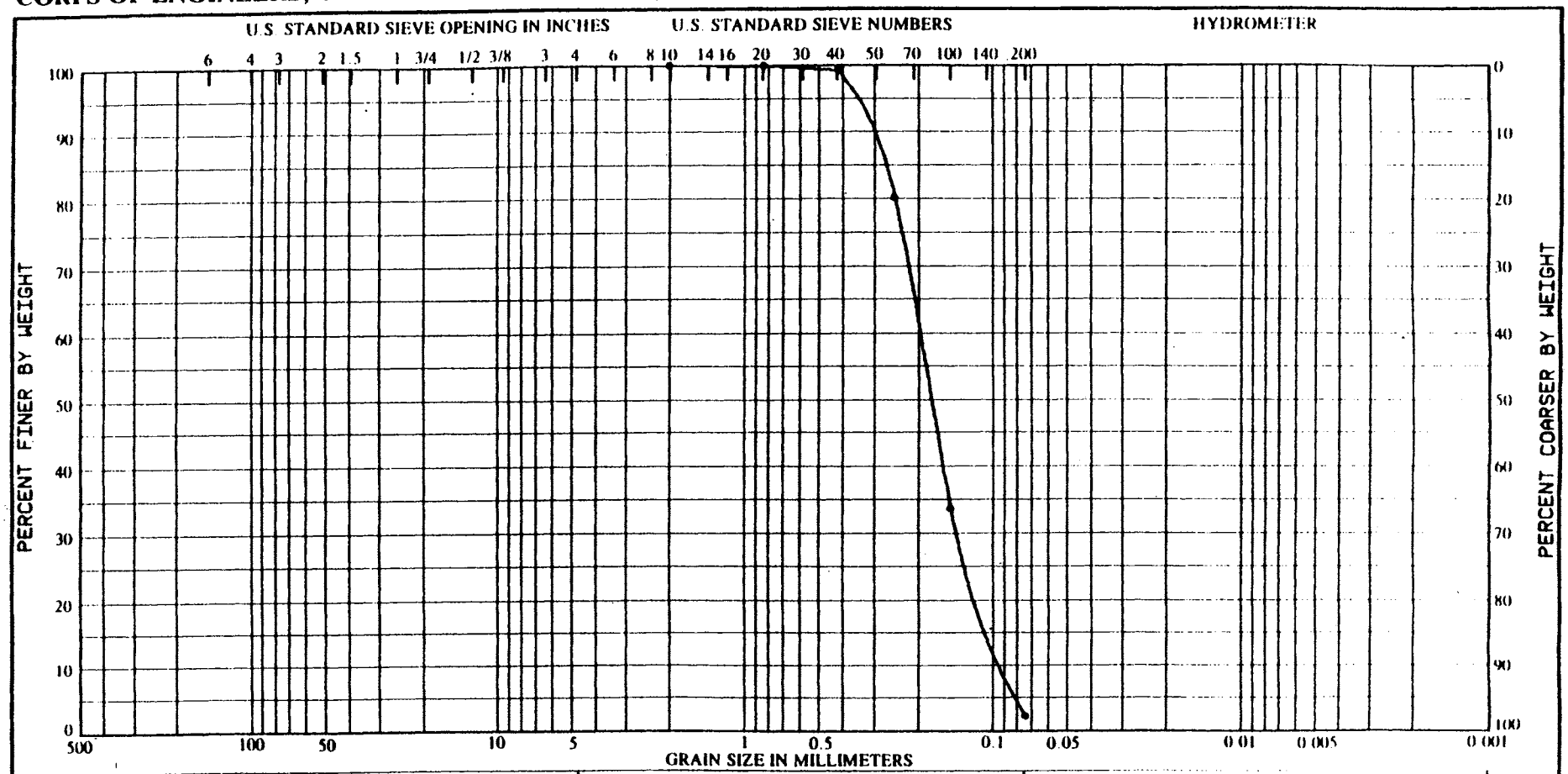
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-6.8 / -7.1'	(VISUAL) DK. GRAY, SILTY SAND (SM).				

GRADATION CURVES

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/876B
Boring No: NJV-151
Date: 06/24/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



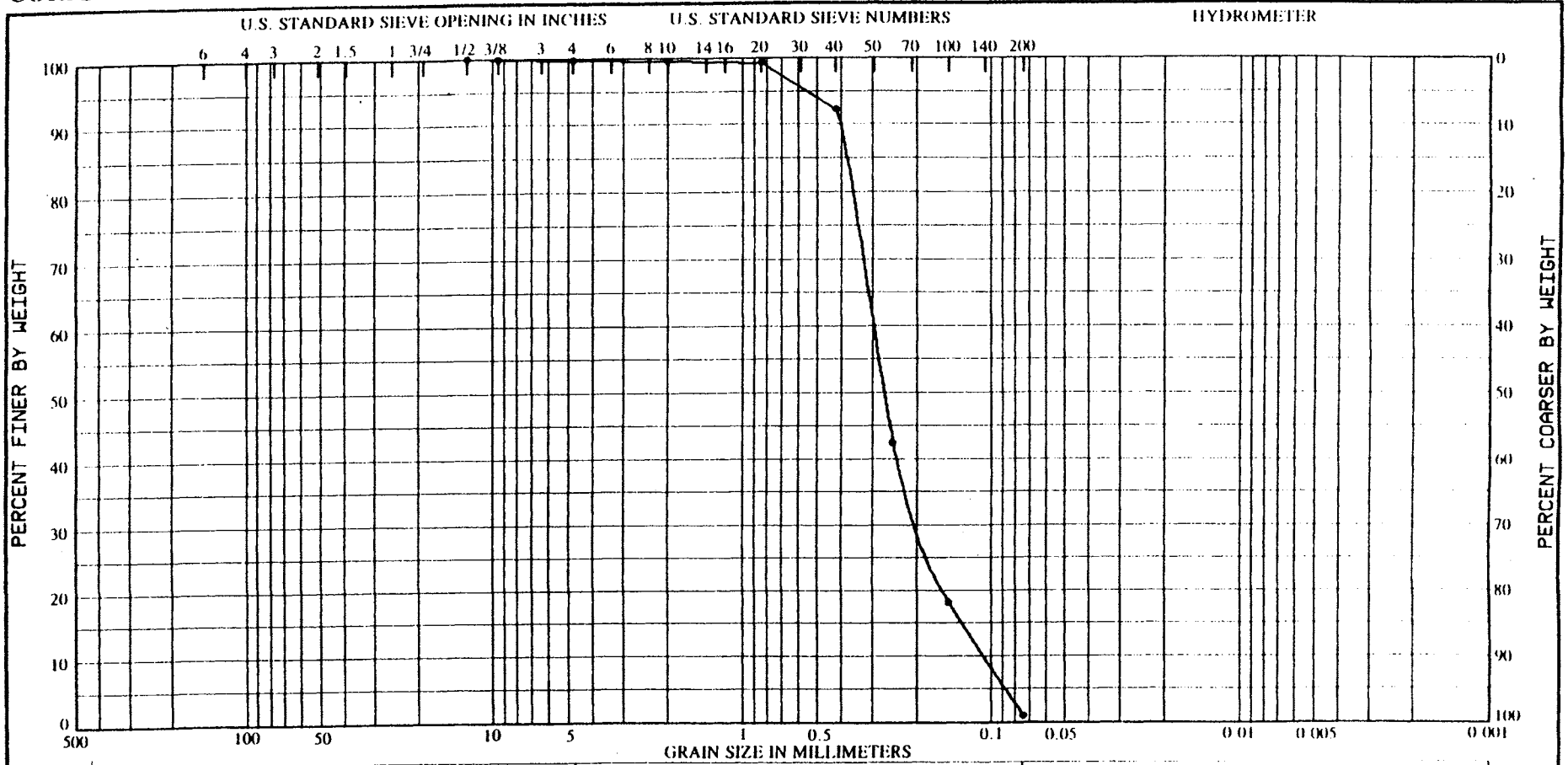
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-11.2 / -11.5'	(VISUAL) GRAY, POORLY GRADED SAND				
		(SP).				

Project: VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No: 184/876C
Boring No: NJV-151
Date: 06/24/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-14.2 / -14.5'	(VISUAL) GRAY, POORLY GRADED SAND (SP), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/876D
Boring No: NJV-151
Date: 07/22/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *VIBRACORE SEDIMENT SAMPLES*		Boring No.	*NJV-152*
Location: *OFFSHORE OF NEW JERSEY*		Lab No.	*184 877*
Boring Depth (ft): *16.40*	Elevation:	Work order:	*7185*
Datum: Notes: *See grain size data on enclosed gradation curves.*		Requisition:	*NAPEN-94-612*

Elev (feet)	Depth (feet)	Legend	Material Description	Comments
0				
	1			
	2			
	3		TAN AND GRAY, POORLY GRADED SAND (SP).	(A) SA 2.8/3.1'
	4			
-5	5			
	6			

	7			(B) SA 6.6/6.9'
	8			
	9			
-10	10			
	11		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH OCCASIONAL POCKETS OF SHELL FRAGMENTS.	(C) MA 10.6/10.9'
	12			
	13			
	14			
-15	15			(D) SA 14.6/14.9'
	16			

	17			
	18			
	19			
-20				

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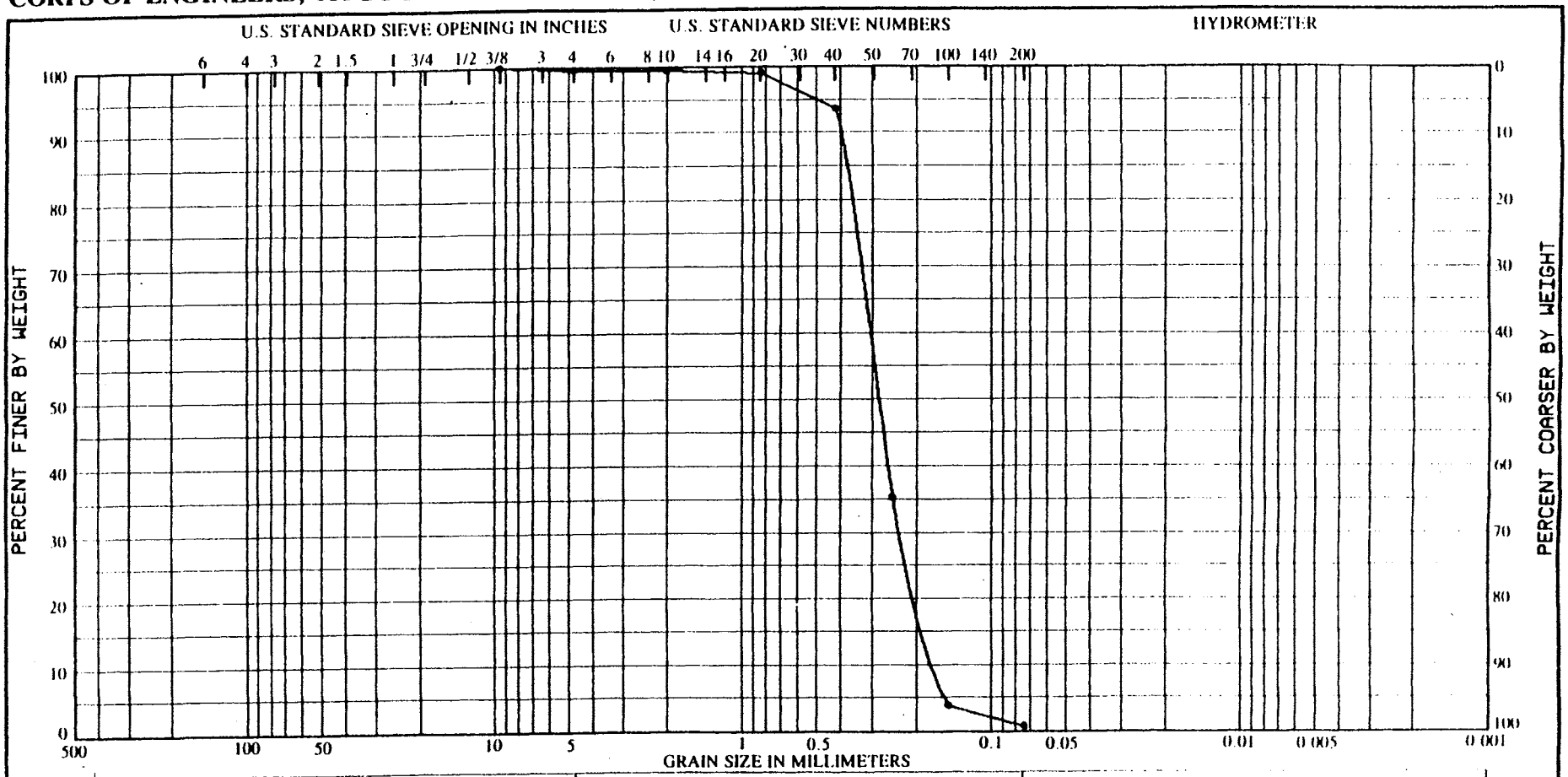
Date: 07/22/94 LABORATORY LOG AND SAMPLE DATUM Sheet 1

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

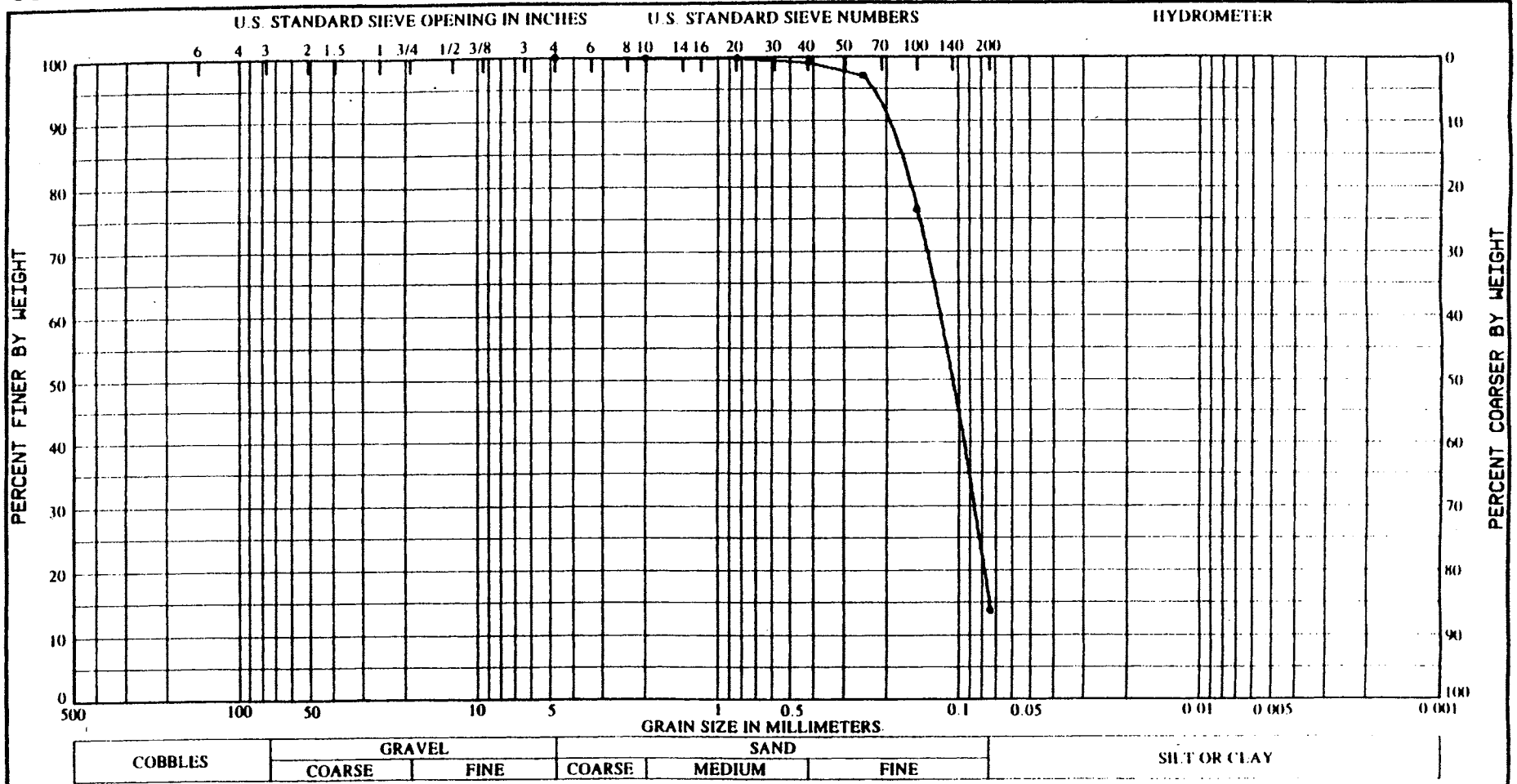
Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-2.8 / -3.1'	(VISUAL) TAN AND GRAY, POORLY GRADED SAND (SP).				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/877a
Boring No: NJV-152
Date: 06/24/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



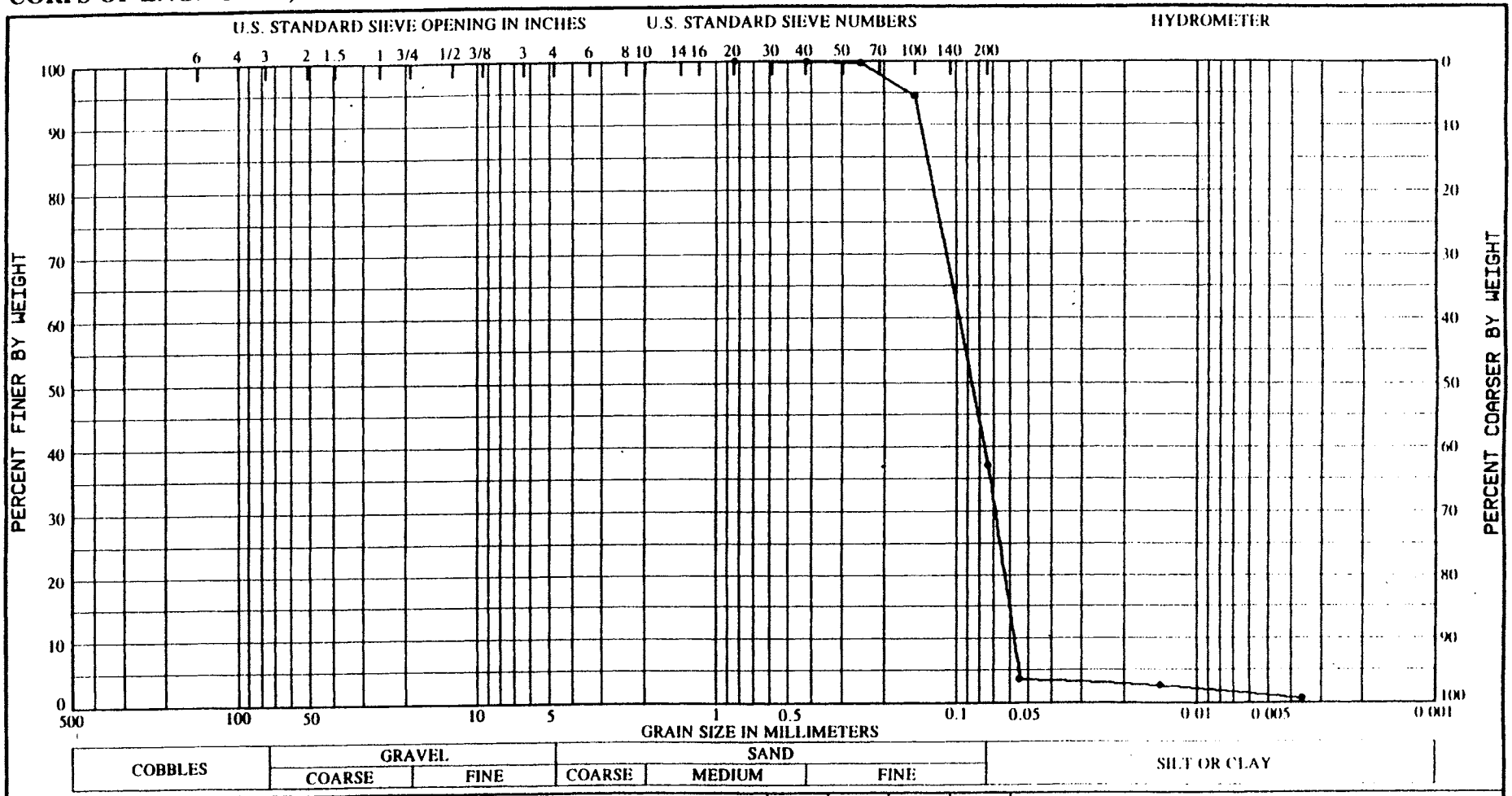
Sample No.	Elev.	Classification	Nat w%	L.L.	Pl.	PI
	-6.6 / -6.9'	(VISUAL) GRAY, SILTY SAND (SM).				

Project VIBRACORE SEDIMENT SAMPLES
OFFSHORE OF NEW JERSEY
Lab No 184/877b
Boring No NJV-152
Date 06/24/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



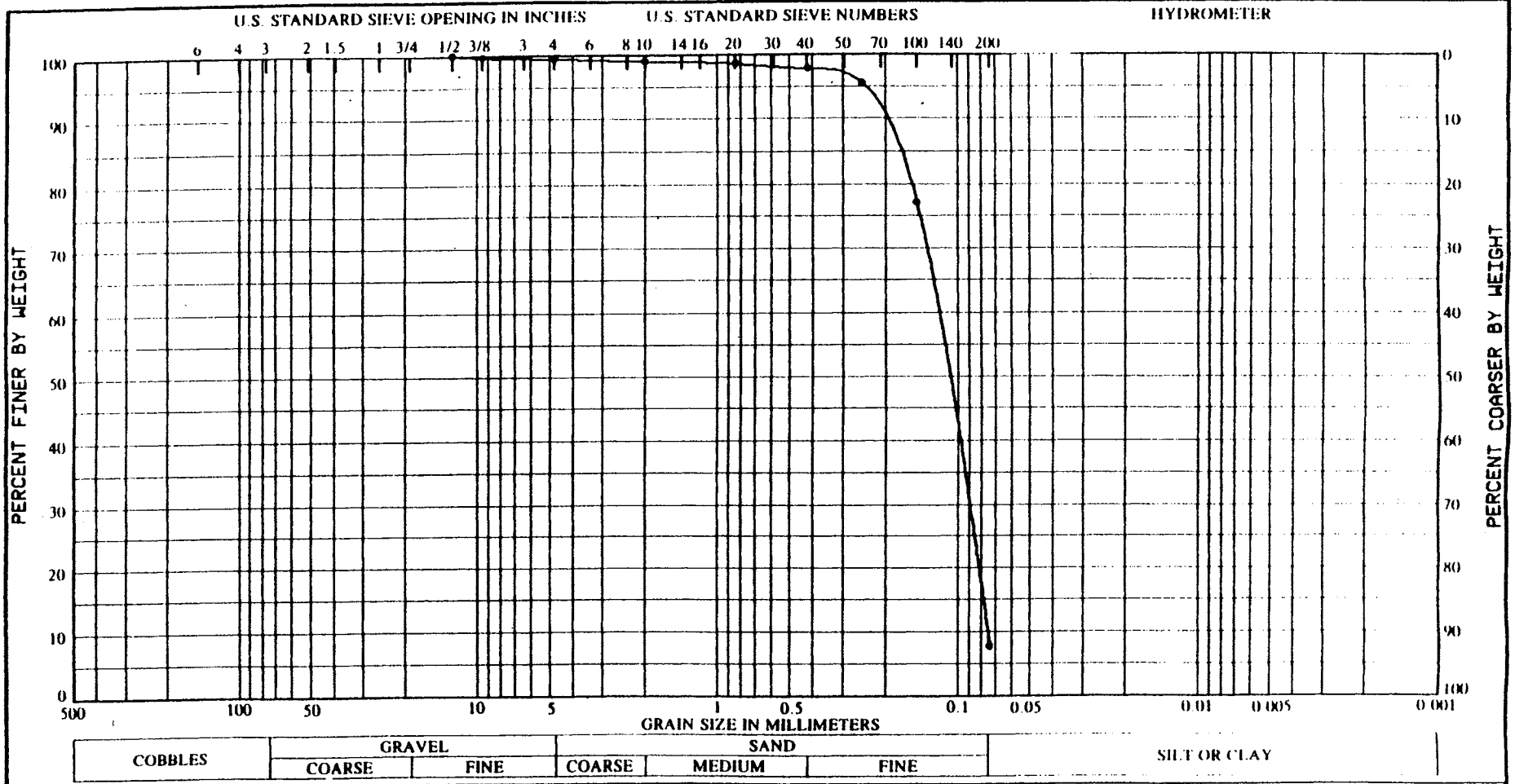
Sample No.	Elev.	Classification	Nat w%	L.L.	P.L.	P.I.
	-10.6 / -10.9'	(VISUAL) GRAY, SILTY SAND (SM), WITH A TRACE OF MICA.				

Project: VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No: 184/877c
Boring No: NJV-152
Date: 06/24/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7185
REQUISITION: NAPEN-94-612



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev.	Classification	Nat w%	LL	PL	PI
	-14.6 / -14.9	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF GRAVEL SIZE SHELL.				

Project VIBRACORE SEDIMENT SAMPLES OFFSHORE OF NEW JERSEY
Lab No 184/877d
Boring No NJV-152
Date 06/24/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *DELAWARE BAY*		Boring No:	*NJV-182*
Location: *VIBRA CORE SAMPLES*		Lab No:	*184 963*
Boring Depth (ft): *18.80*	Elevation:	Work order:	*7476*
Datum Notes: *See grain size data on enclosed gradation curves.*		Requisition:	*CENAP-95-707*

Elev (feet)	Depth (feet)	Legend	Material Description	Comments
	1			
	2			SA D-1 2.1 - 2.6 WET DEN = [illegible] DRY DEN = 110.3 MC = [illegible]
	3			
	4			SA (A) 4.2 - 4.5'
	5			
	6			
	7			
	8			SA D-2 7.5 - 8.0' WET DEN = [illegible] DRY DEN = 109.7 MC = [illegible]
	9			
	10		TAN & LT. GRAY, POORLY GRADED SAND (SP), WITH OCCASIONAL POCKETS OF POORLY GRADED SILTY SAND (SP-SM) AND TRACE OF GRAVEL SIZES AND DECOMPOSED SHELL FRAGMENTS.	SA (B) 9.6 - 9.9'
	11			
	12			
	13			
	14			SA D-3 14.0 - 14.5' WET DEN = 130.1. DRY DEN = 108.0 MC =
	15			SA (C) 15.5 - 15.7'
	16			
	17			SA D-4 17.3 - 17.8' WET DEN = 123.6. DRY DEN = 103.2 MC =
	18			
	19		----------	

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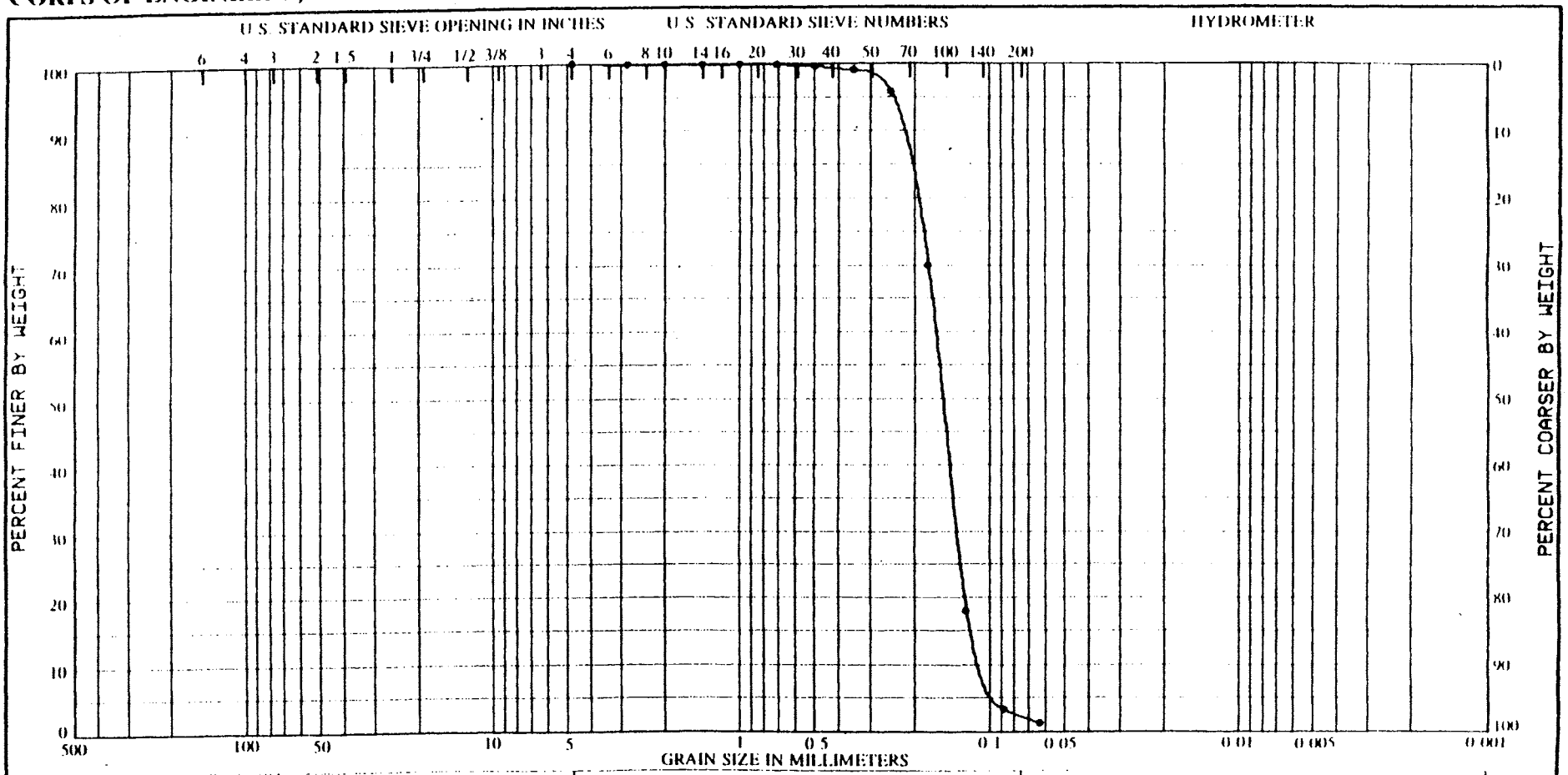
Date: *03/13/95* LABORATORY LOG AND SAMPLE DATUM Sheet [illegible]

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



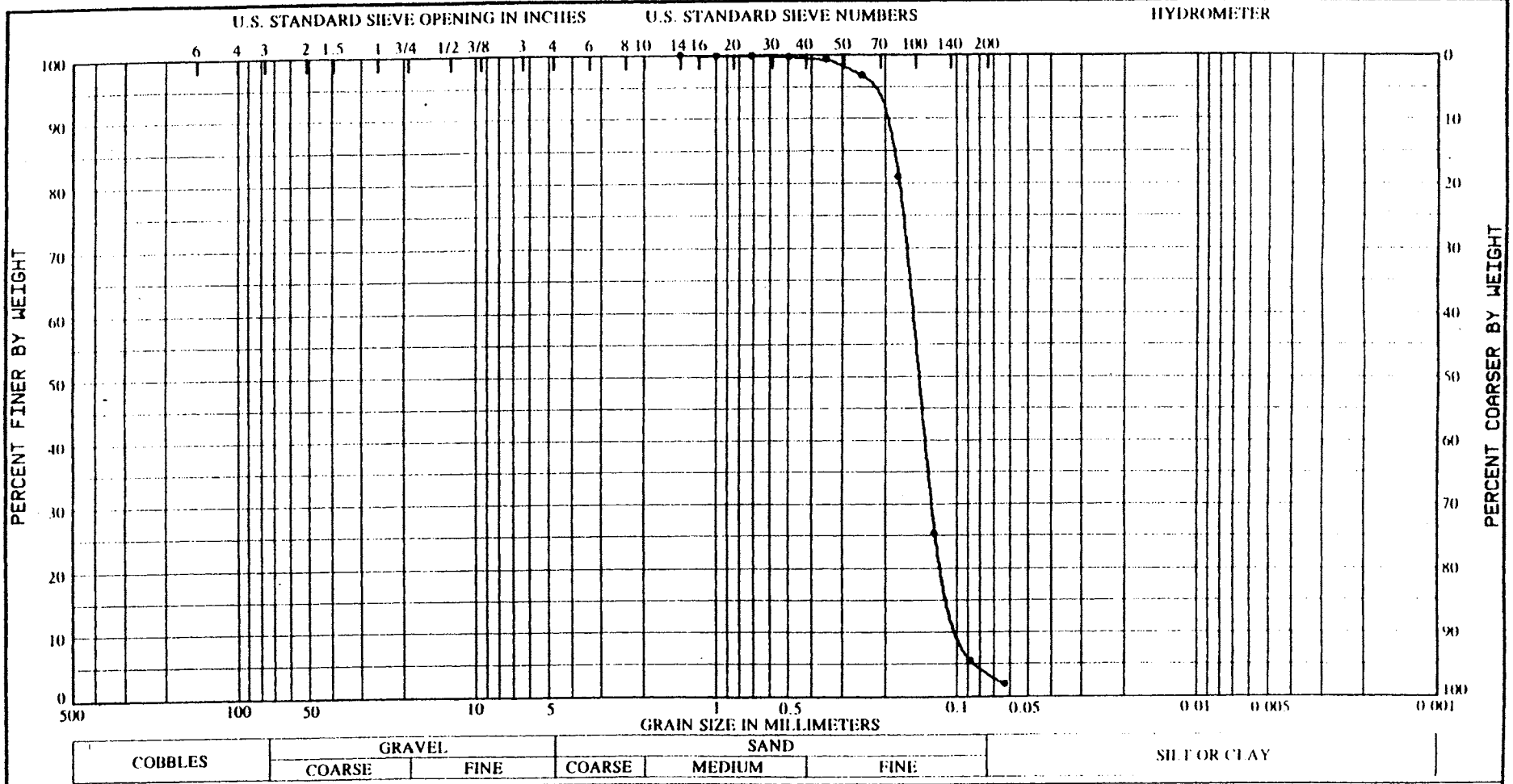
Sample No	Depth	Classification	Nat w%	LL	PL	PI
D-1	21 26'	(VISUAL) TAN & LT. GRAY, POORLY GRADED SAND (SP).	20 3			
		SP. GRAVITY = 2.67				
		WET DENSITY = 132.7 PCF.				
		DRY DENSITY = 110.3 PCF.				

Project DELAWARE BAY
VIBRA CORE SAMPLES
Lab No 184-963
Boring No NJV-182
Date 03-13-95

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
A	4.2-4.5'	(VISUAL) TAN & LT. GRAY, POORLY GRADED SAND (SP).				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/963A
Boring No: NJV-182
Date: 03/13/95

GRADATION CURVES

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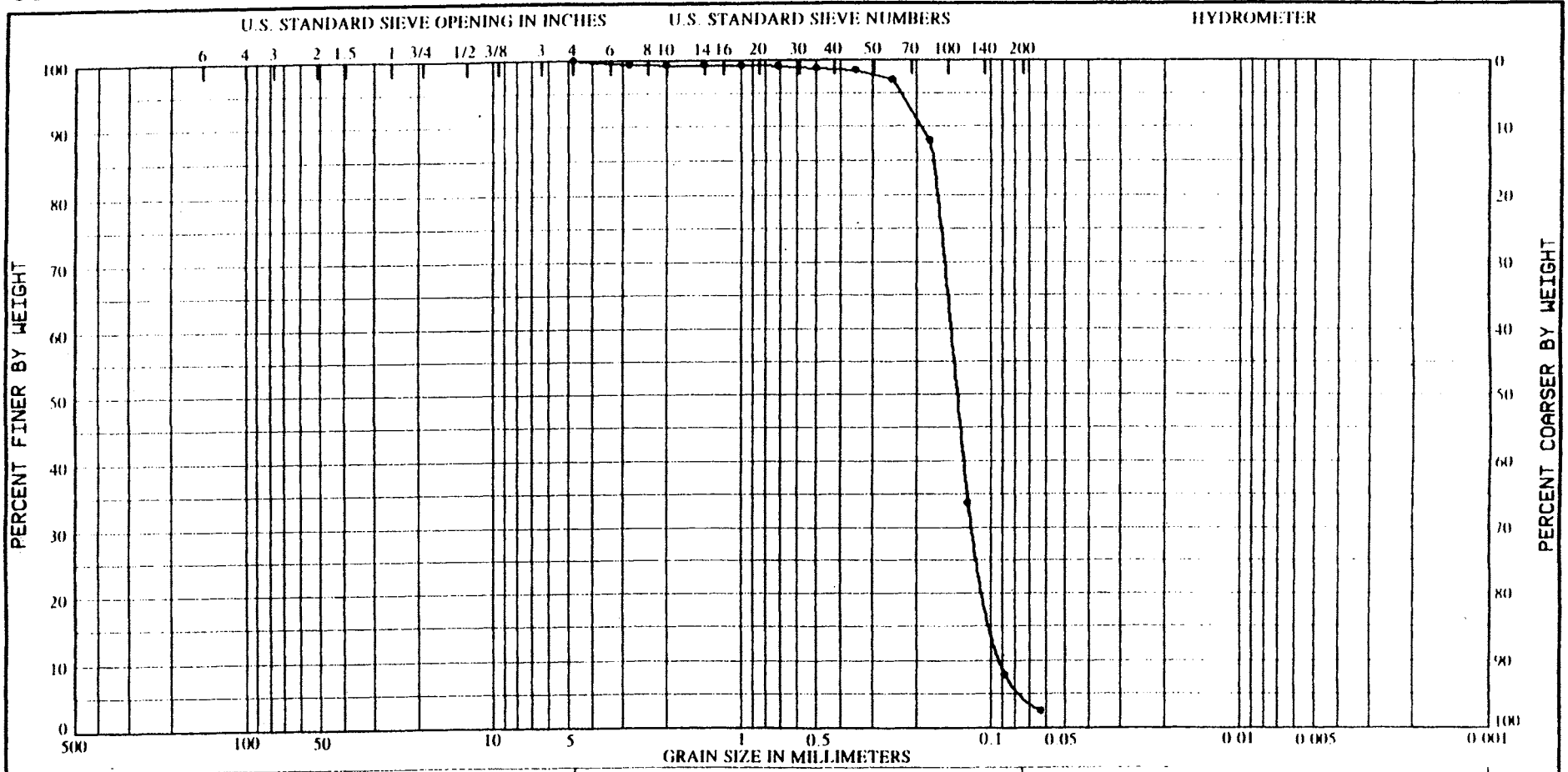
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



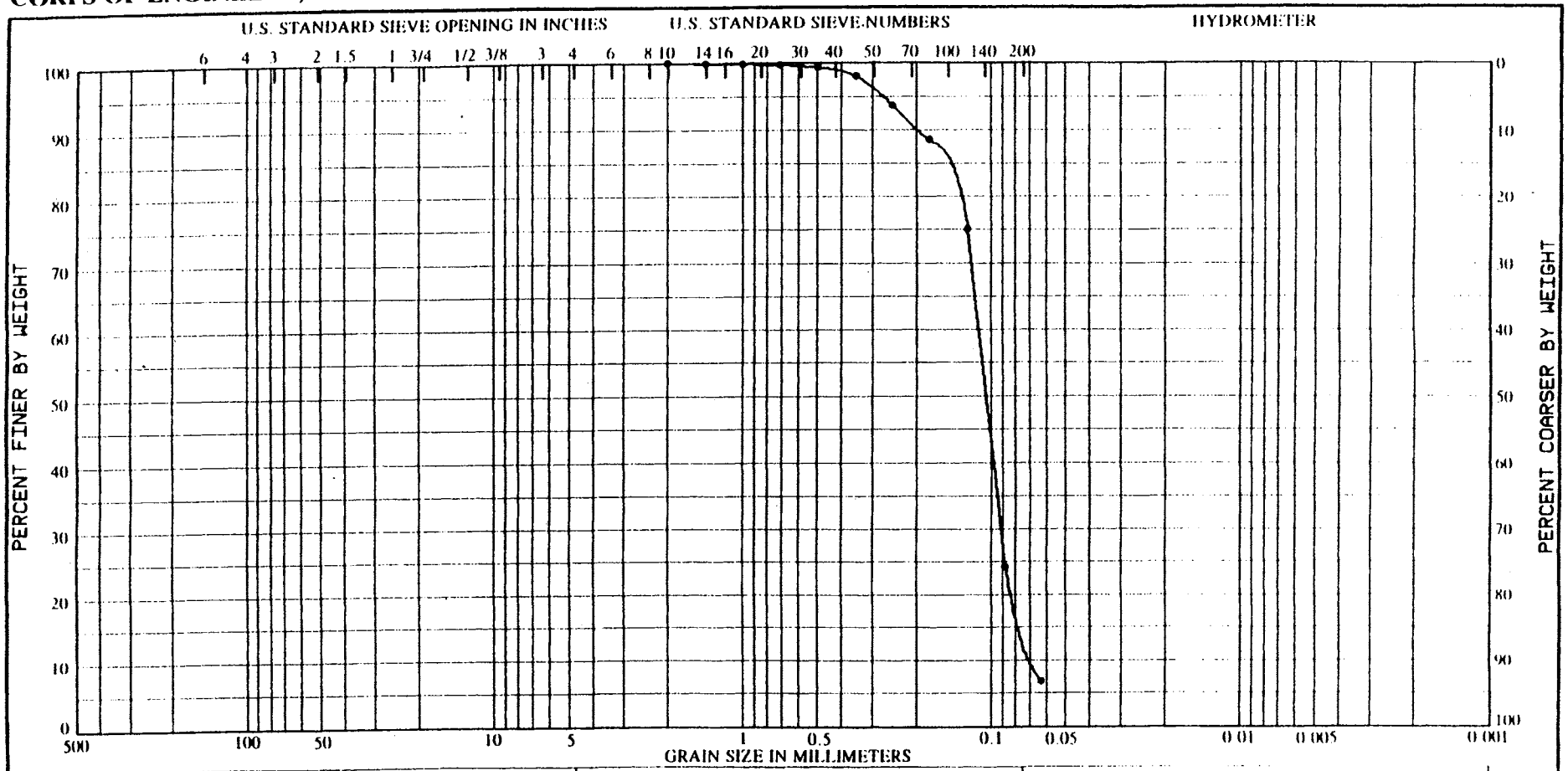
Sample No	Depth	Classification	Nat w%	LL	PL	PI
D-2	7.5-8.0'	(VISUAL) TAN & LT. GRAY, POORLY GRADED SAND (SP),	20.1			
		SP. GRAVITY = 2.67				
		WET DENSITY = 131.9 PCF,				
		DRY DENSITY = 109.7 PCF,				

GRADATION CURVES

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/963
Boring No: NJV-182
Date: 03/13/95

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
B	9.6-9.9'	(VISUAL) TAN & LT. GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/963B
Boring No: NJV-182
Date: 03/13/95

GRADATION CURVES

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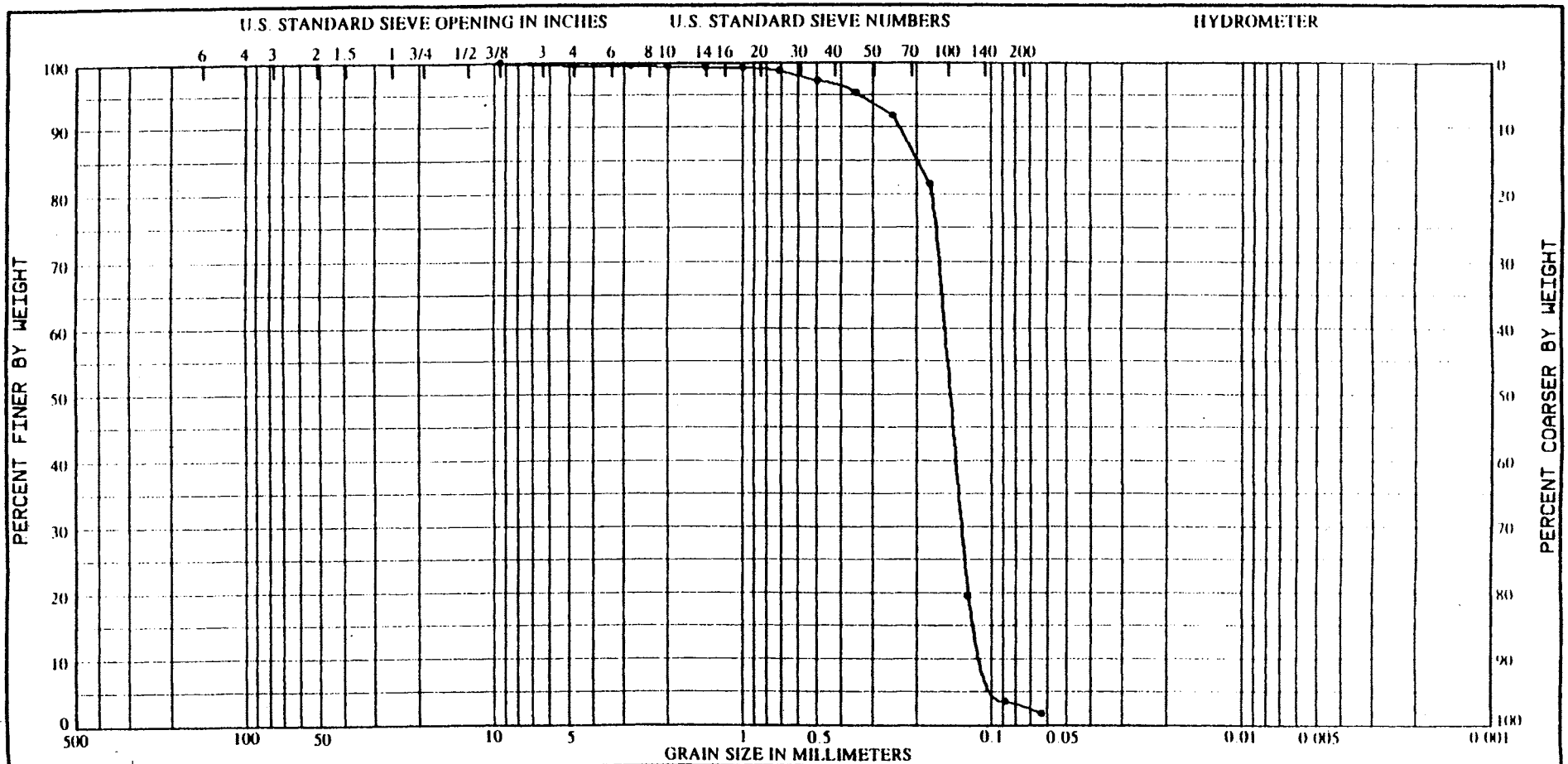
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



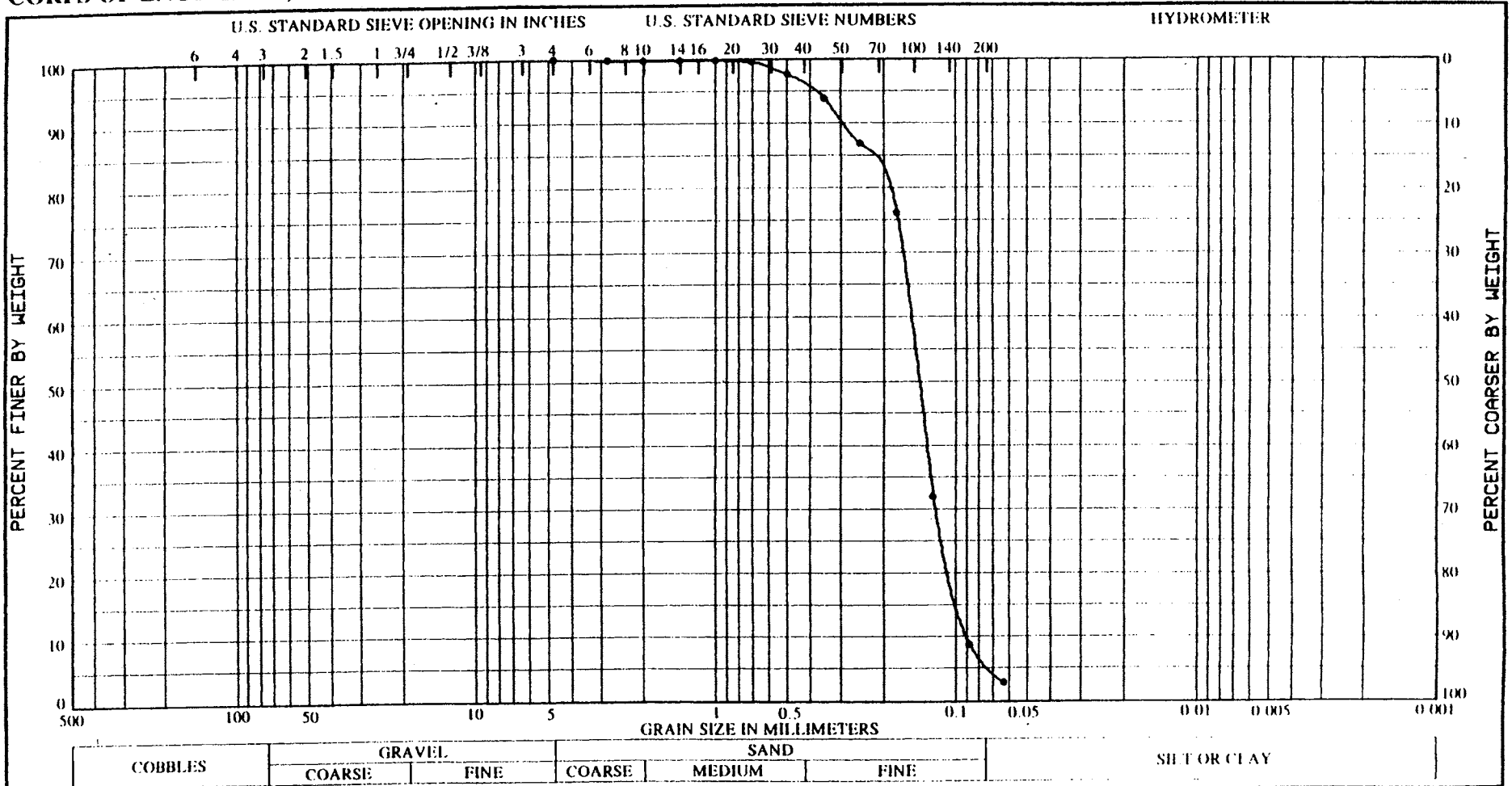
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
D-3	14.0- 14.5	(VISUAL) TAN & LT. GRAY, POORLY GRADED	20.5			
		SAND (SP),				
		SP. GRAVITY = 2.68				
		WET DENSITY = 130.1 PCF.				
		DRY DENSITY = 108.0 PCF.				

Project DELAWARE BAY
VIBRA CORE SAMPLES
Lab No 184/963
Boring No NJV-182
Date 03/13/95

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

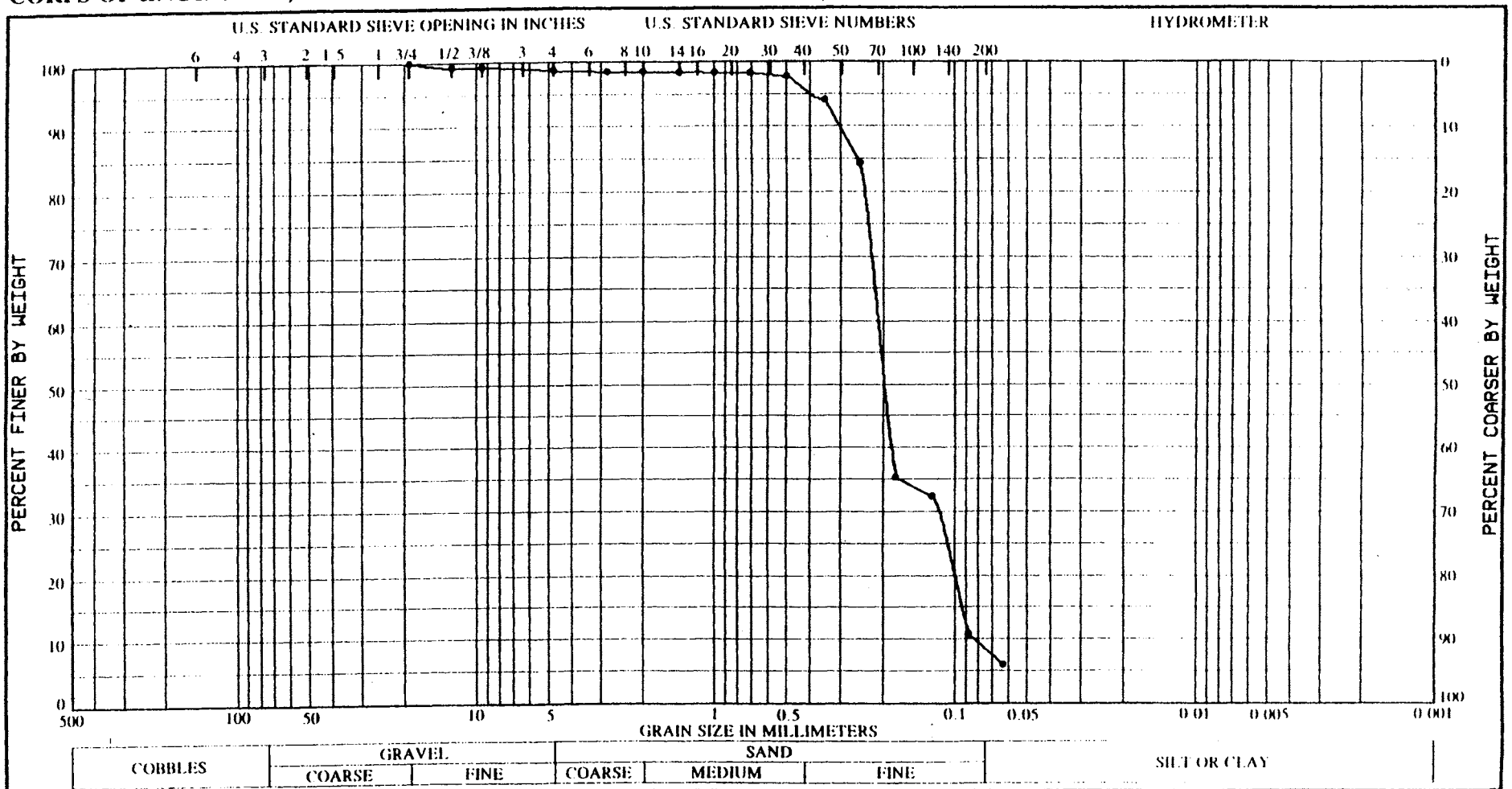
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
C	15.5-15.7'	(VISUAL) TAN & LT. GRAY, POORLY GRADED SAND (SP).				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/963C
Boring No: NJV-182
Date: 03/13/95

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
D 4	17.3-17.8'	(VISUAL) TAN & LT GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH A TRACE OF GRAVEL. SP. GRAVITY = 2.66	19.8			
		WET DENSITY = 123.6 PCF.				
		DRY DENSITY = 103.2 PCF.				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/963
Boring No: NJV-182
Date: 03/13/95

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

Project: *DELAWARE BAY*		Boring No.	*MJV-183*
Location: *VIBRA CORE SAMPLES*		Lab No.	*184-964*
Boring Depth (ft): *17.10*	Elevation:	Work order:	*7476*
Datum/Notes: *See grain size data on enclosed gradation curves.*		Requisition:	*CENAP-95-707*

Elev. (feet)	Depth (feet)	Leg-end	Material Description	Comments
	1			
	2			SA D-1 1.7 - 2.2' WET DEN = 12[illegible] DRY DEN = 107.2, MC = 20.2 %
	3			
	4			SA (A) 4.0 - 4.3'
	5			
	6			
	7			
	8			SA D-2 7.5 - 8.0' WET DEN = 121 [illegible] DRY DEN = 100.7, MC = 20.6 %
	9		GRAY, POORLY GRADED SILTY SAND (SP-SM), WITH OCCASIONAL POCKETS OF SILTY SAND (SM) AND POORLY GRADED SAND (SP).	
	10			
	11			SA (B) 10.7 - 10.9'
	12			SA D-3 12.0 - 12.5', WET DEN = 120.7, DRY DEN = 99.4, MC = 21.4 %
	13			
	14			SA (C) 13.6 - 13.9'
	15			
	16			SA D-4 15.5 - 16.0' WET DEN = 120.1, DRY DEN = 100.4, MC = [illegible] %
	17		----------	

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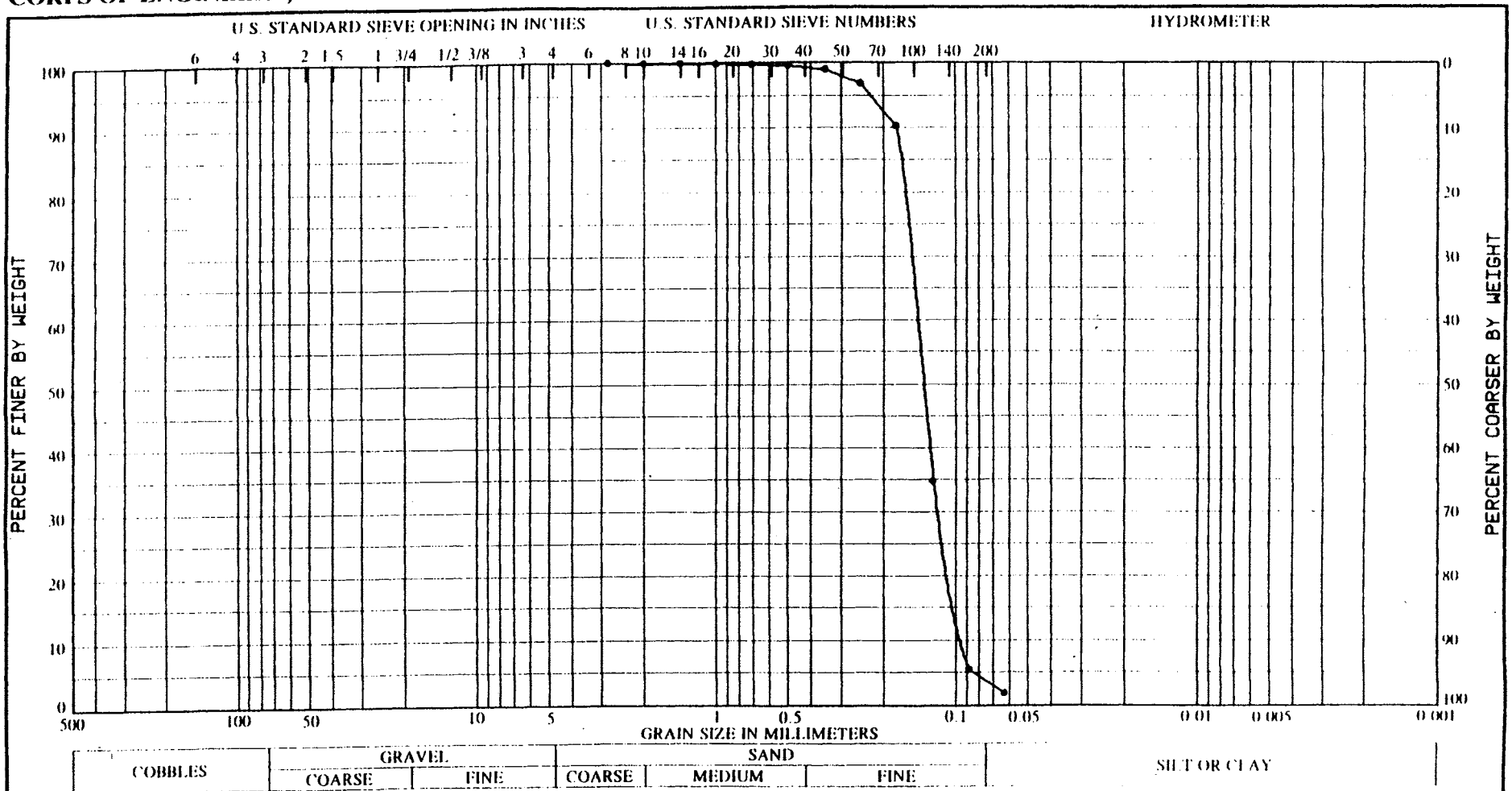
Date: *03/20/95* LABORATORY LOG AND SAMPLE DATUM Sheet No. [illegible]

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



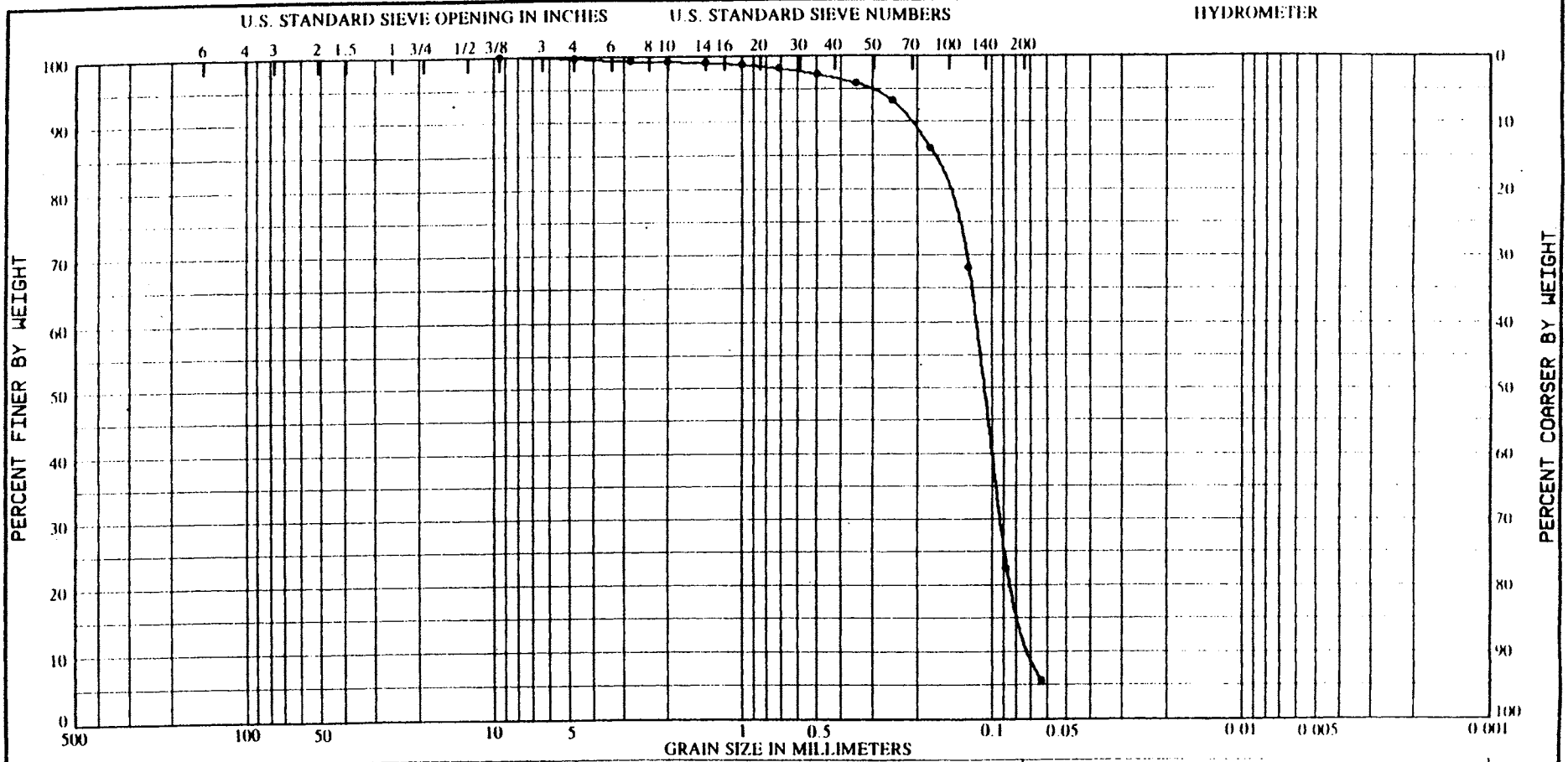
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
D-1	1.7-2.2'	(VISUAL) GRAY, POORLY GRADED SAND (SP).	20.2			
		SP. GRAVITY = 2.66				
		WET DENSITY = 128.8 PCF.				
		DRY DENSITY = 107.2 PCF.				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/964
Boring No: NJV-183
Date: 03/14/95

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
A	4.0-4.3'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/964A
Boring No: NJV-183
Date: 03/14/95

GRADATION CURVES

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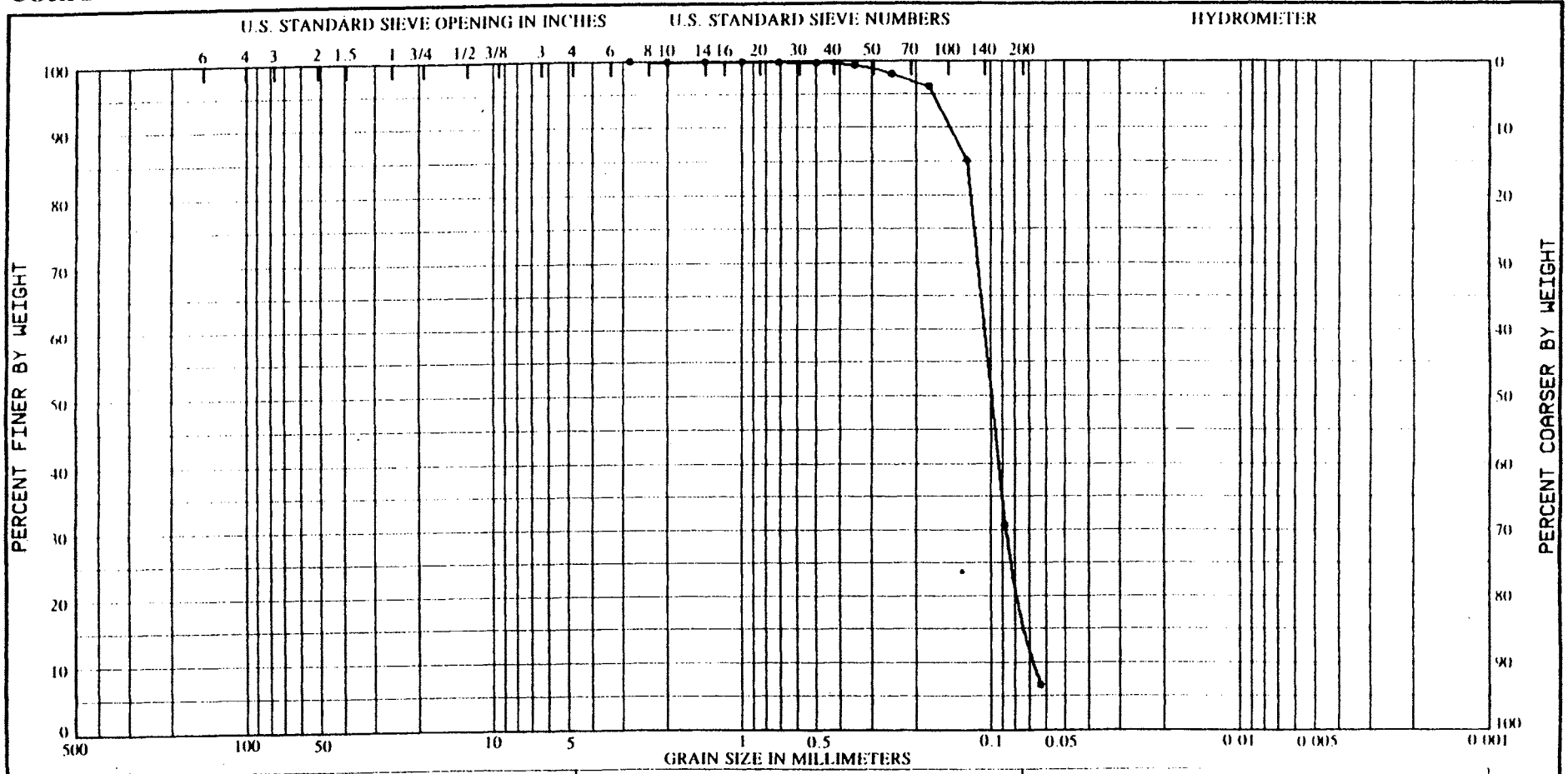
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



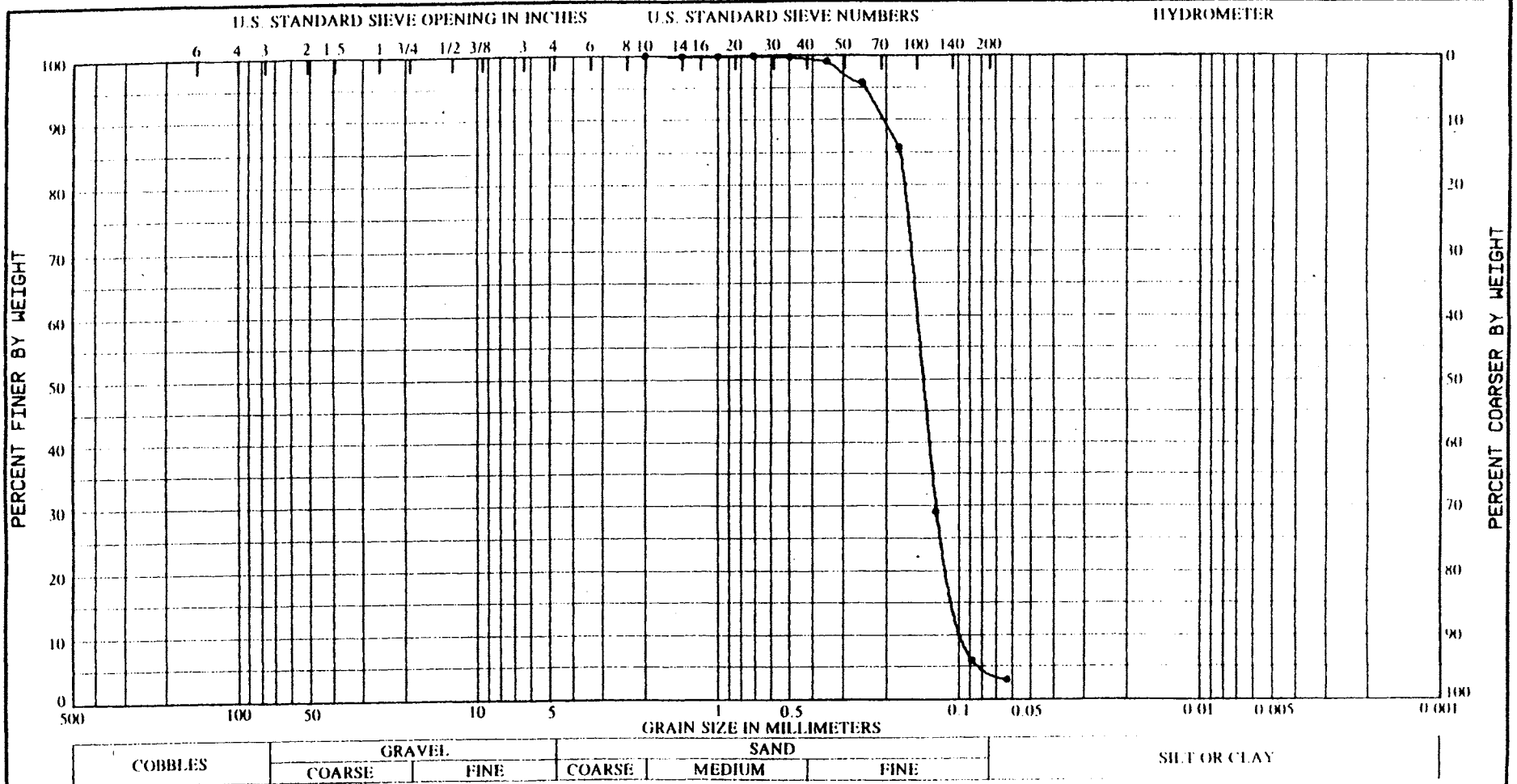
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
D-2	7.5-8.0'	(VISUAL) GRAY, SILTY SAND (SM).	20.6			
		SP. GRAVITY = 2.70				
		WET DENSITY = 121.5 PCF.				
		DRY DENSITY = 100.7 PCF.				

GRADATION CURVES

Project DELAWARE BAY
VIBRA CORE SAMPLES
Lab No 184/964
Boring No NJV-183
Date 03/14/95

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



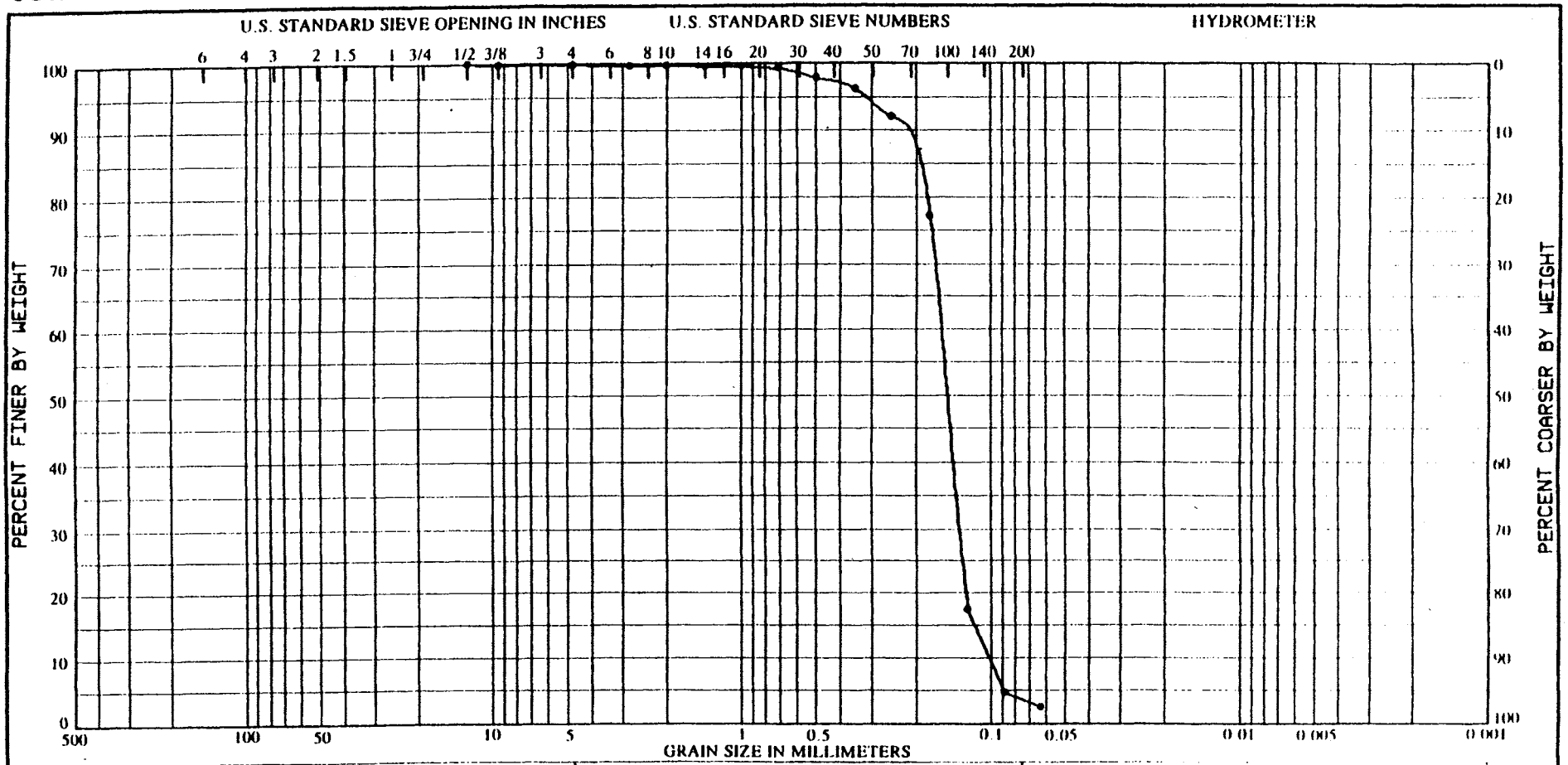
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
D-3	12.0-12.5'	(VISUAL) GRAY, POORLY GRADED SAND (SP).	21.4			
		SP. GRAVITY = 2.64				
		WET DENSITY = 120.7 PCF.				
		DRY DENSITY = 99.4 PCF.				

GRADATION CURVES

Project DELAWARE BAY
VIBRA CORE SAMPLES
Lab No 184/964
Boring No NJV-183
Date 03/14/95

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



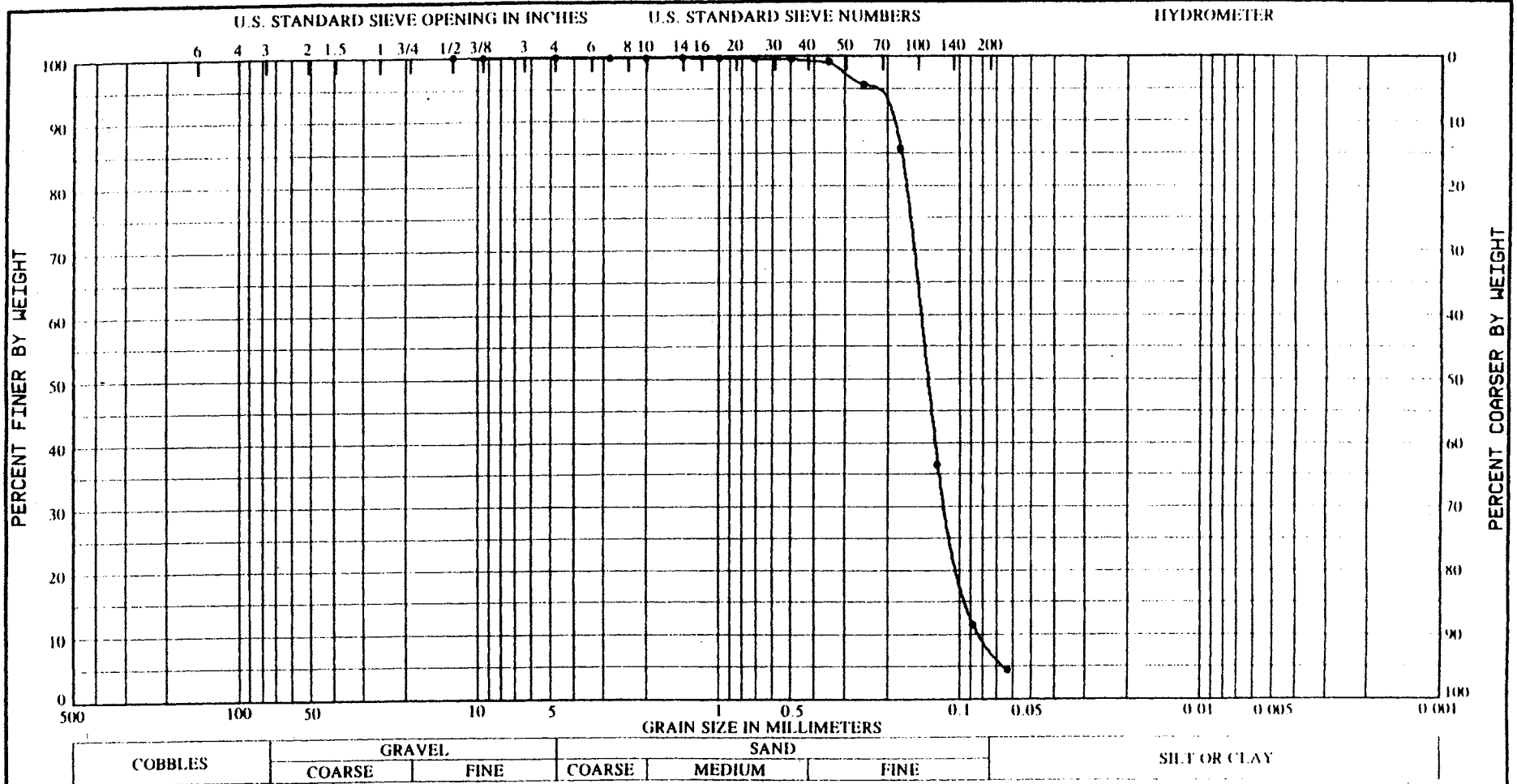
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
B	10.7-10.9'	(VISUAL) GRAY, POORLY GRADED SAND (SP)				

Project DELAWARE BAY
VIBRA CORE SAMPLES
Lab No 184/964B
Boring No NJV-183
Date 03/14/95

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
C	13.6-13.9'	(VISUAL) GRAY, POORLY GRADED SILTY SAND (SP-SM).				

Project: DELAWARE BAY
VIBRA CORE SAMPLES
Lab No: 184/964C
Boring No: NJV-183
Date: 03/14/95

GRADATION CURVES

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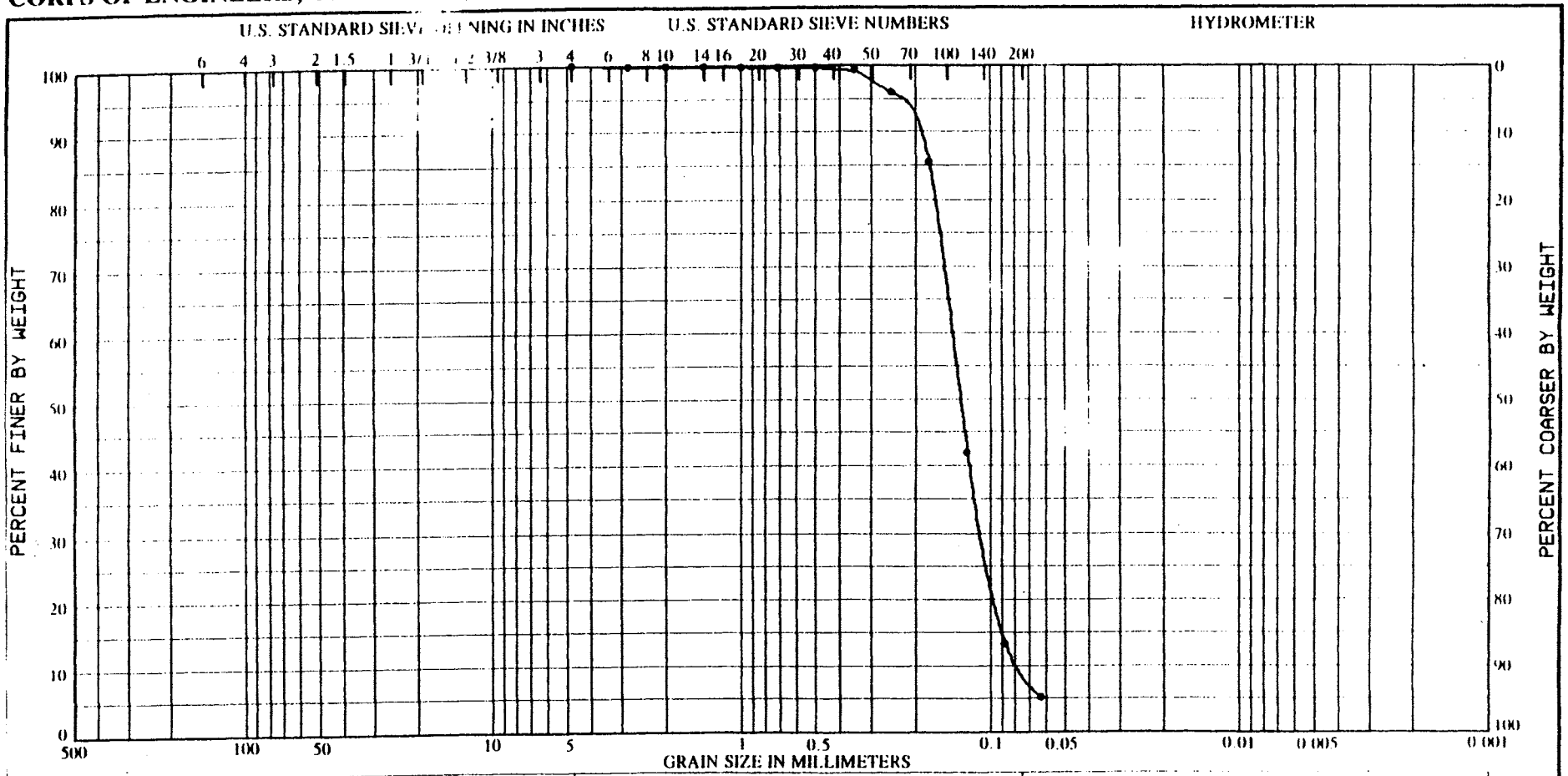
DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE , MARIETTA, GA. 30060

WORK ORDER: 7476
REQUISITION: CENAP-95-707

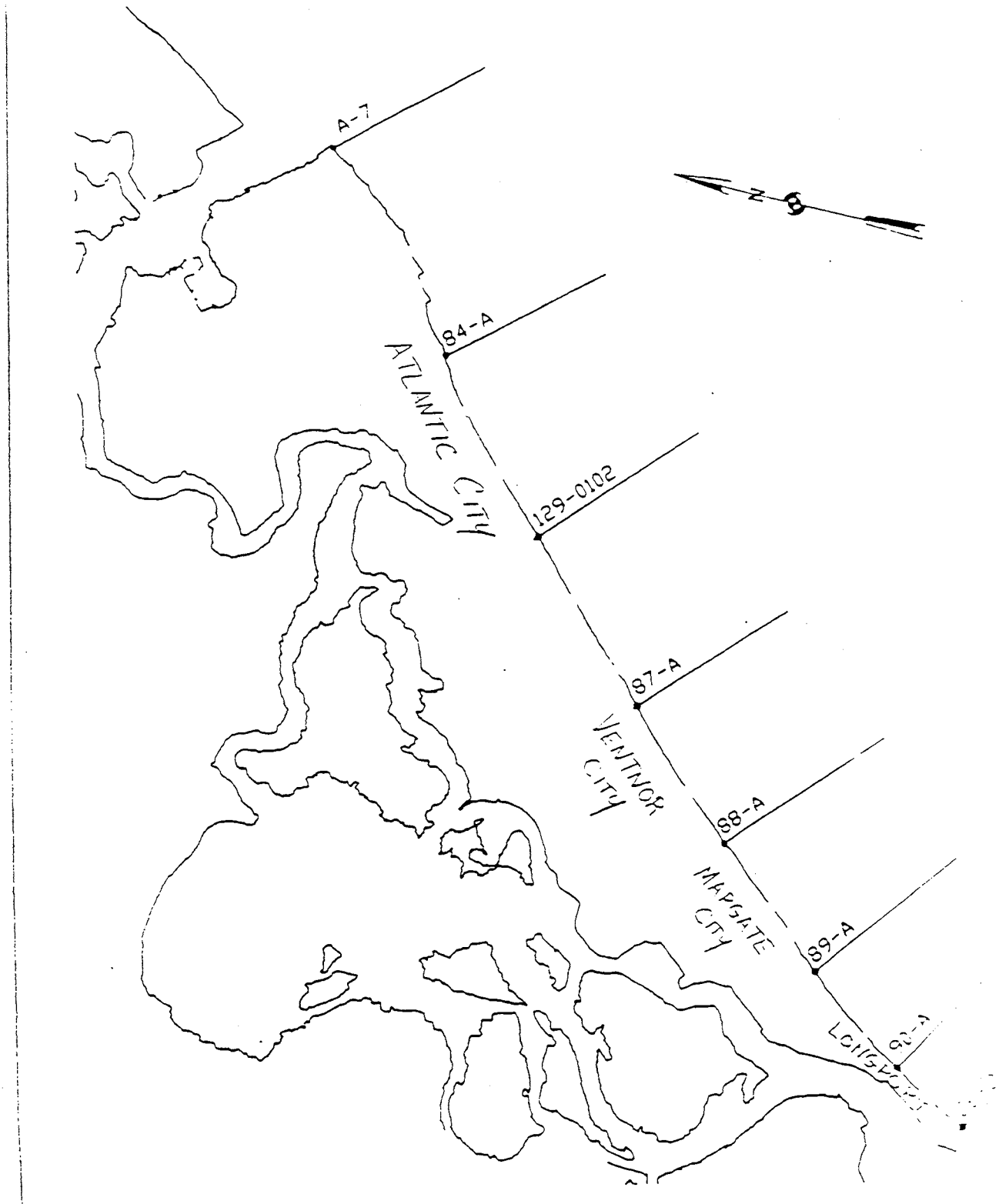


Sample No.	Depth	Classification	Nat w%	LL	PL	PI
D-4	15.5-16.0'	(VISUAL) GRAY, POORLY GRADED SILTY SAND	19.6			
		(SP-SM),				
		SP. GRAVITY = 2.68				
		WET DENSITY = 120.1 PCF,				
		DRY DENSITY = 100.4 PCF,				

Project DELAWARE BAY
VIBRA CORE SAMPLES
Lab No 184/964
Boring No NJV-183
Date 03/14/95

GRADATION CURVES

Section 2
Native Beach Material Analysis

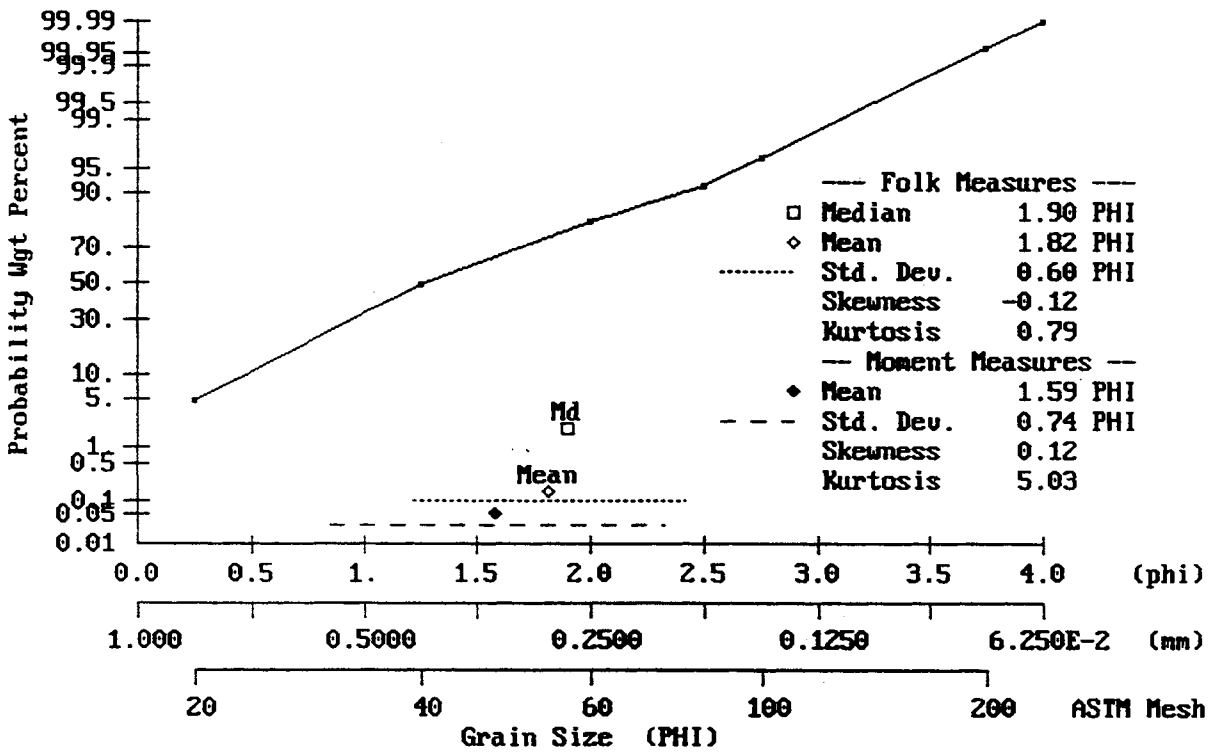


Survey Lines from which Beach Samples Were Acquired

Absecon Island

Composite	Mean Diameter (phi)	Sta. Deviation (phi)	16th Percentile (phi)	16th Percentile (mm)	84th Percentile (phi)	84th Percentile (mm)	Sta. Deviation (mm)
A-7	1.59	0.74	0.85	0.199	2.33	0.555	0.178
84-A	2.39	0.78	1.61	0.111	3.17	0.328	0.108
129-0102	2.43	0.94	1.49	0.097	3.37	0.356	0.130
87-A	2.47	0.81	1.66	0.103	3.28	0.316	0.107
88-A	2.31	0.88	1.43	0.110	3.19	0.371	0.131
89-A	2.40	0.72	1.68	0.115	3.12	0.312	0.099
90-A	2.49	0.75	1.74	0.106	3.24	0.299	0.097
GE-2	2.30	0.60	1.70	0.134	2.90	0.308	0.087

Composite Line A-7
Composite: Absecon



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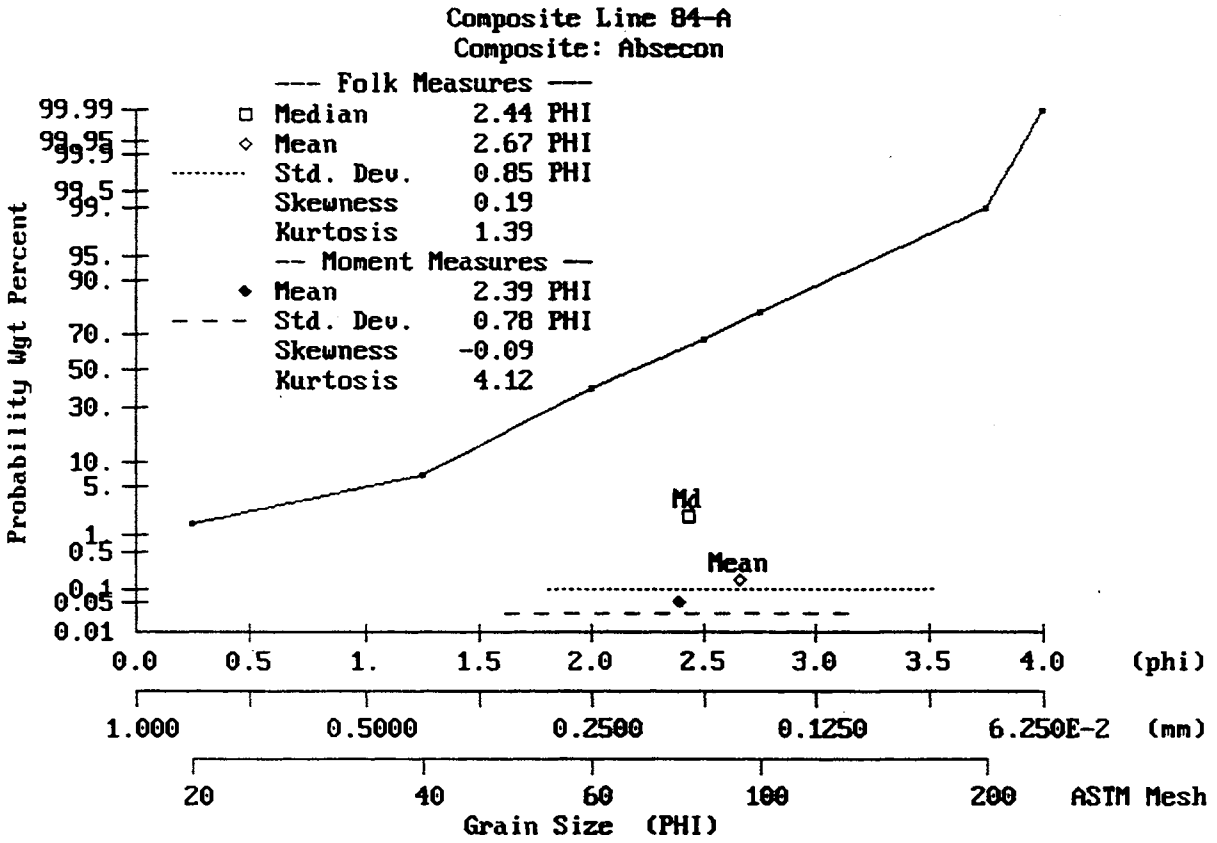
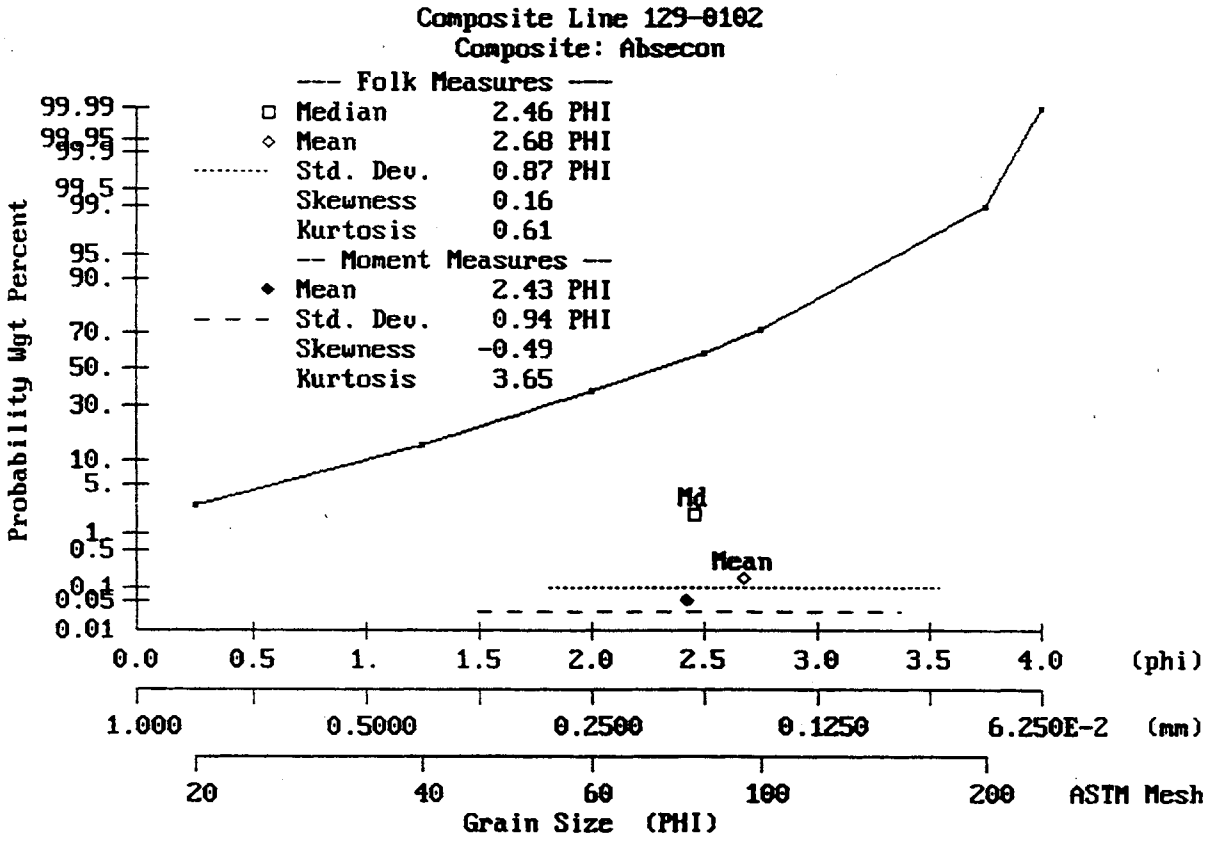
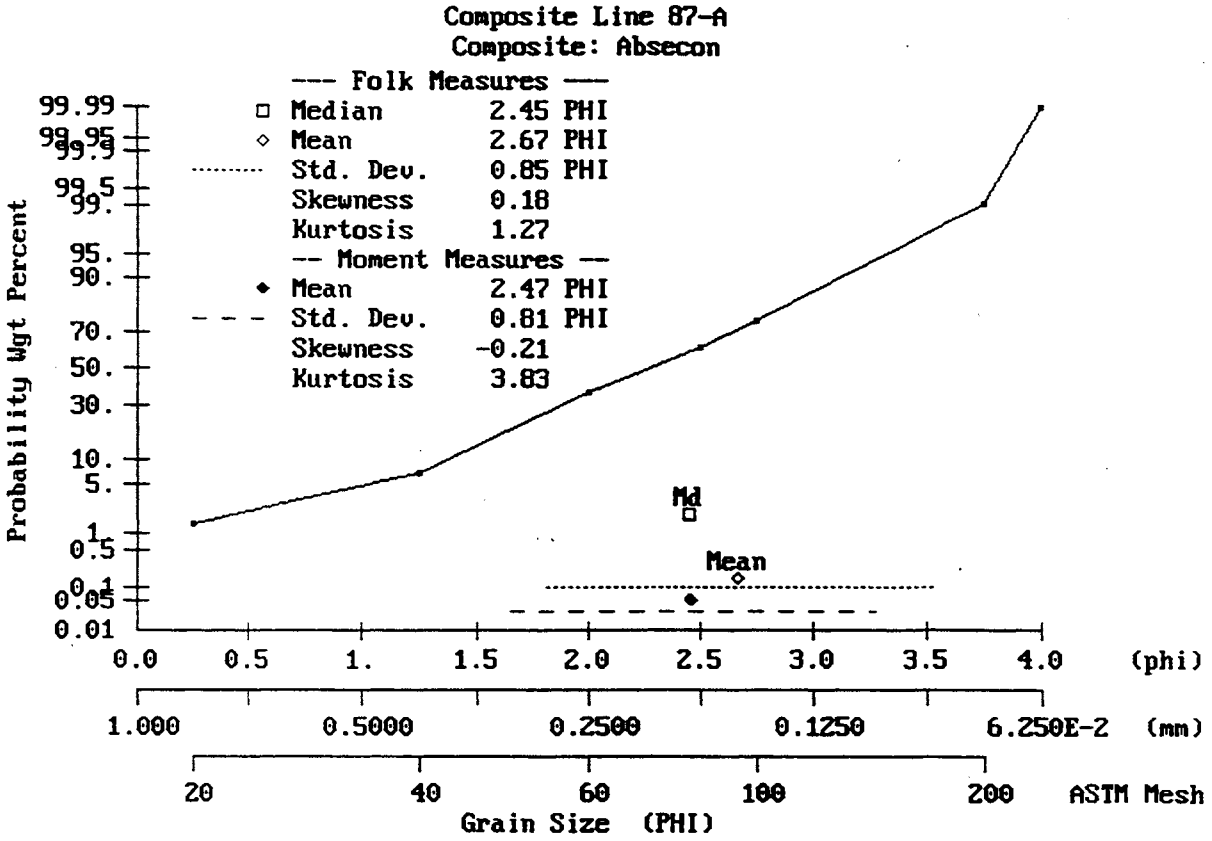
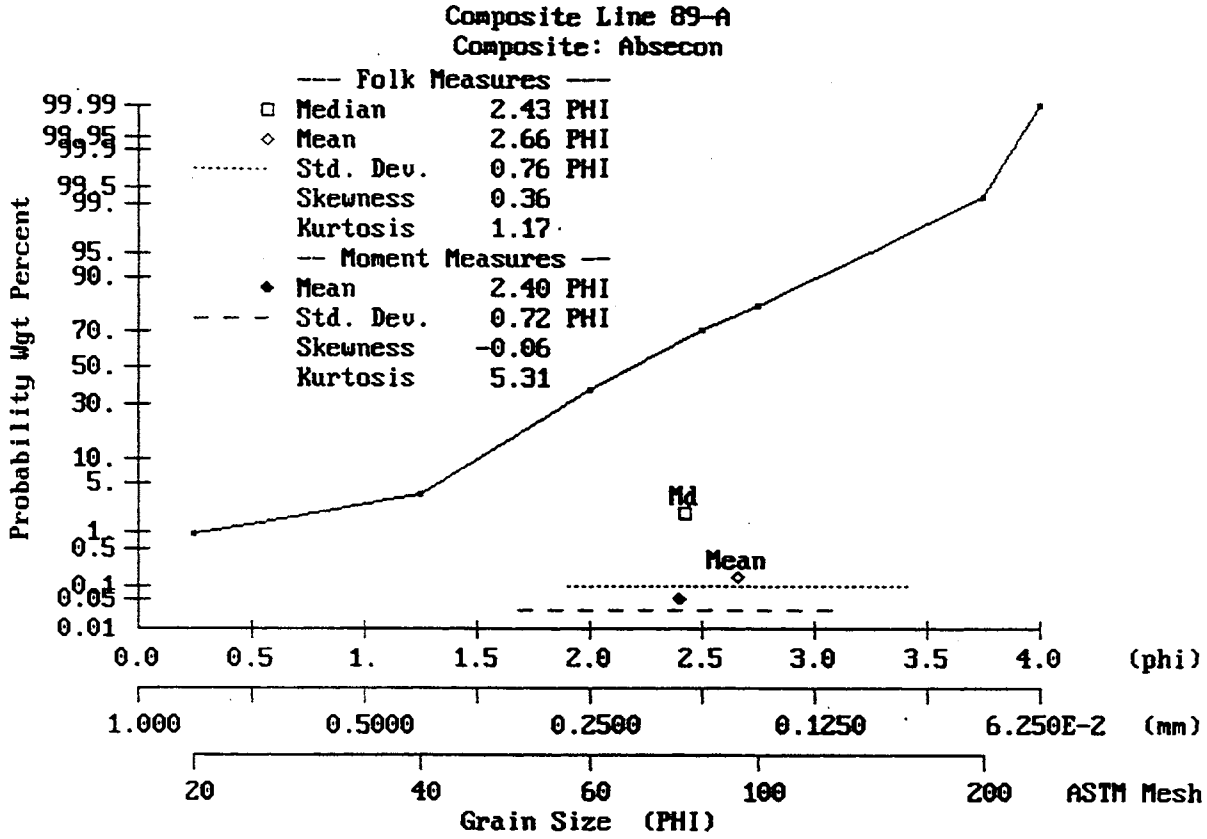
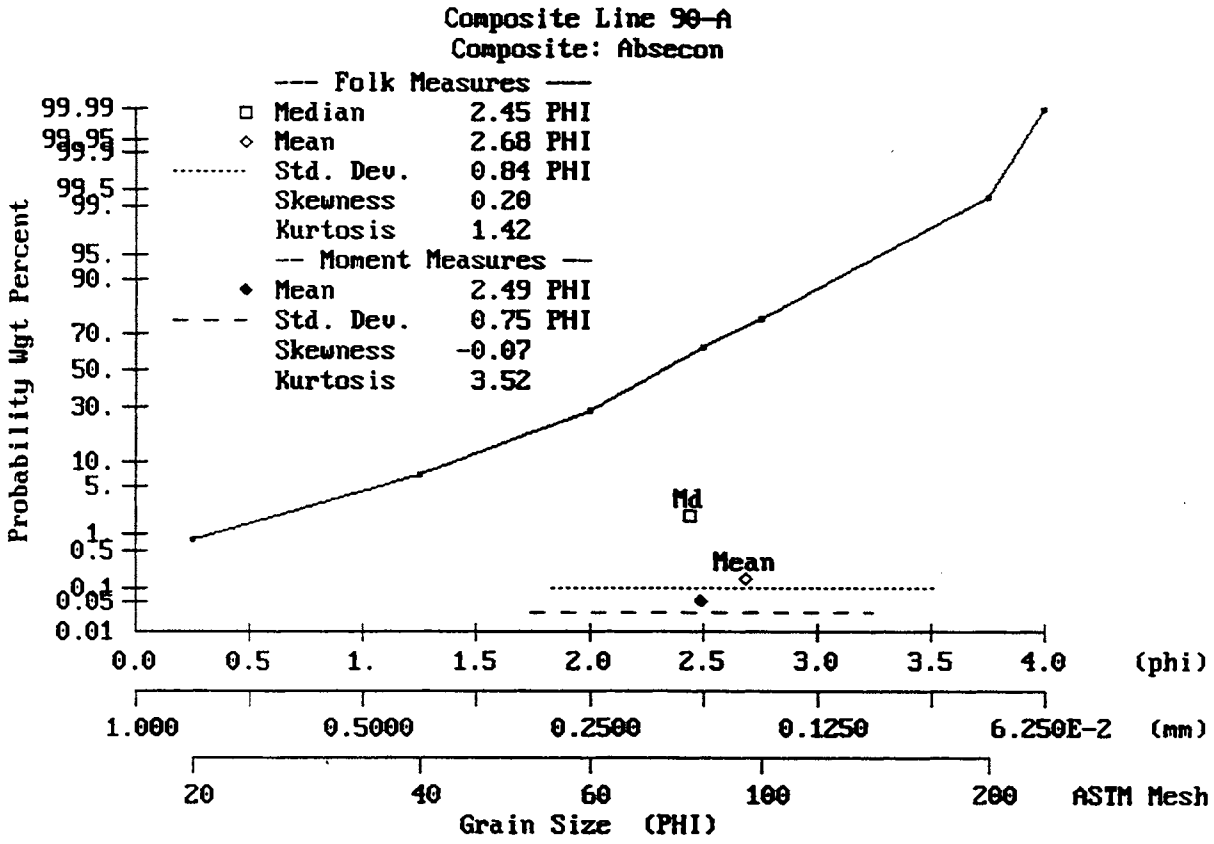
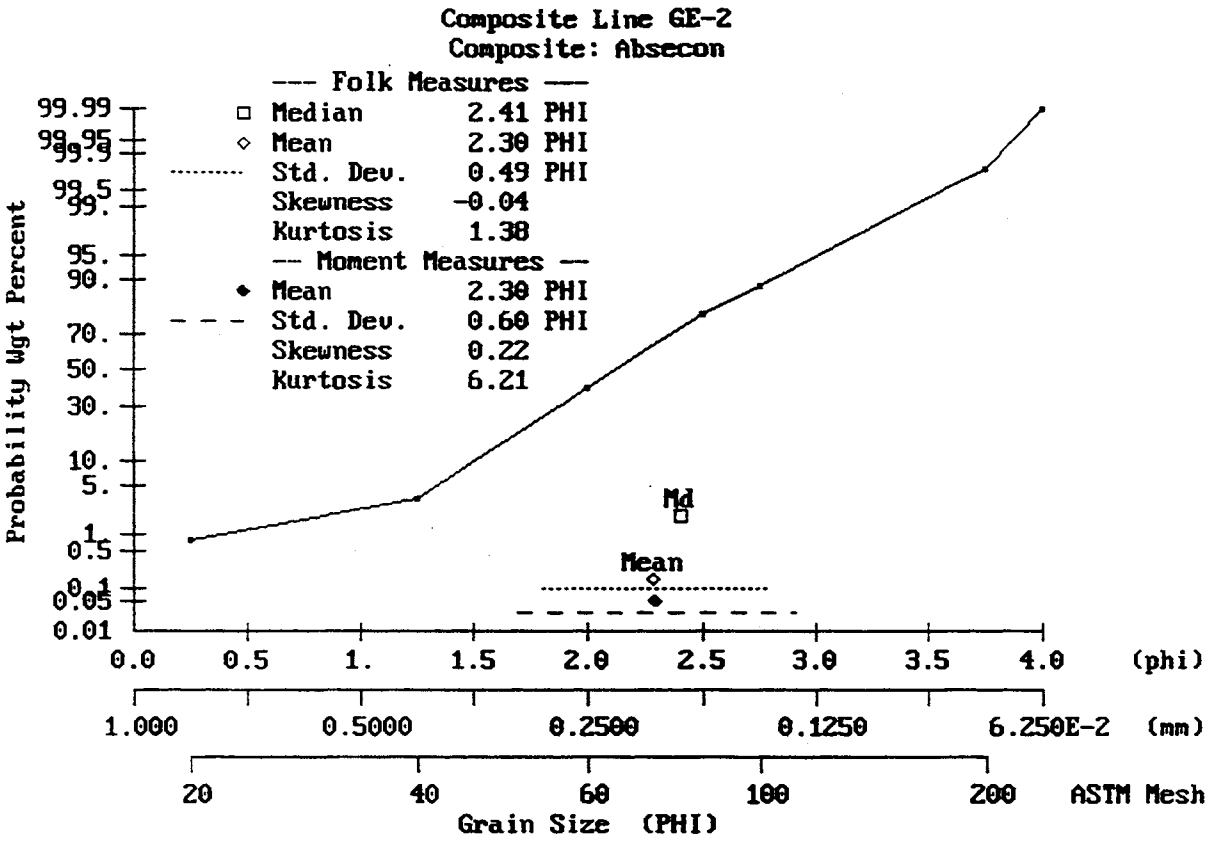

Composite Line 84-A
Composite: Absecon
--- Folk Measures ---
Median 2.44 PHI
Mean 2.67 PHI
Std. Dev. 0.85 PHI
Skewness 0.19
Kurtosis 1.39
-- Moment Measures --
Mean 2.39 PHI
Std. Dev. 0.78 PHI
Skewness -0.09
Kurtosis 4.12
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)

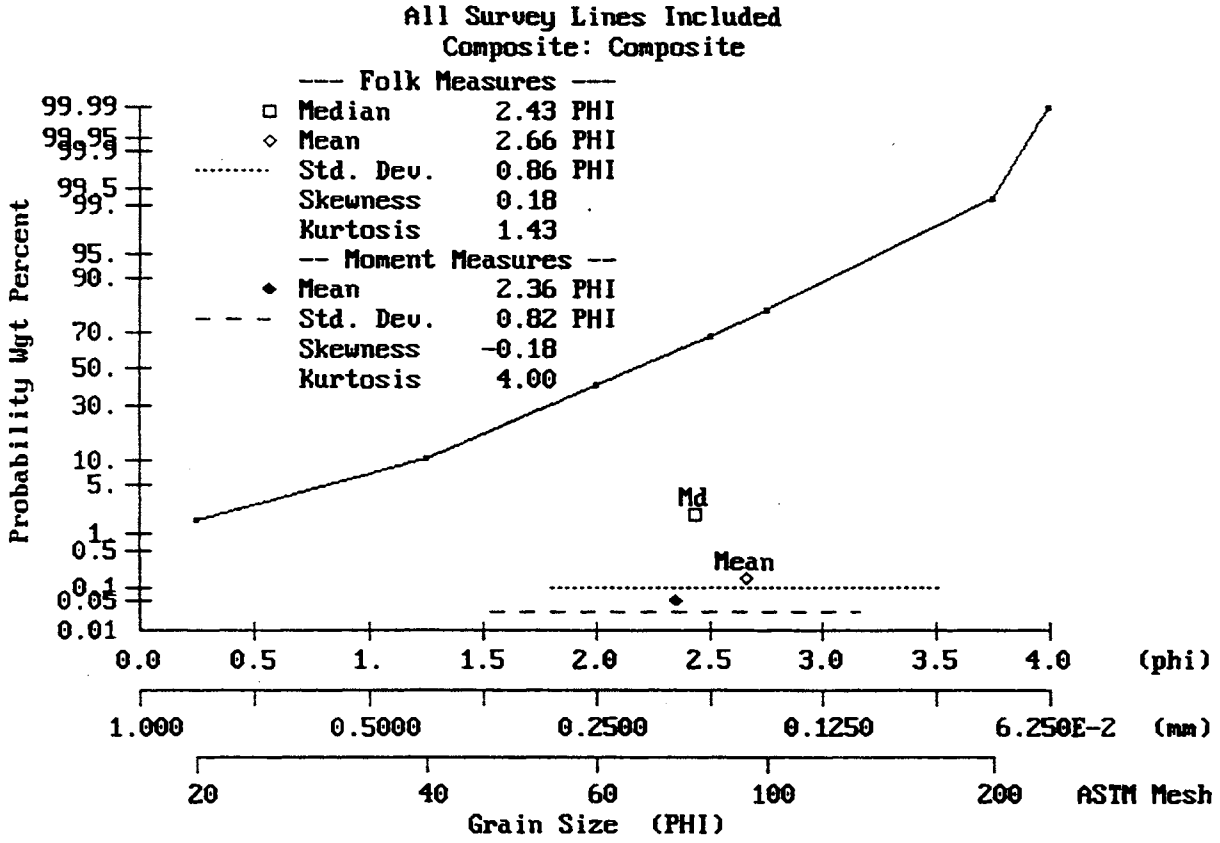

Composite Line 129-0102
Composite: Absecon
--- Folk Measures ---
Median 2.46 PHI
Mean 2.68 PHI
Std. Dev. 0.87 PHI
Skewness 0.16
Kurtosis 0.61
-- Moment Measures --
Mean 2.43 PHI
Std. Dev. 0.94 PHI
Skewness -0.49
Kurtosis 3.65
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)

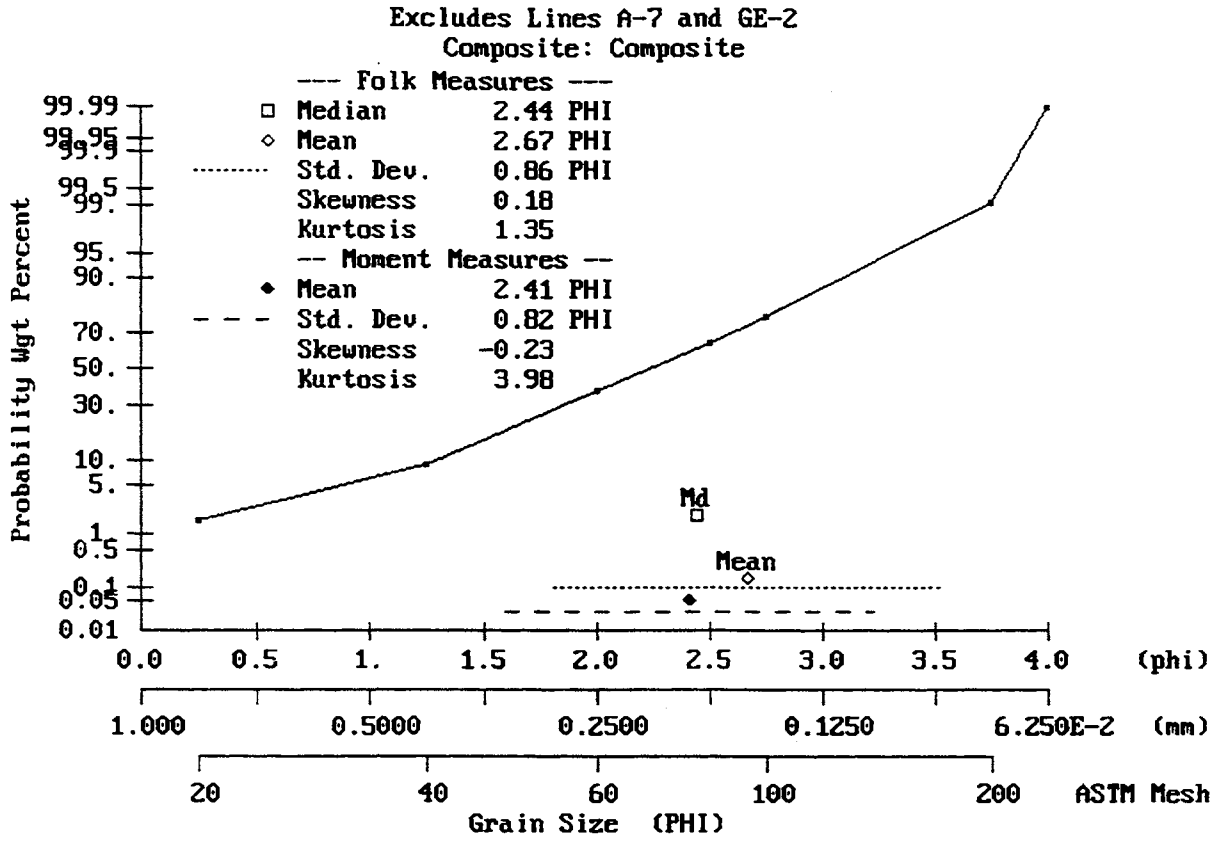

Composite Line 87-A
Composite: Absecon
--- Folk Measures ---
Median 2.45 PHI
Mean 2.67 PHI
Std. Dev. 0.85 PHI
Skewness 0.18
Kurtosis 1.27
-- Moment Measures --
Mean 2.47 PHI
Std. Dev. 0.81 PHI
Skewness -0.21
Kurtosis 3.83
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)


Composite Line 89-A
Composite: Absecon
--- Folk Measures ---
Median 2.43 PHI
Mean 2.66 PHI
Std. Dev. 0.76 PHI
Skewness 0.36
Kurtosis 1.17
-- Moment Measures --
Mean 2.40 PHI
Std. Dev. 0.72 PHI
Skewness -0.06
Kurtosis 5.31
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)


Composite Line 90-A
Composite: Absecon
--- Folk Measures ---
Median 2.45 PHI
Mean 2.68 PHI
Std. Dev. 0.84 PHI
Skewness 0.20
Kurtosis 1.42
-- Moment Measures --
Mean 2.49 PHI
Std. Dev. 0.75 PHI
Skewness -0.07
Kurtosis 3.52
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)


Composite Line GE-2
Composite: Absecon
--- Folk Measures ---
Median 2.41 PHI
Mean 2.30 PHI
Std. Dev. 0.49 PHI
Skewness -0.04
Kurtosis 1.38
-- Moment Measures --
Mean 2.30 PHI
Std. Dev. 0.60 PHI
Skewness 0.22
Kurtosis 6.21
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)


All Survey Lines Included
Composite: Composite
--- Folk Measures ---
Median 2.43 PHI
Mean 2.66 PHI
Std. Dev. 0.86 PHI
Skewness 0.18
Kurtosis 1.43
-- Moment Measures --
Mean 2.36 PHI
Std. Dev. 0.82 PHI
Skewness -0.18
Kurtosis 4.00
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)


Excludes Lines A-7 and GE-2
Composite: Composite
--- Folk Measures ---
Median 2.44 PHI
Mean 2.67 PHI
Std. Dev. 0.86 PHI
Skewness 0.18
Kurtosis 1.35
-- Moment Measures --
Mean 2.41 PHI
Std. Dev. 0.82 PHI
Skewness -0.23
Kurtosis 3.98
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)

145

Section 3
Borrow Area Suitability Analysis

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.490 PHI
Native Standard Deviation	Nstd:	0.750 PHI
Borrow Mean	Bmean:	2.910 PHI
Borrow Standard Deviation	Bstd:	0.720 PHI
Overfill Ratio	Ra:	2.343
Renourishment Ratio	Rj:	1.821
Design Volume	VOLD:	2.343 YD3

NJV-135, 136, 138, and 139 composite

with only Longport Beach characteristics

147

271

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.400 PHI
Native Standard Deviation	Nstd:	0.790 PHI
Borrow Mean	Bmean:	2.900 PHI
Borrow Standard Deviation	Bstd:	0.740 PHI
Overfill Ratio	Ra:	2.874
Renourishment Ratio	Rj:	2.002
Design Volume	VOLD:	2.874 YD3

NJV-135, 138, and 139 composite

with entire Absecon Island Beach characteristics

except lines A-7 and GE-2

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.490 PHI
Native Standard Deviation	Nstd:	0.750 PHI
Borrow Mean	Bmean:	2.760 PHI
Borrow Standard Deviation	Bstd:	0.760 PHI
Overfill Ratio	Ra:	1.556
Renourishment Ratio	Rj:	1.414
Design Volume	VOLD:	1.556 YD3

NJV-135. and 139 composite

with only Longport Beach characteristics

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.490 PHI
Native Standard Deviation	Nstd:	0.750 PHI
Borrow Mean	Bmean:	2.900 PHI
Borrow Standard Deviation	Bstd:	0.740 PHI
Overfill Ratio	Ra:	2.169
Renourishment Ratio	Rj:	1.751
Design Volume	VOLD:	2.169 YD3

NJV-135, 138, and 139 composite

with only Longport Beach characteristics

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.490 PHI
Native Standard Deviation	Nstd:	0.750 PHI
Borrow Mean	Bmean:	2.660 PHI
Borrow Standard Deviation	Bstd:	0.800 PHI
Overfill Ratio	Ra:	1.257
Renourishment Ratio	Rj:	1.171
Design Volume	VOLD:	1.257 YD3

NJV-135 composite

with only Longport Beach characteristics

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.400 PHI
Native Standard Deviation	Nstd:	0.790 PHI
Borrow Mean	Bmean:	2.910 PHI
Borrow Standard Deviation	Bstd:	0.720 PHI
Overfill Ratio	Ra:	3.193
Renourishment Ratio	Rj:	2.076
Design Volume	VOLD:	3.193 YD3

NJV-135, 136, 138, and 139 composite

with entire Absecon Island Beach characteristics

except lines A-7 and GE-2

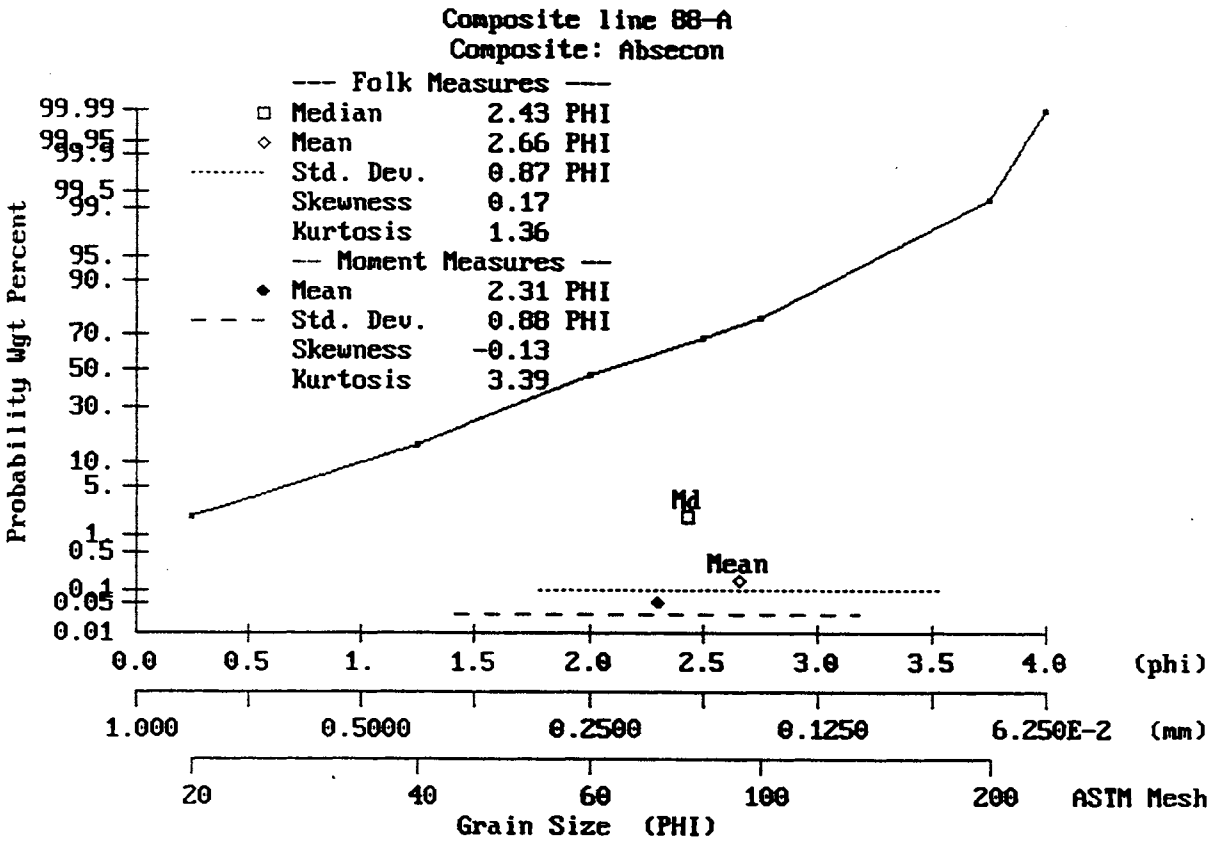
BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.410 PHI
Native Standard Deviation	Nstd:	0.820 PHI
Borrow Mean	Bmean:	2.760 PHI
Borrow Standard Deviation	Bstd:	0.860 PHI
Overfill Ratio	Ra:	1.647
Renourishment Ratio	Rj:	1.458
Design Volume	VOLD:	1.647 YD3

NJV-148. 151,and 152 composite

with entire Absecon Island Beach characteristics

except lines A-7 and GE-2


Composite line 88-A
Composite: Absecon
--- Folk Measures ---
Median 2.43 PHI
Mean 2.66 PHI
Std. Dev. 0.87 PHI
Skewness 0.17
Kurtosis 1.36
-- Moment Measures --
Mean 2.31 PHI
Std. Dev. 0.88 PHI
Skewness -0.13
Kurtosis 3.39
Probability Wgt Percent
99.99
99.95
99.9
99.5
99.
95.
90.
70.
50.
30.
10.
5.
1.
0.5
0.1
0.05
0.01
Md
Mean
0.0 0.5 1. 1.5 2.0 2.5 3.0 3.5 4.0 (phi)
1.000 0.5000 0.2500 0.1250 6.250E-2 (mm)
20 40 60 100 200 ASTM Mesh
Grain Size (PHI)

154

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.410 PHI
Native Standard Deviation	Nstd:	0.820 PHI
Borrow Mean	Bmean:	2.010 PHI
Borrow Standard Deviation	Bstd:	1.680 PHI
Overfill Ratio	Ra:	1.206
Renourishment Ratio	Rj:	0.124
Design Volume	VOLD:	1.206 YD3

NJV-140. 143. 145. and 146 composite

with entire Absecon Island Beach characteristics

except lines A-7 and GE-2

BEACH FILL OVERFILL RATIO AND VOLUME

Initial Volume	VOLI:	1.000 YD3
Native Mean	Nmean:	2.410 PHI
Native Standard Deviation	Nstd:	0.820 PHI
Borrow Mean	Bmean:	2.330 PHI
Borrow Standard Deviation	Bstd:	1.570 PHI
Overfill Ratio	Ra:	1.280
Renourishment Ratio	Rj:	0.239
Design Volume	VOLD:	1.280 YD3

NJV-140, 143, 145, 146, 181 and 182 composite

with entire Absecon Island Beach characteristics

except lines A-7 and GE-2

Photo #1: New anchored timber bulkhead at Maine Ave. facing Absecon Inlet, also showing boardwalk along Inlet.

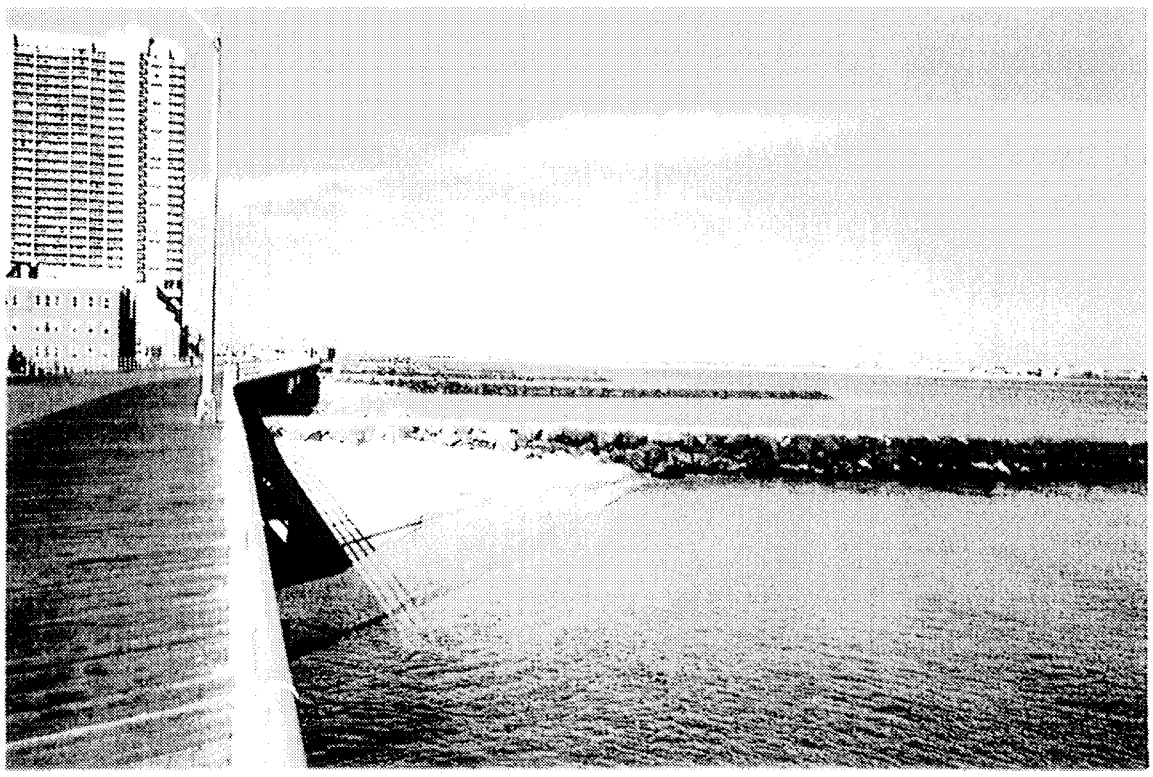


Photo #2: Groin field at Absecon Inlet.

Photo #3: Groin at Massachusetts Ave., Atlantic City.

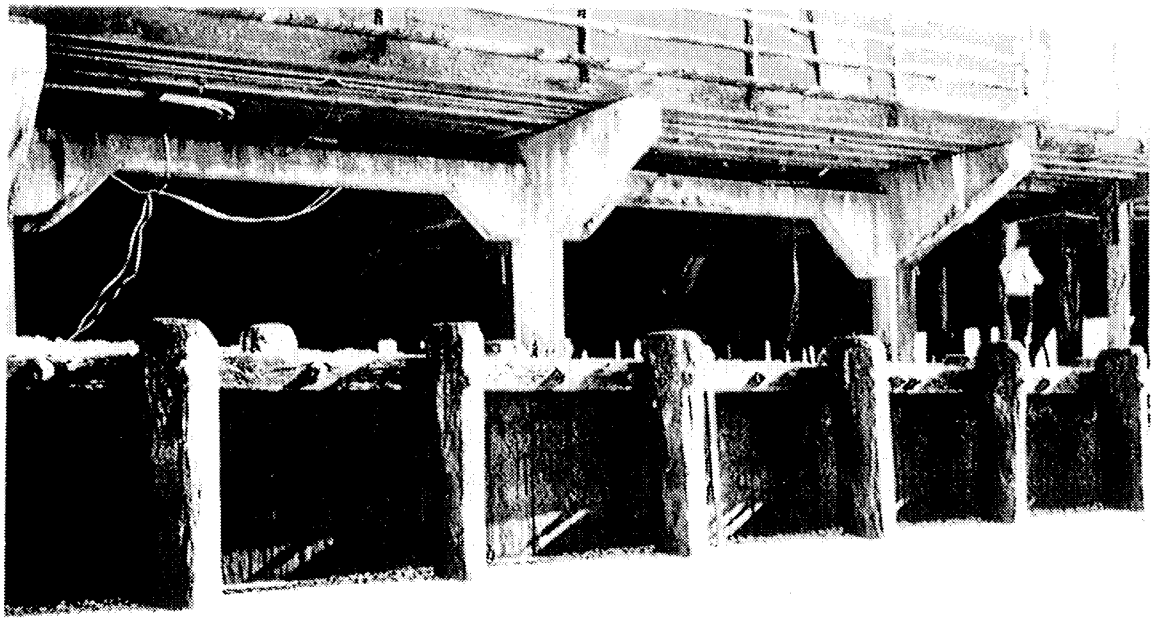


Photo #4: Showing boardwalk in Atlantic City, and timber groin at St. James Place.

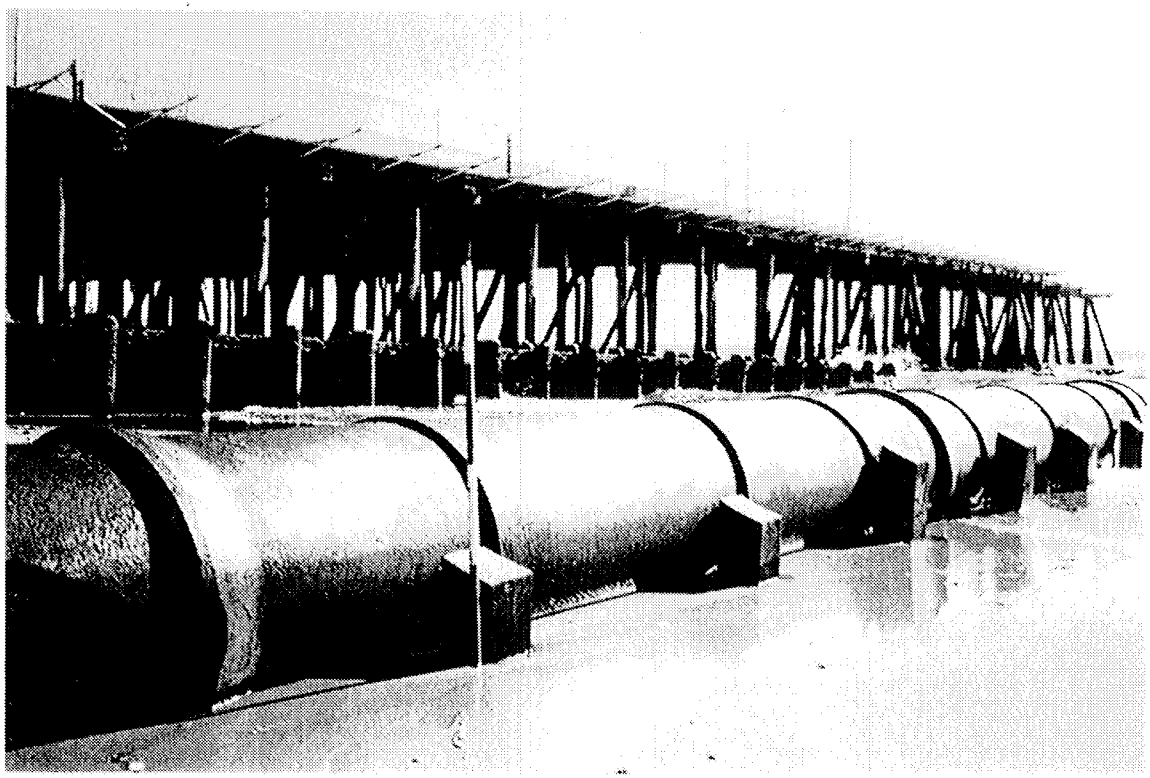


Photo #5: 36" dia. cast iron outfall pipe on timber cribs, at California Ave., Atlantic City.

Photo #6: Showing boardwalk in Ventnor.

Photo #7: R.C.P. outfall at N. side of Vassar Ave., Ventnor.

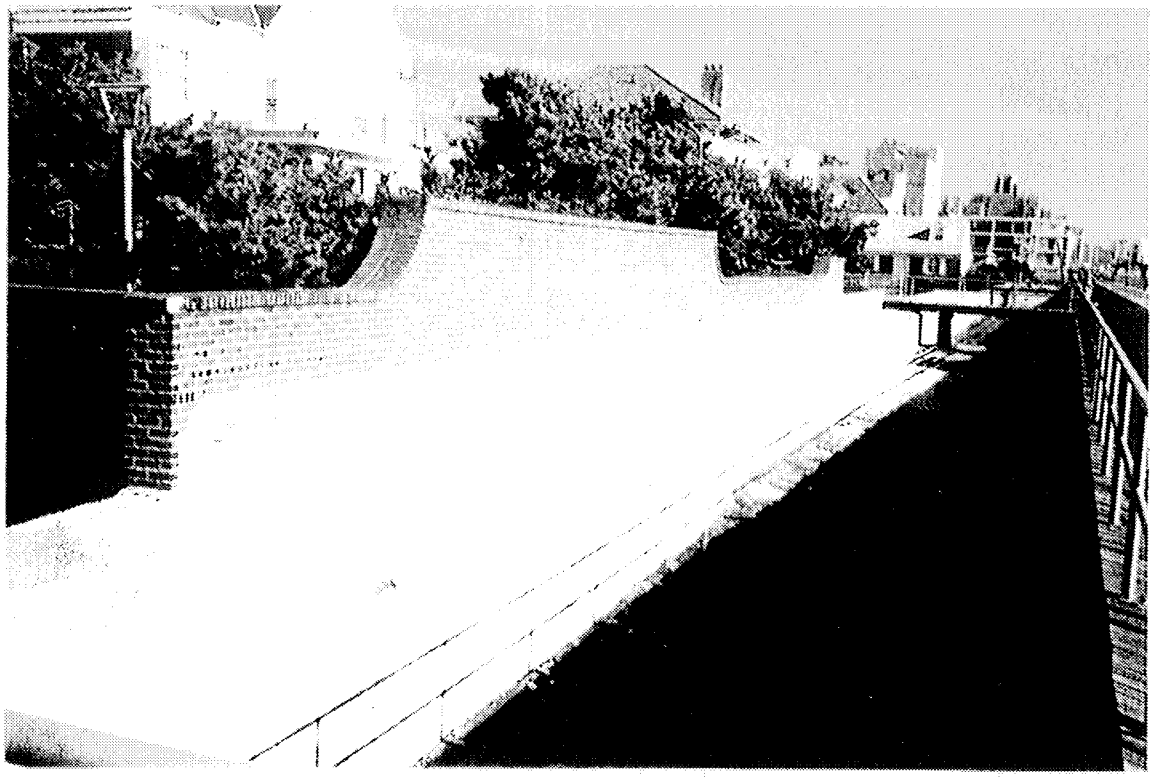


Photo #8: Concrete bulkhead N. of Portland Ave., Ventnor.

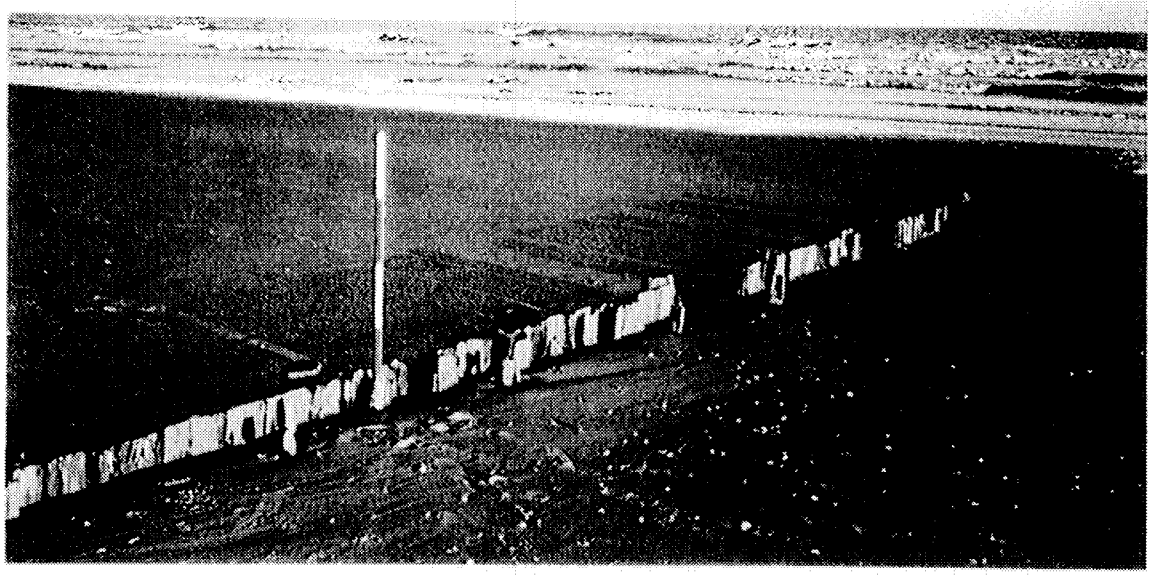


Photo #9: Typical timber groin in poor condition, at Quincy St., Margate.

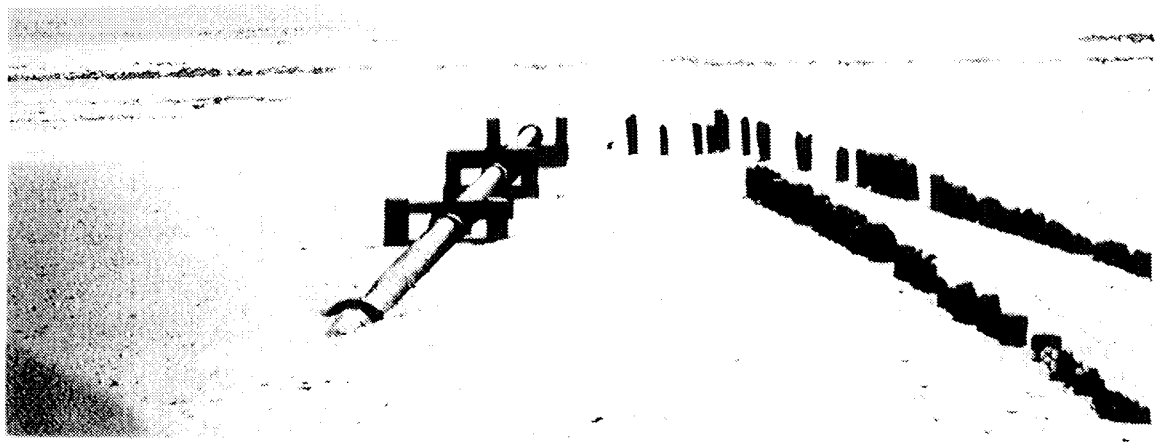


Photo #10: 12" cast iron outfall pipe on timber cribs, and remains of timber crib and stone groin at 14th Ave., Longport.

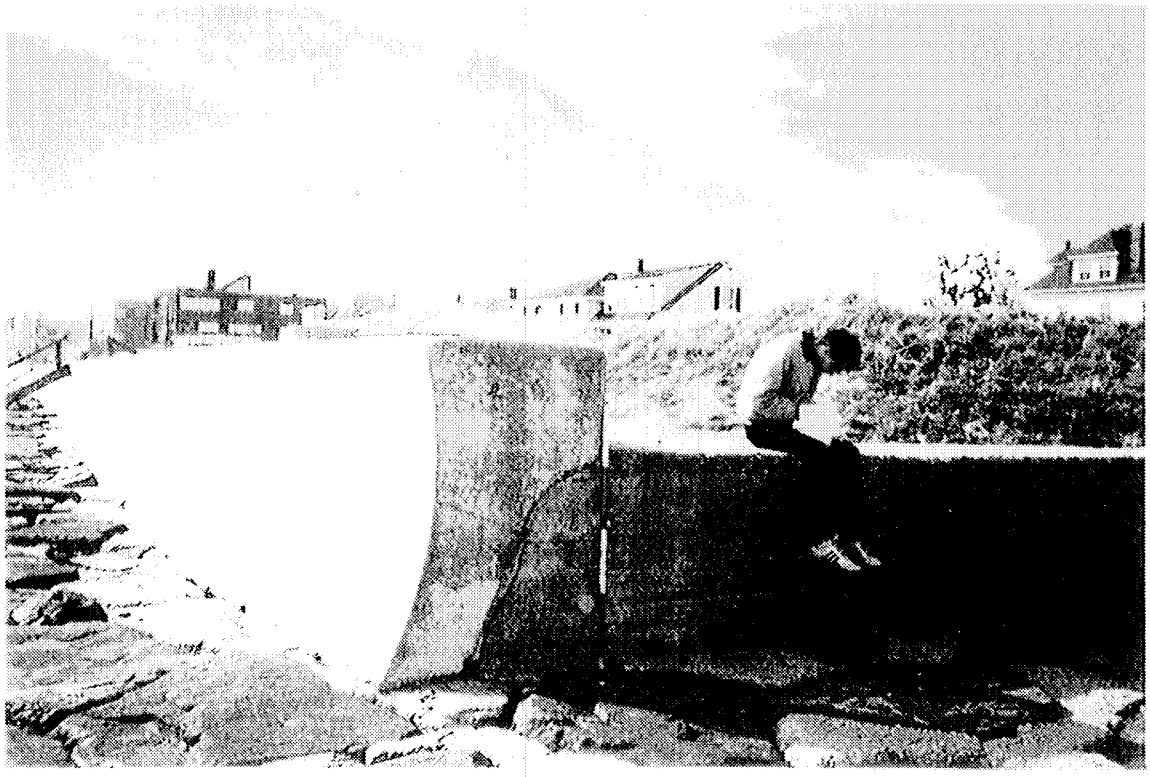


Photo #11: Curved face and stepped concrete seawall showing tie-in to bulkhead.

Photo #12: Stone revetment with concrete void filler providing toe protection for curved face-stepped concrete seawall, Longport.

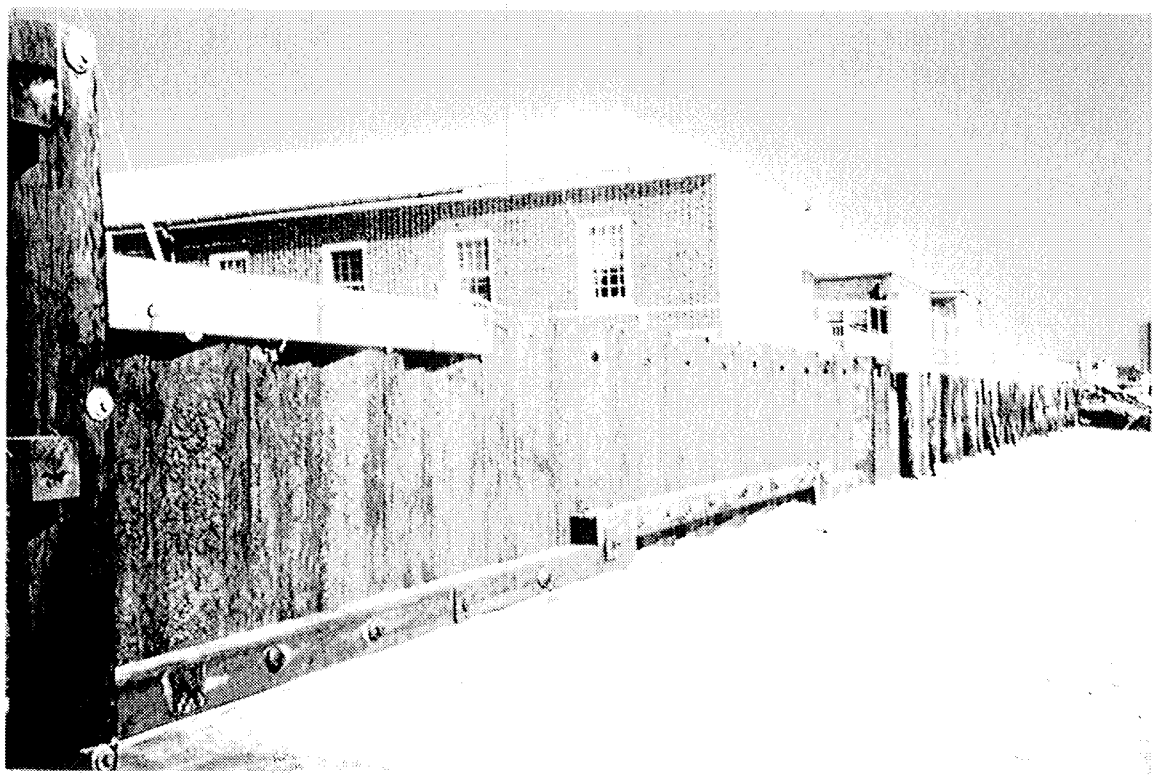


Photo #13: Steel sheet pile bulkhead at 28th Ave., Longport.

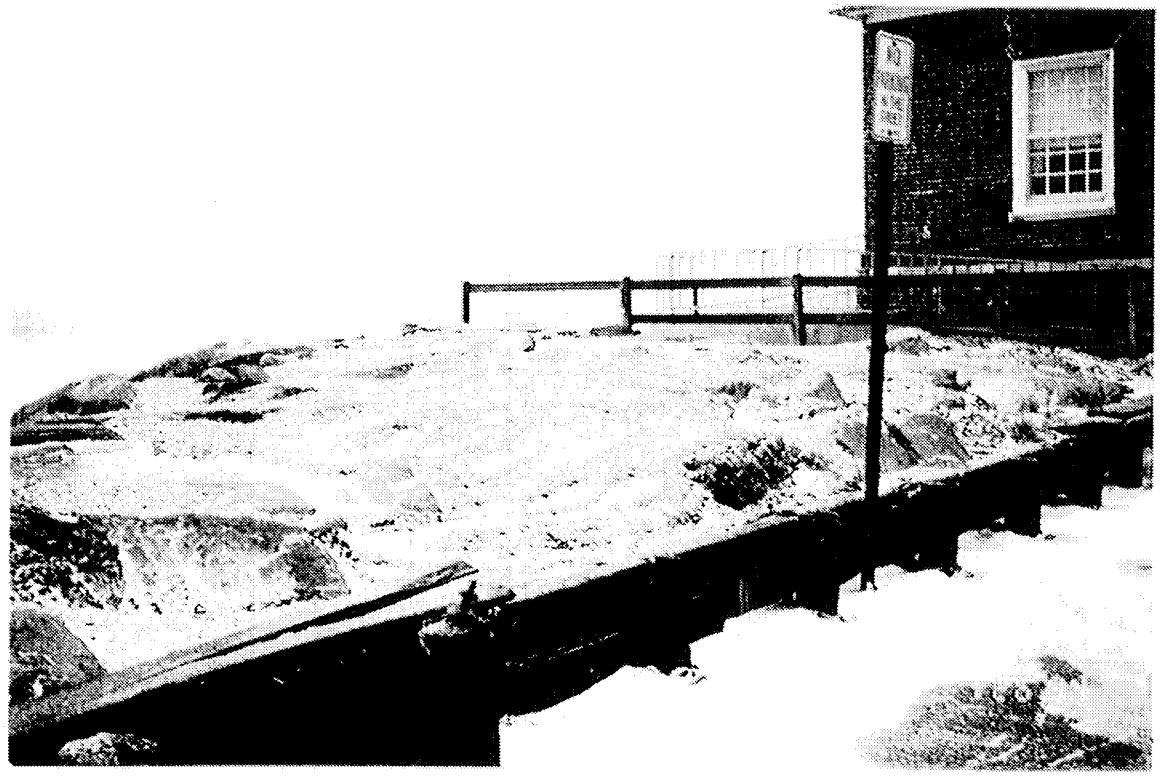


Photo #14: Stone and concrete fronting timber bulkhead at 29th Ave., Longport.

Photo #15: Typical new bulkhead at 30th Ave. and at property N. of 30th Ave., Longport.

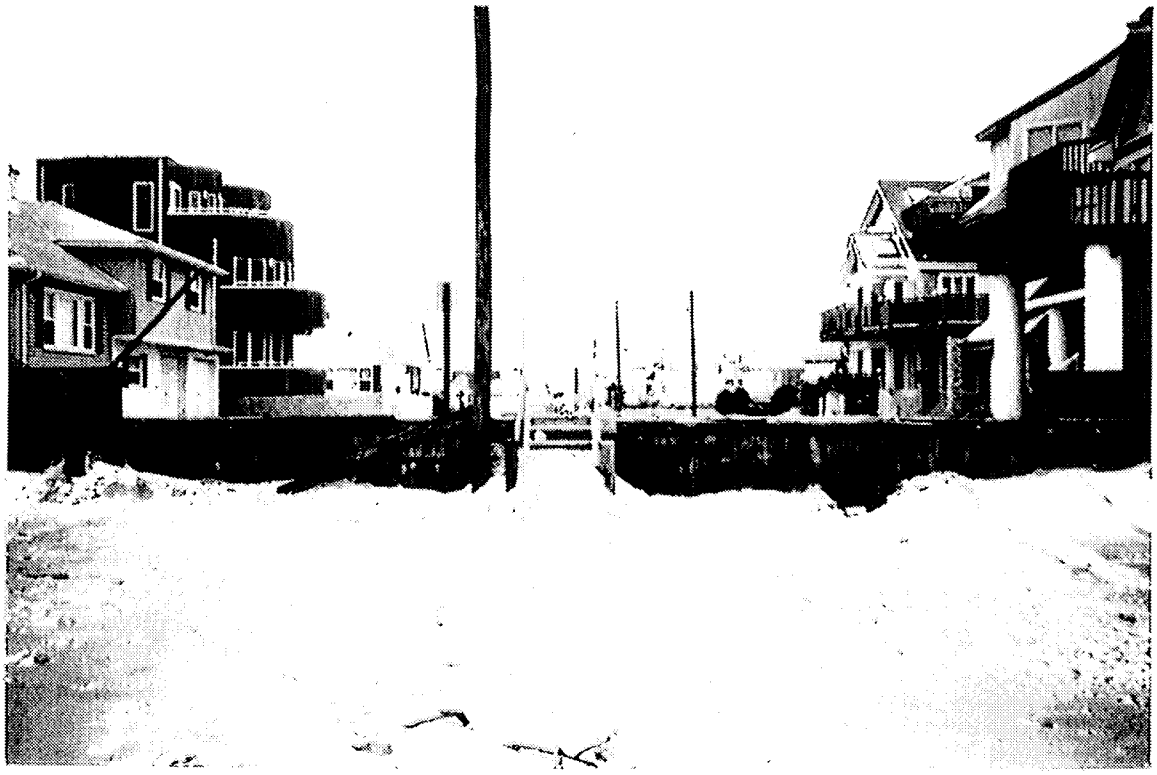


Photo #16: Showing typical bulkhead at street end with low top elevation and poor condition, at Manor Ave., Longport.

Photo #17: Groin at 11th ave., Longport.

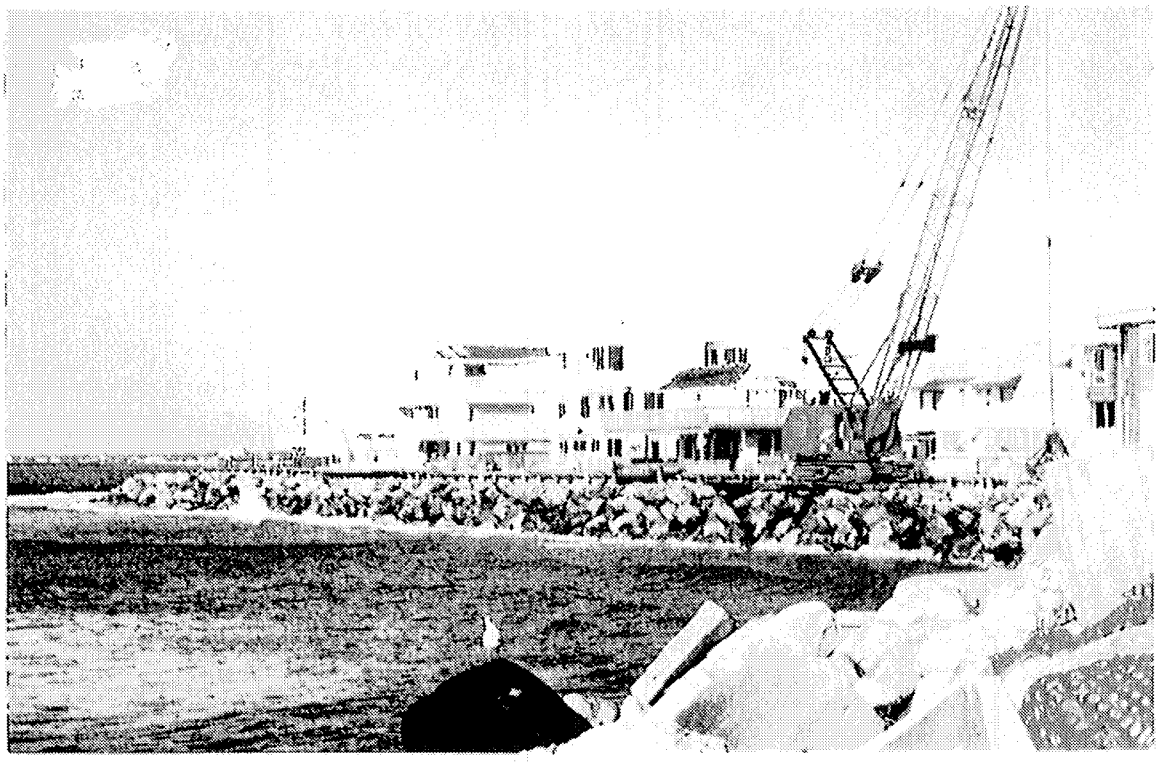


Photo #18: New stone revetment at the point in Longport, from 11th Ave. groin to Atlantic Ave. groin.

Photo 19. Exposed geotube on the beach in Atlantic City. Photo was taken following hurricane Felix.

Photo 20. Geotube reinforced dune on the beach in Atlantic City. Note narrow beach seaward of geotube.

SECTION 5

ENVIRONMENTAL INVESTIGATIONS

(See Volume 1)

SECTION 6

PROJECT DESIGN

SECTION 6
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EXISTING STRUCTURES

A site inspection of the existing coastal structures on Absecon Island was conducted in January 1994. Existing shore protection structures include timber and concrete bulkheads, concrete seawalls, stone revetments, and stone and timber beach groins. A complete structure inventory is attached for reference.

The bulkheads protecting Absecon Island, both along the inlet and the ocean front, are constructed of timber and concrete and conditions vary from excellent to poor. Construction of the timber bulkheads include two basic designs, tied-back and cantilever bulkheads. Both designs include either a single or double row of king piles (through a cross section) connected to a double row of timber sheet piling by means of bolted connections to a face and a lock waler.

In Atlantic City, there are timber bulkheads along the Absecon Inlet frontage and along the ocean frontage.

Along the inlet frontage, there is a new anchored bulkhead along Maine Ave. from Caspian Ave. to Atlantic Ave. (2200 ft. in length), which was constructed in 1993. Top elevation is +15.5 MLW and it is in excellent condition. Also along the inlet frontage is a section of bulkhead from Atlantic to Euclid Aves. (300 ft. in length). It is in very poor condition and is virtually ineffective.

Along the ocean front of Atlantic City, there are remains of a bulkhead with some intact sections from Seaside to Metropolitan Aves. (approx. 1000 ft. in length). This bulkhead was constructed in 1935 and is in very poor condition, with much of its discontinuous length buried under sand.

In Ventnor, all timber and concrete bulkheads were constructed by private interests, and no plans for any of the concrete bulkheads exist in any state or local municipality record. There is 5300 feet of concrete bulkhead and 3400 feet of timber bulkhead in the city of Ventnor. All the concrete bulkheads were constructed between 1925 and 1935, top elevations vary between +12 to +13 MLW, top widths vary between 2 and 3 feet, and conditions range from poor to good. All the concrete bulkheads are mostly intact and continue to provide protection to beachfront properties and street ends. The timber bulkheads in Ventnor were constructed between 1950 and 1952, with approximately 500 feet being replaced following the March 1962 storm. Top elevations vary between +10 and +13 MLW. The majority are in fair condition. Short gaps in construction (less than 20 ft.) exist at the Baton Rouge, Austin, and Amherst Place street ends.

In Margate, the entire shorefront (8450 feet or 1.6 miles) is protected by timber bulkheads. All were built between 1957 and 1964, except the sections of bulkhead at Granville and Rumson Avenues which were replaced in 1993. Top elevations vary between +10 and +13 MLW, and the majority are in fair to good condition.

In Longport, the entire ocean front (1.4 miles) is protected by 4050 feet of timber bulkhead, 55 feet of steel sheet pile bulkhead , and 3300 feet of concrete seawall.

The concrete seawall is a combination curved face and stepped structure, which was originally built in 1917 and was rehabilitated in 1981, at which time the curved face was repaired and the top elevation was raised to +11.6 MLW. When the seawall was originally constructed, the design did not include a pile support for the rear of the structure, which has resulted in the potential for a lack of stability of the wall if the fill supporting the rear of the structure should erode. A stone revetment with 18 inches of concrete void filler provides toe protection along the length of the seawall. The seawall is in fair to good condition, with some minor cracking and spalling. The structure has remained stable since 1963 and has been effective in providing protection to the properties behind it.

The timber bulkheads in Longport vary in top elevation from +10 to +14 MLW and the majority are in fair to good condition. The most recent section replaced was at 30th Ave. and the property just north of 30th, in 1984. Those sections at Pelham, Manor, and 31st Aves. are planned to be replaced in the near future by the State and municipality.

The steel sheet pile bulkhead is located at the seaward end of 28th Ave., and is in poor condition with significant corrosion.

In summary, to provide continuous protection of the Absecon Inlet frontage against erosion and storm damage using bulkheads, 1,050 linear feet of new bulkhead would be required to extend the bulkhead at Maine Ave. to the Oriental Ave. jetty. Along the ocean frontage of Absecon Island, it would require 2.4 miles (12,700 feet) of new timber bulkhead (almost entirely in Atlantic City) to provide a continuous line of storm protection. This distance does not include those areas where the concrete foundations of casinos abut the boardwalk, and represents a straight linear distance. This does not take into account the staggered lengths of the street ends and those areas where the bulkheads facing the ocean are connected by perpendicular bulkhead sections, adding to the total bulkhead length. Another option for improving the bulkhead-seawall system for Absecon Island would involve replacing those sections that have top elevations below +11 MLW. This occurs primarily at street ends, as most of the residents in Ventnor, Margate and Longport who own beachfront property maintain the bulkheads at a top elevation of

at least +11 MLW and the majority are kept in fair to good condition. Approximately 25 percent of the bulkheads protecting the street ends in these shore communities would need to be replaced under this option.

There are currently eight (8) groins, approximately 500 feet apart, in Atlantic City along the Absecon Inlet frontage. Two timber groins were constructed by the City and State in 1930-32, and repaired and protected with stone ends in 1958. Five stone groins and one timber and stone groin were also constructed along the inlet by the City and State between 1946 and 1958. Also along the inlet in Atlantic City is the Oriental Avenue jetty. It was built by the Federal Government in 1946-48 and extended in 1961-62 to its present length, and rehabilitated by the State in 1983. All eight inlet groins and the jetty are in good condition.

Along the ocean coast of Absecon Island, there are a total of twenty-nine (29) beach groins. Nine are stone groins that are in good to fair condition with little or negligible displacement or loss of stone along their visible length. Several of the stone groins in Atlantic City were rehabilitated by the City and the State in 1983. The work included extending and raising the crest elevation of the Vermont Ave. groin, raising the crest elevation and filling voids in the armor with concrete at the Massachusetts Ave. groin, and construction of a new timber groin with stone extension directly adjacent to the existing structure at Illinois Ave. Eleven beach groins are constructed of timber that are in fair to poor condition, many with rotting timbers which render them permeable. It appears that the local communities are maintaining the stone groins in a more intact state than the timber groins. There are nine groins constructed of stone and timber cribbing that are in poor condition, with all but a few cases existing in a state of debris, nearly invisible. These do not appear to serve their original function, and similar structures have not been constructed since the late 1920's.

There are three stone revetments providing erosion protection for bulkheads and seawalls on Absecon Island. There is a new stone revetment along the length of the new timber bulkhead at Maine Avenue on the Absecon Inlet frontage. It is constructed of 2 to 3 ton riprap and the slope of the revetment follows the existing slope of the sand fronting the bulkhead. There is also a stone revetment providing erosion protection along the length of the combination curved face and stepped reinforced concrete seawall which extends from 11th Ave. to 15th Ave. and then from between 23rd and 24th Aves. in the city of Longport. Top elevation of the revetment varies between +6 to +6.3 MLW and has concrete void filler in the upper 18" of stone. It is in fair to good condition. Also in the city of Longport is

96

a new stone revetment at 11th Ave., extending to the inner end of the stone groin constructed at Atlantic Ave. The crest of the revetment has a design top width of 14+ feet and a top elevation of +8.0 MLW. The revetment was constructed using 8 to 9 ton weight rough quarrystone, and fronts an existing timber bulkhead with a top elevation varying between +10.0 and +12.0 MLW. This replaces a previous concrete block and stone revetment. Constructed by the State of New Jersey in 1993. Plans are on file in C&S Section.

There are a total of twenty-three (23) storm drain outfall pipes that extend the width of the existing beaches to drain into the ocean on Absecon Island. In Atlantic City, all outfall pipes are cast iron and are set on timber cribbing. These include five (5) 36-inch diameter pipes, two (2) 30-inch pipes, two (2) 24-inch pipes, and one (1) 20-inch pipe. In the city of Ventnor, there are four (4) 12-inch diameter precast reinforced concrete pipes which are laid on sand, one (1) 12-inch cast iron pipe on timber cribbing, two 12-inch corrugated metal pipes laid on sand, and two (2) 12-inch PVC pipes laid on sand. In the city of Longport, there are four (4) 12-inch diameter cast iron pipes on timber cribbing. All outfalls are in fair to good condition, however many were covered by sand except for those in Atlantic City. **

**At the time of the last structure inventory, most outfalls as noted in the Existing Structures section of this report were intact and in fair to good condition. At the present time, the condition of some of these outfalls has degraded. In Atlantic City, all outfalls are intact up to approximately the mean low water line; however, several of the existing outfall pipes have broken off at pipe sections located in the surf zone. The existing length of these outfalls is not adequate to assure unhindered drainage for those proposed beachfill alternatives having a berm width of 200 feet or greater. Therefore, these outfalls were extended for the corresponding Cycle 3 alternatives. This required extending approximately 270' of 20" diameter ductile iron pipe, and 170' of 24" diameter D.I.P., with timber support systems spaced at 18 feet. 220' of 30" diameter D.I.P., and 150' of 36" diameter D.I.P. will also be extended with timber support systems spaced at 9 feet. Several outfalls in Ventnor, Margate and Longport have also suffered damage, and in some cases have sheared off completely at the bulkhead. These outfalls were also extended for the Cycle 3 beachfill alternatives. It was assumed that all outfalls would be replaced with 12" diameter D.I.P., for a total length of 1,650 feet, including timber support systems spaced every 18 feet.

GEOTUBES

A system of geotube reinforced dunes were constructed in Atlantic City during the summer of 1995. Geotubes have been placed in sections extending between Chelsea Avenue to Martin Luther King Boulevard and from Massachusetts to Vermont Avenues, with a total approximate length of 6,300 feet. The geotubes were constructed on top of the existing man made dunes, and were made of a permeable gortex material which was filled with a sand/water slurry. This slurry was obtained directly from the existing beach in Atlantic City at the surf zone, and at the final phase of construction, the water component of the mix drained out of the gortex membrane, resulting in a solid geotube filled with sand. The seaward edge of the geotubes is located approximately 75 ft. in front of the boardwalk. As positioned, the geotubes are 6 ft. high by 12 ft. wide, and are covered by approximately 1 ft. of sand to form a dune with a top elevation of +14.0 NGVD. (see photos 19&20).

BOARDWALKS

The boardwalk in Atlantic City extends from Caspian Ave. on the Absecon Inlet side around to the borough line at Jackson Ave. on the ocean frontage. The design and width of the boardwalk varies from 60 ft. wide with steel reinforced concrete girders and concrete piles (9000 ft. in length) to a 40 ft. wide section which is a combination of timber and concrete girders and piles (6600 ft. in length) to a 20 ft. wide section composed entirely of timber (6700 ft. in length). The last reconstruction of the boardwalk occurred in 1995 along the Absecon Inlet portion. These repairs involved replacing whole portions of deck, girders, and encasing piles in plastic. Various utilities including electric, storm drains, cable television, telephone and water lines are located underneath boardwalk along the ocean frontage. Top of deck elevations vary between +11 to +13 MLW. Along the ocean frontage the boardwalk is in fair to good condition with the exception of that part of the boardwalk that extends northeast from approximately New Jersey Ave., however the boardwalk along the Absecon Inlet frontage regularly sustains damages during minor storm events. The conditionof the boardwalk in this area therefore varies. (See photos #1&4)

The boardwalk in Ventnor is of timber construction and is 20 ft. wide. It extends from the borough line with Atlantic City at Jackson Ave. to the borough line with Margate at Fredericksburg Ave., with a top of deck elevation varying between +12 and +13 MLW. The length is 8,750 ft, condition is fair to good.(See photo #6)

FB

ABSECON ISLAND
FEASIBILITY STUDY
EXISTING SHORELINE CONDITIONS
EROSION CONTROL STRUCTURE INVENTORY
1994

BULKHEADS AND SEAWALLS

AB=Absecon Inlet Frontage
AC=Atlantic City Ocean Frontage
V=Ventnor
M=Margate
L=Longport
NOTE: Photographs referenced are included at the end of this inventory.

1. Cell AB2 and AB3: Existing bulkhead @ Maine Ave. has been replaced with new anchored timber bulkhead in 1993, adjacent to Maine Ave. from Atlantic to Madison and then from Melrose to Caspian. Stone toe protection. Length 2200 feet. (See photo #1)

2. Cell AB3: Timber, from Atlantic Ave. to Euclid. Condition poor. Length approximately 300 feet.

3. Cell AC4: Timber, from Seaside to Metropolitan. Condition very poor. Bulkhead is buried in many areas and is discontinuous at street ends. Length approximately 1000 ft.

4. Cell AC6-AC10: Concrete foundations for hotel/casino resorts in these cells which abut the boardwalk consist of piles founded on stable strata and are not included in the analysis. No bulkheads exist in these cells.

5. Cell AC9-AC11: Concrete, from Boston to Jackson Ave., only extending the length of street ends. Short length and gravity wall design (no pile foundations) provide no erosion protection. Not to be included in analysis.

6. Cell V12: Concrete, from Jackson to south side of Surrey. Condition fair. Small gaps exist in construction (<20') at Baton Rouge, Austin, and Amherst Place. Length 2100 feet.

7. Cell V12: Timber, fronted by concrete bulkhead from south side of Surrey to Suffolk, condition fair. Length 300 feet.

8. Cell V13: Timber, fronted by concrete bulkhead from Suffolk to Somerset, condition fair. Length 400 feet.

9. Cell V13: Concrete, from Somerset to Portland, condition fair to poor from Somerset to Cornwall, in good condition from

Cornwall to Cambridge, poor condition Cambridge to Portland. Length 2450 feet. (See photo #8)

10. Cell V14: Timber, from Portland to between Portland and Stratford, condition fair. Length 100 feet.

11. Cell V14: Concrete, from between Portland and Stratford to Stratford. Condition fair, length 75 feet.

12. Cell V14: Timber, from Stratford to New Haven, condition fair. Length 500 feet.

13. Cell V14: Concrete, from New Haven to Richards, condition fair. Length 525 feet.

14. Cell V15: Timber, from Richards to Martindale, condition ranges from new at the Richards Ave. section to fair. Length 2100 feet.

15. Cell V15: Concrete, from Martindale to Fredericksburg, condition fair. Length 180 feet.

16. Cell M16: Timber, from Fredericksburg to Brunswick, condition fair to poor. Length 700 feet.

17. Cell M17: Timber, from Brunswick to Douglas, condition fair to poor. Length 700 feet.

18. Cell M18: Timber, from Douglas to Kenyon, anchor type construction from south side Douglas to Exeter. In good to fair condition except for length from Franklin to Exeter. Interrupted by short concrete bulkhead at Jerome to Plymouth, which is continuous with the timber bulkhead and is in good condition. Plans exist for the Granville Ave. section, which was replaced in 1993. Length 2450 feet.

19. Cell M19: Timber, from Kenyon to Mansfield, in good to fair condition. Length 350 feet.

20. Cell M19: Concrete, from Mansfield to Osbourne, condition fair to good, length is 518'. Length is 400 feet.

21. Cell M19: Timber, from Osbourne to Sumner, condition fair to good, length is 825 feet. Section at Rumson Ave was replaced in 1993.

22. Cell M20: Timber, from Sumner to Benson, condition fair to good. Length 1200 feet.

23. Cell M21: Timber, from Benson to between Coolidge and 36th

160

St., condition fair to good, length 2000 feet.

24. Cell L22: Timber, from between Coolidge and 36th St. to 32nd St., condition fair. 1,100 ft. length.

25. Cell L23: Timber, from 32nd Ave. to 29th Ave. New bulkhead section at 30th Ave. and property north of 30th Ave., bulkhead sections at 31st, Pelham and Manor are scheduled to be replaced in the near future. 1,100 ft. length. (See photos #15&16)

26. Cell L24: Timber, from 29th to 27th Aves., 600 ft. length. Section of bulkhead at 29th Ave. is fronted by large stone with concrete void filler, with an average top width of 18 feet. Good condition. Timber bulkhead at 28th Ave. is fronted by a steel sheet pile bulkhead, with fill in between, condition poor, severe rusting of sheet pile and bolts. (See photos #13&14)

27. Cell L25: Timber, from 27th Ave. to 23rd Ave., good condition. Length 950 feet.

28. Cell L26: Combination curved face and stepped seawall constructed of concrete with steel reinforcement at the seaward face and stone and concrete toe protection extends from between 23rd and 24th Aves. to 16th Avenue. Top elevation +11.6 NGVD, condition good, some minor cracking and spalling, length 2200 feet. Plans are on file in C&S Section. (See photo #11)

29. Cell L27: Timber, from 16th to 15th Aves., condition good. Ties in to curved concrete seawall @15th Ave., length 350 feet.

30. Cell L27: Combination curved face and stepped seawall constructed of concrete with steel reinforcement at the seaward face and with stone and concrete toe protection extends from 15th Ave. to 11th Ave. Top elevation +11.6 NGVD, condition good, some minor cracking and spalling of concrete. Plans are on file in C&S Section. Length 1100 feet. (See photo #11)

REVETMENTS

1. Cell AB2 and AB3: Revetment providing toe protection along the length of the new timber bulkhead at Maine Avenue. Constructed of 2 to 3 ton riprap and the slope of the revetment follows the existing slope of the sand fronting the bulkhead. (See photo #1)

2. Cell L26 and Cell L27: Revetment providing toe protection for combination curved face and stepped reinforced concrete seawall which extends from 11th Ave. to between 23rd and 24th Aves. with the exception of a section from 15th to 16th Aves. Top elevation

of revetment varies between +6 to +6.3 MLW and has concrete void filler in the upper 18" of stone. Fair to good condition. (See photo #12)

3. Cell L27: New stone revetment constructed in 1993 at 11th Ave., extending to the inner end of the stone groin constructed at Atlantic Ave. The crest of the revetment was constructed with a top width of 14+ feet, a top elevation of +8.0 MLW, using 8 to 9 ton weight rough quarrystone. The revetment fronts an existing timber bulkhead with a top elevation varying between +10.0 and +12.0 MLW. Replaces previous concrete block and stone revetment. Constructed by the State of New Jersey. (See photo #18)

GROINS

1. Cells AB2 and AB3: Along the northern end of the island fronting Absecon Inlet there exists a field of eight groins, starting at Adriatic Ave. and continuing to Pacific Ave. Five of the groins are composed of rough quarrystone, and three of timber and quarrystone (Melrose, Drexel, Adriatic). The groins are approximately 500 feet apart and have a 14 ft. crest width, with a top of crest design elevation of +8.0 MLW at the landward end to +7.0 MLW at the seaward end. All eight groins are in good condition. (See photo #2)

2. Cell AC4: Extending from Oriental Ave. along Absecon Inlet is a stone jetty which is 1177 feet long. It was constructed with a crest width of 14 ft., at an elevation of +11.0 MLW at the landward end and +7.0 MLW at the seaward end. Condition is good. Extended to its current length in 1961 and concrete void filler placed. In 1983 it was repaired and its crest elevation raised to the +11.0 MLW elevation with added capstone.

3. Cell AC4: Stone groin at Vermont Ave., approximately 400 feet in length. It was originally constructed with a crest width of 14 ft., at an elevation of +10.0 MLW at the landward end and +7.0 MLW at the seaward end. Condition is good. "Dog-leg" extension and placement of concrete void filler were constructed in 1961. In 1983 it was repaired and extended approximately 200 ft. to a water depth of about -8.3 MLW, and the and the seaward crest elevation was raised to the +7.0 MLW elevation with added capstone.

4. Cell AC5: Massachusetts Ave. Groin, approximately 550 ft. in length. It was constructed of stone with a crest width of 15 ft., at an elevation of +10 MLW at the landward end and +7.0 MLW at the seaward end. Condition is fair. In 1983 it was repaired, its seaward crest elevation raised to +7.0 MLW with added capstone. (See photo #3)

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5. Cell AC6: Two timber groins are located in this cell; one at Delaware Ave. which is approximately 600 ft. in length, and one at Presbyterian Ave (just south of Steel Pier) which is approximately 470 ft. long. Both were constructed using a double row of timber sheeting connected to staggered king piles, with an elevation of +8.0 at the landward ends and +1.0 at the seaward ends. The condition of the Delaware Ave. groin is poor, and the Presbyterian Ave. groin is in fair condition.

Also located in this cell is a stone groin located at Virginia Ave., just north of the Steel Pier. Approximately 140 ft. of its length was exposed at the time the inventory was taken. No design information was found for this groin. Its condition is fair.

6. Cell AC7: Two timber groins are located in this cell; one between North Carolina and South Carolina Aves. which is approx. 610 ft. in length, and one at St. James Place which is approximately 600 ft. in length. Both were constructed using a double row of timber sheeting connected to staggered king piles, with an elevation of +8.0 at the landward ends and +1.0 at the seaward ends. The condition of both of the groins is fair. (see photo #4)

A stone groin at Tennessee Ave. is also located in this cell. It was constructed with a crest width of 14 ft., at an elevation of +8.0 MLW at the landward end and +7.0 MLW at the seaward end, however no plans are on file to verify this information. Approximately 275 ft. of its length was exposed at the time the inventory was taken. Fair condition.

7. Cell AC8: Two timber groins are located at Illinois Ave. (Martin Luther King Ave.). The southern one is approximately 300 ft. in length and was constructed in 1948-50. It was constructed using a double row of timber sheeting connected to staggered king piles, with an elevation of +8.0 MLW at the landward end and +1.0 MLW at the seaward end. Its condition is poor. Plans are on file in C&S Section. It was essentially replaced by building a new timber groin adjacent to and approx. 10 ft. north of the existing structure. A 270 ft. long stone extension was added to the timber portion making the total length of the new groin approximately 800 ft. The timber portion was constructed similarly to the old groin, with an elevation of +10.0 MLW at the landward end sloping to +9.0 MLW 300 ft. from the boardwalk, continuing at a 1:30 slope to an elevation of +2.0 MLW. The stone extension terminates at a water depth of -9.0 MLW. The condition of this groin is fair.

8. Cell M18: Two stone groins are located in this cell; one at Exeter Ave. which is approximatley 300 ft. in length, and one at

Jerome Ave. which is approximately 330 ft. in length. The Exeter Ave. groin was constructed with a crest width of 15 ft., to an elevation of +11.0 MLW at the landward end and +2.0 MLW at the seaward end. It is in fair condition. The Jerome Ave. groin was constructed with a crest width of 15 ft., to an elevation of +11.0 MLW at the landward end and +4.0 MLW at the seaward end. Its condition is also fair.

9. Cell M19: Timber groin at Quincy St., approx. 250 ft. in length. It was constructed to an elevation of +11.0 MLW at the landward end and +4.0 MLW at the seaward end. The groin is in poor condition and is virtually gone. (See photo #9)

A timber and stone groin is also located in this cell at Sumner St. It was constructed to an elevation of +11.0 MLW at the landward end, +4.0 MLW at the seaward end, with a length of approximately 350 ft. The groin is in poor condition.

10. Cell M20: Stone groin located at Cedar Grove Ave., approximately 400' in length. It was constructed with a crest width of 15 ft., to an elevation of +6.0 MLW at the landward end and +3.0 MLW at the seaward end. The groin is in fair condition.

11. Cell M21: Timber crib and stone groin located at Adams Ave., approximately 200 ft. in length. It was constructed with a crest width of 9 ft., to an elevation of +9.0 MLW at the landward end and +0.0 MLW at the seaward end. Its condition is poor.

Two timber groins are also located in this cell; one at Madison Ave. and one at Monroe Ave. They were similarly constructed to an elevation of +11.0 MLW at the landward ends and +2.0 MLW at the seaward ends, at lengths of approximately 300 ft. Both are in poor condition with rotting timbers.

Also, a stone groin approximately 425 ft. in length is located in this cell at Coolidge Ave. It was constructed with a crest width of 12 ft., to an elevation of +8.0 MLW at the landward end and +1.0 MLW at the seaward end. The condition of this groin is fair, however, the seaward end has settled.

12. Cell L22 to L25: There are six timber and stone groins located within these cells. All are in very poor conditon with rotting timbers, and are virtually ineffective. They are located at 23rd St., 24th St., 27th St., 29th St., 32nd St., and 33rd St.
13. Cell L26 and L27: Three timber crib groins are located at 14th St., 18th St., and 20th St. They range in length from 250 ft. to 300 ft., are in poor condition, and are virtually ineffective. The cribbing was constructed using two rows (at a spacing of approx. 9 ft.) of timber sheeting connected to staggered king piles, at an elevation of +4.0 MLW at the landward

ends and at +1.0 MLW at the seaward ends.

14. Cell L27: Stone groin at 11th Ave., top elevation +12.0 MLW at the landward end, +7.0 MLW at the seaward end, with a top crest width of 14 ft. Originally constructed in 1917, was extended from 400 ft. to 500 ft. in length in 1922, was rehabilitated in 1953 and again in 1972. It is now approximately 510 ft. in length and is in good condition. (See photo #17)

PILE STRUCTURES

1. Cell AB2: Pile structure (bath house) located at Drexel Avenue.

2. Cell AC6: Pile structure, "Garden Pier", located between Oriental and New Jersey Aves., 250 feet length, 185 feet width. Includes remains of previous pier at seaward end.

3. Cell AC6: Pile structure, "Steel Pier", located between Pennsylvania and Virginia Aves., 1000 feet length, 150 feet width.

4. Cell AC6: Pile structures (bath house) located at Connecticut and States Avenues.

5. Cell AC7: Structure constructed on 30" concrete piles located at St. James Place. Fair to poor condition.

6. Cell AC7: Pile structures (bath house) located at South Carolina and New York Avenues.

7. Cell AC7: Concrete pile structure, "Steeplechase Pier", located 400 feet south of Steel Pier. Length 550 feet, width 50 feet.

8. Cell AC7: Pile structure, "Central Pier", located between Tennessee Ave. and St. James Place. Length 600 feet, width 150 feet.

9. Cell AC8: Pile structure located at Michigan Avenue.

10. Cell AC9: Pile structure located at Missouri Avenue.

11. Cell AC9: Concrete pile structure, "Ocean One Mall" located at Arkansas Ave., length 900 feet, width 200 feet.

12. Cell AC10: Pile structure (bath house) located at Chelsea Avenue.

13. Cell AC11: Pile structures (bath house) located at Hartram Place and Lincoln Place, good condition.

14. Cell V12: Small pile structures (16 ft. x 12 ft.) located at Vassar, Austin, Frankfort, and between Victoria and Surrey Avenues. Fair condition. (see photo #)

15. CELL V13: Pile structure (fishing pier), located at Cambridge Ave., 1000 feet length, 55 feet wide.

16. Cell V13: Small pile structures (16 ft. x 12 ft.) located between Suffolk and Somerset, at Dorset, Cambridge, and between Sacramento and Harvard Avenues. Fair condition.

17. Cell V14: Small pile structures (16 ft. x 12 ft.) located between Newport and New Haven Avenues. Fair condition.

18. Cell V15: Small pile structures (16 ft. x 12 ft.) located Buffalo, Lafayette, and between Martindale and Washington Avenues. Fair condition.

19. Cell M18: Pile structure (fishing pier), located between Essex and Exeter Avenues. Length 85 feet, width 70 feet.

OUTFALLS

1. Cell AC6: 20" diameter cast iron pipe on timber cribbing located at Connecticut Ave., 30" cast iron pipe on timber cribbing located at New Jersey and Virginia Avenues.

2. Cell AC7: 36" diameter cast iron pipe on timber cribbing located at Mansion Ave. and St. James Place.

3. Cell AC8: 36" diameter cast iron pipe on timber cribbing located at Illinois Avenue.

4. Cell AC9: 36" diameter cast iron pipe located at Arkansas, Boston and California Aves., 24" cast iron pipe at Georgia and Mississippi Aves., all on timber cribbing. (See photo #5)

5. Cell V12: (2) 12" diameter pre-cast reinforced concrete pipes laid on sand at Vassar and Oakland Avenues. (See photo #7)

6. Cell V13: (1) 12" diameter cast iron pipe at Suffolk Ave. on timber cribbing. (1) 12" corrugated metal and (1) 12" PVC pipe at Cornwall and Dudley Aves. laid on sand.

7. Cell L22: 12" diameter cast iron pipe on timber cribbing at 33rd Avenue.

8. Cell L23: 12" diameter cast iron pipe on timber cribbing at Manor Avenue.

9. Cell L26: 12" diameter cast iron pipe on timber cribbing at 23rd Avenue.

10. Cell L27: 12" diameter cast iron pipe on timber cribbing at 14th Avenue. (See photo #10)

ABSECON ISLAND OUTFALL PIPE INFORMATION (continued)
Updated for Cycle 3 and Selected Plan
4/30/95

LONGPORT

33rd ST.
10" I.P.
DIST B.H. TO M.H. = 107' M.H. RIM= 7.28 INV.= 4.15
DIST B.H. TO SEA END = 263' INV. @ PIPE END 3.40

MANOR AVE.
12" I.P.
DIST B.H. TO M.H. = 6' M.H. RIM = 8.25 INV.= 2.50
DIST B.H. TO SEA END = 145' INV. @ PIPE END 1.59

MARGATE / VENTNOR

CORNWALL AVE.
12" P.V.C.
PIPE BROKE OFF @ B.H. INV.= 7.18
B.H. WIDTH 1.7' INV. STREET SIDE = 7.60
C.M. PIPE BURIED IN SAND

DUDLEY AVE.
12" C.M. INV. = 7.81
12" P.V.C. INV. = 7.59
BOTH PIPES BROKEN OFF AT B.H.

SUFFOLK AVE.
12" C.I. INV. = 7.27
PIPE BROKEN OFF @ B.H.

OAKLAND AVE.
NORTH PIPE 12" P.V.C. INV. = 6.98
SOUTH PIPE 12" ACP INV. = 6.23

VASSAR AVE.
PIPES BURIED UNDER SAND

ATLANTIC CITY

BOSTON AVE.
36" I.P.
PIPE EXPOSED @ 331' FROM B.W.
TOP PIPE = 2.03 @ 331'
" = 1.87 @ 364'
" = 1.80 @ 440'
PIPE AND CRIBBING END @ 490'

CALIFORNIA AVE.
30" I.P.
PIPE EXPOSED @ 211' FROM B.W.
TOP PIPE = 2.81 @ 211'
" = 2.70 @ 295'

PIPE INV.= -.90 @ 400'
PIPE AND CRIBBING END @ 400'

GEOGIA AVE.
24" I.P.
PIPE EXPOSED @ 170' FROM ABUTMENT OF EXTENDED B.W.
TOP PIPE = 1.35 @ 170'
" = 1.00 @ 214'
PIPE INV.=-1.23 @ 320'
PIPE ENDS @ 320' CRIBBING ENDS @ 410'

MISSISSIPPI AVE.
2 PIPES
NORTH PIPE = 24" I.P.
PIPE EXPOSED @ 290' FROM B.W.
TOP PIPE = 1.23 @ 290'
" = 1.14 @ 312'
" = 0.68 @ 443 END OF PIPE
SOUTH PIPE = 18" I.P.
PIPE EXPOSED @ 282' FROM B.W.
TOP PIPE = 1.55 @ 282'
" = 1.47 @ 312'
" = 1.03 @ 449' END OF PIPE
CRIBBING ENDS @ 658' APPROX.

ARKANSAS AVE.
36" I.P.
PIPE EXPOSED @ 291' FROM B.W.
TOP PIPE = 2.31 @ 291'
" = 1.47 @ 439'
PIPE ENDS @ 451' CRIBBING ENDS @ APPROX 600'

ILLINOIS AVE.
24" I.P.
PIPE EXPOSED @ 248' FROM B.W.
TOP PIPE = 1.66 @ 248'
" = 1.17 @ 348'
" = 0.48 @ 528'
PIPE & CRIBBING END @ APPROX 550'

ST. JAMES PLACE
36" I.P.
PIPE EXPOSED @ 164' FROM B.W.
TOP PIPE = 3.09 @ 164'
" = 1.97 @ 444'
PIPE & CRIBBING END @ APPROX 460'

NORTH CAROLINA AVE.
36" I.P.
PIPE EXPOSED @ 310' FROM B.W.
TOP PIPE = 1.42 @ 310'
" = 0.55 @ 468'
PIPE & CRIBBING END @ APPROX 470'

VIRGINIA AVE.
36" I.P.
PIPE EXPOSED @ 318' FROM B.W.
TOP PIPE = 1.14 @ 318'
" = 0.56 @ 364'
PIPE ENDS @ 364' CRIBBING ENDS @ APPROX 475'

NEW JERSEY AVE.
30" I.P.
PIPE EXPOSED @ 215' FROM B.W.
TOP PIPE = 2.15 @ 215'
" = 1.94 @ 274'
" = 0.99 @ 332'
PIPE & CRIBBING END @ 332'

CONNECTICUT AVE.
20" I.P.
PIPE EXPOSED @ 150' FROM B.W.
TOP PIPE = 1.42 @ 150'
" = 0.88 @ 251'
INTACT PIPE ENDS @ 251'
BROKEN PIPE & CRIBBING END @ APPROX 400'

NOTE: ELEVATIONS ARE NGVD29 DISTANCES ARE FROM THE FACE OF THE BULKHEAD OR BOARDWALK

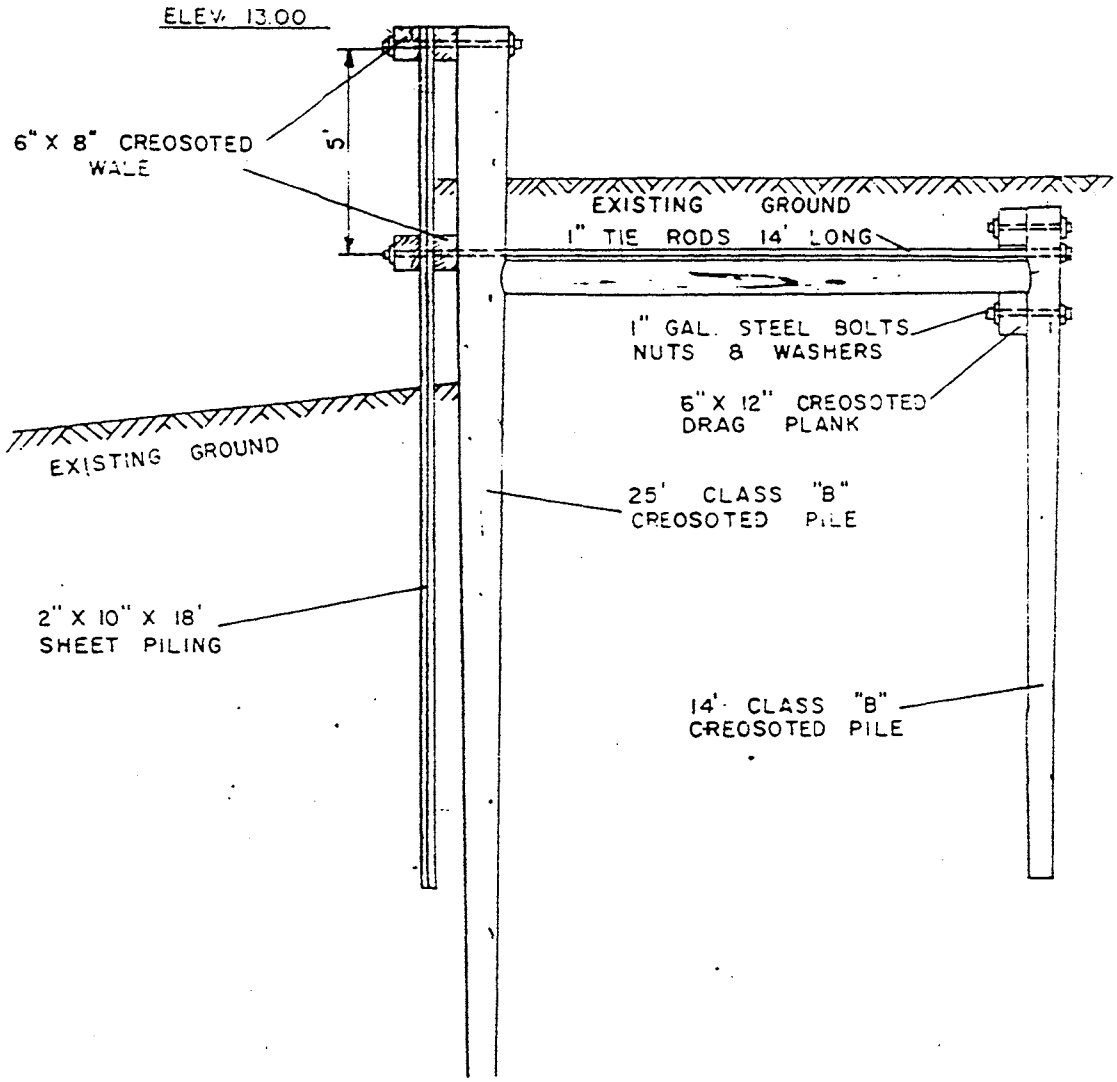
WITHOUT PROJECT FUTURE CONDITIONS

The continued erosion of the protective beach berm within the study area makes the existing bulkheads, seawalls, groins, storm drain outfall pipes, and boardwalks more vulnerable to damage and failure during storm events. Continued erosion of the existing beaches will result in higher costs as these shore structures will require repairs and or replacement.

In areas where there is insufficient protective berm widths and/ or existing protection structures, the continued erosion of land will cause damages to utilities and private and public property. Increased maintenance costs will be incurred to repair damaged utilities and street ends. Damages incurred by wave attack will cause increased maintenance costs to continually repair boardwalks. Oceanfront property will disappear unless these damages and the continued erosion are prevented.

BULKHEAD FAILURE ANALYSIS

If nothing is done about the continued erosion of the beaches on the Absecon Island oceanfront, the existing bulkheads will become unstable. As part of the without project analysis and as input to the storm erosion modelling efforts, a simplified bulkhead failure analysis was completed. This information, along with other parameters, was used to determine at what point the erosion will continue beyond the existing bulkhead structures. The problem was simplified by assuming static equilibrium conditions and failure due to loss of sand seaward of the toe. The analysis proceeded by investigating ever smaller amounts of passive soil resistance on the seaward side of the bulkhead(erosion reduces this). The point at which passive soil resistance became too small resulted in failure. Schematics of typical bulkheads analyzed for failure is included, as well as analysis summaries.



SECTION

ANCHORED BULKHEAD

Bulkhead Failure Analysis
Anchored Bulkhead

Assumptions:

Fill on both sides of wall is sand;

$\gamma_T = 110\,pcf$

$\gamma_B = 50\,pcf$

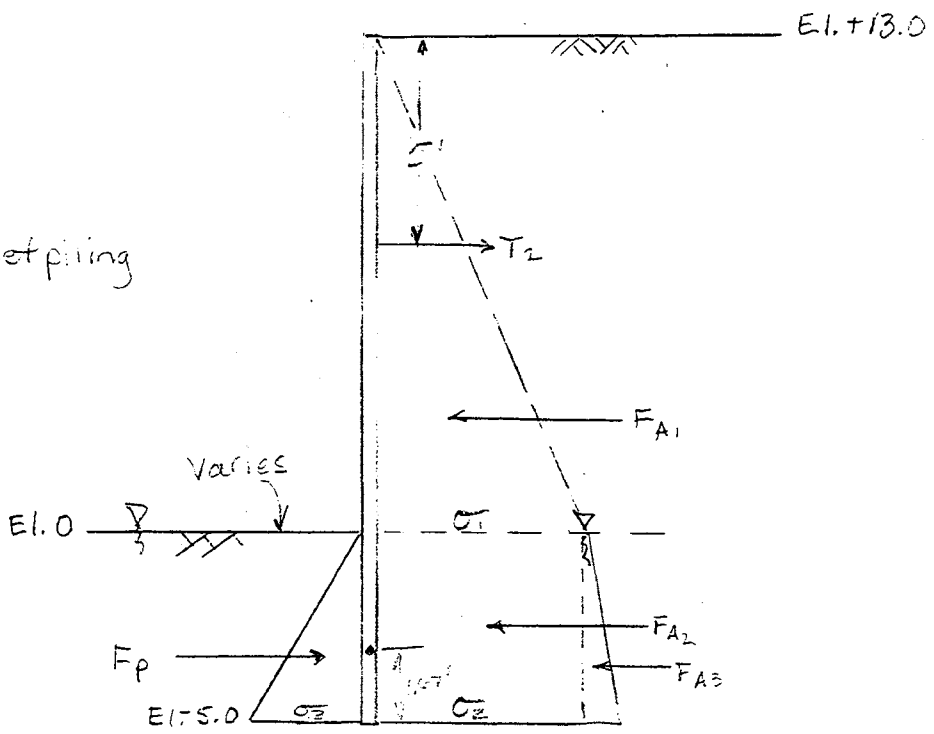
$\gamma_w = 62.4\,pcf$

$K_A = .33$? $\rho' = 30°$

$K_p = 3.0$

2"x10"x16" timber sheet piling
Use Rankine Theory

Worst Case - Backfill up to top of bulkhead



Assume passive fill is at elevation 0 (GWT)

Pressures:

Active:

@ $z = 0$, $\sigma_1 = (110\,lb/ft^3)(13\,ft)(.33) = 472\,lb/ft^2$

@ $z = -5$ $\sigma_2 = [(50\,lb/ft^3)(5\,ft) + (110\,lb/ft^3)(13\,ft)].33 = 554.4\,lb/ft^2$

Passive:

@ $z = -5$, $\sigma_3 = (50\,lb/ft^3)(5\,ft)(K_p) = 250K_p\,lb/ft^2$

Sum Horizontal Forces

$F_{A1} = \frac{1}{2}(13\,ft)(472\,lb/ft^2)(\frac{10''}{12''}) = 2556.7\,lb$

$F_{A2} = (5\,ft)(472\,lb/ft^2)(\frac{10''}{12''}) = 1965.9\,lb$

$F_{A3} = \frac{1}{2}(5\,ft)(554.4 - 472)(\frac{10''}{12''}) = 171.7\,lb$

$F_p = \frac{1}{2}(5\,ft)(250K_p)(\frac{10''}{12''}) = 520.6\,K_p$

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Find $\bar{x}$: (for passive fill only)

$520.6\ K_p(5/3) = 520.6 K_p \bar{x}$

$\bar{x} = 1.67'$

$\curvearrowleft \Sigma M_x = 2556.7(7.68') + 1965.9(.83') - T_1(11.33) = 0$ (F_{A3} & F_p are in the same location as $\bar{x}$)

$T_1 = 1882.0^{k}$

Find K_p:

$\Sigma F_H = F_{A1} + F_{A2} + F_{A3} - T_1 = F_p$

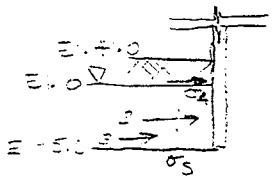
$2556.7 + 1965.9 + 171.7 - 1882 = 520.6\ K_p$

$K_p = 5.4 > 3.0$ NO GOOD

Try Passive Fill @ El. +1.0

@ El. +1.0, $\sigma_1 = (110^{lb}/_{ft^3})(1.0')(K_p) = 110\ K_p^{lb}/_{ft^2}$

$\sigma_5 = (110 K_p)(5') + (50^{lb}/_{ft^3})(5')K_p = 360\ K_p^{lb}/_{ft^2}$



$F_{p1} = \frac{1}{2}(110 K_p)(1.0)(1'/12') = 45.8\ K_p$

$F_{p2} = (110 K_p)(5')(10''/12'') = 458.2\ K_p$

$F_{p3} = \frac{1}{2}(5')(360 K_p - 110 K_p)(10''/12'') = 520.6\ K_p$

$\Sigma = 1024.6^{k}$

$\bar{x}$ location: (passive)

$45.8 K_p(5.33) + 458.2 K_p(2.5') + 520.6 K_p(1.67') = 1024.6 K_p \bar{x}$

$\bar{x} = 2.2'$ [illegible]

$\curvearrowleft \Sigma M_x = 2556.7(7.13') + 965.9(0.3') - 171.7(.53') - T_1(10.8) = 0$

$T_1 = 1734.1^{k}$

Find K_p:

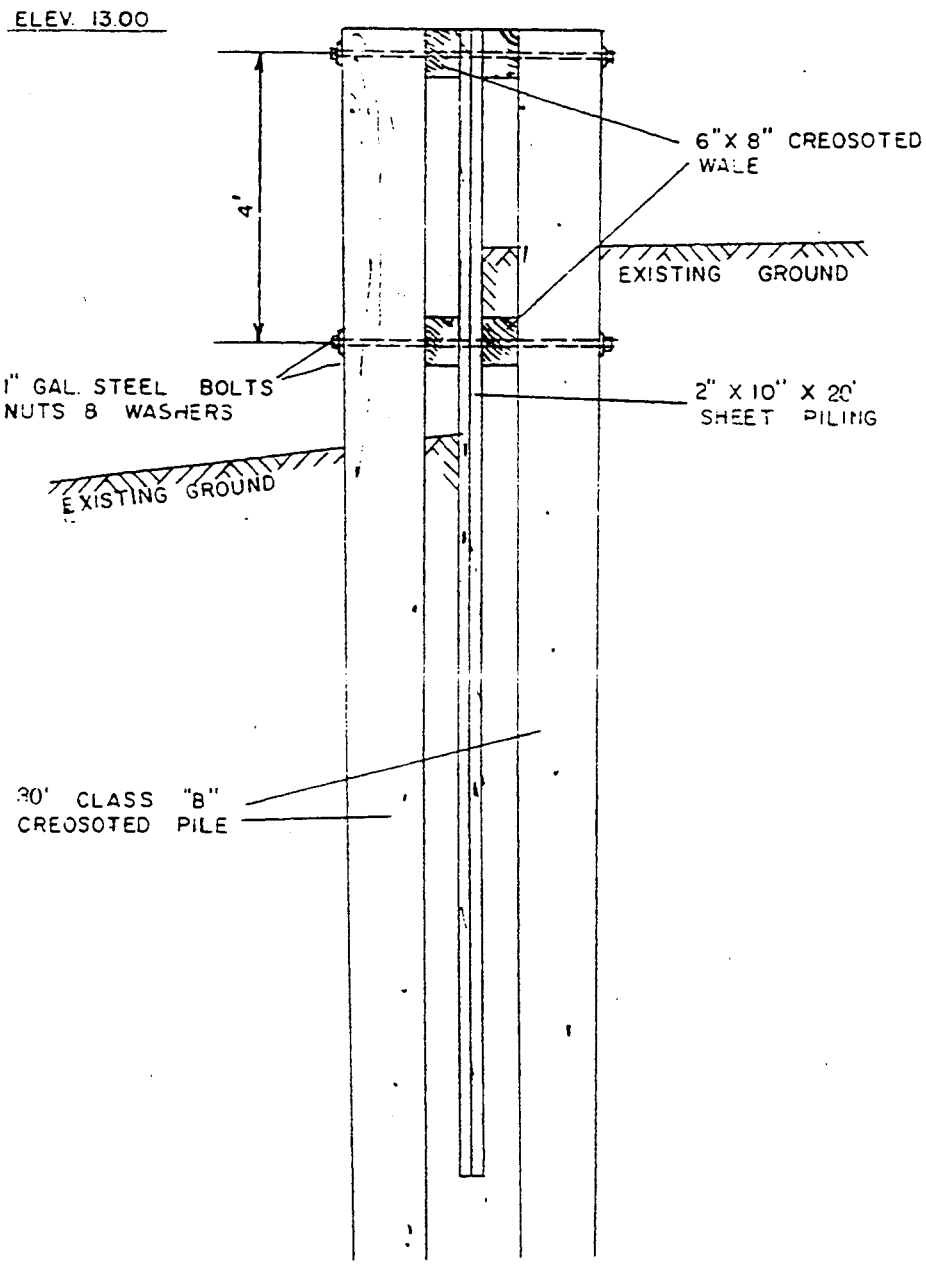
$\Sigma F_H = F_{A1} + F_{A2} + F_{A3} - T_1 = F_p$

$2556.7 + 1965.9 + 171.7 - 1734.1 = 1024.1\ K_p$

$K_p = 2.9 \approx 3.0$

∴ Depth of scour to failure for sand seaward of bulkhead is at El. +1.0 or 12 feet from the top of the bulkhead.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD



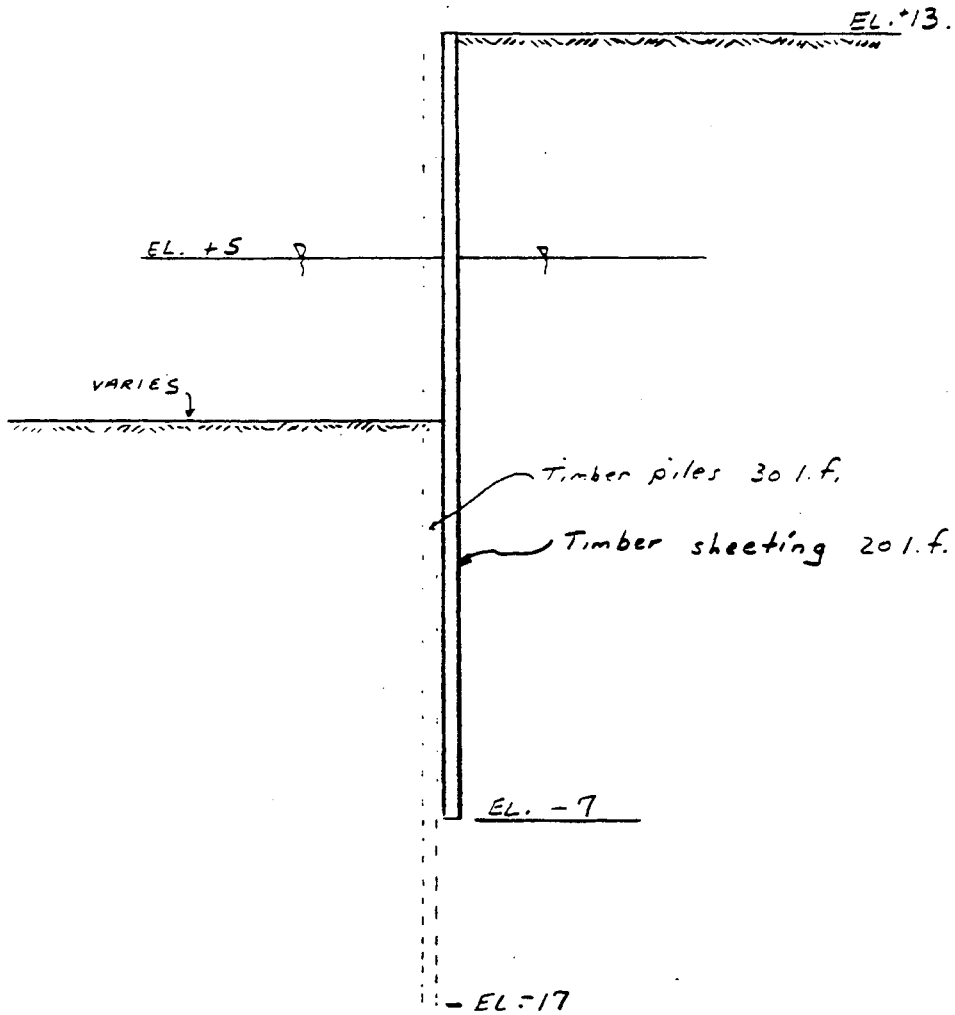
SECTION
CANTILEVER BULKHEAD

616

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

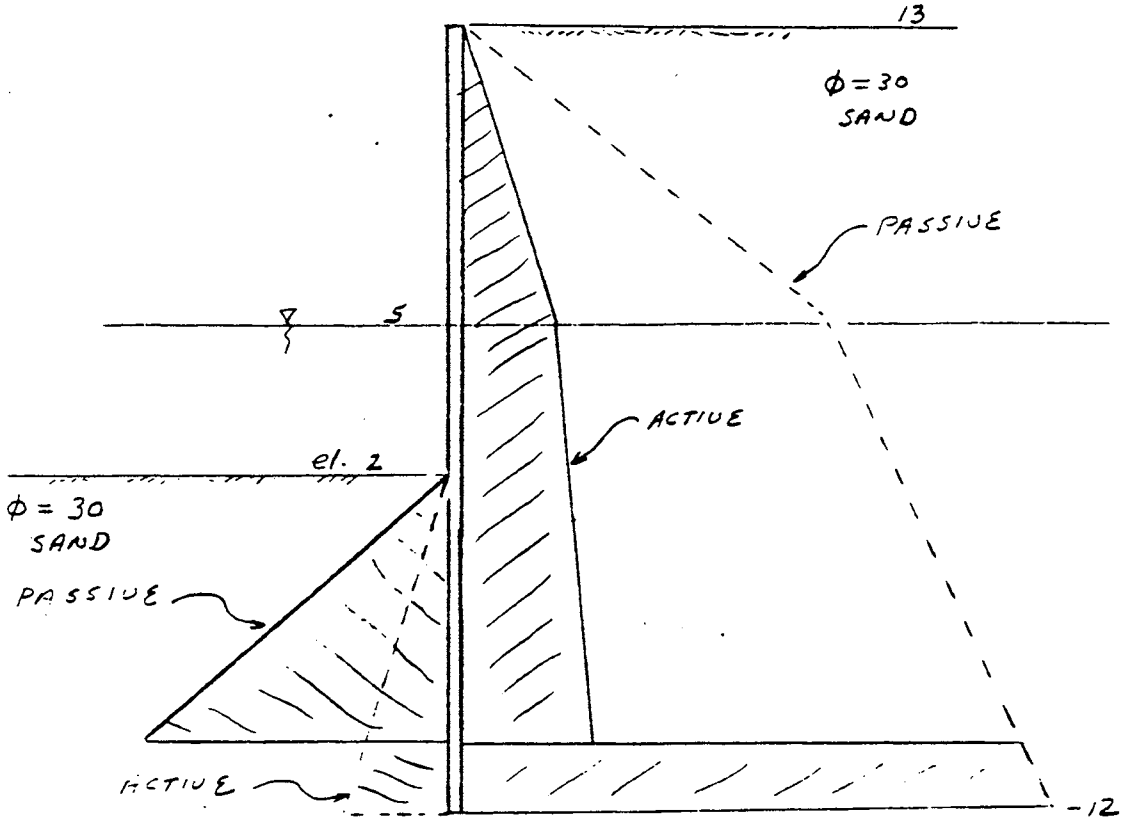
BULKHEAD FAILURE ANALYSIS

SITUATION: TYPICAL BULKHEAD ALONG SHORE WITH DECREASING SAND ELEVATION ON SEAWARD SIDE - NO LOSS OF SAND FILL ON LANDWARD SIDE.



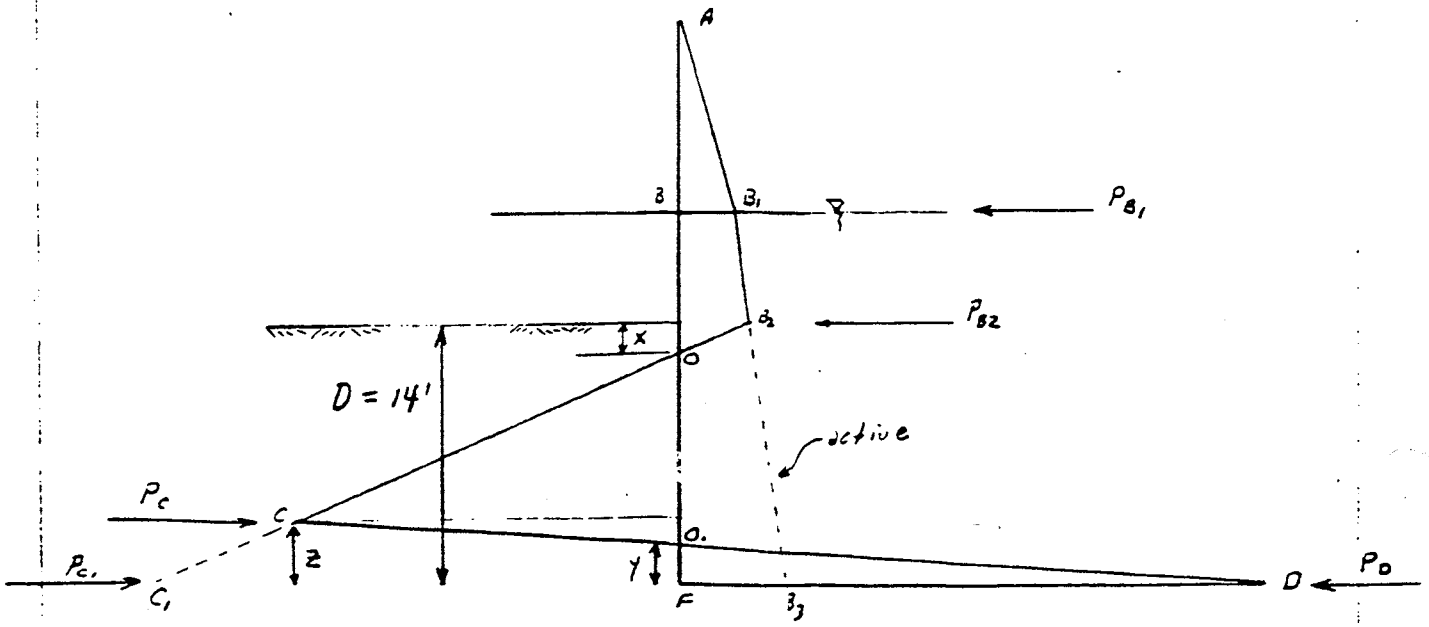
assume bottom el. of bulkhead ≈ -12

Analyze as cantilever bulkhead
Try seaward sand at el. +2



$\phi = 30$, sand
δ = wall friction angle = 15°
$\beta = 0$, level backfill
$K_a = .3$, $K_p = 5.0$ Coloumb theory
$\gamma = 115$ lbs/ft³ SAT, γ' = bouyant wt = $\gamma - \gamma_w = 53$ pcf

Resultant pressure diagram:



22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Lateral earth pressures:

$P_{B1} = 8(.3)(115) = 276 \text{ psf}$

$P_{B2} = 276 + 3(.3)(53) = 324 \text{ psf}$

$P_{C1} = (53)(5.0-.3)(14) - 324 = 3,163 \text{ psf}$

$P_D = (115)(5)(8) + 53(5)(3) + 53(5-.3)(14) = 8,882 \text{ psf}$

$\left(P_{B2} \Big/ \frac{P_{B2}+P_{C1}}{D}\right) = X = 1.3' \quad P_{B3} = P_{B2} + 14(53)(.3) = 547 \text{ psf}$

Σ Forces horizontal = 0 , using areas.

Area (ABB_1) + area (BB_1B_3F) + area (C,CD) - area $(C,B_2B_3) = 0$

$$P_{B1}(8)(.5) + [(P_{B1}+P_{B3})/2]17 + (P_{C1}+P_D)z/2 - (P_{C1}+P_{B2})\frac{D}{2} - (P_{B3}-P_{B2})\frac{D}{2} = 0$$

$$1104 + 6,996 + 6,023z - 24,409 - 1,561 = 0$$

$z = 3.0'$

if $z = 3.3'$ then $P_c = P_{C1} - \left(\left(\left[P_{B2}+P_{C1}\right]/14\right)(z)\right) = 2,416 \text{ psf}$

also, $y = P_D/((P_D+P_c)/2) \quad y = 2.4'$

Σ Moments about F

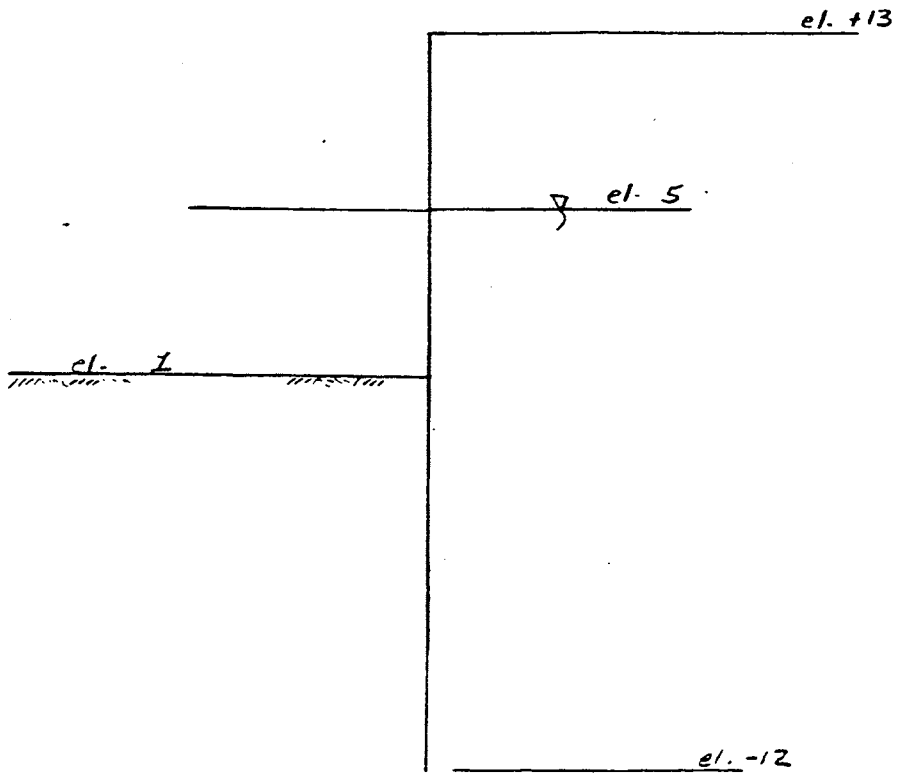
$$P_{B1}(8)(.5)(8/3+17) + P_{B1}(3)(15.5) + (P_{B2}-P_{B1})(3)(.5)(15)$$
$$+ P_{B2}(1.3)(.5)(13.6) - P_c(9.7)(6.2)(.5) - P_c(.6)(.5)(2.8)$$
$$+ P_D(2.4)(.5)(.8)$$

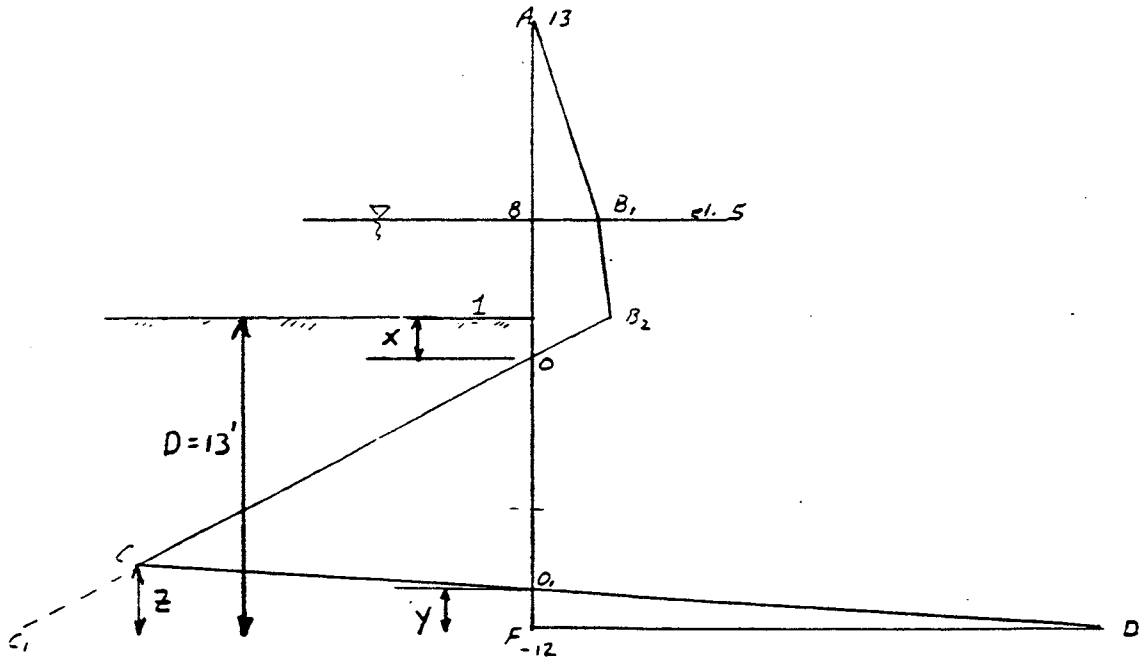
$$276(78.7) + 276(3)(15.5) + (324-276)(3)(.5)(15)$$
$$+ 324(8.8) - 2,416(30.1) - 2,416(.84)$$
$$+ 8,882(1.0) = -27,383$$

Moment preventing rotation exceeds overturning.
Bulkhead stable,

try a lower elevation on seaward side.

try:





22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Lateral earth pressures:

P_{B1} = 276 psf unchanged

$P_{B2} = 276 + 4(.3)(53) = 340$ psf

$P_{C1} = 53(4.7)(13) - 340 = 2,898$ psf

$P_D = 115(5)(8) + 53(5)(4) + 53(4.7)(13) = 8,898$ psf

$X = 1.4'$, $P_{B3} = P_{B2} + 13(53)(.3) = 547$ psf

$\Sigma Forces = 0$

$$P_{B1}(8)(.5) + [(P_{B1} + P_{B3})/2]17 + (P_{C1} + P_D)\frac{z}{2} - (P_{C1} + P_{B2})\frac{D}{2} - (P_{B3} - P_{B2})\frac{D}{2}$$

$1,104 + 6,996 + 5,898z - 21,047 - 1,346 = 0$

$z = 2.4'$

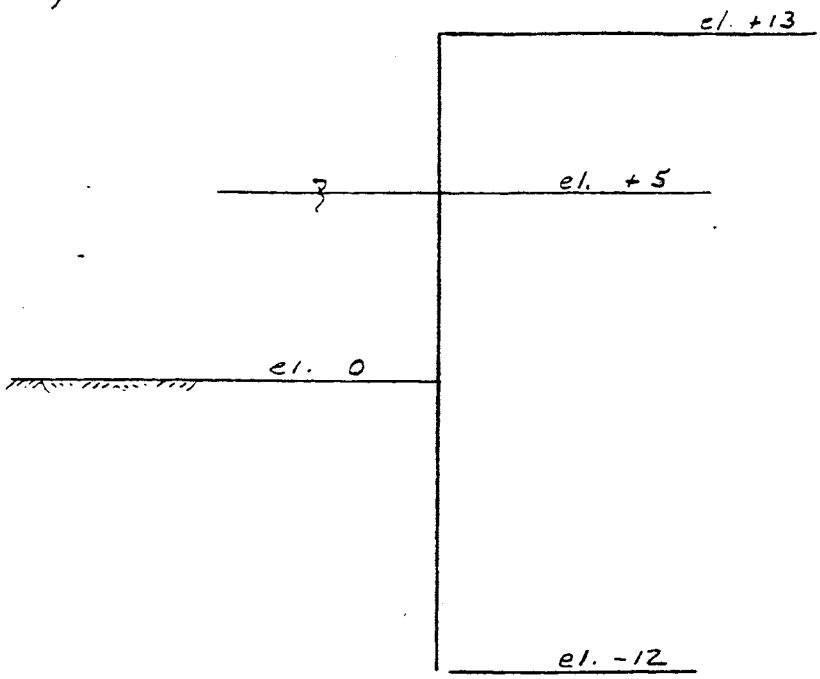
$P_c = 2,898 - ((340 + 2,898)/13)z = 2,300$ psf

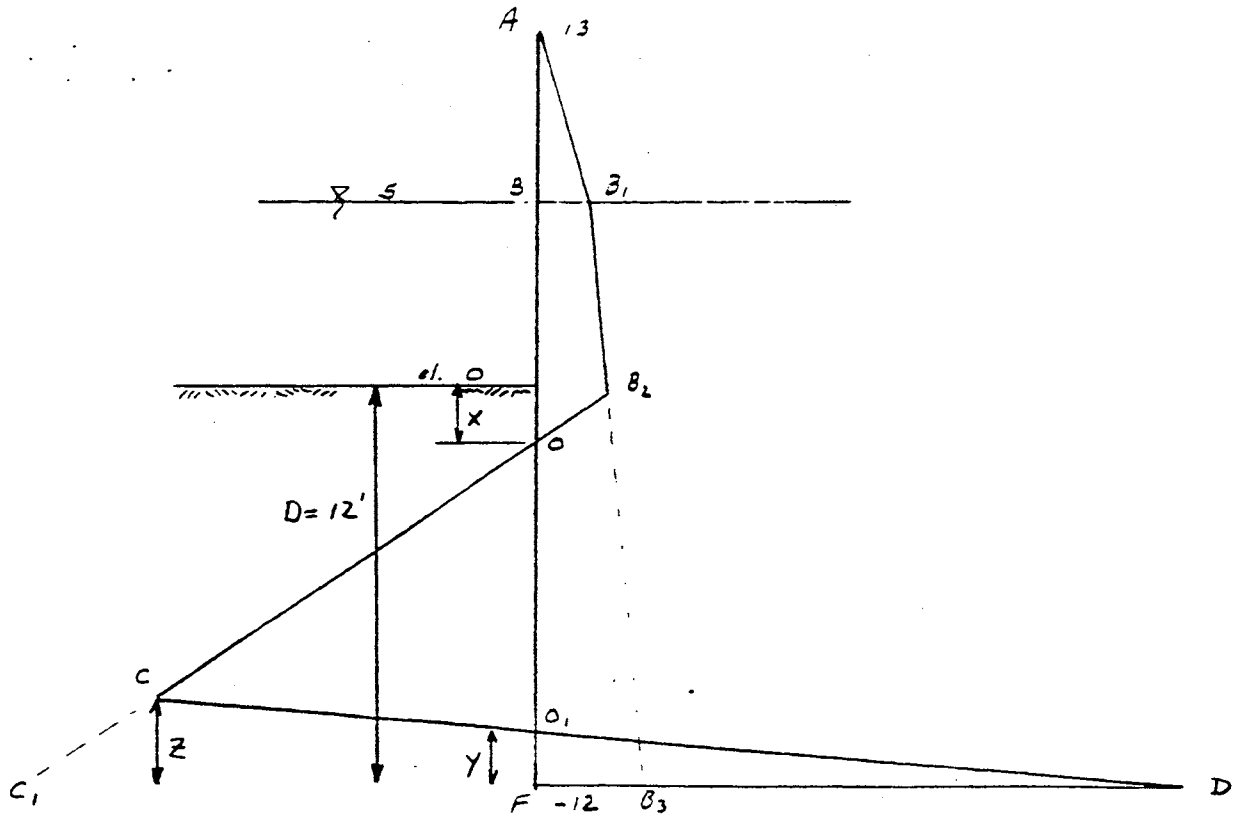
$y = 8,898/((8,898 + 2,300)/2.4) = 1.9'$

$\Sigma M_F^{\circlearrowleft +} = -11,269$ Moment preventing rotation exceeds rotating moment but is very close

try a lower elevation on seaward side.

Try:





22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Lateral earth pressures:

$P_{B_1} = 276$ psf

$P_{B_2} = 356$ psf

$P_{C_1} = 2,633$ psf

$P_D = 8,914$ psf

$X = 1.4'$

$P_{B_3} = 547$ psf

find Z summing areas

$Z = 1.9'$ $\quad Y = 1.5'$

$P_C = 2,160$ psf

ΣM_E ↺+

$P_{B_1}(8)(.5)(19.6') + P_{B_1}(5)(14.5')$

$+ (P_{B_2} - P_{B_1})(5)(.5)(13.7') + P_{B_2}(1.4)(.5)(11.5')$

$- P_C(8.7)(.5)(4.8') - P_C(.4)(.5)(1.8')$

$+ P_D(1.5)(.5)(.5') = 4,719$ ft lbs ↻

unstable - overturning moment exceed restraining moment

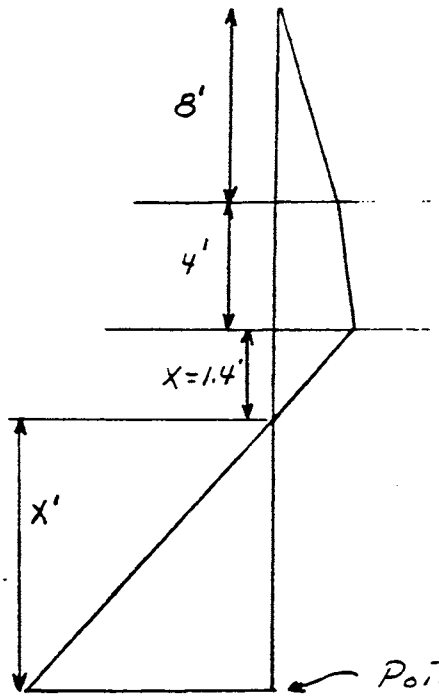
Choose failure elevation of +1, for sand seaward of bulkhead.

check bending stress in timbers:

find point of zero shear

shear on active side =

$$P_{B1}(8)(.5) + \left[\left(P_{B1} + P_{B2}\right)/2\right](4) + P_{B2}(1.4)(.5) = 2{,}574 \text{ lbs/ft.}$$



The point at which passive shear = active is as follows:

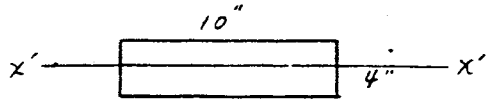
$$2{,}574 = \left(\frac{P_c}{(D-X-Z)}\right)X'(X'/2)$$

$$4.5' = X'$$

Moment about point of zero shear = max. moment.

$$P_{B1}(8)(.5)(8/3 + 4 + 1.4 + 4.5) + P_{B1}(4)(2 + 1.4 + 4.5)$$
$$+\left(P_{B2} - P_{B1}\right)(.5)(4)[1.3 + 1.4 + 4.5] + P_{B2}(1.4)(.5)[2/3(1.4) + 4.5]$$
$$-\left[\frac{P_c}{(D-Z-X)}\right](4.5)^2(.5)(4.5/3) = 20{,}014 \text{ ft-lbs/ft.}$$

sheeting:



$$I_{x\text{-}x'} = \frac{1}{12}bh^3 = 47 \text{ in}^3 \text{ (dressed sizes)}$$

$$\frac{Mc}{I} = \sigma_{b\,max} = \frac{(20{,}014)(12)(1.95)(10/12)}{47 \text{ in}^3} = 8303 \text{ psi}$$

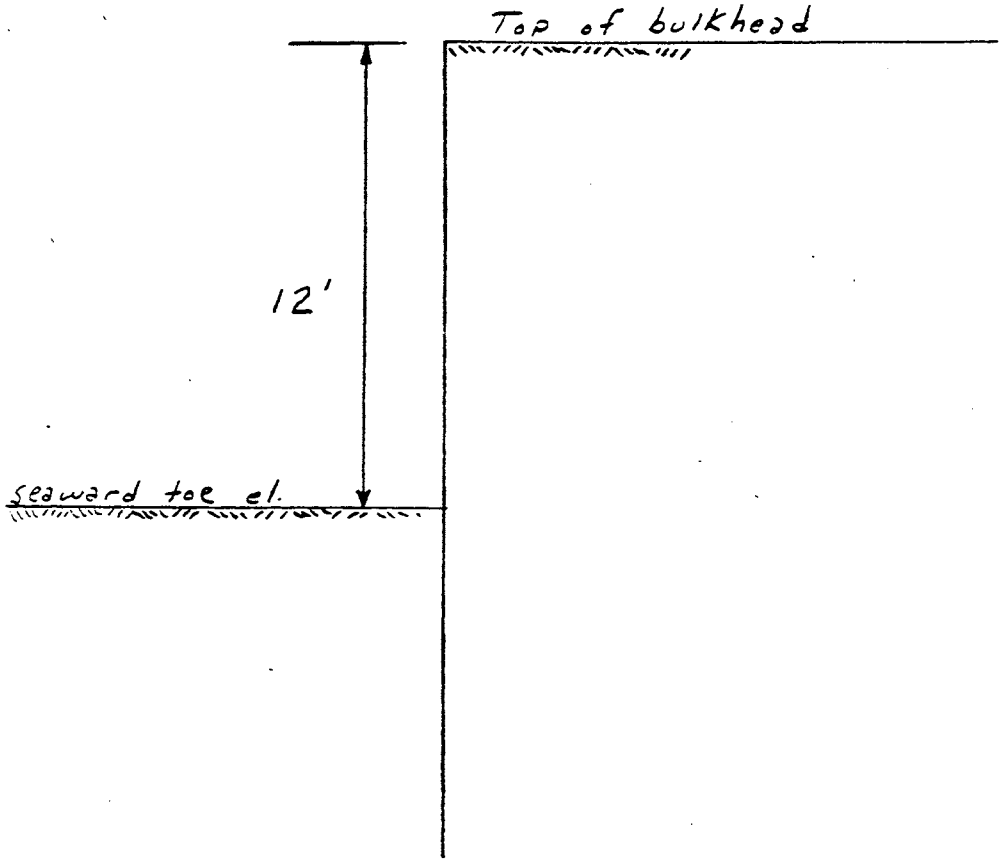
σ_{design} for timber $\simeq$ 1,900 psi

σ_b is 4.5 times higher than design, but considering failure stress it is probably less.

so, $\sigma_d < \sigma_{act.} < \sigma_{failure}$ $\quad 1900 < 8303 < 12{,}000$ OK.

Summary:

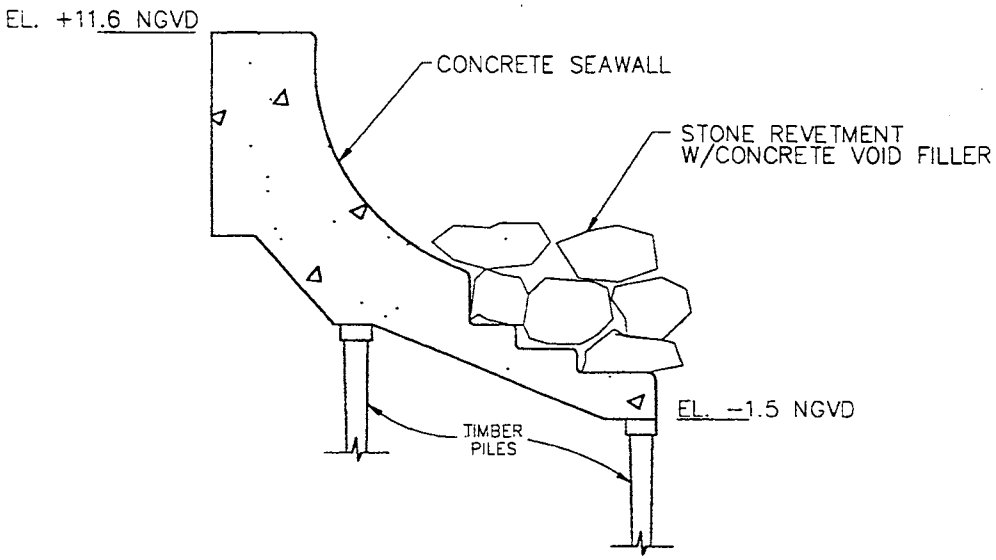
Assume failure is by loss of seaward toe sand. Bending stresses at that point are higher than design allowable but failure stress is probably much higher than design. This is because so many S.F. are applied to timber properties.



22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

SEAWALL FAILURE ANALYSIS

If the continued erosion of the beach in Longport is not addressed, the existing combination stepped and curved face seawall in Longport will become unstable. As shown in the section below, the design does not include a support pile on the landward side of the structure, which is also the portion that contributes a significant amount of the structure's weight. If the depth of scour erosion in front of the seawall reaches the bottom of the concrete portion of the structure (elevation -1.5 NGVD), the fill underneath and consequently behind the seawall will erode, and the structure will become unstable and will fail. Erosion will continue unhindered landward of the seawall..



ANALYSIS OF GEOTUBES

The use of Geotubes as a form of protection in coastal areas is increasing; however, very few projects exist where geotubes have been used in a similar manner to those in Atlantic City (see photos 19&20, project design section). Procedures to analyze the project life of these structures have not yet been developed. Based on an analysis of the few prototype projects, some supporting computations of hydrostatic and dynamic forces, and engineering judgement considering all available known information on these types of structures, the geotubes were assumed to withstand a 20 year event, but fail before a 50 year event for the without project condition. For the Cycle 3 project alternatives, the geotube failure event varies between a 50 year event and a 200 year event depending upon the protection provided by each alternative.

INFRASTRUCTURE REPLACEMENT

Storm induced erosion causes damage to existing utilities within the project area. If the erosion is not prevented (i.e., without project conditions)existing infrastructure will have to be replaced. To facilitate the economics analysis, the cost of replacing utilities within the project area was completed. Lists of the utilities affected are shown on the attached pages. Costs to replace are also listed, and are based on May 1994 price levels.

ABSECON ISLAND
FEASIBILITY STUDY
INFRASTRUCTURE REPLACEMENT
VENTNOR, MARGATE, LONGPORT

* 1 RESIDENCE/50' (Average) BOTH SIDES OF STREET

ROAD REPLACEMENT

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Pavement, includes ID-2 Wearing Course (55' Wide) Bituminous Base Course Subbase	$4,222.78	$3,373.34	$4,231.95	$4,247.23	$5,683.34	$5,500.00
2. Drainage - 15" CMP ($/LF)	$100.00	$73.76	$38.48	$26.73	$20.32	$19.25
3. Sidewalk (4' Wide) with curb (8" Wide)	$381.60	$763.20	$1,908.00	$3,816.00	$7,632.00	$11,948.00

SANITARY SEWERS/ WATER LINES/ GAS LINES

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Fire Hydrants	$1,475	$1,475	$1,475	$1,475	$1,475	$1,475
2. 6" DIP Water Line (No sewer line first 20')	-	-	$1,071	$2,141	$4,282	$6,423
3. 8" PVC Sewer Line	$120	$99	$42	$22	$18	$17
4. Sanitary Manhole (1 in first 20'; 1 @ 400')	$0	$2,352	$2,352	$2,352	$2,352	$2,352
5. 3/4" DIP Water line lateral (70' long, from on side of street to the other)	-	-	$169	$337	$675	$1,012
6. Valves (2/400') (70' long, from on side of street to the other)	-	-	$37	$73	$146	$219
7. 4" PVC Sewer line laterals	$2,352	$2,352	$2,352	$4,704	$7,055	$10,583
8. 4" DIP Gas Line (70' long, from on side of street to the other)	-	-	$3,168	$6,336	$12,672	$19,008
9. 1-1/2" W.S. Gas Line Letral	-	-	$1,018	$2,035	$4,070	$6,105

ELECTRIC LINES

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Poles - 30' high with 5 crossarms; 100' spacing, street lights every other pole	$3,420.80	$3,420.80	$3,420.80	$3,420.80	$6,841.60	$6,841.60
2. Transformers - 1 every 200' (7200V - 120/240 - IP)	$1,282.80	$1,282.80	$1,282.80	$1,282.80	$1,282.80	$1,282.80
3. Service connectors - 2#4 & 1#6 house 60' 2#4 lights	$1,175.90	$1,175.90	$1,175.90	$2,351.80	$3,527.70	$5,879.50
4. Wire - 3#2 Wires (Primary from A.C.E. transformer)	$88.50	$58.80	$23.52	$11.76	$6.42	$4.28

TELEPHONE/CABLE (Use elec. poles)

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Cable - Service & Wiring (1-35' cable to each residence, 625 RG6 drop cable)	$908.65	$908.65	$908.65	$1,817.30	$2,779.40	$5,558.80
2. Telephone - Service & Wiring	$100.00	$48.11	$18.18	$9.63	$5.35	$4.28

ABSECON ISLAND
FEASIBILITY STUDY
INFRASTRUCTURE REPLACEMENT
ATLANTIC CITY

ROAD REPLACEMENT

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Pavement, (60' WIDE), includes ID-2 Wearing Course, Bituminous Base Course, Subbase	$5,298.00	$4,232.00	$5,310.00	$5,333.34	$7,133.34	$6,900.00
2. Drainage						
14" CMP ($/LF)	$115.00	$84.79	$44.25	-	-	-
18" CMP ($/LF)	$131.48	$96.94	$50.59	$35.14	$26.72	$25.31

SANITARY SEWERS/ WATER LINES/ GAS LINES

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Fire Hydrants	-	-	-	$3,393	$1,696	$1,696
2. DIP Water Line						
Jackson to Albany - 6"	$189.20	$378.40	$1,231.00	$2,462.00	$4,924.00	$7,386.00
Albany to Brighton - 8"	$266.30	$532.60	$2,100.50	$4,831.15	$9,662.30	$14,493.45
Brighton to Martin Luther Blvd - 12"	$711.28	$1,137.35	$1,616.50	$3,233.00	$6,466.00	$9,699.00
M L K Blvd to danny Thomas - 12" HP	$711.28	$1,137.35	$2,100.50	$4,831.15	$9,662.30	$14,493.45
8"	$266.30	$532.60	$1,616.50	$3,233.00	$6,466.00	$9,699.00
Danny Thomas to Mass. - 12" HP						
8"						
Mass. to New Hampshire - 6"	$189.20	$378.40	$1,231.00	$2,462.00	$4,924.00	$7,386.00
Oriental to Madison - 4"	$189.20	$378.40	$1,231.00	$2,462.00	$4,924.00	$7,386.00
1-8"	$266.30	$532.60	$1,616.50	$3,233.00	$6,466.00	$9,699.00
1-20"	$787.80	$1,575.60	$4,224.00	$8,448.00	$16,896.00	$25,344.00
Madison to Caspian - 6"	$169.20	$378.40	$1,231.00	$2,462.00	$4,234.00	$7,386.00
Water Lines Lateral (DIP)						
2" DIP	$265.00	$265.00	$265.00	$530.00	$1,060.00	$1,590.00
3. Gas Lines						
Ocean front use 6" DIP	-	-	$4,066.70	$8,133.40	$16,266.80	$24,400.20
Inlet use 10" DIP	-	-	$8,033.30	$16,066.60	$32,133.20	$48,199.30
Gas Lines Laterals						
2" DIP	-	-	$851.20	$1,702.40	$3,404.80	$5,107.20
4. Sanitary Sewer Lines (PVC)						
Jackson to Albany - 10"	$103.50	$207.00	$920.10	$1,840.20	$3,680.40	$55,202.60
Albany to Brighton - 12"	$124.20	$248.40	$1,023.60	$2,047.20	$4,094.40	$6,141.60
Brighton to Arkansas - 15"	$188.60	$377.20	$1,345.60	$2,691.20	$5,382.40	$8,073.60
Arkansas to M.L.K. Blvd. - 15"	$188.60	$377.20	$1,345.60	$2,691.20	$5,382.40	$8,073.60
M L K Blvd to Danny Thomas - 12"	$124.20	$248.40	$1,023.60	$2,047.20	$4,094.40	$6,141.60
Danny Thomas to Mass. - 8"	$74.70	$149.40	$776.10	$1,552.20	$3,104.40	$4,656.60
Rest of study area - 8"	$74.70	$149.40	$776.10	$1,552.20	$3,104.40	$4,656.60
5. Sanitary Manhole (1 MH @ 200')	$5,409.14	$5,409.14	$5,409.14	$2,704.57	$2,704.57	$2,704.57

ATLANTIC CITY
FEASIBILITY STUDY
INFRASTRUCTURE REPLACEMENT

ELECTRIC / TELEPHONE / CABLE

DESCRITPTION	LENGTH REPLACED <10'	<20'	<50'	<100'	<200'	<300'
1. Electric						
Poles (with Lights) 1/180' & 1#4	$1,204.05	$1,204.05	$1,204.05	$1,204.05	$2,408.10	$3,612.15
Wires (primary) 3-500 MCM - 600V	$241.70	$483.40	$1,208.50	$2,417.00	$4,834.00	$7,251.00
Wires (Service) 3#4, 1#2	$423.20	$423.20	$483.20	$846.40	$1,692.80	$2,539.20
Wires (Lights) 2#4, in 2" PVC	$76.10	$152.20	$380.50	$761.00	$1,522.00	$2,283.00
* Conduit 4" PVC						
Service Box 1/100'	$144.50	$289.00	$722.50	$1,445.00	$2,890.00	$4,335.00
Manholes 1/275'	-	-	-	$2,704.57	$2,704.57	$2,704.57
Transformer vault 1/275'	-	-	-	$66,500.00	$66,500.00	$66,500.00
* Assume 4" ducts in 3" concrete envolop	-	-	-	$13,371.00	$26,742.00	$40,113.00
2. Telephone						
Conduit BKMA~1, ADTC-6	$158.40	$31,680.00	$79,200.00	$158,400.00	$316,800.00	$475,200.00
Manhole 1/200'	-	-	-	$2,704.57	$2,704.57	$2,704.57
3. Cable (only 10% of streets)	$1,175.90	$1,175.90	$1,175.90	$2,351.80	$3,527.70	$5,879.50
Main 1 2-860QR Cable						
450-20.9						
50-260						
Transformers 1/370'	$66,500.00	$66,500.00	$66,500.00	$66,500.00	$66,500.00	$66,500.00

ABSECON ISLAND
FEASIBILITY STUDY
INFRASTRUCTURE REPLACEMENT

VENTNOR BOARDWALK - 20' X 70' (1,400 SF)

1. Timber Piles 12" Diameter x 25' long, driven 20'		$8,908.80
2. Beams 6" x 14" x 20'		$9,570.62
3. Stringers 3" x 12" x 16'		$4,500.14
4. Decking - includes treatment 2" x 4" x 14'		$12,042.24
5. 1" Galvanized W.I. Bolts (24), Nuts (48), 4" Oggee washers (48)	Included above	
6. Galvanized W.I. straps (160), with 40d galvanized spikes (960)	Included above	
7. Stairs - 9' high		$5,595.43
8. Lighting pole, arm, light, 3-#4 wires (i per street)		$730.00
9. Railing - IPS Standard, SCH 40 Al pipe 1-1/2" pipe 395' shoes - 22 ea deck flange - 22 ea 1/2" x 6" galvanized lag screws - 44 ea 1/2" x 3" galvanized lag screws - 44 ea		$9,282.50
		==========
		$55,130.00
(For ramp; multiply total cost of 20' x 70' boardwalk by 0.4)		$22,052.00

ATLANTIC CITY BOARDWALK - 60' X 100' (6,000 SF)

1. Concrete Piles 18" Diameter Classc B	$26,445.00
2. Beams 12" x 24" x 60'	$125,000.00
3. Joists 4" x 14" x 22'	$210,553.50
4. Decking - includes treatment 2" x 4" x 14'	$43,008.00

ABSECON ISLAND
FEASIBILITY STUDY
INFRASTRUCTURE REPLACEMENT

5. Straps -Hardware Type 2 - 40 Type 4 - 40 Type 1 - 10	Included above	
6. Lighting pole, arm, light, 3-#4 wires (i per street)		$730.00
7. Railing - IPS Standard, SCH 40 Al pipe 1-1/2" pipe 395' shoes - 22 ea deck flange - 22 ea 1/2" x 6" galvanized lag screws - 44 ea 1/2" x 3" galvanized lag screws - 44 ea		$423,000.00

ATLANTIC CITY BOARDWALK - 40' X 70' (2,800 SF)

1. Concrete Piles		
18" Diameter Class B		$17,630.00
8" x 8" x 70' Timbers		$11,111.47
2. Beams		
8" x 14" x 20' Concrete Girders		$5,625.00
6" x 16" x 120' Timber		$12,489.60
3. Girders - Wood		
3" x 12" x 16'		$21,094.42
4" x 14" x 16'		$51,043.28
4. Decking - includes treatment 2" x 4" x 14'		$24,085.00
5. Straps -Hardware Type 4 Type 3	Included above	
6. Lighting pole, arm, light, 3-#4 wires (i per street)		$730.00
7. 2" x 8" x 30" Steel Fish plate connection with		$35.95
1" x 12" Galvanized Bolt, nuts & washers		$240.00
8. Railing - IPS Standard, SCH 40 Al pipe 1-1/2" pipe 395' shoes - 22 ea deck flange - 22 ea 1/2" x 6" galvanized lag screws - 44 ea 1/2" x 3" galvanized lag screws - 44 ea		$310,200.00

ABSECON ISLAND
FEASIBILITY STUDY
INFRASTRUCTURE REPLACEMENT

FOR 20' WIDE BOARDWALK	
USE COSTS FOR VENTNOR BOARDWALK	
TOTAL LENGTH OF 20' WIDE BOARDWALK = 6700 LF.	$5,848,095.00
NO STAIRS IN A.C. ONLY RAMPS	
FOR RAMPS MULTIPLY COSTS FOR 20' WIDE BY 0.40	$221,717.89

CYCLE 1 ALTERNATIVES - ABSECON INLET.

Alternative cycle 1 structural measures considered for this area are as follow:

Lengthen the Brigantine Jetty
Realign the Absecon Inlet channel
Beach restoration
Relocation of the boardwalk
Bulkheads with and without revetments
Navigation type breakwater at the entrance of Absecon Inlet
Wave breaking structure
Perched beach using geo-tubes

Structural Measures. Following are discussions of structural measures considered under the Absecon Inlet cycle 1 analysis. The first three measures were proposed previously in the Atlantic City, NJ, Beach Erosion Control Study, House Document No. 538, 81st Congress, 2nd Session, 1950.

Lengthen the Brigantine Jetty. The Brigantine Jetty, to the northeast of Absecon Inlet, was designed and modeled by the Corps and subsequently authorized by Congress for construction as part of a larger project. The project was re-authorized in section 605 of the Water Resources Development Act of 1986. The design length is 5,749 feet at an elevation of +8'MLW. The jetty was to serve three purposes: 1) to prevent the elongation of Brigantine Island and thus halt the southward migration of the channel, 2) to act as a breakwater which affords protection from waves, and 3) reduce shoaling in the inlet. This project was to be constructed in conjunction with dredging the northeast side of the channel, widening it and thus relocating it closer to Brigantine.

The existing jetty was built by the State of New Jersey in 1952 and lengthened in 1966 to a total of 3,730 feet. The present configuration of the existing jetty is accomplishing everything for which it was designed. In fact, the channel has not been dredged since 1978 and is presently deeper than the authorized depth. As noted at the time of design, a jetty such as this has the potential to starve downdrift beaches. While the present jetty does not seem to be responsible for erosion at Atlantic City, it is effectively halting transport of sand into the inlet. Therefore it can be surmised that a lengthening of the jetty by an additional 2000 feet could have adverse effects on natural bypassing.

Benefits which could be obtained from lengthening this structure are that it is an essential component of the channel realignment, and it would serve as a wave breaker. However, as will be seen in the next discussion, channel realignment is not an option because the new location is already deeper than the authorized 20' depth. The merits of lengthening the jetty must rest solely on reducing incident wave energy into the inlet during northeast storms. This alternative will be considered further.

Realign the Absecon Inlet Channel. The purpose of moving and widening the channel was to reduce tidal currents within the inlet and hence the erosional pressure on the southwestern boundary of the inlet. As mentioned earlier, this is not a viable alternative since the depth in the

new location is already deeper than the authorized depth. Water depths in the channel reach nearly -50 feet NGVD (see figure 33). The Brigantine jetty has effectively stopped southward migration of that island and Atlantic City's Maine Avenue groins stabilize the channel location. In the original design, the realignment option was not to be undertaken until after the jetty was built to its design length.

Inlet Beach Restoration. The beach restoration design found in HD 81-538 for the inlet frontage served two purposes: 1) recreation and 2) reduce wave impact. Beaches of suitable dimensions are effective in dissipating wave energy and affording protection for the upland area when maintained to properly designed berm widths and beach slopes. It was recognized however, in the authorized project, that bulkheading in this area is the more important defense against property damage. Protective beaches also remedy the basic cause of most erosion problems, that is, a deficiency in the natural sand supply which appears acute at this time.

The technical feasibility of this alternative in this area is questionable since the expected residence time of the beachfill is extremely short due to prevailing currents. Also, the existing slope is so steep that a tremendous quantity of sand would be required to fill the sub-aqueous portion of the beach, thus increasing the shoaling potential of the channel. The physical model tested at WES in the 1940s indicated that beachfill should only be conducted after the Brigantine Jetty is lengthened and the channel moved to the northeast. This alternative will be evaluated in cycle 2 in conjunction with lengthening the Brigantine Jetty.

Perched Beach Using Geo-tubes. A way to increase the residence time of a beachfill on an inlet can be to employ a perched beach concept. A sill is created, usually constructed with sand bags or geo-tubes that are located in the immediate offshore zone and run parallel to the shoreline. The sills dissipate wave energy, and thus, sand can be deposited in the region between the sills and the shoreline. The greatest advantage of beach sills is that they do not restrict the use or affect the aesthetics of the beach.

Disadvantages of this alternative include the questionable durability of certain components of the geo-tubes, their susceptibility to vandalism, and the depth of water at the location necessary for the structure to provide protection. The existing offshore elevation would have to be raised with beachfill, thus creating a potentially unstable foundation for the geo-tubes. Additionally, strong tidal currents would tend to undermine the tubes. Recent experiences in nearby Townsends Inlet are not favorable. Due to the considerable disadvantages, the perched beach will not be considered further to address the planning objectives of the study.

Relocation of the Boardwalk. A major piece of infrastructure along the inlet is the boardwalk. This structure has been repeatedly damaged during storms and repaired. One alternative to reduce this type of damage is to relocate all or portions of the boardwalk. The boardwalk which continues northwest from the Oriental Avenue Jetty is located directly in front of and above existing bulkheads and revetments for approximately 50% of its length. During storms, waves hit the bulkhead and splash upward with a force sufficient to damage the boardwalk. If the boardwalk were moved, this form of runup would cease to be a damage mechanism. However, there is little space between the existing road and the bulkhead for relocation. This alternative

will be evaluated in cycle 2.

Wave Breaking Structure. An alternative to relocating the boardwalk is to extend the wave impact zone seaward of the boardwalk. This also removes wave induced erosion from the toe of the bulkhead and decreases wave induced superelevation at that location. The structure would be similar to a rubble revetment except that surface roughness would be maximized to dissipate wave energy and the slope would be gradual to extend the subaerial profile seaward.

Bulkhead With Revetment. A continuous bulkhead constructed along a shoreline is a viable protective measure. The primary purpose of a bulkhead is to retain or prevent erosion of upland, with the secondary purpose being to afford protection to backshore areas from wave action and inundation. Bulkheads are normally vertical walls of concrete, timber, or steel sheetpile. Depending on the wave climate to which bulkheads are exposed, beach nourishment or revetment toe protection may be a requirement in front of the bulkhead. New bulkheads would be tied in with existing bulkheads and stone groins.

Revetment toe protection must also be considered as part of the bulkhead alternative. A revetment is, in general, a stone or concrete face placed to protect an embankment or existing shore protection structure against erosion by wave action or currents. The bulkhead alternative along the inlet will require toe protection if other alternatives to reduce wave energy are shown not to be effective. There is the possibility that, due to settlement or erosion, the revetment could fail unless precautionary measures are taken. Bulkheads along the inlet frontage have recently been constructed (see photo #1) except for a 1,050 foot section between Oriental Avenue and Atlantic Avenue, and a 550 foot long section between Madison and Melrose Aves.

Navigation Type Breakwater. The construction of a inlet breakwater to reduce the force of waves striking the shoreline was another protective measure considered. Offshore breakwaters are typically massive stone structures founded in relatively deep water. This alternative is similar to the extension of the Brigantine Jetty except that the movement of sand around the structure would be very different. Particular care must be taken in the design and location of the structure as erosion of the downdrift beach can occur. Gaps or breaks between structures must also be permitted to prevent the development of undesirable currents between the ends of the structures. Breakwaters provide sheltered water for boating but have extremely high construction costs especially in deep water and can present a potential navigation hazard. Due to the disadvantages mentioned above, especially high construction costs, the use of a channel structure was eliminated from further consideration as a viable alternative for Absecon Inlet.

ABSECON ISLAND OCEANFRONT

CYCLE 1 ALTERNATIVES - ABSECON ISLAND OCEANFRONT. Alternative cycle 1 structural measures considered for this area are as follow:

Beach Restoration With and Without Dunes
Seawalls
Beach Restoration With Bulkheading
Extend the Longport Terminal Groin
Beach Restoration With Offshore Detached Breakwaters
Beach Restoration With Groin Field
Perched Beach
Submerged Reef With Beachfill
Offshore Submerged Feeder Berm

Beach Restoration With and Without Dune. This alternative involves the placement of beach fill material (sand), from an offshore borrow source, directly onto the beach in order to widen and stabilize the existing beach profile. Usually the sand is pumped onto the existing shore using a dredge. An appropriate design uses borrow material that has similar properties to the existing native beach sand. In addition, the restored beach is graded to a certain design elevation and width to provide the desired level of storm protection. The beach requires additional sand placement, renourishment, on a periodic basis so that the design beach width and elevation is maintained. For purposes of this evaluation, a uniform berm width of 100 feet at an elevation of +8.5' NGVD was designed for the entire oceanfront.

The beach restoration with dune alternative provides the same beach restoration plan as described above with additional sand placed upland of the beach to create a dune at a designed elevation and width. The dune provides additional storm surge protection similar to that of a bulkhead. For purposes of this evaluation, a uniform dune top width of 25 feet, with side slopes of 1V on 5H, at an elevation of +12.5' NGVD was designed for the entire oceanfront. This alternative will be evaluated in cycle 2.

Beach Restoration with Groin Field. This alternative provides the same beach restoration plan as described above with the addition of groins. Groins are coastal structures built perpendicular to the shoreline. Groins extend from the upper beach face into the surf zone. A properly designed groin field will reduce erosion. However, a groin field will not provide protection from storm surge unless combined with a properly designed beach restoration and/or an additional structure specifically designed for storm surge protection.

The feasibility of constructing groins in the problem area was evaluated. Groins are long, narrow structures usually constructed perpendicular to the shoreline for the purpose of building or stabilizing a beach by the trapping of littoral material or retaining artificially placed beachfill. In

order for a system of groins to be effective, an adequate longshore movement of sand must be present and groins must be designed consistent with the beach profiles. Otherwise downdrift groins may not fill properly and direct periodic artificial filling of groin compartments may be necessary. Groins tend to accumulate material on the updrift side with a corresponding erosion of material on the downdrift side. The resulting irregularly shaped shoreline, together with the presence of the groin structures themselves, make groin-protected shorelines aesthetically displeasing to some individuals. Groin construction warrants consideration as a feature to retain littoral material and reduce periodic nourishment.

Beach Restoration with Bulkhead. This alternative provides the same beach restoration plan as described above with the addition of a bulkhead. A bulkhead protects upland areas from erosion and storm damage. While the bulkhead will protect upland areas, beach restoration will limit erosion in front of the bulkhead and will provide additional protection to upland areas. Since a bulkhead does not interact with the littoral transport, it will not reduce nourishment cycles as a groin field would. This alternative will be evaluated in cycle 2.

Beach Restoration with Offshore Detached Breakwaters. This alternative provides the same beach restoration plan as described above with the addition of offshore detached breakwaters. An offshore detached breakwater is a structure which reduces the wave energy impacting the beaches thus reducing erosion. In many cases the offshore detached breakwater is a series of rubble mound structures that are visible from the beach during low tide periods. The beach restoration aspect of this option provides the needed storm protection and maintains the littoral drift. Since an offshore detached breakwater does not protect against storm surge the required initial beachfill is the same as described above. However,the breakwater alternative has many problems: constructability, aesthetics, safety and cost. Since construction of the breakwater must be done entirely from the water, all stone must be brought in on barges and all equipment used must be secured to jack-up barges. There is the additional difficulty of working in an open ocean environment. For these reasons the cost to construct an offshore breakwater can be quite high and therefore will not be considered in cycle 2.

Perched Beach. This alternative provides the same beach restoration plan as described above with the addition of a submerged stone rubble mound structure which is used to support the offshore end of the placed beachfill thus eliminating the outer part of beach profile near its closure with the ocean bottom. Therefore, the actual amount of fill material to be placed is less than in a typical beachfill. The submerged rubble mound structure acts in the same way as the natural bar formed offshore during storm events creating a "perched beach" with a wider berm. The main problem with this alternative is that the angled swell scours in front of and behind the offshore structure resulting in the need for heavy maintenance. In addition, any interception of littoral drift will cause erosion downcoast, even if only temporarily. Due to the expense of initial construction and high maintenance this alternative will not be considered in cycle 2.

Seawall. This alternative includes the construction of a "Longport type" curved face seawall placed along the entire project length, replacing all existing discontinuous and dilapidated bulkheads, with a top elevation of +11.5 NGVD (see photo #11, Appendix A). This structure includes stone toe protection, is pile supported and provided with underlying sheeting to reduce

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underseepage. This alternative would not provide any recreational beach restoration but would provide storm damage protection consistent with other structural alternatives. The major problem with this alternative is its expense.

Seawalls may retain a low fill but their primary purpose is to withstand and to deflect or dissipate wave energy on an ocean shoreline. Costs of construction would be prohibitively high with values of thousands of dollars per linear foot depending on the size and construction material used. Because seawalls protect only the land immediately behind them, maintenance of a beach would be difficult. Also, scouring in front of the seawall and increased erosion can be expected during storms due to the reflection of waves. The widening and maintenance of the beach in front of the structures would be necessary to reduce scour and to continue recreational use of the shoreline. For these reasons, this alternative will not be carried into cycle 2.

Extend the Longport Terminal Groin. The existing stone groin at 11th Street in Longport is 510' in length with an elevation sloping from +12' NGVD to +7' NGVD at the seaward end (see photo #17). The fillet on the updrift side appears relatively stable and the groin is filled to capacity. Therefore, to retain an increased berm width along Longport's shoreline, groin extension should be investigated. The potential problem with this structure is the possibility of downdrift starvation of the sand fillet at Atlantic Avenue and of the Great Egg Harbor Inlet ebb shoal complex.

Submerged Reef With Beachfill. Another sand retention alternative involves the use of interlocking concrete units which form an offshore reef. This reef is intended to dissipate incident wave energy during storms, and to prevent outgoing currents from carrying sand to deeper water. Experience to date with this alternative along the New Jersey shore does not indicate that it is cost effective. Therefore, this alternative will not be considered further to address the planning objectives of the study.

Offshore Submerged Feeder Berm. Potentially high costs associated with onshore placement have led to the development of alternate less expensive methods of beach nourishment. One such method is nearshore berm placement. In some areas, nearshore berms can reduce wave damage and provide sand to the littoral system with a cost as little as half that of onshore placement (Allison and Pollock, 1993 and McLellan et. al, 1990).

Prototype experience with berms is limited, and proper design techniques are still being researched and developed. For the berm to function successfully as a beach nourishment technique, several factors such as berm depth, wavelength, wave height, and wave velocity must be within proper ratios (Hands and Allison, 1991). Long term sediment transport trends, both longshore and cross-shore, must also be examined. Berm placement site must be a proper distance downdrift of an inlet or jetty to reduce the tendency of the sediment to return to the inlet or be caught by the jetty (McLellan et. al, 1990).

Between 1935 and 1943, 3,554,000 cubic yards of sand was dredged from Absecon Inlet and placed in a mound offshore of Absecon Island. The berm was located southwest of the Steel Pier between approximately the 12-ft and 20-ft depth contours. Monitoring of the mound was conducted over a several year period. Since monitoring was limited, there has been no

documented evidence that sand deposited in the nearshore at Atlantic City between 1935-1943 made it up to the beach. Hands and Allison (1991) classify the Atlantic City berm as stable, although it is close to the active limit. Although it has not been documented, some of this material may have eventually moved onto the southern beaches of Absecon Island (Personal Communication, Hands, 6/94).

Because nearshore placement was not successful in the past and current design techniques are limited, nearshore placement is a higher risk option than direct onshore placement at Absecon Island. Also, because nourishment areas are located adjacent to the potential borrow sources, the difference in cost between direct onshore and nearshore placement may not be significant. Therefore, this alternative will not be considered further to address the planning objectives of the study.

CYCLE 2 ALTERNATIVES FOR ABSECON INLET.

Inlet Beach Restoration. For purposes of this evaluation, a uniform berm width of 50 feet at an elevation of +8.5' NGVD was designed for the inlet frontage. The beach nourishment alternative involves two phases. The first consists of placing the basic (minimum) protection plus any advanced nourishment. The second phase consists of nourishing and maintaining the basic protection on a periodic basis. Beach nourishment was evaluated using dredging, hydraulic pumping and mechanical methods.

The dredging method would use conventional floating dredge techniques with the borrow source being the ebb shoal. The sand would be pumped to the beach. The beachfill quantity used for cost estimating purposes was obtained using a typical section. More than 400,000 cubic yards of sand would be required for the inlet shoreline. Periodic nourishment was based on half the initial fill every two years.

About 483,000 cubic yards of fill was placed along the inlet frontage in July, 1948. More than 80% of the material was lost by May, 1950. It is assumed that a similar beachfill today would suffer the same fate unless the Brigantine Jetty were extended, and the channel were completely redesigned. Because the cost of this alternative when coupled with the extension of the jetty is very nearly equal to the total annualized damages, this alternative will not be carried into cycle 3.

Lengthen the Brigantine Jetty. This alternative represents a costly method of reducing wave energy at the inlet frontage based on preliminary cost estimates, but may provide positive net benefits. This alternative was evaluated in cycle 3.

Relocate the Boardwalk. Relocating the boardwalk removes the structure from the area where damage occurs. This alternative does nothing for the erosion, inundation and wave attack problems at the inlet. Therefore this alternative should be considered only in conjunction with other measures. The estimated cost of moving the boardwalk exceeds the total annualized damages and therefore will not be considered further.

Wave Breaking Structure. This alternative will be effective in reducing incident wave energy at the bulkhead. Once installed, its longevity will far exceed a beachfill. This alternative was evaluated in cycle 3.

Bulkhead With Revetment. Construction of a bulkhead with stone revetment for the remaining 1,050 feet of inlet frontage would result in a continuous level of protection along the entire inlet frontage shoreline. The bulkhead will be constructed similar to the cross section shown in Figure 1A. This alternative was be evaluated in cycle 3.

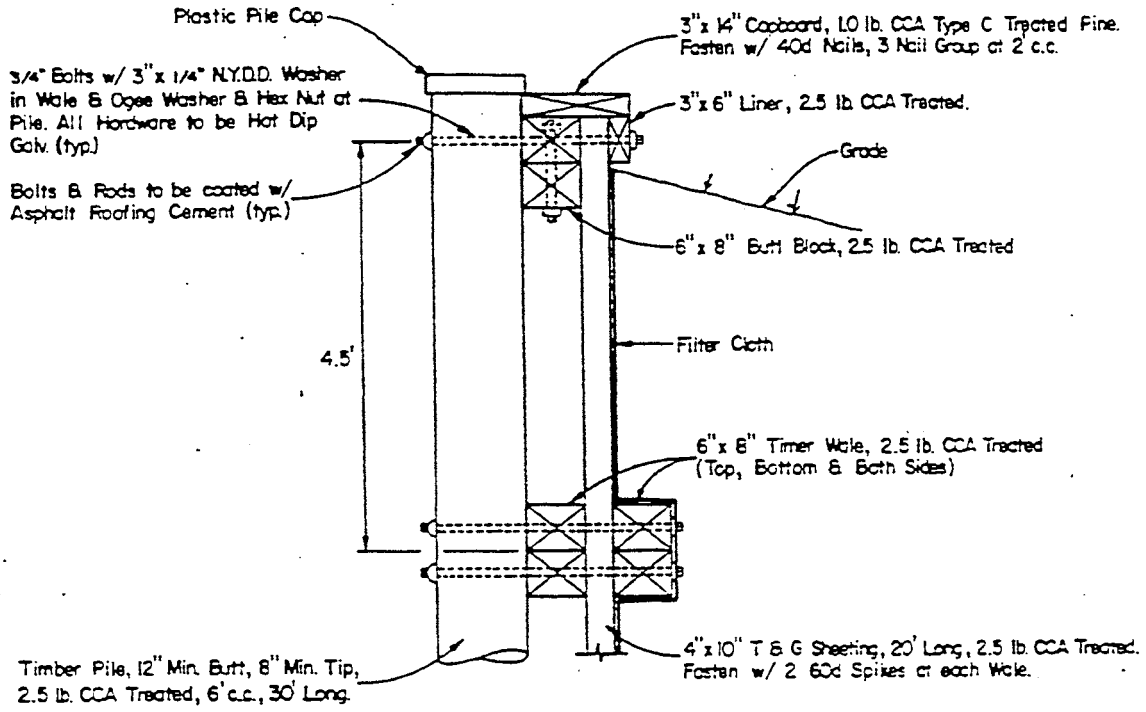


FIGURE 1A

TYPICAL SECTION

BULKHEAD

CYCLE 2

CYCLE 2 ALTERNATIVES FOR ABSECON ISLAND OCEANFRONT

Beach Restoration. A typical beachfill section as developed during cycle 2 is shown in Figure 2A of the project design section. The sand would be placed along the entire shoreline as needed to obtain a 100 foot berm at an elevation of +8.5' NGVD. This design was preliminary and refinements to the design template were made for Cycle 3 and Selected Plan formulation. The preliminary sand source is located approximately one mile offshore. The beachfill quantities used for cost estimating purposes were obtained using the typical section mentioned above. An estimated initial fill quantity of 1,150,000 cubic yards of sand would be required. Estimated periodic nourishment requirements are included in the preliminary annualized cost.

Beach Restoration With Dune. The design template for this alternative is shown in Figure 2B of the project design section. It is similar to the above beachfill with the inclusion of a dune having a top elevation of +12.5' NGVD. As designed in Cycle 2, this results in a subaerial berm and dune width of over 185 feet. This design was preliminary and refinements to the design template were made for Cycle 3 and Selected Plan formulation. An estimated initial quantity of 2,500,000 cubic yards of sand would be required. Placement and sand source location are the same as above. A similar periodic nourishment cycle is included in the preliminary annualized cost.

Beach Restoration With Bulkhead. In this alternative, the beachfill would not include a dune, since the bulkhead provides storm surge protection. To protect the entire length of Absecon Island at a uniform elevation would require the construction of an additional 14,075 l.f. of bulkhead. The new bulkhead would tie into the existing sections of timber bulkhead along the oceanfront. The typical bulkhead section is shown in Figure 1A.

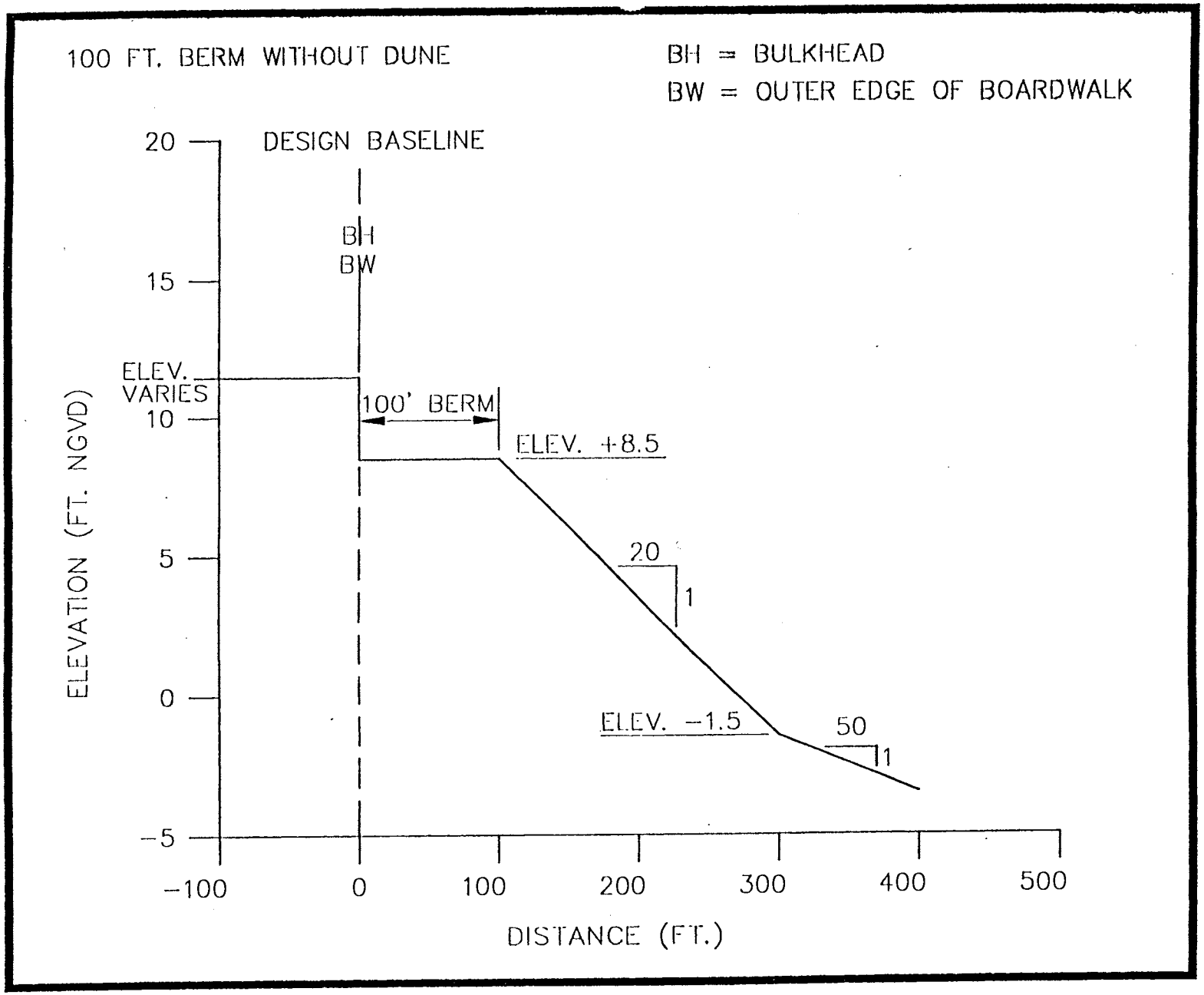
Since 58% of the Absecon Island ocean frontage has existing timber or concrete bulkheads and seawalls parallel to the ocean front, this alternative examined extending the timber bulkhead walls along the entire length of the study area. Under this alternative, it would require 12,700 feet of new timber bulkhead to provide a continuous line of storm protection along Atlantic City, and in contrast, Ventnor, Margate and Longport would require approximately 1400 linear feet of bulkhead, primarily at road ends, to complete a continuous line of storm protection This distance does not include those areas where the concrete foundations of casinos abut the boardwalk. Also, this does not take into account the staggered lengths of the street ends and those areas where the bulkheads facing the ocean are connected by perpendicular bulkhead sections, adding to the total bulkhead length.

Another option for improving the bulkhead-seawall system for Absecon Island would involve replacing those sections that have top elevations below +9.5 NGVD and which are in poor condition (see photo #16). This occurs primarily at the street ends in Ventnor, Margate and Longport, as most of the residents in these communities who own beachfront property maintain the bulkheads at a top elevation of at least +9.5 NGVD and the majority are kept in fair to good condition. Approximately 25 percent of the bulkheads protecting the street ends in these shore communities would need to be replaced under this option. This results in a total length of 1400

linear feet. While bulkheads will protect upland areas, beach restoration will limit erosion in front of the bulkheads and will provide additional protection to upland areas. Since bulkheads do not interact with the littoral transport, it will not reduce nourishment cycles as a groin field would. There may be institutional problems with the concept of a contiguous bulkhead line due to the potential for moving development seaward in some locations.

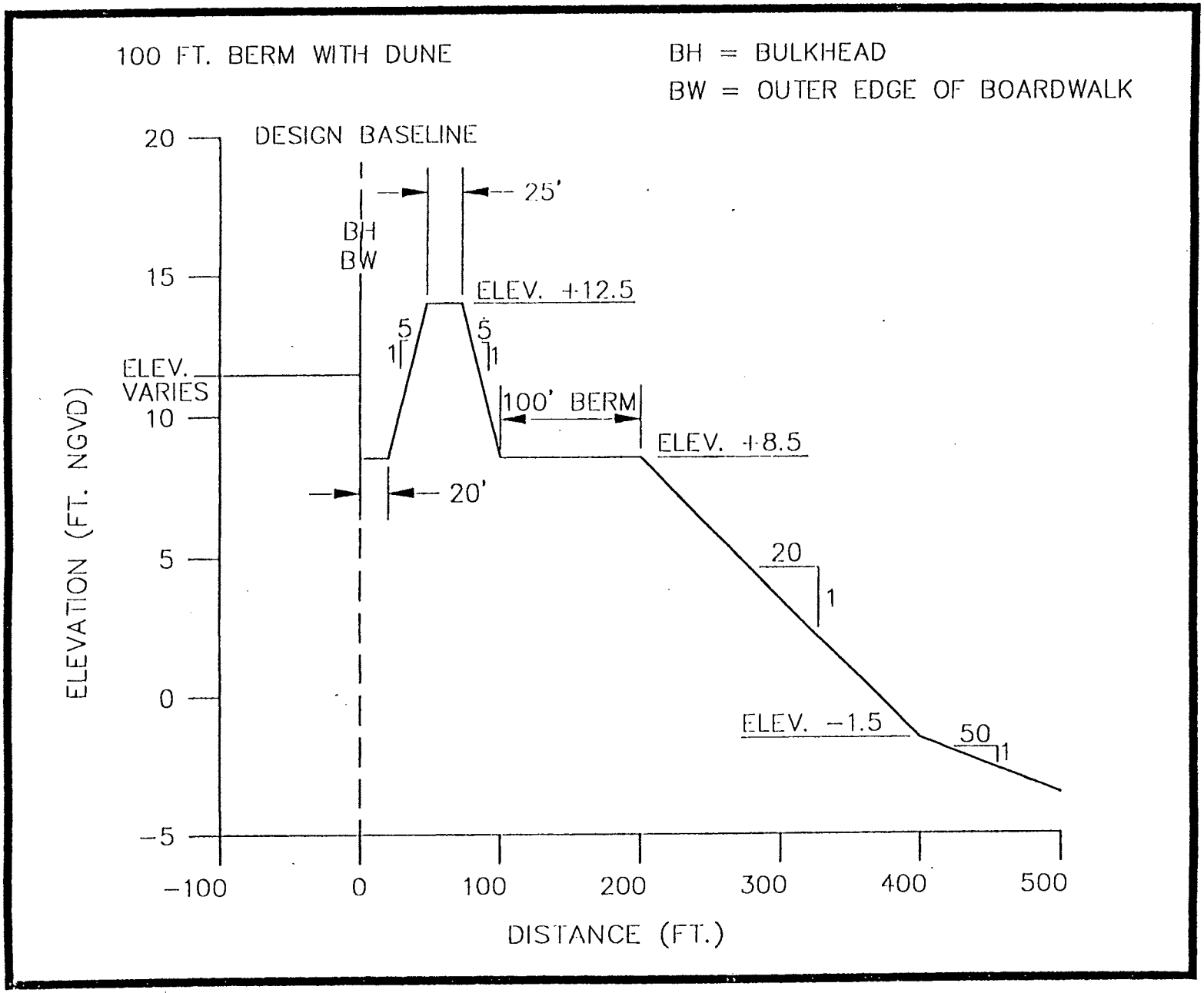
Beach Restoration With Groins. The longevity of a beach restoration project may be short depending upon the shoreline's vulnerability and the frequency and intensity of coastal storms. Frequent renourishment of a section of beach may be required to maintain a given level of protection. The use of beach stabilization structures, such as groins, may be appropriate to increase the amount of time that placed sand remains on the beach. Economic justification for the cost of the groins or other beach stabilization structures is the savings realized by lengthening the time interval between renourishments. Groins are generally constructed perpendicular to the shoreline and control the rate of longshore transport through a project area. If properly designed, they are effective in stabilizing beaches and beach fill projects where sand is typically lost by longshore transport. Functional design of a groin or groin system should maximize the amount of material accumulated or maintained on the updrift side and minimize erosion downdrift of the structure. Important design parameters to consider include the proper siting and type of groin as well as groin length, height, crest width, alignment, spacing, and permeability.

Extend the Longport Terminal Groin. A cost estimate was developed for extending the terminal groin from 500 feet to 1000 feet, using As-Built plans for the rehabilitation of this groin dated 1972. Crest width 14 feet, top elevation +7.0 MLW at the seaward end.



CYCLE 2

FIGURE 2A



CYCLE 2
FIGURE 2B

Cycle 3
Beach Restoration Alternatives

Design of the beach restoration alternatives was done in accordance with CETN II-5, the Shore Protection Manual and accepted coastal engineering practice.

Design Baseline

A design baseline was established along the ocean frontage of the project study area in order to determine the alignment of the proposed beach restoration alternatives. In Atlantic City, the design baseline was set as the seaward edge of the existing boardwalk. In the city of Ventnor, the design baseline was also located at the seaward edge of the existing boardwalk up to Richards Avenue. From Richards Avenue south to the end of the boardwalk(which is also the end of Ventnor), the baseline was located 10' behind the seaward edge of the existing boardwalk. In the cities of Margate and Longport, the design baseline was located at the seaward edge of the bulkheads and/or seawalls which projected the greatest distance seaward, relative to all the bulkheads that traverse the length of the ocean front in these communities.

Design Template

A berm elevation of +8.5 feet NGVD was used to analyze all alternatives. The average existing berm elevation in the study area varies between +7.0 and +9.0 feet NGVD. Berm widths ranging from 100 feet to 250 feet were evaluated for Atlantic City, in 50 foot increments. Berm widths ranging from 75 feet to 200 feet were evaluated for the communities of Ventnor, Margate and Longport, also in 50' increments, starting with the 100' wide berm. The foreshore slope for all alternatives was set as 30H:1V down to the mean low water elevation. A 30H:1V slope closely matches the existing foreshore slope of the beach in the study area. Below mean low water the slope follows that of the existing profile down to the closure depth. Dune top width for berm widths of 100' or greater was 25' and for the 75' berm dune top width was 15'. Dune side slopes were set at 5H:1V, which was determined to be the optimum condition based on native sand grain size, and the grain size of sand to be obtained from offshore borrow areas. Top of dune elevations range from +12.5 to +18 feet NGVD.

Dune Alignment

The landward toe of the proposed dune system in Atlantic City was offset 25' seaward from the design baseline to align the design with the existing dunes and geotube reinforced dunes. The

landward toe of the dune in Ventnor, Margate and Longport was located as close as possible to the design baseline at the landward edge of the proposed berm.

Beachfill Closures

The beachfill will extend from the Oriental Avenue jetty at the northern end of the project to the terminal groin in Longport at the southern end of the project study area.

Design Beachfill Quantities

Quantities for each alternative were calculated by superimposing the proposed design templates on the existing beach survey cross sections. Average end area methods were used to compute the volumes. Quantities calculated in Cycle 3 are presented in Table 1.

Nourishment Volumes

In order to maintain the beachfill design template, nourishment or maintenance quantities are required on a periodic basis. This nourishment volume is sacrificial and protects the design beachfill, and at the end of the periodic nourishment cycle, the design profile remains. The nourishment cycle for Absecon Island is 3 years. The nourishment quantities calculated for the study area were increased by an overfill factor of 1.4, resulting in final nourishment quantities of 546,000 cubic yards for Atlantic City, 238,000 cubic yards for Ventnor, 378,000 cubic yards for Margate, and 504,000 cubic yards for Longport, for a total volume of 1,666,000 cubic yards. This advanced nourishment quantity for the first maintenance cycle of 3 years was added to the initial design volumes obtained from the survey cross sections.

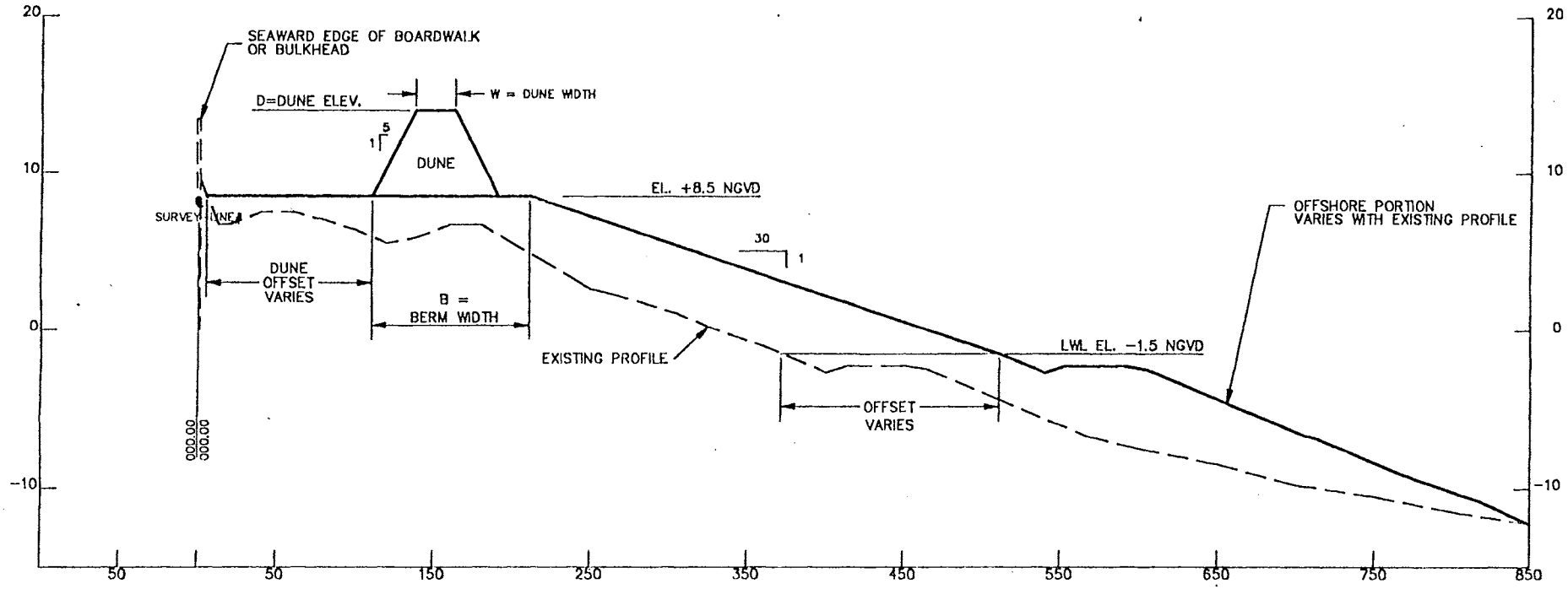
Storm Drain Outfalls

At the time of the last structure inventory, most outfalls as noted in the Existing Structures section of this report were intact and in fair to good condition. At the present time, the condition of some of these outfalls has degraded. In Atlantic City, all outfalls are intact up to approximately the mean low water line; however, several of the existing outfall pipes have broken off at pipe sections located in the surf zone. The existing length of these outfalls is not adequate to assure unhindered drainage for those proposed beachfill alternatives having a berm width of 200 feet or greater. Therefore, these outfalls were extended for the corresponding Cycle 3 alternatives. This required extending approximately 270' of 20" diameter ductile iron pipe, and 170' of 24" diameter D.I.P., with timber support systems spaced at 18 feet. 220' of 30" diameter

D.I.P., and 150' of 36" diameter D.I.P. will also be extended with timber support systems spaced at 9 feet. Several outfalls in Ventnor, Margate and Longport have also suffered damage, and in some cases have sheared off completely at the bulkhead. These outfalls were also extended for the Cycle 3 beachfill alternatives. It was assumed that all outfalls would be replaced with 12" diameter D.I.P., for a total length of 1,650 feet, including timber support systems spaced every 18 feet.

Typical Beachfill Sections

Figure 1 shows the cycle 3 beachfill alternatives superimposed on a typical survey cross section of the existing beach.



CYCLE 3 ALTERNATIVE	BERM WIDTH B FT.	DUNE WIDTH W FT.	DUNE ELEV. D + FT. NGVD
A	75	15	12.5
BX	100	25	14
CW	150	25	–
CX	150	25	14
CY	150	25	16
DX	200	25	14
DY	200	25	16
DZ	200	25	18
EY	250	25	16

SELECTED PLAN	BERM WIDTH B FT.	DUNE WIDTH W FT.	DUNE ELEV. D + FT. NGVD
ATLANTIC CITY	200	25	16
VENTNOR, MARGATE, LONGPORT	100	25	14

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
CYCLE 3 AND SELECTED PLAN
DESIGN TEMPLATE

SCALE: N.T.S. | FIGURE 1

CYCLE 3 QUANTITIES

TABLE 1
ABSECON ISLAND

ALL QUANTITIES ARE IN CUBIC YARDS

OPTION	BERM	DUNE	ADVANCED NOURISHMENT	TOTAL INITIAL QUANTITY
12.5' DUNE 75' BERM *SEE NOTE 1*	2,699,151	129,682	1,120,000	3,918,833
14.0' DUNE 100' BERM *SEE NOTE 1*	3,052,164	266,930	1,120,000	4,439,094
NO DUNE 150' BERM	5,451,752	--	1,666,000	7,117,752
14.0' DUNE 150' BERM	5,451,752	279,118	1,666,000	7,396,870
16.0' DUNE 150' BERM	5,451,752	582,811	1,666,000	7,699,863
14.0' DUNE 200' BERM	7,274,249	279,118	1,666,000	9,219,367
16.0' DUNE 200' BERM	7,274,249	582,811	1,666,000	9,522,360
18.0' DUNE 200' BERM **SEE NOTE 2**	1,063,586	267,027	546,000	1,876,613
16.0' DUNE 250' BERM **SEE NOTE 2**	1,974,255	125,333	546,000	2,645,588

*NOTE 1: Beachfill quantified for Ventnor, Margate and Longport only.
**NOTE 2: Beachfill quantified for Atlantic City only.

Cycle 3
Absecon Inlet Alternatives

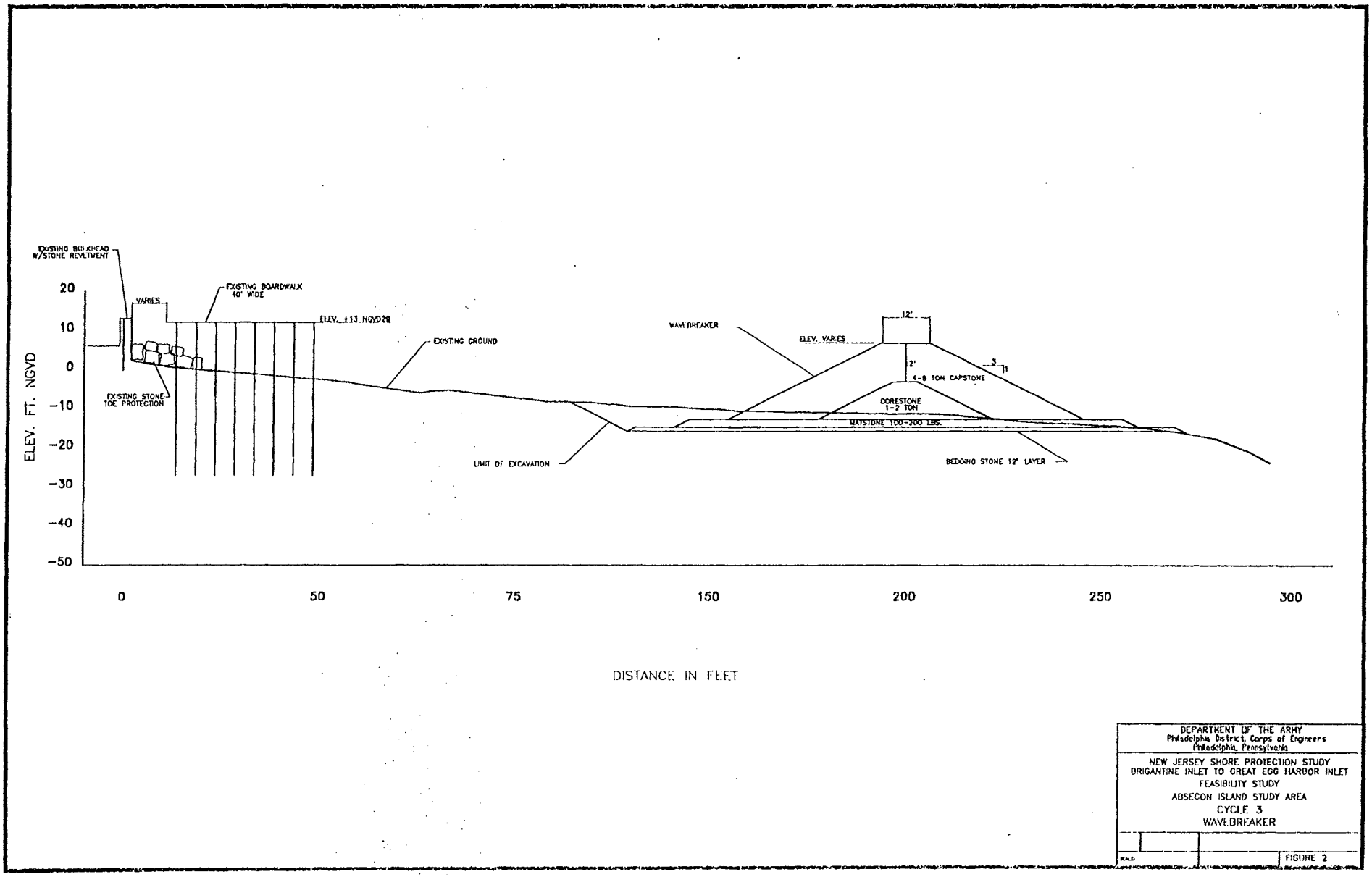
Along the Absecon Inlet frontage in Atlantic City, most damages occur in those areas that are not protected by the existing timber bulkhead constructed along Maine Avenue. In these areas, damage occurs on a regular basis to the boardwalk. Damages to the boardwalk are generally caused by a combination of inundation and direct wave attack, and frequently occur during minor storm events. The cycle 3 alternatives that were analyzed to prevent these damages include construction of a timber bulkhead to complete the line of protection along the inlet and an offshore wavebreaker constructed of stone armor units.

Bulkhead Alternative. The bulkhead alternative consisted of constructing two separate sections; one from Madison Ave. to Melrose Ave., for a length of 550 feet, and one section from Atlantic Ave. to Oriental Ave., for a length of 1,050 feet. The timber sheet-pile bulkhead would tie in to the existing one at both locations. From Atlantic to Oriental Aves., the bulkhead would be located at the seaward edge of the existing boardwalk. Both sections of bulkhead would be constructed to a top elevation of +14 NGVD, with pile anchors and tie-backs. A revetment of rough quarrystone will be constructed to an elevation of +5 NGVD on the seaward side of the bulkhead. This bulkhead would prevent damages from inundation and wave attack.

Wavebreaker Alternative. The analysis for the wavebreaker alternative involved investigating several different designs to determine the configuration providing sufficient wave height reduction at the boardwalk. The location of the wavebreaker was set at a distance of 200' offshore of the existing boardwalk. Crest elevations were determined by the storm frequencies from a 5 year to a 500 year event, and varied from +1.0 NGVD to a height of +14 NGVD. The entire structure consisted of three separate segments constructed in the first three groin cells beginning from the entrance to Absecon inlet at the Oriental Avenue jetty. For the analysis, side slopes of the structure were 1V:3H. Size of capstone was 4-8 tons, with a crest width of 12 feet. Other materials consisted of a layer of 12" size bedding stone, 50 to 100 lb. matstone, and 750lb. to 1 ton corestone. A typical section of the wavebreaker analyzed in Cycle 3 is shown in Figure 2.

Brigantine Jetty. The jetty extension consisted of adding 2000 ft to the existing seaward end to achieve a total length of 5,749 feet. Crest width was 14', with a top elevation of +8 MLW (6.5' NGVD). Existing bottom profile for the 2000' extension varied from elevation -3.62NGVD to -13.62NGVD. As described in cycle 1, the only remaining benefit gained by extending the north jetty would be a reduction in wave energy. This would reduce wave heights throughout the inlet during northeasters and would result in a small reduction in inundation due to wave setup. Since the present length is effective in preventing shoaling in the inlet, extending the jetty would almost certainly create a deficit of sand reaching the inlet littoral system. This would in turn cause adverse downdrift impacts to Atlantic City's beaches. This would also disturb the sediment budget in the inlet which is the principle source of sand for the oceanfront shore protection alternatives.

Analysis showed that the primary impact of lengthening the jetty was on long-term inlet processes as opposed to short-term, storm-related processes. The primary eff ect appears to be a reorientation of tidal currents to pass around the end of the new longer jetty. The newly directed currents will have sufficient velocity to erode the existing shoal at the end of the Brigantine jetty. Larger-scale inlet processes such as the transport to the flood tidal shoal or the ebb tidal transport around the Oriental Avenue jetty do not appear to be affected. A larger-scale possible effect may be the transfer of the ebb shoal farther offshore. A seaward shift of that shoal will provide increased sheltering of the Atlantic City shoreline. The sheltering, due to a decrease in water depth from the present 16 ft to the shoal depth of 10 ft, could be potentially significant for storm waves from the east to northeast, but appears to have a relatively insignificant potential effect on long-term longshore transport rates. The effects of storm wave reduction are generally in the vicinity of the shoal. Storm wave heights impacting the shoreline remain depth-limited. Therefore, extension of the north jetty provides no significant benefits to the Absecon Inlet shoreline and this alternative was not justified.



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Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
CYCLE 3
WAVE BREAKER

SCALE | FIGURE 2

Selected Plan

The selected plan for the Absecon Island ocean frontage is a beachfill restoration. In Atlantic City, the design beachfill template will consist of a 200' wide berm with a top elevation of +8.5 NGVD. The 200' berm will begin at the seaward side of the existing boardwalk and extend out to the foreshore slope. The foreshore slope was set as 1V:30H, which closely matches the existing beach foreshore slope, and extends down to the mean low water line. Below the mean low water line, the slope follows that of the existing profile down to the closure depth. A dune with a top elevation of +16 NGVD, top width of 25', and side slopes of 1V:5H will also be constructed, with the landward toe of the dune located 25' seaward of the seaward side of the boardwalk, to follow the existing dune alignment. In Ventnor, Margate, and Longport the beachfill will have a 100' wide berm with a top elevation of +8.5 NGVD. The 100' berm will begin at the design baseline and will extend seaward. Exact location of the design baseline can be seen in the Selected Plan layout, sheets 2 through 9, beginning on page 81 of the project design section. In Ventnor, Margate, and Longport, dunes will also be constructed to a top elevation of +14 NGVD, with a 25' top width, and side slopes of 1V:5H. The landward toe of the dunes will be located at the lanward edge of the 100' berm. The design beachfill for the entire study area would require a total volume of 6,174,013 cubic yards, to be placed over a total length of 42,825 linear feet of oceanfront. To maintain the design beachfill, periodic nourishment of 1,666,000 c.y. would be placed every 3 years. The initial fill volume includes the design beachfill requirements plus advanced nourishment equal to one periodic cycle. The beachfill will be transitioned from a 200' berm to a 100' berm between Atlantic City and Ventnor for a distance of 1000'. Design beachfill quantities calculated for the Selected Plan are presented in Table 2. A typical design beachfill template cross section is shown in Figure 1. The survey cross sections used to develop the Selected Plan beachfill quantities are presented on pages 89 through 95 of the project design section.

Vehicular access to the beach would be maintained through the new dunes at those areas currently used by the communities in the study area. Pedestrian access will also be maintained at every street end throughout the study area. Access would be established by using sand fence to create paths at skewed angles through the dunes. The plan also includes the planting of 91 acres of dune grass and the erection of 63,675 linear feet of sand fence.

The selected plan for the Absecon Inlet frontage consists of the construction of an anchored timber sheet-pile bulkhead in two

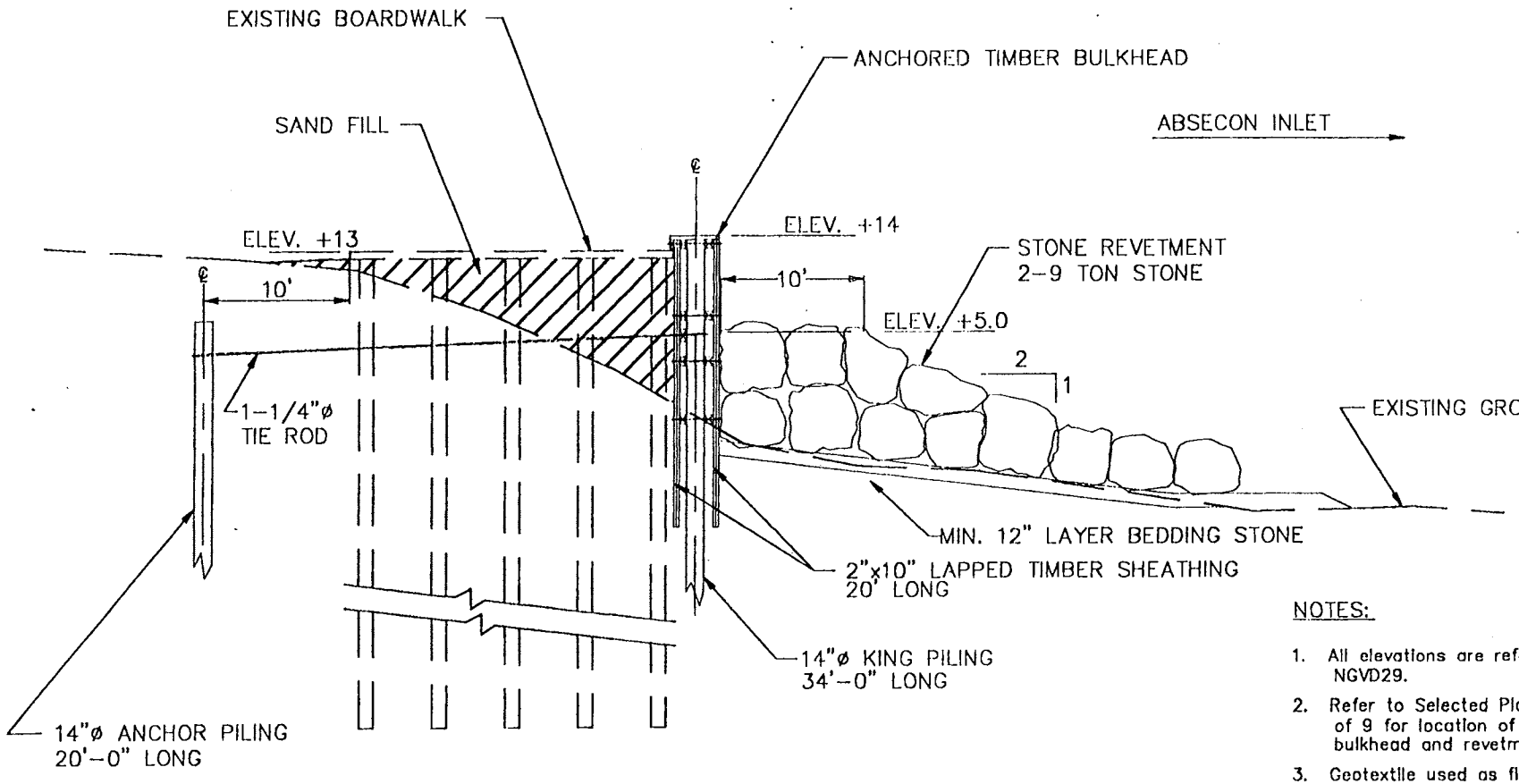
sections; one from Madison Ave. to Melrose Ave., for a length of 550 feet, and one section from Atlantic Ave. to Oriental Ave., for a length of 1,050 feet. The anchored timber sheet-pile bulkhead would be aligned with and tie in to the existing bulkhead constructed along Maine Avenue from Madison Avenue to Melrose Avenue. From Atlantic to Oriental Aves., the bulkhead will be located at the seaward side of the existing boardwalk, and will be connected with a return wall to the existing bulkhead parallel to Maine Ave. and which terminates at Atlantic Avenue. Toe protection for the bulkhead consisting of stone armor units will be provided on the seaward side of the bulkhead. The final design of the bulkhead will follow the as-built drawings for the adjacent anchored timber bulkhead along Maine Avenue, constructed in 1993. A cross section of this bulkhead, which is the same for both sections is shown in Figure 3 of the project design section, and the exact locations are shown on the Selected Plan layout, Sheet 1 of 9.

ABSECON ISLAND FEASIBILITY STUDY

TABLE 2
SELECTED PLAN BEACHFILL QUANTITIES

ALL QUANTITIES ARE IN CUBIC YARDS

	BERM	DUNE	RENOURISHMENT QUANTITY	TOTAL QUANTITY
ATLANTIC CITY 200' BERM 16.0' DUNE	1,063,586	125,333	546,000	1,734,919
VENTNOR, MARGATE & LONGPORT 100' BERM 14.0' DUNE	3,052,167	266,930	1,120,000	4,439,097
ABSECON ISLAND TOTALS	4,115,750	392,263	1,666,000	6,174,013



NOTES:

1. All elevations are referenced to NGVD29.
2. Refer to Selected Plan, Sheet 1 of 9 for location of proposed bulkhead and revetment.
3. Geotextile used as filter blanket below bedding stone not shown for clarity.

TYPICAL SECTION @ ABSECON INLET

ANCHORED TIMBER BULKHEAD WITH STONE REVETMENT
N.T.S.

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NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN
TYPICAL SECTION - ABSECON INLET

FIGURE 3

SCALE: NOT TO SCALE

ABSECON INLET
CYCLE 3

BULKHEAD W/ REVETMENT

Anchor Piles 20' long 14" ø Jetted	210
King Piles 34' long 14" ø Jetted	210
Galvanized Threaded Tie Rods 1¼" ø	9450 LF (20 rods @ 45' long)
Timber Sheet Piling	34,000 Board Feet Seawall Grade Lumber 126,000 Board Feet Preservative Treated Lumber 160,000 BF
Wales (20' lengths)	8"x10" — 2150 LF 8"x8" — 1100 LF 8"x6" — 4250 LF 6"x4" — 1100 LF 6"x6" — 2150 LF
Galvanized Tie Bolts (ea. 3'-8" long)	870 bolts
Stone Toe Protection (2-9 ton rough quarrystone) for prelim. cost purp.	10,000 tons
Filter Material (3)-15' wide rolls for a distance=1100'	
Sand Fill (trucked)	27,800 c.y.

AMPAD 22-141 50 SHEETS 22-142 100 SHEETS 22-144 200 SHEETS

ABSECON ISLAND FEASIBILITY
ABSECON INLET SELECTED PLAN

STONE SIZE ANALYSIS FOR TOE SCOUR PROTECTION FOR BULKHEAD

STORM EVENT (YR.)	H (ft)	d (ft)	$d+\frac{H}{2}$ (ft)	$H_{D_{20-30}}$ (ft)	H_{D_o} (ft)	W (lbs.)	W (tons)	∅ (ft.)
5	6.9	8.8	12.3	9.6	7.0	3600	1.8	3.6
10	7.3	9.4	13.1	10.2	7.4	4300	2.2	3.8
20	7.8	10.0	13.9	10.8	7.9	5200	2.6	4.0
50	8.7	11.2	15.6	12.2	8.9	7400	3.7	4.4
100	9.6	12.3	17.1	13.3	9.7	9600	4.8	4.8
200	10.4	13.3	18.5	14.4	10.5	12,200	6.1	5.2
500	11.6	14.9	20.7	16.1	11.8	17,300	8.7	6.0

1. STONES FOR SCOUR PROTECTION FOR TOE OF BULKHEAD MUST BE ABLE TO RESIST WAVE ATTACK.
2. ASSUMING SCOUR IN FRONT OF STONE TOE PROTECTION ALSO, ADD ½ THE ANTICIPATED WAVE HEIGHT TO ESTIMATE DEPTH OF SCOUR. THIS RESULTS IN A WATER DEPTH THAT WILL SUPPORT A WAVE HEIGHT CAPABLE OF CAUSING 20-30% DAMAGE. AT 30% DAMAGE, REVETMENTS ARE CONSIDERED FAILED (SPM, PAGE 7-212)
3. OBTAIN ZERO DAMAGE WAVE HEIGHT, $H_{D_{20-30}} \div 1.37$ (SPM, TABLE 7-9)
4. CALCULATE WEIGHT OF STONE BY EQN. 7-116 (SPM) FOR EACH H_{D_o}

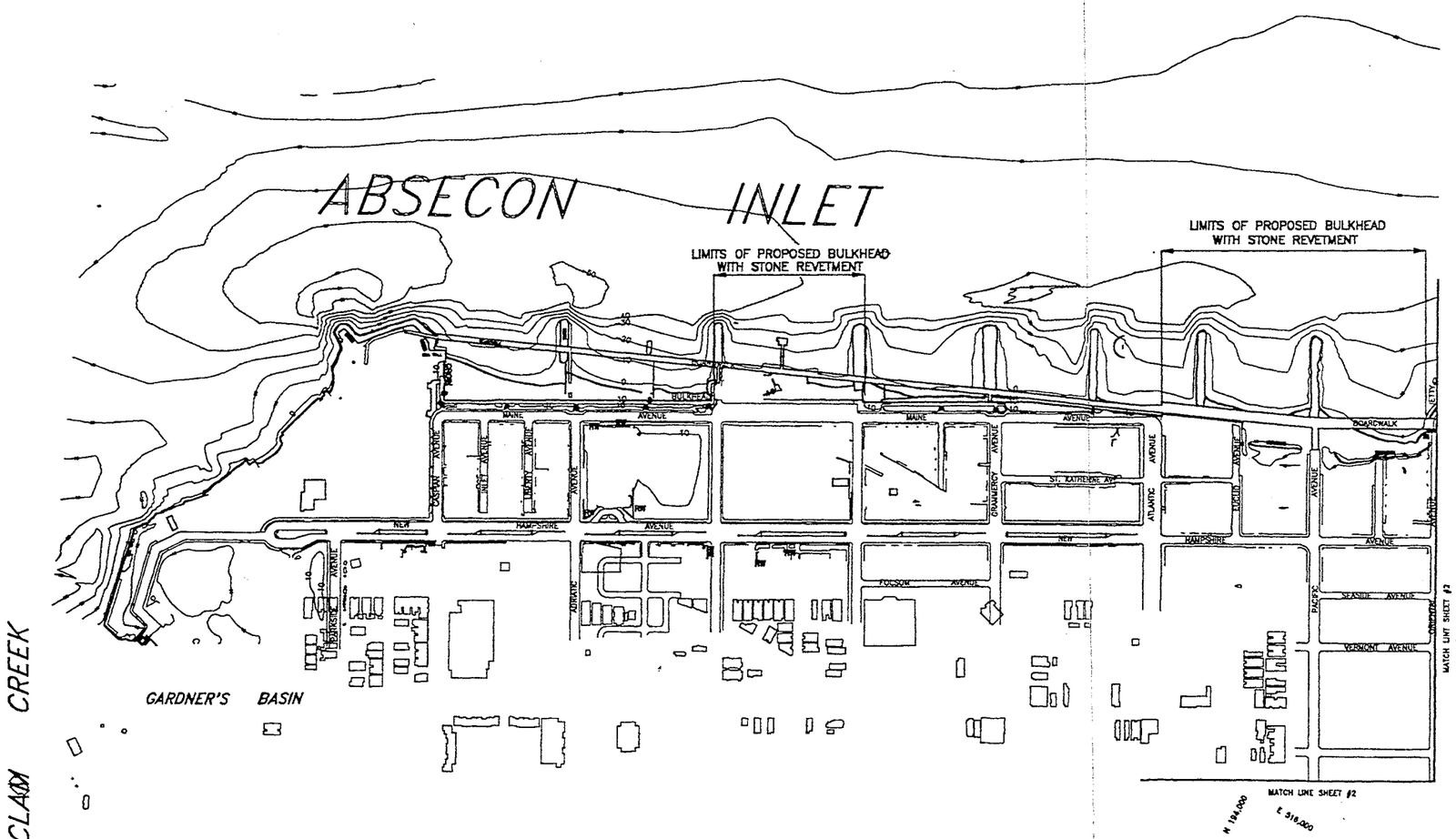
$$W = \frac{W_r \cdot H^3}{K_D (S_r - 1)^3 \cot\theta}$$

$W_r = 160$ lb/ft³
$K_D = 2.0$ (TABLE 7-8, SPM)
$S_r = 2.65$
$\cot\theta = 2.0$

} 2.9 ton STONE SELECTED AS ACCEPTABLE RANGE

5. CALCULATE CREST WIDTH, (EQN. 7-120 SPM)

$$B = nK_\Delta \left(\frac{W}{W_r}\right)^{1/3} = 3(1.0)\left(\frac{8000}{160}\right)^{1/3} = 11.0 \text{ ft, say } 10 \text{ ft.}$$



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NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN

pg. 80

SCALE | SHEET 1 OF 9

ATLANTIC OCEAN

ABSECON INLET

PROJECT LIMIT

SEAWARD EDGE OF BOARDWALK DESIGN BASELINE

SEAWARD EDGE OF PROPOSED 200' BERM EL +8.5 NGVD

SURVEY LINE #5

SURVEY LINE #6

MATCH LINE TO SHEET 1

MATCH LINE TO SHEET 1

MATCH LINE SHEET 3

MARTIN LUTHER KING JR. BLVD

200 100 0 200 400

CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 9-24-1993

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NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY

ABSECON ISLAND STUDY AREA
SELECTED PLAN

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SHEET 2 OF 9

ATLANTIC OCEAN

MATCH LINE SHEET #2

MATCH LINE SHEET #4

SEAWARD EDGE OF PROPOSED 200' BERM

SEAWARD EDGE OF BOARDWALK DESIGN BASELINE

SURVEY LINE #7

SURVEY LINE #8

OUTFALL

BOARDWALK

RAMP

PARKING

AVENUE

PACIFIC AVENUE

MONTREAL AVENUE

MARYLAND AVENUE

INDIANA AVENUE

OHIO AVENUE

MICHIGAN AVENUE

ARKANSAS AVENUE

MISSOURI AVENUE

MISSISSIPPI AVENUE

COLORADO AVENUE

ORIENTAL AVENUE

BELLEVUE AVENUE

TEXAS AVENUE

CALIFORNIA AVENUE

DELAWARE AVENUE

BRIGHTON AVENUE

200 100 0 200 400

SCALE

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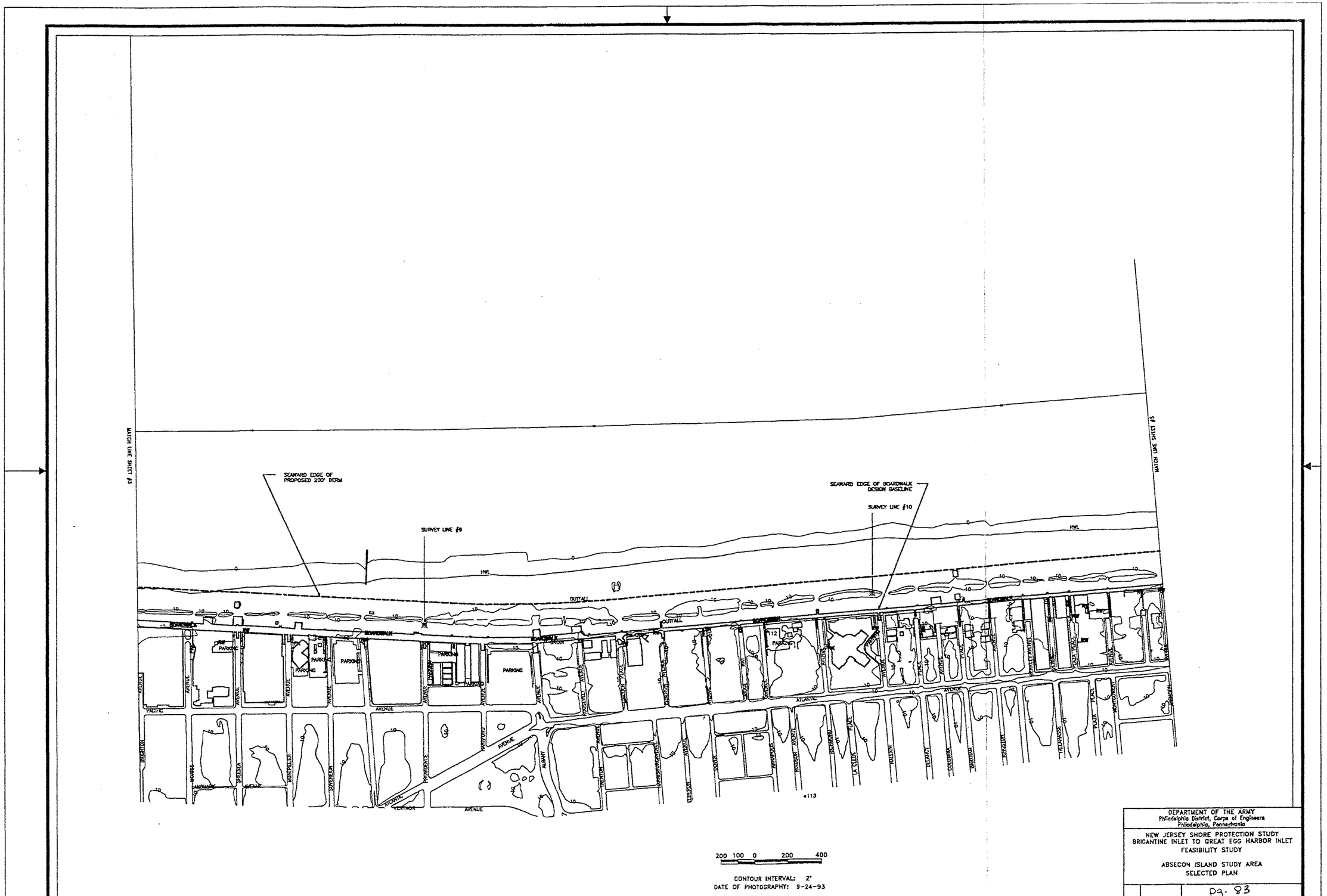
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY

ABSECON ISLAND STUDY AREA
SELECTED PLAN

Pg. 82

SHEET 3 OF 9



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NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY

ABSECON ISLAND STUDY AREA
SELECTED PLAN

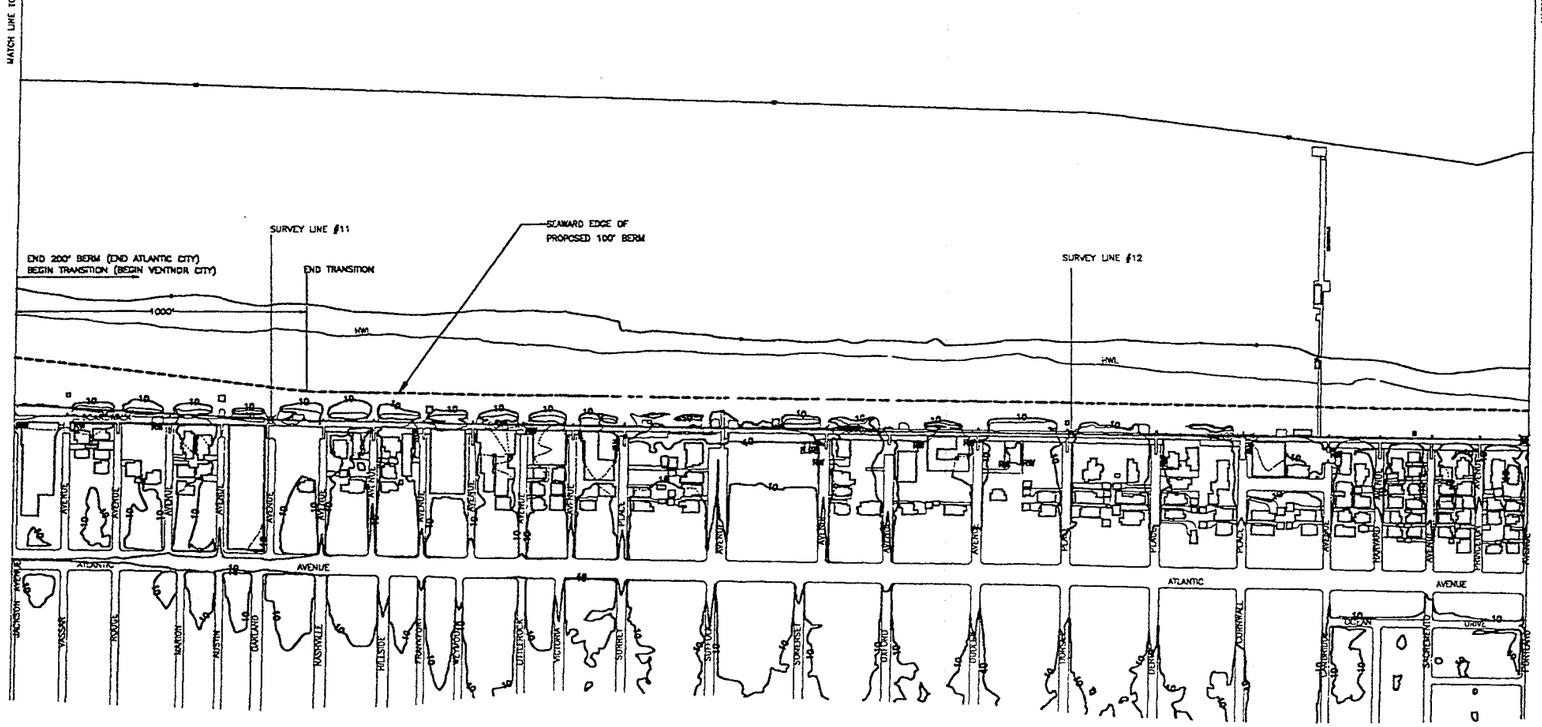
pg. 83

SCALE: 1" = 200'
SHEET 4 OF 9

ATLANTIC OCEAN

MATCH LINE TO SHEET 4

MATCH LINE TO SHEET 6



200 100 0 200 400

CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 9-24-93

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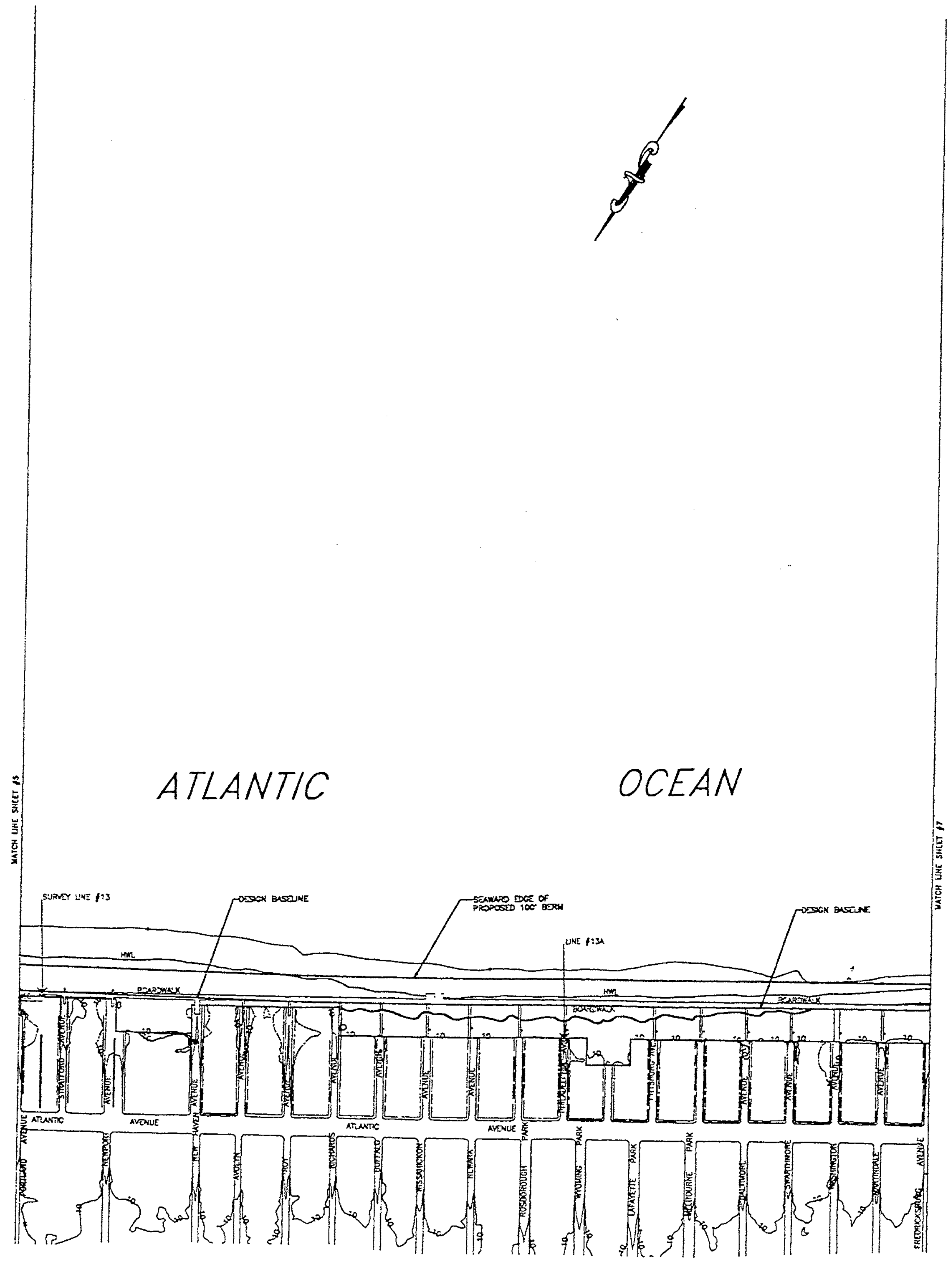
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY

ABSECON ISLAND STUDY AREA
SELECTED PLAN

pg. 84

SCALE: AS SHOWN SHEET 5 OF 9



THE UNDERWATER CONTOURS SHOWN ON THIS MAP ARE APPROXIMATE.

200 100 0 200 400

CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 9-24-93

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NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN

B. 85

SCALE: AS SHOWN SHEET 8 OF 9

ATLANTIC OCEAN

MATCH LINE SHEET #8

MATCH LINE SHEET #9

SEAWARD EDGE OF PROPOSED 100' BERM

SURVEY LINE #14

DESIGN BASELINE

SURVEY LINE #15

END VENTNOR CITY
BEGIN MARGATE CITY

ATLANTIC AVENUE

THE UNDERWATER CONTOURS SHOWN ON THIS MAP ARE APPROXIMATE.

200 100 0 200 400

CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 9-24-93

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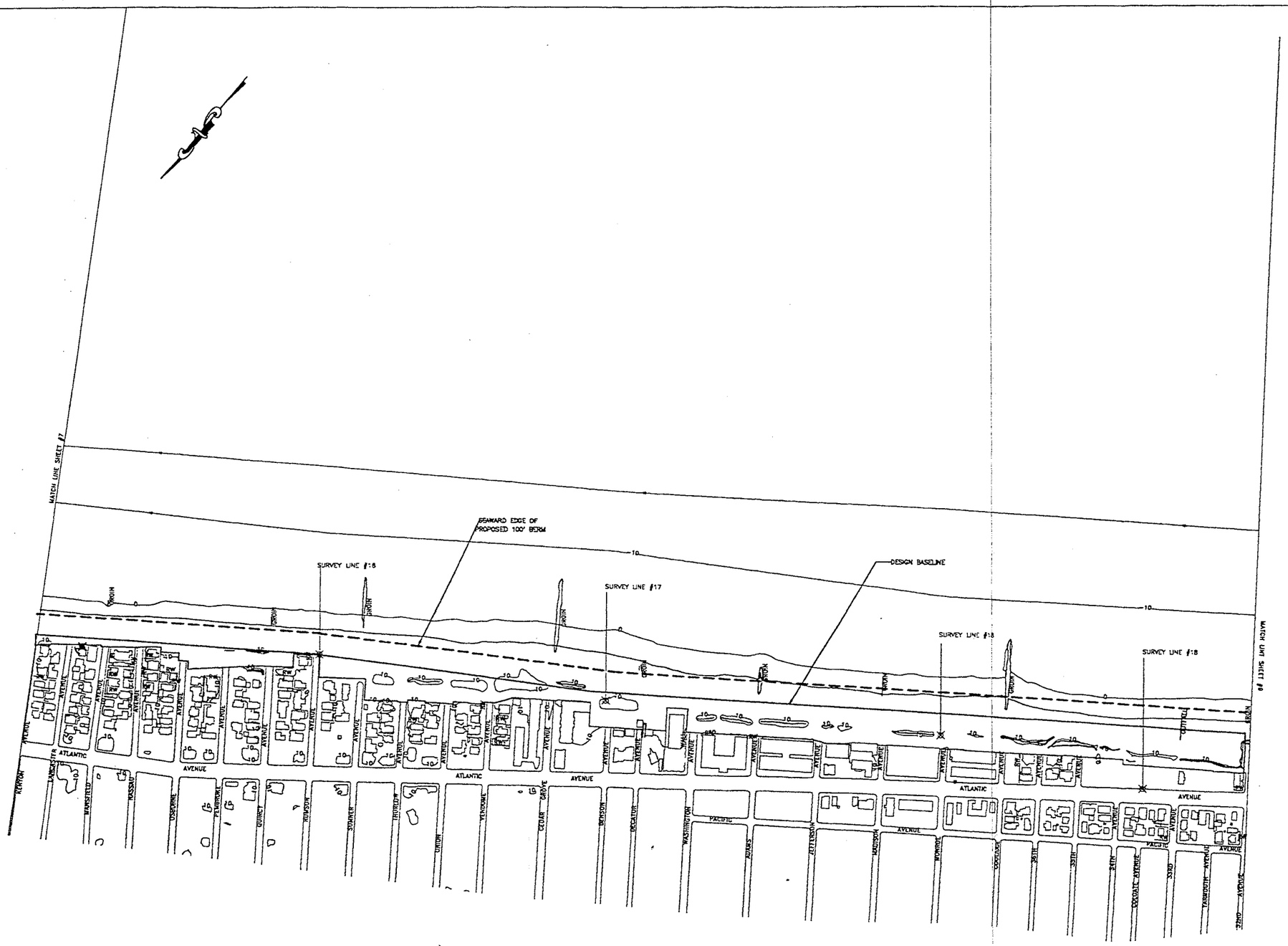
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN

pg. 86

SHEET 7 OF 9



THE UNDERWATER CONTOURS SHOWN ON THIS MAP ARE APPROXIMATE.

200 100 0 200 400

CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 9-24-93

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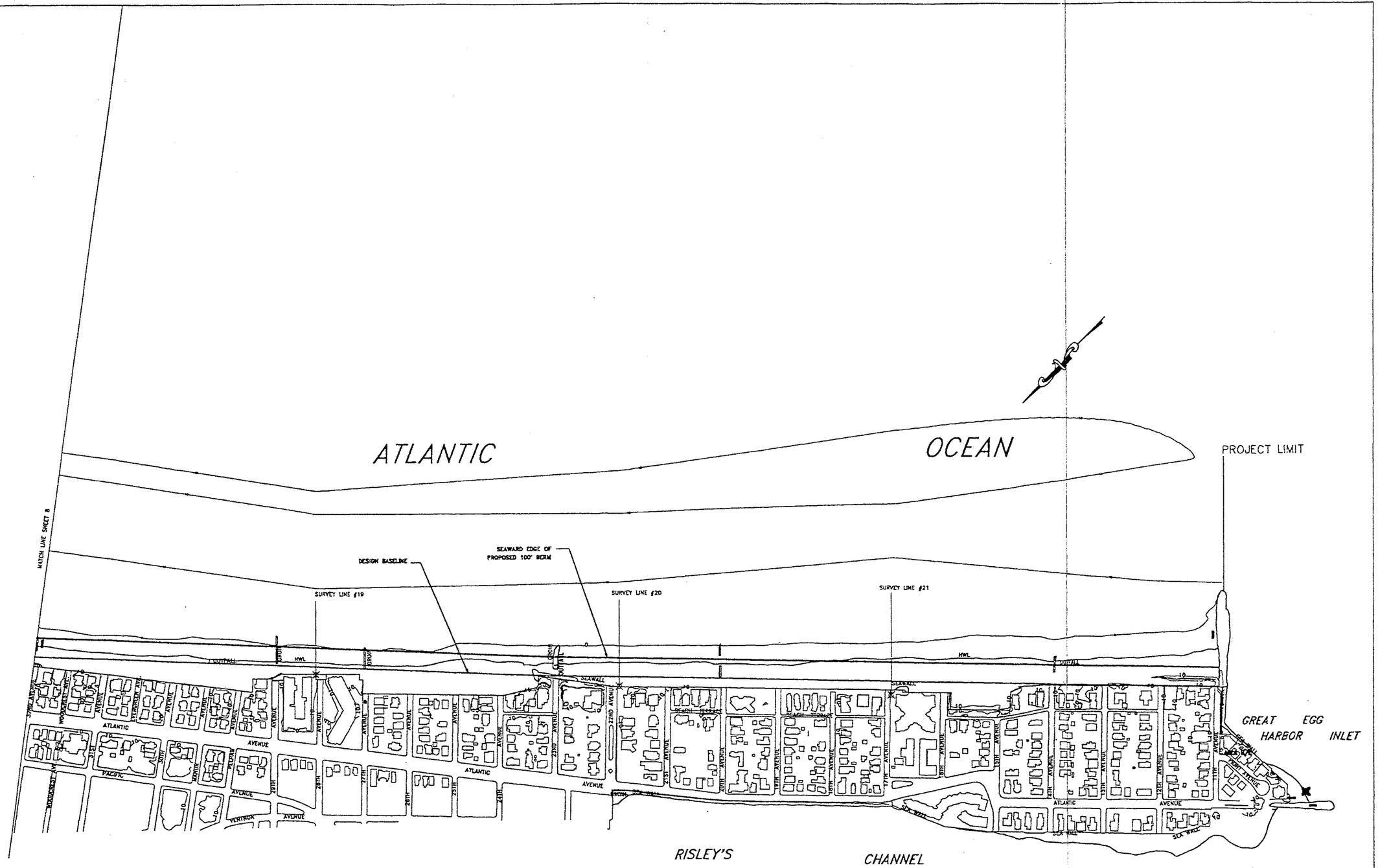
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY

ABSECON ISLAND STUDY AREA
SELECTED PLAN

pg 87

SCALE AS SHOWN | SHEET 8 OF 9



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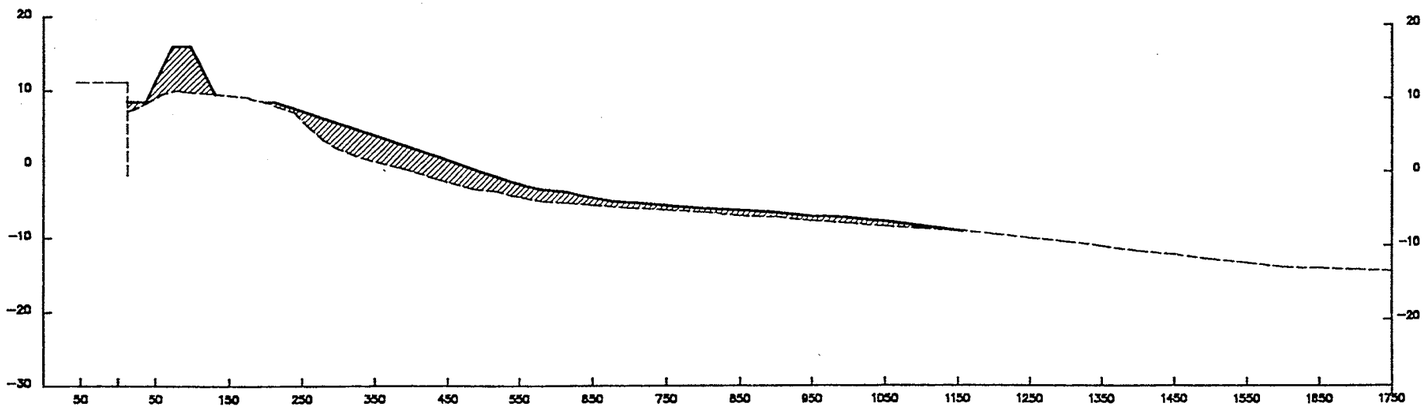
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY

ABSECON ISLAND STUDY AREA
SELECTED PLAN

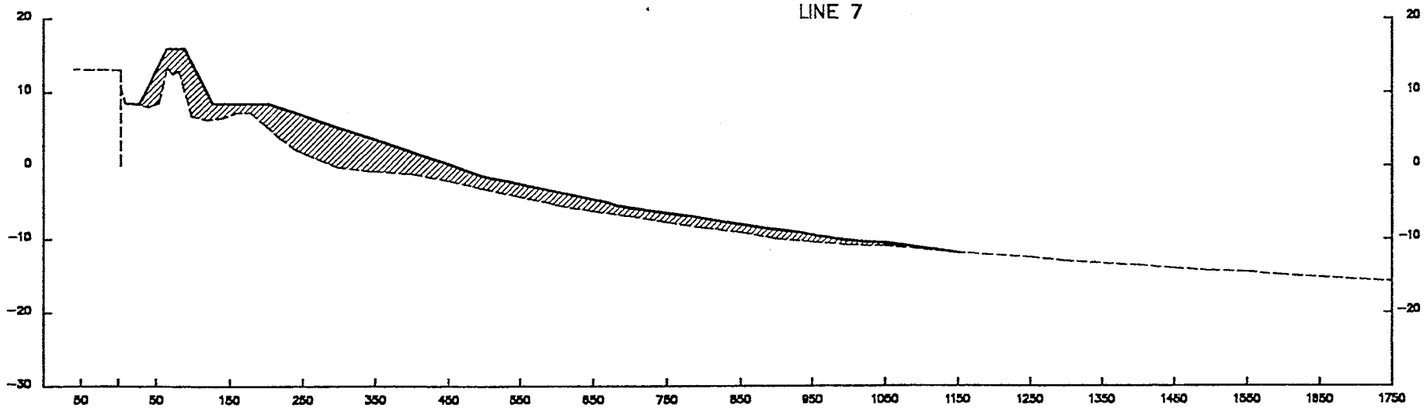
pg. 88

SCALE AS SHOWN

SHEET 9 OF 9



LINE 7



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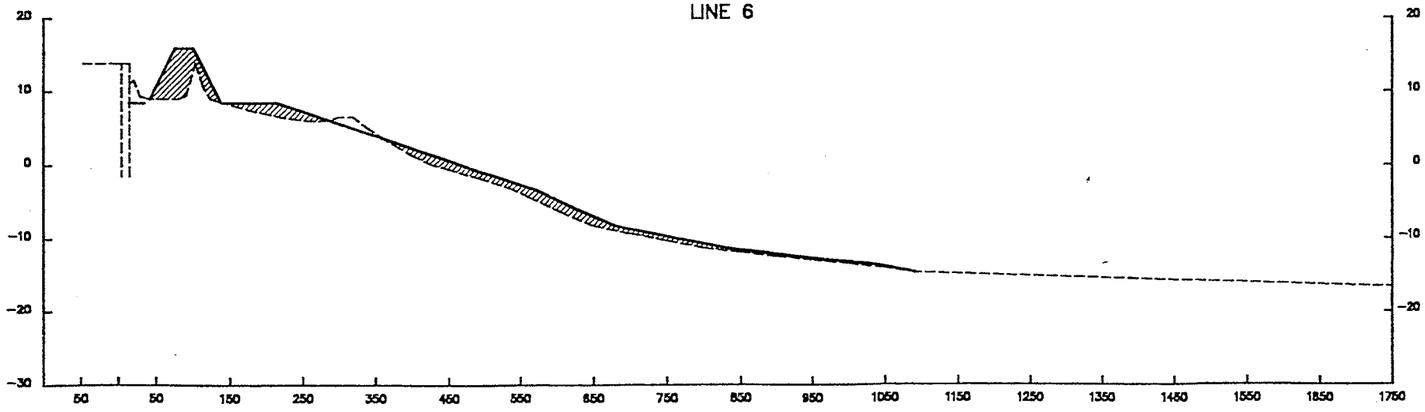


LINE 5 – FIRST SURVEY LINE IN ATLANTIC CITY
200 FT. BERM

NOTES:

1. SURVEY LINES 5 THRU 10 REPRESENT ATLANTIC CITY. SELECTED PLAN TEMPLATE FOR ATLANTIC CITY INCLUDES, 200 FT BERM, DUNE WITH TOP ELEVATION @+16.0 NGVD.

2. SURVEY LINES 11 THRU 21 REPRESENT VENTNOR, MARGATE AND LONGPORT. SELECTED PLAN TEMPLATE INCLUDES, 100 FT BERM, DUNE TOP ELEVATION @ +14.0 NGVD.

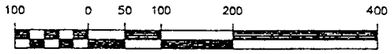
3. ALL BERM TOP ELEVATION ARE +8.5 NGVD.

——————— BEACHFILL TEMPLATE

– – – – – – – – – – EXISTING GROUND

BEACHFILL REQUIRED

HORIZONTAL GRAPHIC SCALE



(IN FEET)

VERTICAL GRAPHIC SCALE

(IN FEET)

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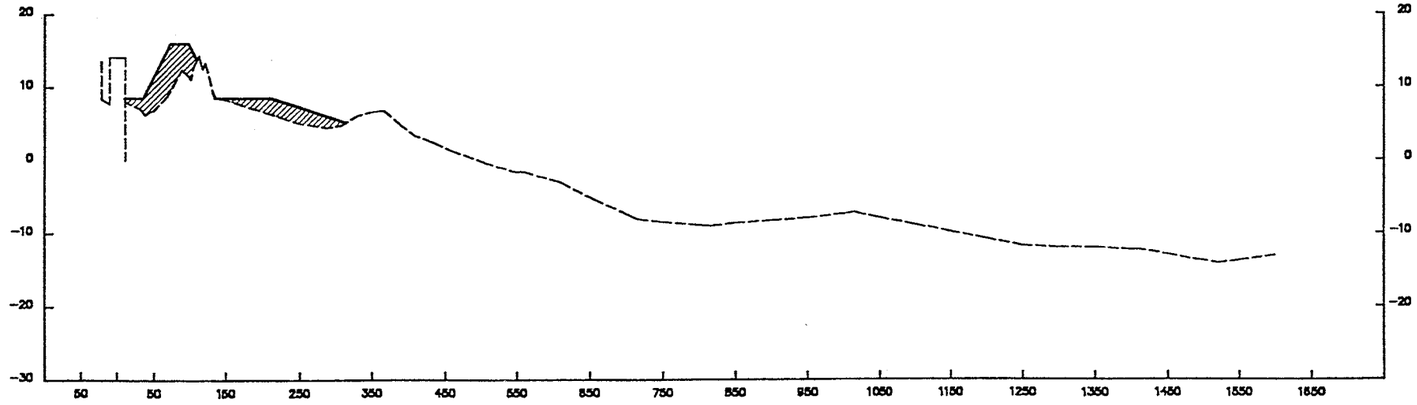
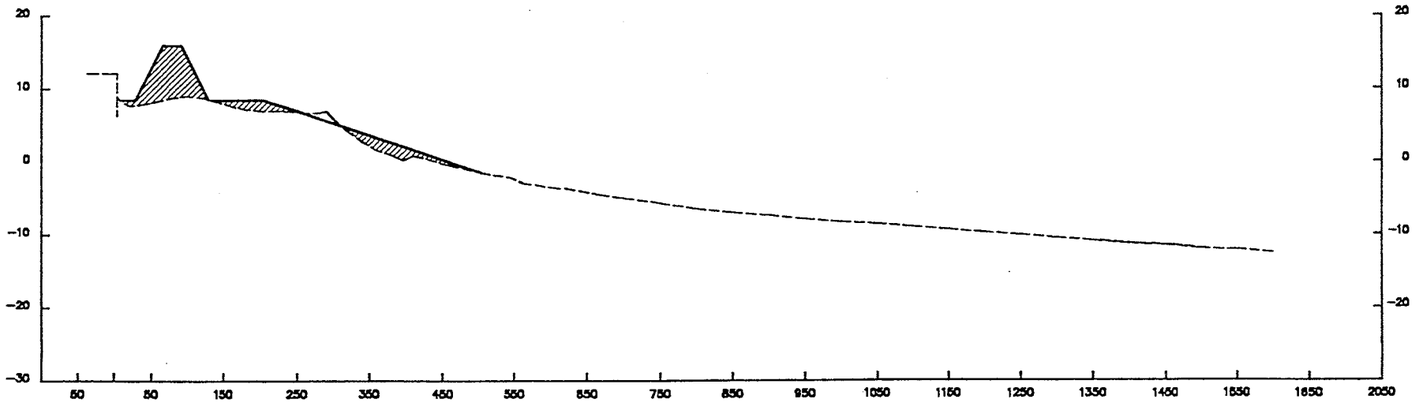
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN
DESIGN CROSS SECTIONS

Pg. 89

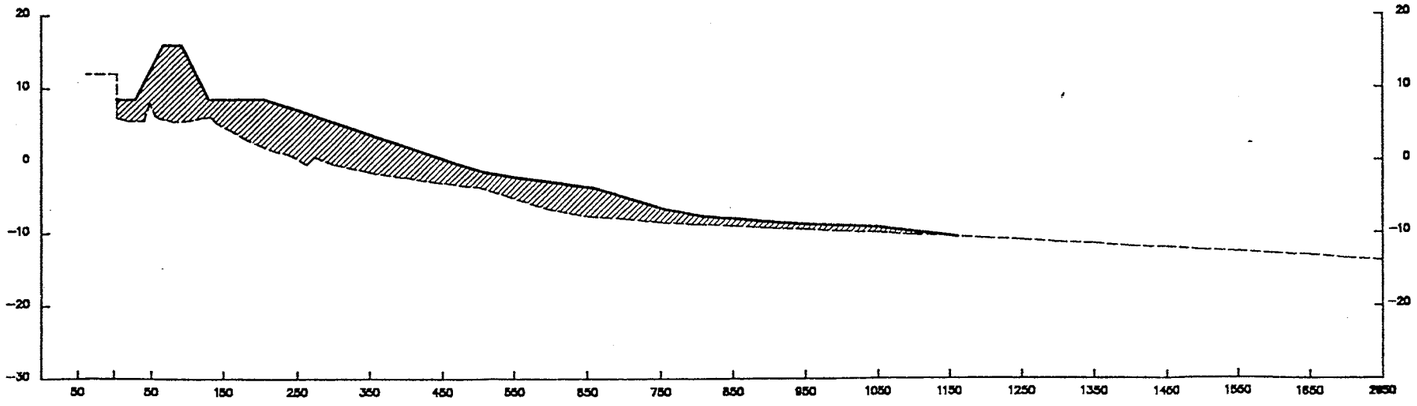
SCALE | SHEET 1 OF 7



LINE 10

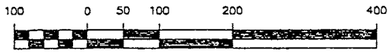


LINE 9



LINE 8

HORIZONTAL GRAPHIC SCALE



(IN FEET)

VERTICAL GRAPHIC SCALE

(IN FEET)

BEACHFILL TEMPLATE

EXISTING GROUND

BEACHFILL REQUIRED

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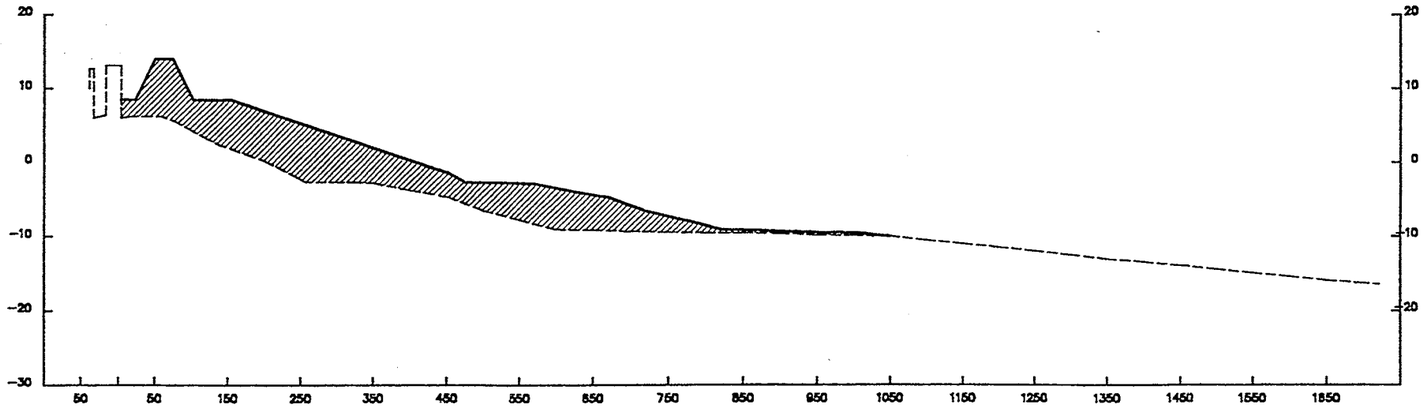
NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN
DESIGN CROSS SECTIONS

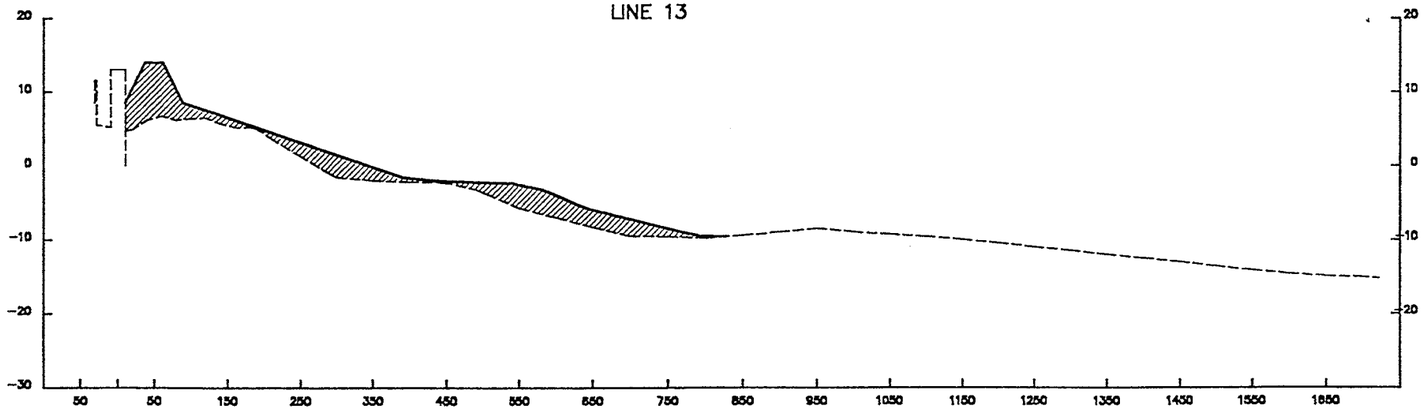
Pg. 90

NAD

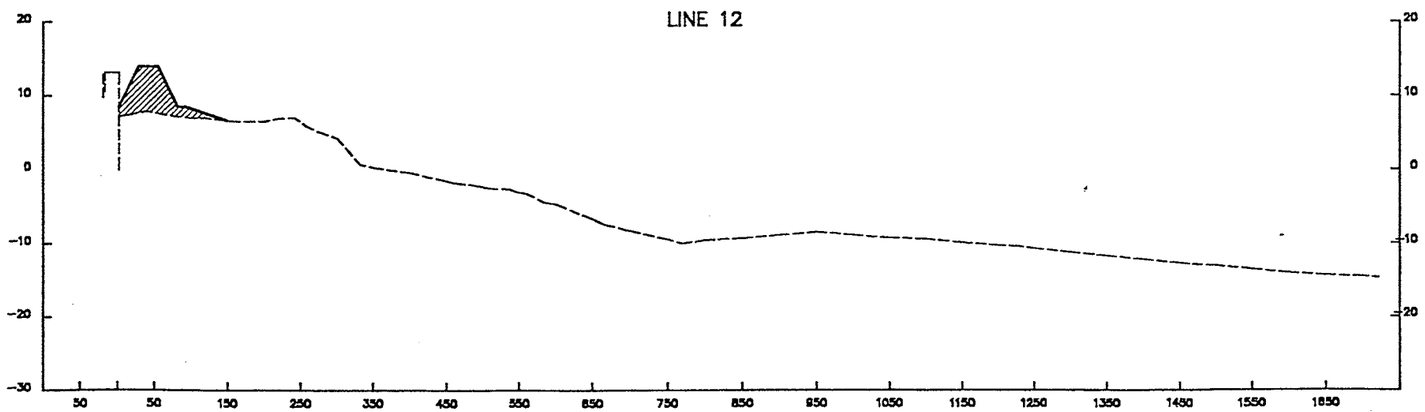
SHEET 2 OF 7



LINE 13

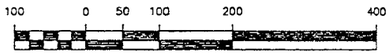


LINE 12



LINE 11 – FIRST SURVEY LINE IN VENTNOR
100 FT. BERM

HORIZONTAL GRAPHIC SCALE



(IN FEET)

VERTICAL GRAPHIC SCALE

(IN FEET)

BEACHFILL TEMPLATE

EXISTING GROUND

BEACHFILL REQUIRED

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
FEASIBILITY STUDY
ABSECON ISLAND STUDY AREA
SELECTED PLAN
DESIGN CROSS SECTIONS

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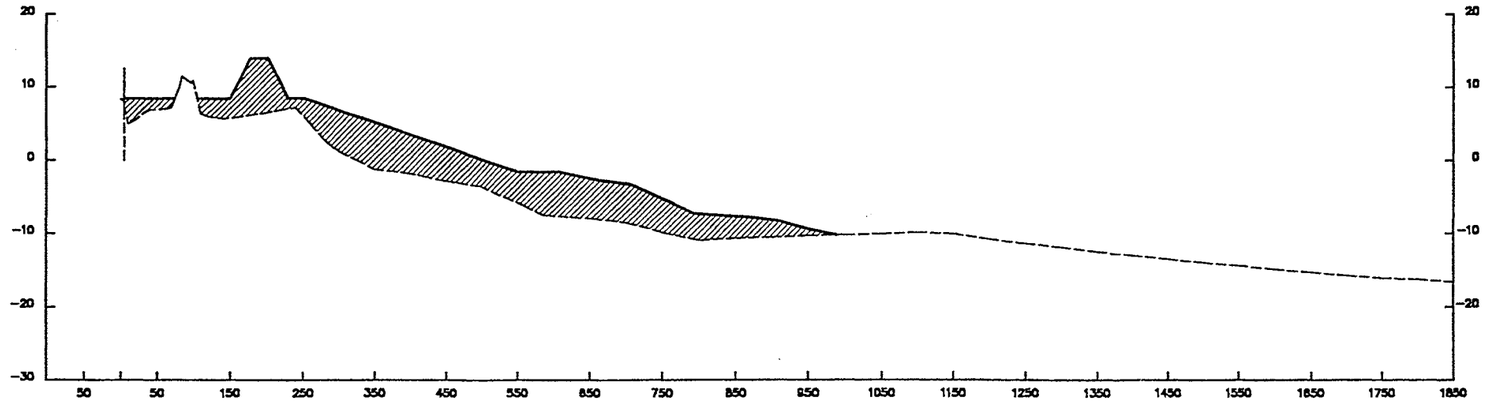
SCALE

SHEET 3 OF 7



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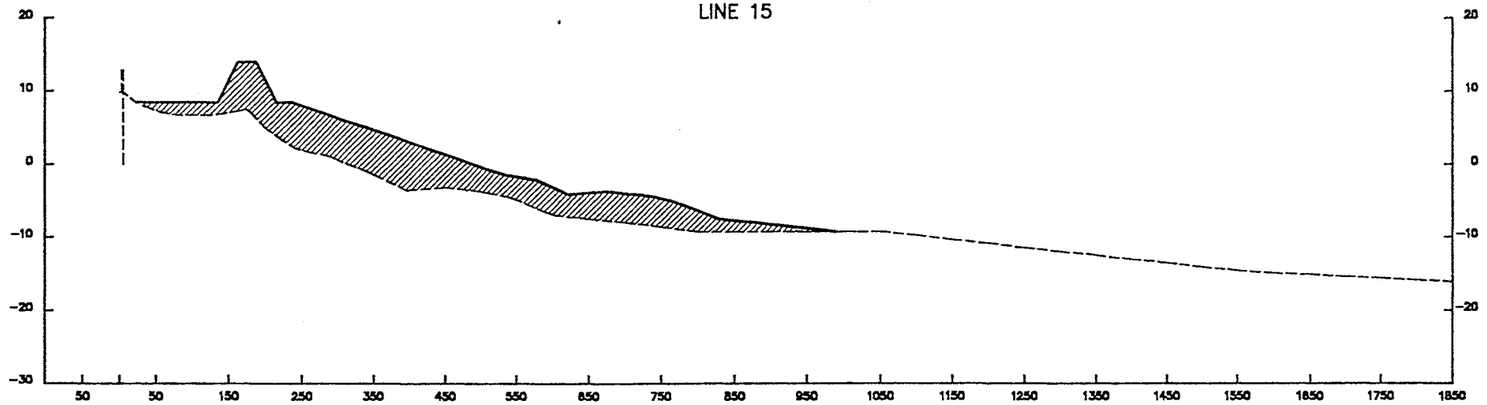

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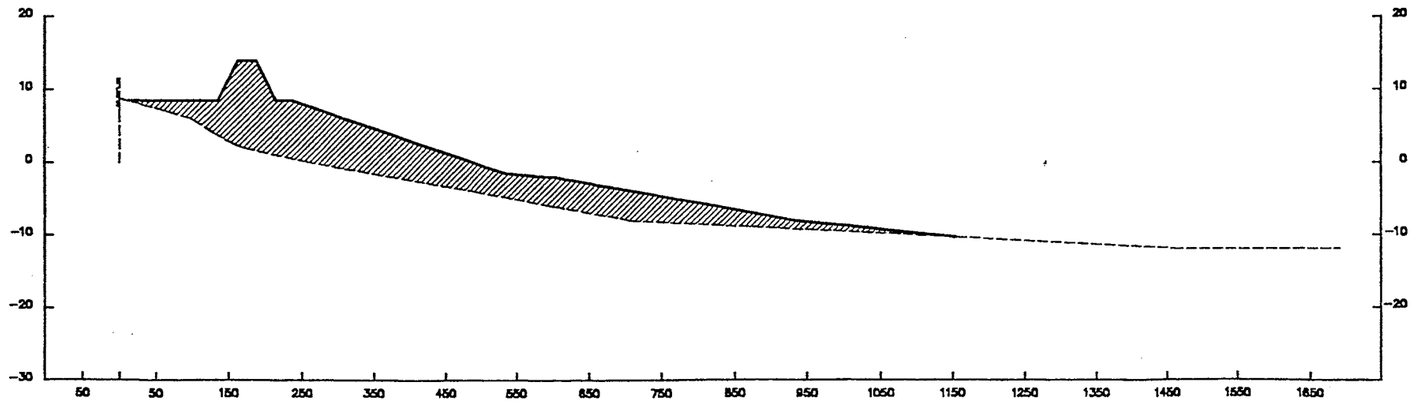
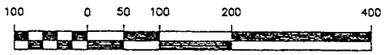


LINE 13A

HORIZONTAL GRAPHIC SCALE



(IN FEET)

VERTICAL GRAPHIC SCALE

(IN FEET)

BEACHFILL TEMPLATE

EXISTING GROUND

BEACHFILL REQUIRED

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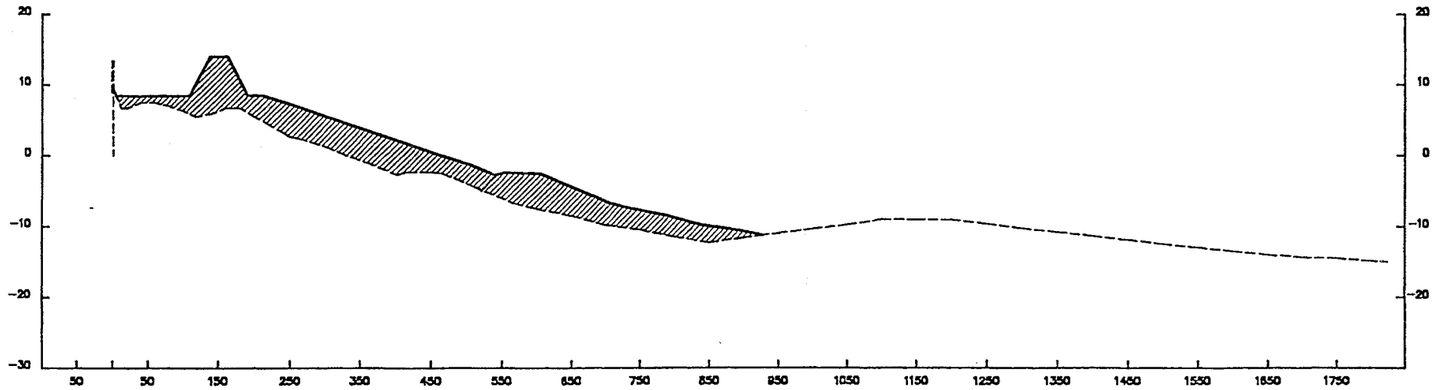
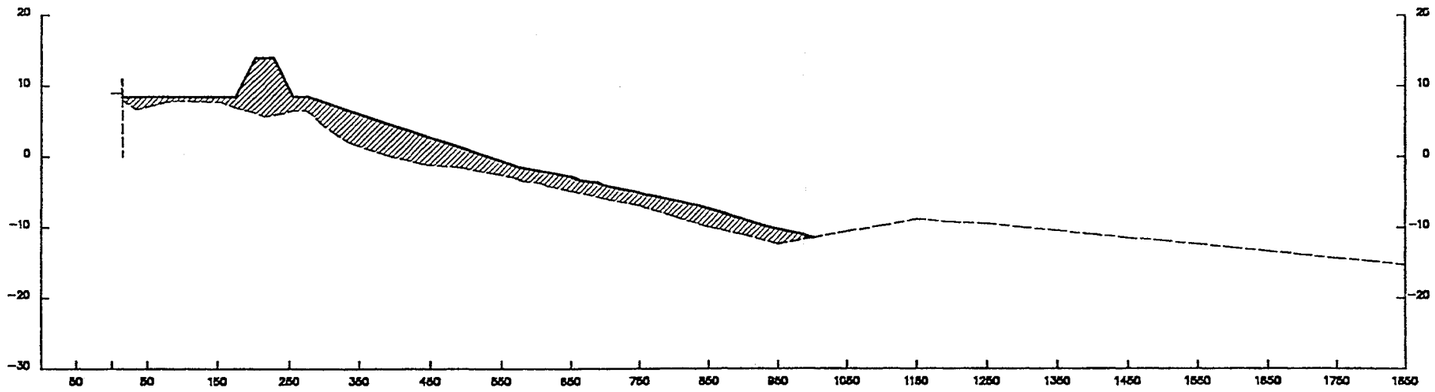
SCALE

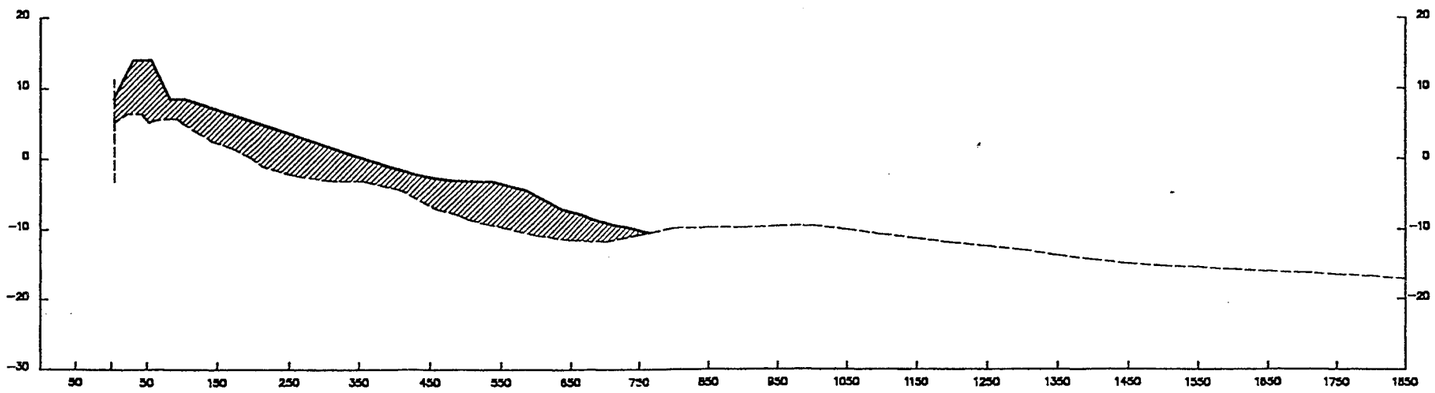
SHEET 4 OF 7



LINE 18

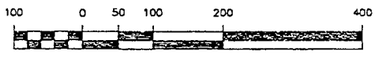


LINE 17



LINE 16

HORIZONTAL GRAPHIC SCALE



(IN FEET)

VERTICAL GRAPHIC SCALE

(IN FEET)

BEACHFILL TEMPLATE

EXISTING GROUND

BEACHFILL REQUIRED

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
BRIGANTINE INLET TO GREAT EGG HARBOR INLET
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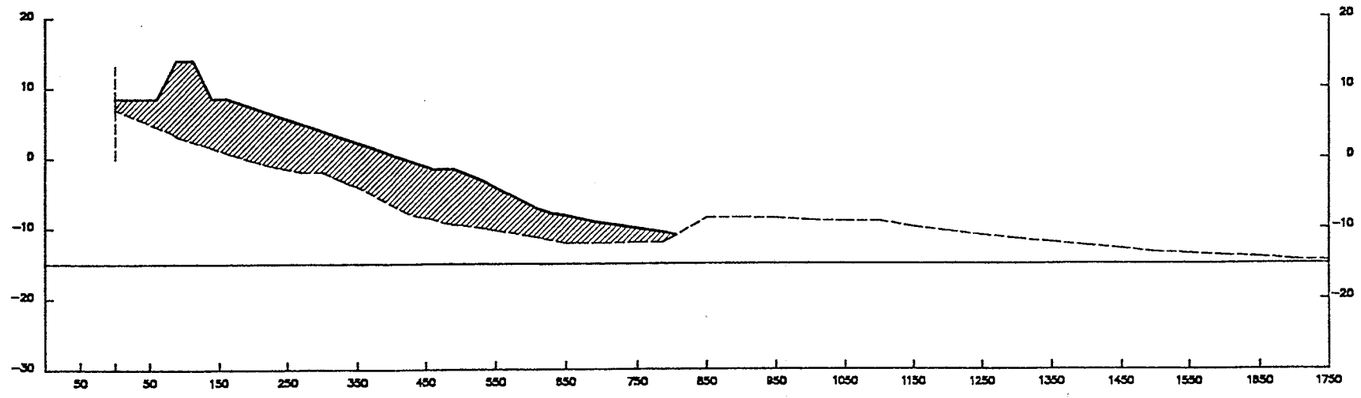
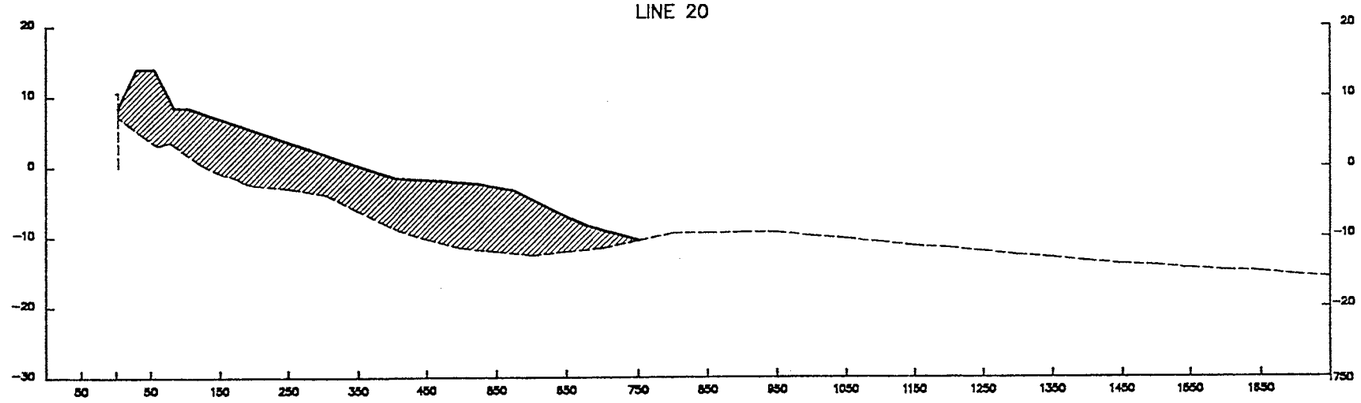
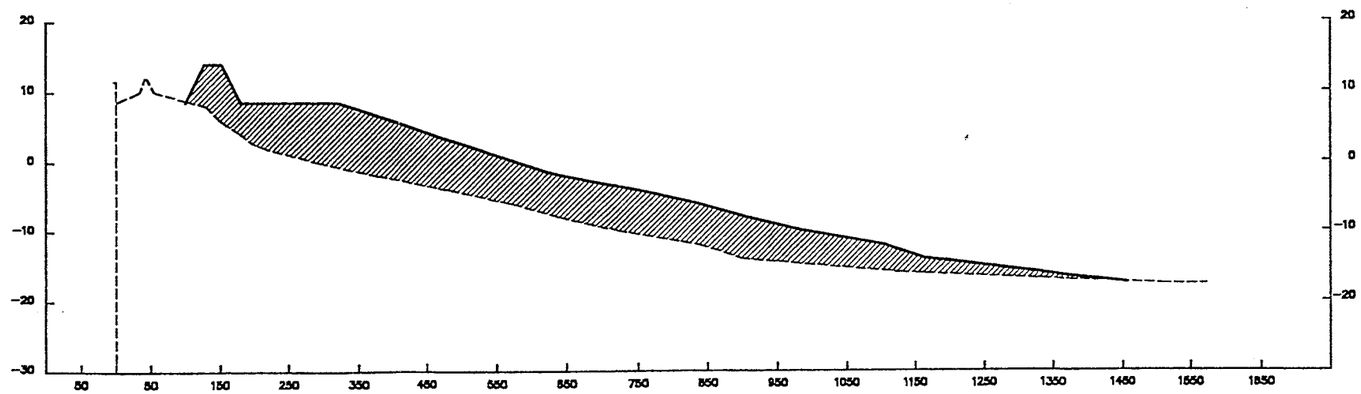
SHEET 5 OF 7



LINE 20

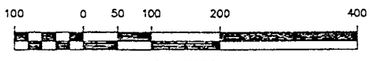


LINE 19



LINE 18A

HORIZONTAL GRAPHIC SCALE



(IN FEET)

VERTICAL GRAPHIC SCALE

(IN FEET)

BEACHFILL TEMPLATE

EXISTING GROUND

BEACHFILL REQUIRED

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Philadelphia, Pennsylvania

NEW JERSEY SHORE PROTECTION STUDY
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SHEET 8 OF 7

LINE 21

HORIZONTAL GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)

VERTICAL GRAPHIC SCALE

10 0 5 10 20 40

(IN FEET)

BEACHFILL TEMPLATE

EXISTING GROUND

BEACHFILL REQUIRED

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SCALE

SHEET 7 OF 7

SECTION 7

CONSTRUCTION PROCEDURE AND WATER CONTROL PLAN

The method of construction used by the contractor is not specified beforehand in the contract specifications. However, based on previous beachfill construction in the District, it is anticipated that the contractor will use a hydraulic dredge with a cutterhead to excavate material from the offshore borrow site. The material will then be pumped from the borrow area to the beach through a submerged pipeline. Once on the beach the pipeline will run north-south close to the proposed dune line.

The material will then be worked on the beach by bulldozers and front-end loaders. Pipe will be moved by front-end loaders with grapple arms. Miscellaneous equipment to be stored on the beach will include a light tower, fuel tank with containment, welding machine, and a temporary shanty for personnel.

A water quality plan is not required since only minor temporary turbitity may result from dredging and fill operations.

For the bulkhead construction on the inlet, it is anticipated that the timber sheet pile, king piles and anchor piles will be installed by the contractor using a pile driver with jetting equipment. A crane will be used to place the quarry stone revetment.

SECTION 8

INITIAL RESEVOIR FILLING AND SURVEILLANCE PLAN - N/A

SECTION 9

STORM EMERGENCY PLAN

An emergency plan, New Jersey Hurricane Evacuation Study, 1992, was previously completed by the District in coordination with NJ State Police Office of Emergency Management, FEMA and NOAA-NWS.

The local sponsor will be appraised of frequency events where the storm parameters exceed the design capabilities of the project.

SECTION 10

CONSTRUCTION MATERIALS

The beachfill material is from an offshore borrow area and is fully compatible with the existing beach sand. The dredged material is clean sand; chemical contamination is not a concern with this type of material. No leaching is expected. For more detailed information on the borrow material, refer to SECTION 4: Geotechnical Investigation. For more detailed information on the borrow stie, refer to SECTION 5: Environmental and Cultural Investigations.

SECTION 11

RESERVOIR CLEARING - N/A

SECTION 12

OPERATION AND MAINTENANCE

Operation and Maintenance (O&M) of the completed initial beachfill project is a Non-Federal Sponsor responsibility. An O&M plan detailing the requirements for completed surveys, eliminating/isolating hazardous conditions and maintaining the dunes will be prepared during the Construction phase of the project.

Periodic nourishment of the project will be performed pm am estimated 3-year cycle, as part of continuing construction, and will be a Federal/Non-Federal cost shared responsibility. A major rehabilitation, placement of more sand than the normal periodic nourishment is scheduled for year 24 of the 50-year project. Major Rehabilitation attempts to account for the likelihood of a major storm eroding a substantial portion of the beach once during the life of the project.

The existing outfalls on Absecon Island are a pre-existing condition and their O&M is not part of this project. Minimal O&M of the dunes will be required by the Non-Federal Sponsor between periodic nourishments.

SECTION 13

ACCESS

Most of the work in conjunction with this project will be done offshore or using waterfront access to the beach. The required grading equipment will be transported via local roads in accordane with State and local regulations including a traffic control plan. Exact access to the beach will be determined and coordinated during the plans and specifications phase and will inclued the necessary easements.

For information on public access see Section 15, Project Security.

SECTION 14

CORROSION MITIGATION - N/A

SECTION 15

PROJECT SECURITY

Initial construction and periodic nourishment of the project will necessitate a temporary (approximately one week) restriction/closure of a two-block section of beach as filling operations move down the beach. For security and public safety, temporary fencing along with signage will be requred around work areas. Contractor personnel will be required to insure security and public safety. In reference to the submerged pipeline, navigation will not be impeded, and a standard notification to mariners will be issued by the Coast Guard.

SECTION 16

COST ESTIMATE

Table 2 - E - Total First Cost

Plan 5 (16' Dune/150' Berm)

Account Code	Description	Estimated Amount	Contingency	Total Amount
01	Lands and Damages	$0	$0	$0
17	Beach Replenishment			
	Mob & Demob	$807,651	$96,918	$904,569
	Placement of 7,744,564 c.y. of sand	$35,757,699	$5,363,655	$41,121,354
	Subtotal	$36,565,350	$5,460,573	$42,025,923
	E&D	$391,304	$58,696	$450,000
	Construction Management	$2,682,350	$402,352	$3,084,702
	Total Cost	$39,639,004	$5,921,621	$45,560,625
	(Rounded)	$39,639,000	$5,922,000	$45,561,000

Table 2 - F - Total First Cost

Plan 6 (14' Dune/200' Berm)

Account Code	Description	Estimated Amount	Contingency	Total Amount
01	Lands and Damages	$0	$0	$0
17	Beach Replenishment			
	Mob & Demob	$804,127	$96,495	$900,622
	Placement of 9,263,367 c.y. of sand	$42,575,365	$6,386,305	$48,961,670
	Subtotal	$43,379,492	$6,482,800	$49,862,292
	E&D	$391,304	$58,696	$450,000
	Construction Management	$3,091,462	$463,719	$3,555,181
	Total Cost	$46,862,258	$7,005,215	$53,867,473
	(Rounded)	$46,862,000	$7,005,000	$53,867,000

SUMMARY REPORTS SUMMARY PAGE

PROJECT INDIRECT SUMMARY - Sub-Facl.....1

DETAILED ESTIMATE DETAIL PAGE

ZB. Bulkhead Construction
1. Absecon Inlet Frontage.....1
2. Hackney's Frontage.....4
ABS2. Absecon Island Study:Beachfill
6. Beachfill w/Dune.....7
7. Beachfill w/o Dune.....8
X. Dune Grass Selected Plan.....9
Y. Sand Fence Selected Plan.....10
OTFL. Outfalls
100B. 100 Berm.....11
200B. 200 Berm.....15

BACKUP REPORTS BACKUP PAGE

CREW BACKUP.....1
LABOR BACKUP.....4
EQUIPMENT BACKUP.....5

* * * END TABLE OF CONTENTS * * *

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
AA Prime Contractor											
OVERHEAD	P		12.00								
HOME OFFICE	P		0.00								
PROFIT	P		10.00								
BOND	P		1.00								

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
ZB	Bulkhead Construction									
ZB/ 1	Absecon Inlet Frontage									
ZB/ 1. 1	Bulkhead	1100.00	LF	1,710,149	205,218	0	191,537	21,069	2,127,972	1934.52
ZB/ 1. 3	Toe Protectn:2-9 Tn Quarry Stone	10000.00	TON	395,013	47,402	0	44,242	4,867	491,523	49.15
ZB/ 1. 5	Sand Fill - Trucked	27800.00	CY	240,943	28,913	0	26,986	2,968	299,810	10.78
TOTAL	Absecon Inlet Frontage	1100.00	LF	2,346,105	281,533	0	262,764	28,904	2,919,305	2653.91
ZB/ 2	Hackney's Frontage									
ZB/ 2. 1	Bulkhead	580.00	LF	901,744	108,209	0	100,995	11,109	1,122,058	1934.58
ZB/ 2. 3	Toe Protectn:2-9 Tn Quarry Stone	5272.72	TON	210,205	25,225	0	23,543	2,590	261,562	49.61
ZB/ 2. 5	Sand Fill - Trucked	14658.17	CY	127,042	15,245	0	14,229	1,565	158,081	10.78
TOTAL	Hackney's Frontage	580.00	LF	1,238,991	148,679	0	138,767	15,264	1,541,702	2658.11
TOTAL	Bulkhead Construction	1680.00	LF	3,585,096	430,212	0	401,531	44,168	4,461,007	2655.36
ABS2	Absecon Island Study:Beachfill									
ABS2/ 6	Beachfill w/Dune									
ABS2/ 6. A	Beachfill w/Dune	1.00	MO	141,171	0	0	0	0	141,171	141171.01
ABS2/ 6. B	Mob & Demob (one time cost)	1.00	EA	10,635	0	0	0	0	10,635	10634.76
TOTAL	Beachfill w/Dune	1.00	MO	151,806	0	0	0	0	151,806	151805.77
ABS2/ 7	Beachfill w/o Dune									
ABS2/ 7. A	Beachfill w/o Dune	1.00	MO	87,673	0	0	0	0	87,673	87673.32
ABS2/ 7. B	Mob & Demob (one time cost)	1.00	EA	7,090	0	0	0	0	7,090	7089.84
TOTAL	Beachfill w/o Dune	1.00	MO	94,763	0	0	0	0	94,763	94763.16
ABS2/ X	Dune Grass Selected Plan	440440.00	SY	853,837	102,460	0	95,630	10,519	1,062,446	2.41
ABS2/ Y	Sand Fence Selected Plan	63675.00	LF	198,832	23,860	0	22,269	2,450	247,410	3.89
TOTAL	Absecon Island Study:Beachfill	1.00	JOB	1,299,237	126,320	0	117,899	12,969	1,556,425	1556425
OTFL	Outfalls									
OTFL/100B	100 Berm									
OTFL/100B. 1	Ventnor and Margate	1.00	JOB	263,174	31,581	0	29,475	3,242	327,472	327472.19

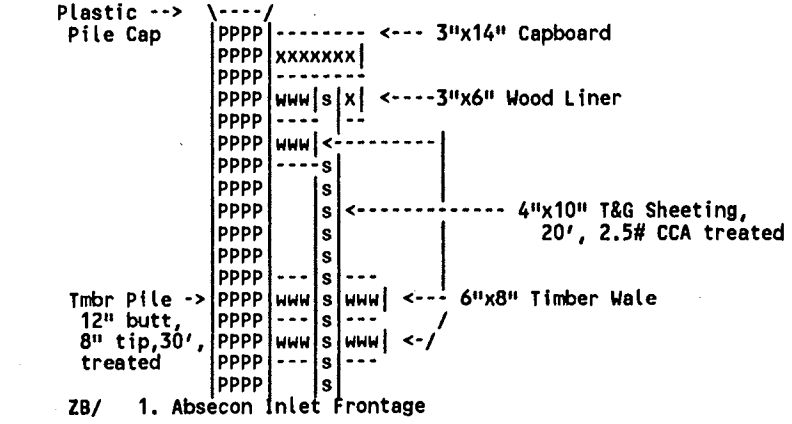
		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
OTFL/100B. 2	Longport	1.00	JOB	72,025	8,643	0	8,067	887	89,622	89622.49
TOTAL	100 Berm	1.00	JOB	335,199	40,224	0	37,542	4,130	417,095	417094.68
OTFL/200B	200 Berm									
OTFL/200B. 3	Atlantic City	1.00	JOB	214,886	25,786	0	24,067	2,647	267,387	267387.22
TOTAL	200 Berm	1.00	JOB	214,886	25,786	0	24,067	2,647	267,387	267387.22
TOTAL	Outfalls	1.00	JOB	550,085	66,010	0	61,610	6,777	684,482	684481.90
TOTAL	Absecon Island Feasibility Study	1.00	EA	5,434,419	622,542	0	581,039	63,914	6,701,914	6701914

ZB/ 1. Absecon Inlet Frontage	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST

ZB. Bulkhead Construction

Typical Section, Bulkhead

(Note- wales are connected to the pile by (3) 3/4" by 44" bolts (horizontal) except for the second wale at the top which is connected by a 3/4" by 1' bolt (vertical).



ZB/ 1. Absecon Inlet Frontage

ZB/ 1. 1. Bulkhead

USR AA <02318 1001 > 4" x 10" Wood Sheeting 20', Treated Quantity:60" per 6' or 6 Sheets @ 20' per 6 l.f.	160000	BF	CPIDC	176.25	0.05 7,264	1.92 307,072	0.60 96,032	0.89 142,400	3.41 545,504
L USR AA <02318 1001 > 14" Butt x 8" Tip Wood Piles 210 @ 20' & 210 @ 30', Treated Jetted	11340	LF	CPIDC-JET	120.00	0.07 756	2.82 31,965	1.01 11,419	4.00 45,360	7.83 88,745
B USR AA <06710 1004 > Threaded Anch Bolt,3/4"Dia x44"L Threaded on Two Ends w/Two Nuts	870.05	EA	N/A	0.00	0.00 0	0.00 0	0.00 0	8.50 7,395	8.50 7,395
USR AA <02318 2001 > Walers - 8"x10" @ 2150'= 14,333 BF 8"x 8" @ 1100'= 5,867 BF 8"x 6" @ 4250'= 17,000 BF 6"x 4" @ 1100'= 2,200 BF 6"x 6" @ 2150'= 6,450 BF 45,850 BF	45850	BF	CPIDC	144.00	0.06 2,549	2.35 107,702	0.73 33,681	0.80 36,680	3.88 178,063

ZB/ 1. Absecon Inlet Frontage		QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
M MIL AA <06311 1001 >	Creosote Treat, Dosage to 8 #/CF					0.00	0.00	0.00	0.20	0.20
	Preservative Treated Lumber	45850	BF	N/A	0.00	0	0	0	9,170	9,170
B CIV AA <02318 3002 >	Add for Mobilization -					0.03	1.13	0.35	0.50	1.98
	25,000 LF Pile Job	11340	VLF	CPIDC	300.00	303	12,786	3,998	5,670	22,454
B USR AA <06710 1004 >	Threaded Tie Rods 1-3/4"D x 45'L					1.20	53.88	11.62	22.00	87.49
	Galvanized, 210 rods @ 45'/EA	9449.99	LF	SIWSF	3.33	11,340	509,143	109,775	207,900	826,817
M MIL AA <06311 1001 >	Creosote Treat, Dosage to 8 #/CF					0.00	0.00	0.00	0.20	0.20
	Preservative Treated Lumber	160000	BF	N/A	0.00	0	0	0	32,000	32,000
	TOTAL Bulkhead					22,212	968,667	254,906	486,575	1,710,149

ZB/ 1. 3. Toe Protectn:2-9 Tn Quarry Stone

Work consist of placing a capstone revetment. Capstone shall consist of quarried rock each weighing between 2 and 9 tons. Capstone shall be selected for placement and placed as to produce a minimum of voids in the surface. Stone shall be closely fitted together and interlocked in a staggered pattern to prevent continuous joint in the revetment surface. A tolerance of plus or minus 6 inches measured vertically from the top and side slope elevation is allowed.

Assume contractor will use a 80 ton crawler crane with a grapple/clamshell bucket, a 7 CY rubber tired front-end loader will assist during the placement of the capstone.

Production includes a 75% efficiency factor and all production is rounded to the nearest day.

MIL AA <	> BKT,CLAM,5CY, GEN PURP/SQ NOSE					0.00	0.00	9.14	0.00	9.14
	5.000 CY, GEN. PURPOSE/SQUARE NO	416.00	HR	B25ES013	1.00	0	0	3,801	0	3,801
MIL AA <	> CRA,DRAG/CLAM,2.5CY,50'B,ADD BKT					0.00	0.00	90.52	0.00	90.52
	2.5 CY,DRAGLINE/CLAM (ADD BUCKET	416.00	HR	C85NO004	1.00	0	0	37,657	0	37,657
MIL AA <	> LDR,FE,WH, 7 CY, ARTIC, 988-B					0.00	0.00	92.11	0.00	92.11
	7 CY, ARTICULATED	416.00	HR	L40CA008	1.00	0	0	38,316	0	38,316
MIL AA <	> Eq Oper, Crane/Shovl					1.00	50.48	0.00	0.00	50.48
		416.00	HR	B-EQOPRCRN	1.00	416	21,000	0	0	21,000
MIL AA <	> Eq Oper, Medium					1.00	48.38	0.00	0.00	48.38
		416.00	HR	B-EQOPRMED	1.00	416	20,125	0	0	20,125
MIL AA <	> Foreman - Eq Oper, Medium					1.00	48.88	0.00	0.00	48.88
		416.00	HR	B-EQOPRMED	1.00	416	20,333	0	0	20,333
TWT AA <	> Eq Oper, Oilers					1.00	39.92	0.00	0.00	39.92
		416.00	HR	B-EQOPROIL	1.00	416	16,607	0	0	16,607

ABS2/ 6. Beachfill w/Dune				QUANTY UOM CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ABS2. Absecon Island Study:Beachfill										
ABS2/ 6. Beachfill w/Dune										
ABS2/ 6. A. Beachfill w/Dune										
	L USR	<02226 1005 >	Berm Fill, (4) D-9H Dozer W/U-Blade 410 HP, Move 150' and Stockpile (includes an allowance for misc. supplies/material)	21.00 DAY CODTN_3	0.13	32.00 672	1615.39 33,923	3329.13 69,912	30.00 630	4974.52 104,465
	USR	<02101 1001 >	Move Shore Pipe - (includes an allowance for misc. supplies/material)	21.00 DAY COEMC1	0.13	16.00 336	774.03 16,255	208.25 4,373	30.00 630	1012.28 21,258
	USR	<01380 40021>	Surveying Crew (3) men	21.00 DAY USRYA	0.13	24.00 504	720.38 15,128	0.00 0	15.25 320	735.63 15,448
		TOTAL	Beachfill w/Dune			1,512	65,306	74,285	1,580	141,171
ABS2/ 6. B. Mob & Demob (one time cost)										
	L USR	<01630 0001 >	Mob and Demob	2.00 DAY UTDHA5	0.13	32.00 64	1051.54 2,103	720.92 1,442	0.00 0	1772.46 3,545
	L USR	<01630 0001 >	Mob and Demob	2.00 DAY UTDHA5	0.13	32.00 64	1051.54 2,103	720.92 1,442	0.00 0	1772.46 3,545
	L USR	<01630 0001 >	Mob and Demob	2.00 DAY UTDHA5	0.13	32.00 64	1051.54 2,103	720.92 1,442	0.00 0	1772.46 3,545
		TOTAL	Mob & Demob (one time cost)			192	6,309	4,325	0	10,635
		TOTAL	Beachfill w/Dune			1,704	71,615	78,610	1,580	151,806

ABS2/ 7. Beachfill w/o Dune				QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ABS2/ 7. Beachfill w/o Dune												
ABS2/ 7. A. Beachfill w/o Dune												
	L USR	<02226 1005 >	Berm Fill, (2) D-9H Dozer w/U-Blade 410 HP, Move 150' and Stockpile	21.00	DAY	CODTN24	0.13	16.00 336	807.70 16,962	1664.56 34,956	0.00 0	2472.26 51,917
	USR	<02101 1001 >	Move Shore Pipe -	21.00	DAY	COEMC1	0.13	16.00 336	774.03 16,255	208.25 4,373	0.00 0	982.28 20,628
	USR	<01380 40021>	Surveying Crew (3) men	21.00	DAY	USRYA	0.13	24.00 504	720.38 15,128	0.00 0	0.00 0	720.38 15,128
		TOTAL	Beachfill w/o Dune					1,176	48,344	39,329	0	87,673
ABS2/ 7. B. Mob & Demob (one time cost)												
	L USR	<01630 0001 >	Equipment Mob	2.00	DAY	UTDHA5	0.13	32.00 64	1051.54 2,103	720.92 1,442	0.00 0	1772.46 3,545
	L USR	<01630 0001 >	Equipment Demob	2.00	DAY	UTDHA5	0.13	32.00 64	1051.54 2,103	720.92 1,442	0.00 0	1772.46 3,545
		TOTAL	Mob & Demob (one time cost)					128	4,206	2,884	0	7,090
		TOTAL	Beachfill w/o Dune					1,304	52,550	42,213	0	94,763

ABS2/ X. Dune Grass Selected Plan	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ABS2/ X. Dune Grass Selected Plan									
L USR AA <02810 2002 > Dune Grass Seedlings	3963960	SF	XLABEB	3124.48	0.00	0.04	0.00	0.17	0.22
					5,153	170,054	9,910	673,873	853,837
TOTAL Dune Grass Selected Plan					5,153	170,054	9,910	673,873	853,837

ABS2/ Y. Sand Fence Selected Plan	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ABS2/ Y. Sand Fence Selected Plan									
B CIV AA <02712 6201 > Stl Post, 10'OC f/4' Sand Fence					0.06	2.10	0.03	1.00	3.12
	63675	LF	XLABC	54.55	3,897	133,463	1,694	63,675	198,832
TOTAL Sand Fence Selected Plan					3,897	133,463	1,694	63,675	198,832
TOTAL Absecon Island Study:Beachfill					12,058	427,682	132,427	739,128	1,299,237

OTFL/100B. 100 Berm	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
OTFL. Outfalls									
OTFL/100B. 100 Berm									
OTFL/100B. 1. Ventnor and Margate									
OTFL/100B. 1. 1.1. Timber Pipe Supports									
USR AA <02318 1001 > 12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	1760.00	LF	CPIDC	80.00	0.10 176	4.23 7,442	1.32 2,327	3.85 6,776	9.40 16,545
USR AA <02318 2001 > Walers 2"x4" & 2"x6"	528.00	BF	ACARD	24.00	0.09 50	4.03 2,129	0.08 44	1.00 528	5.11 2,701
L CIV AA <02318 3001 > Add for Pile Mob/Demob 10,000 LF Pile Job	3520.00	VLF	CPIDC	160.00	0.05 176	2.11 7,442	0.66 2,327	1.00 3,520	3.78 13,289
OTFL/100B. 1. 1.2. 12" DIP									
B MIL AA <02455 1005 > 12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	200.00	LF	XXPLB	15.00	0.50 100	19.22 3,843	2.06 412	15.50 3,100	36.78 7,355
OTFL/100B. 1. 2.1. Timber Pipe Supports									
USR AA <02318 1001 > 12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	2240.00	LF	CPIDC	80.00	0.10 224	4.23 9,471	1.32 2,962	3.85 8,624	9.40 21,057
USR AA <02318 2001 > Walers 2"x4" & 2"x6"	672.00	BF	ACARD	24.00	0.09 63	4.03 2,709	0.08 56	1.00 672	5.11 3,437
L CIV AA <02318 3001 > Add for Pile Mob/Demob 10,000 LF Pile Job	4480.00	VLF	CPIDC	160.00	0.05 224	2.11 9,471	0.66 2,962	1.00 4,480	3.78 16,913
OTFL/100B. 1. 2.2. 12" DIP									
B MIL AA <02455 1005 > 12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	250.00	LF	XXPLB	15.00	0.50 125	19.22 4,804	2.06 515	15.50 3,875	36.78 9,194
OTFL/100B. 1. 3.1. Timber Pipe Supports									
USR AA <02318 1001 > 12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	2240.00	LF	CPIDC	80.00	0.10 224	4.23 9,471	1.32 2,962	3.85 8,624	9.40 21,057

OTFL/100B. 100 Berm			QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	672.00	BF	ACARD	24.00	0.09 63	4.03 2,709	0.08 56	1.00 672	5.11 3,437
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	4480.00	VLF	CPIDC	160.00	0.05 224	2.11 9,471	0.66 2,962	1.00 4,480	3.78 16,913
OTFL/100B.	1. 3.2. 12" DIP										
	B MIL AA <02455 1005 >	12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	250.00	LF	XXPLB	15.00	0.50 125	19.22 4,804	2.06 515	15.50 3,875	36.78 9,194
OTFL/100B.	1. 4.1. Timber Pipe Supports										
	USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	2640.00	LF	CPIDC	80.00	0.10 264	4.23 11,162	1.32 3,491	3.85 10,164	9.40 24,817
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	792.00	BF	ACARD	24.00	0.09 74	4.03 3,193	0.08 66	1.00 792	5.11 4,051
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	5280.00	VLF	CPIDC	160.00	0.05 264	2.11 11,162	0.66 3,491	1.00 5,280	3.78 19,934
OTFL/100B.	1. 4.2. 12" DIP										
	B MIL AA <02455 1005 >	12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	300.00	LF	XXPLB	15.00	0.50 150	19.22 5,765	2.06 618	15.50 4,650	36.78 11,033
OTFL/100B.	1. 5.1. Timber Pipe Supports										
	USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	2640.00	LF	CPIDC	80.00	0.10 264	4.23 11,162	1.32 3,491	3.85 10,164	9.40 24,817
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	792.00	BF	ACARD	24.00	0.09 74	4.03 3,193	0.08 66	1.00 792	5.11 4,051
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	5280.00	VLF	CPIDC	160.00	0.05 264	2.11 11,162	0.66 3,491	1.00 5,280	3.78 19,934
OTFL/100B.	1. 5.2. 14" DIP										
	L MIL AA <02455 1006 >	14" Dia Mechanical Joint,DI Pipe (36cm) Diameter, No Fittings	300.00	LF	XXPLB	13.16	0.57 171	21.91 6,572	2.35 704	20.56 6,168	44.81 13,444

OTFL/100B. 100 Berm		QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
	TOTAL Ventnor and Margate					3,299	137,138	33,519	92,516	263,174
OTFL/100B. 2. Longport										
OTFL/100B. 2. 1.1. Timber Pipe Supports										
USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	1360.00	LF	CPIDC	80.00	0.10 136	4.23 5,750	1.32 1,798	3.85 5,236	9.40 12,785
USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	408.00	BF	ACARD	24.00	0.09 38	4.03 1,645	0.08 34	1.00 408	5.11 2,087
L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	2720.00	VLF	CPIDC	160.00	0.05 136	2.11 5,750	0.66 1,798	1.00 2,720	3.78 10,269
OTFL/100B. 2. 1.2. 12" DIP										
B MIL AA <02455 1005 >	12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	150.00	LF	XXPLB	15.00	0.50 75	19.22 2,882	2.06 309	15.50 2,325	36.78 5,516
OTFL/100B. 2. 2.1. Timber Pipe Supports										
USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	480.00	LF	CPIDC	80.00	0.10 48	4.23 2,030	1.32 635	3.85 1,848	9.40 4,512
USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	144.00	BF	ACARD	24.00	0.09 14	4.03 581	0.08 12	1.00 144	5.11 737
L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	960.00	VLF	CPIDC	160.00	0.05 48	2.11 2,030	0.66 635	1.00 960	3.78 3,624
OTFL/100B. 2. 2.2. 12" DIP										
B MIL AA <02455 1005 >	12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	50.00	LF	XXPLB	15.00	0.50 25	19.22 961	2.06 103	15.50 775	36.78 1,839
OTFL/100B. 2. 3.1. Timber Pipe Supports										
USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	880.00	LF	CPIDC	80.00	0.10 88	4.23 3,721	1.32 1,164	3.85 3,388	9.40 8,272

OTFL/100B. 100 Berm			QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	264.00	BF	ACARD	24.00	0.09 25	4.03 1,064	0.08 22	1.00 264	5.11 1,350
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	1760.00	VLF	CPIDC	160.00	0.05 88	2.11 3,721	0.66 1,164	1.00 1,760	3.78 6,645
OTFL/100B.	2. 3.2. 12" DIP										
	B MIL AA <02455 1005 >	12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	100.00	LF	XXPLB	15.00	0.50 50	19.22 1,922	2.06 206	15.50 1,550	36.78 3,678
OTFL/100B.	2. 4.1. Timber Pipe Supports										
	USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	480.00	LF	CPIDC	80.00	0.10 48	4.23 2,030	1.32 635	3.85 1,848	9.40 4,512
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	144.00	BF	ACARD	24.00	0.09 14	4.03 581	0.08 12	1.00 144	5.11 737
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	960.00	VLF	CPIDC	160.00	0.05 48	2.11 2,030	0.66 635	1.00 960	3.78 3,624
OTFL/100B.	2. 4.2. 12" DIP										
	B MIL AA <02455 1005 >	12" Dia Mechanical Joint,DI Pipe Diameter, No Fittings	50.00	LF	XXPLB	15.00	0.50 25	19.22 961	2.06 103	15.50 775	36.78 1,839
	TOTAL	Longport					905	37,656	9,264	25,105	72,025
	TOTAL	100 Berm					4,204	174,794	42,784	117,621	335,199

TOTAL PROJECT COST SUMMARY - INITIAL CONSTRUCTION

TOTAL - ALL CONTRACTS

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE FEASIBILITY STUDY

PROJECT: NJ COASTLINE, BRIGANTINE INLET TO GREAT EGG HARBOR INLET, ABSECON ISLAND INTERIM FEASIBILITY STUD DISTRICT: PHILADELPHIA

LOCATION: ABSECON, [redacted] ISLAND, NJ P.O.C.: JOSE R. ALVAREZ, P.E., CHIEF, COST ENGINEERING BRANCH

		CURRENT MCACES ESTIMATE PREPARED: OCT 95				AUTHORIZ./BUDGET YEAR: FY-98/99				FULLY FUNDED ESTIMATE				
		EFFECTIVE PRICING LEVEL: OCT 95				EFFECTIVE PRICING LEVEL: OCT 96								
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID - PT	OMB	COST ($K)	CNTG ($K)	FULL ($K)
02	RELOCATIONS	$684.482	$102.672	15.00%	$787.154	1.028	$703.305	$105.495	$808.800	JUN -00	1.060	$745.504	$111.825	$857.329
16	BANK STABILIAZATION	$4,461.006	$669.152	15.00%	$5,130.158	1.028	$4,583.684	$687.554	$5,271.238	JUN -00	1.060	$4,858.705	$728.807	$5,587.512
17	BEACH REPLENISHMENT	$36,509.104	$5,465.010	14.97%	$41,974.114	1.028	$37,513.104	$5,615.298	$43,128.402	JUN -00	1.060	$39,763.891	$5,952.216	$45,716.106
	TOTAL CONSTRUCTION COST	$41,654.592	$6,236.834	14.97%	$47,891.426		$42,800.093	$6,408.347	$49,208.440			$45,368.100	$6,792.848	$52,160.947
01.	LANDS AND DAMAGES	$93.675	$14.053	15.00%	$107.728	1.028	$96.251	$14.439	$110.691	JAN-99	1.041	$100.197	$15.031	$115.229
30.	PLANNING, ENGINEERING AND DESIGN													
	Plans & Specifications	$540.000	$81.000	15.00%	$621.000	1.048	$565.920	$84.888	$650.808	APR-98	1.021	$578.070	$86.711	$664.781
	Environmental Coordination	$40.000	$9.750	24.38%	$49.750	1.048	$41.920	$10.220	$52.140	JUL-98	1.694	$71.008	$17.312	$88.320
	Value Engineering	$70.000	$10.500	15.00%	$80.500	1.048	$73.360	$11.004	$84.364	APR-98	1.021	$74.935	$11.240	$86.175
	PCA Execution	$20.000	$3.000	15.00%	$23.000	1.048	$20.960	$3.144	$24.104	JAN-99	1.031	$21.610	$3.242	$24.852
	Advertise & Award	$5.000	$0.750	15.00%	$5.750	1.048	$5.240	$0.786	$6.026	APR-99	1.059	$5.550	$0.833	$6.383
	E&D During Construction	$330.000	$11.250	3.41%	$341.250	1.048	$345.840	$11.793	$357.633	NOV-00	0.255	$88.183	$3.007	$91.190
	Project Management	$100.000	$49.500	49.50%	$149.500	1.048	$104.800	$51.876	$156.676	JAN-99	3.517	$368.541	$182.428	$550.969
	PLANNING, ENGINEERING AND DESIGN TOTAL	$1,105.000	$165.750	15.00%	$1,270.750		$1,158.040	$173.711	$1,331.751			$1,207.897	$304.771	$1,512.668
31.	CONSTRUCTION MANAGEMENT (S & I)	$2,500.959	$375.144	15.00%	$2,876.103	1.048	$2,621.005	$393.151	$3,014.156	NOV-99	1.121	$2,938.127	$440.719	$3,378.846
	TOTAL PROJECT COST	$45,354.226	$6,791.781	14.97%	$52,146.007		$46,675.389	$6,989.648	$53,665.038			$49,614.321	$7,553.370	$57,167.690

EC 11-2-159

TOTAL COSTS (Rounded) $57,044,000

Cumulative Compounded Percent Rates of Change

	Class 1	Class 2		Class 1	Class 2
Oct 95 - FY 96	1.000	1.000	Oct 98 - FY 99	1.091	1.063
Oct 96 - FY 97	1.048	1.028	Oct 99 - FY 00	1.132	1.096
Oct 97 - FY 98	1.050	1.031			

THIS TPCS REFLECTS A PROJECT COST CHANGE $ _____

THE TOTAL MAXIMUM PROJECT COST IS $ _____

DISTRICT APPROVED:

_____ CHIEF, COST ENGINEERING

_____ CHIEF, REAL ESTATE

_____ CHIEF, PLANNING

_____ CHIEF, ENGINEERING

_____ CHIEF, CON-OPS

_____ CHIEF, PROGRAMS MANAGEMENT

_____ PROJECT MANAGER

_____ DDE (PM)

DIVISION APPROVED:

_____ CHIEF, COST ENGINEERING

_____ DIRECTOR, REAL ESTATE

_____ CHIEF, PROGRAMS MANAGEMENT

_____ DIRECTOR OF PPMD

APPROVED DATE: _____

OTFL/200B. 200 Berm		QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
OTFL/200B. 200 Berm										
OTFL/200B. 3. Atlantic City										
OTFL/200B. 3. 1.1. Timber Pipe Supports										
	USR AA <02318 1001 > 12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	2400.00	LF	CPIDC	80.00	0.10 240	4.23 10,148	1.32 3,174	3.85 9,240	9.40 22,561
	USR AA <02318 2001 > Walers 2"x4" & 2"x6"	720.00	BF	ACARD	24.00	0.09 68	4.03 2,903	0.08 60	1.00 720	5.11 3,683
	L CIV AA <02318 3001 > Add for Pile Mob/Demob 10,000 LF Pile Job	4800.00	VLF	CPIDC	160.00	0.05 240	2.11 10,148	0.66 3,174	1.00 4,800	3.78 18,121
OTFL/200B. 3. 1.2. 20" DIP										
	L MIL AA <02455 1009 > 20" Dia Mechanical Joint,DI Pipe (51cm) Diameter, No Fittings	270.00	LF	XXPLB	9.61	0.78 211	30.00 8,100	3.22 868	33.26 8,980	66.47 17,948
OTFL/200B. 3. 2.1. Timber Pipe Supports										
	USR AA <02318 1001 > 12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	1520.00	LF	CPIDC	80.00	0.10 152	4.23 6,427	1.32 2,010	3.85 5,852	9.40 14,289
	USR AA <02318 2001 > Walers 2"x4" & 2"x6"	456.00	BF	ACARD	24.00	0.09 43	4.03 1,838	0.08 38	1.00 456	5.11 2,332
	L CIV AA <02318 3001 > Add for Pile Mob/Demob 10,000 LF Pile Job	3040.00	VLF	CPIDC	160.00	0.05 152	2.11 6,427	0.66 2,010	1.00 3,040	3.78 11,477
OTFL/200B. 3. 2.2. 24" DIP										
	L CIV AA <02455 1011 > 24" Dia Mechanical Joint,DI Pipe (61cm) Diameter, No Fittings	170.00	LF	XXPLB	8.24	0.91 155	35.00 5,950	3.75 638	43.24 7,351	81.99 13,938
OTFL/200B. 3. 3.1. Timber Pipe Supports										
	USR AA <02318 1001 > 12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	2000.00	LF	CPIDC	80.00	0.10 200	4.23 8,456	1.32 2,645	3.85 7,700	9.40 18,801

OTFL/200B. 200 Berm			QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	600.00	BF	ACARD	24.00	0.09 56	4.03 2,419	0.08 50	1.00 600	5.11 3,069
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	4000.00	VLF	CPIDC	160.00	0.05 200	2.11 8,456	0.66 2,645	1.00 4,000	3.78 15,101
OTFL/200B.	3. 3.2. 30" DIP										
	L CIV AA <02455 1012 >	30" Dia Mechanical Joint,DI Pipe (76cm) Diameter, No Fittings	220.00	LF	XXPLB	6.41	1.17 258	45.00 9,900	4.82 1,061	58.71 12,916	108.53 23,877
OTFL/200B.	3. 4.1. Timber Pipe Supports										
	USR AA <02318 1001 >	12" Butt x 8" Tip Wood Piles Treated - 8 piles per pipe support driven 10' each where large production value is 750 per day	1360.00	LF	CPIDC	80.00	0.10 136	4.23 5,750	1.32 1,798	3.85 5,236	9.40 12,785
	USR AA <02318 2001 >	Walers 2"x4" & 2"x6"	408.00	BF	ACARD	24.00	0.09 38	4.03 1,645	0.08 34	1.00 408	5.11 2,087
	L CIV AA <02318 3001 >	Add for Pile Mob/Demob 10,000 LF Pile Job	2720.00	VLF	CPIDC	160.00	0.05 136	2.11 5,750	0.66 1,798	1.00 2,720	3.78 10,269
OTFL/200B.	3. 4.2. 36" DIP										
	L CIV AA <02455 1013 >	36" Dia Mechanical Joint,DI Pipe (91cm) Diameter, No Fittings	150.00	LF	XXPLB	3.84	1.95 293	75.00 11,250	8.04 1,206	80.61 12,092	163.65 24,547
	TOTAL	Atlantic City					2,577	105,567	23,208	86,111	214,886
	TOTAL	200 Berm					2,577	105,567	23,208	86,111	214,886
	TOTAL	Outfalls					6,781	280,362	65,992	203,732	550,085
	TOTAL	Absecon Island Feasibility Study					57,033	2,347,580	727,226	2,359,612	5,434,419

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	ACARD	2 B-carpnter + Misc Power Tools			PROD = 100%				CREW HOURS =	275
MIL	B-CARPNTERF	Carpenters	0.25	HR	43.45	0.25	10.86			10.86
MIL	B-CARPNTERL	Carpenters	2.00	HR	42.95	2.00	85.89			85.89
MIL	XMIXX010 E	Misc. Power Tools	0.19	HR	5.90			0.19	1.12	1.12
MIL	XMIXX020 E	Small Tools	0.61	HR	1.45			0.61	0.88	0.88
	TOTAL					2.25	96.75	0.80	2.01	98.76
*	CODTG-1	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp			PROD = 100%				CREW HOURS =	244
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	48.38	1.00	48.38			48.38
MIL	T10CA013 E	BLADE, UNIVERSAL, HYDR (FOR D7	1.00	HR	6.14			1.00	6.14	6.14
MIL	T15CA013 E	DOZER,CWLR, D-7H,PS (ADD BLADE	1.00	HR	61.38			1.00	61.38	61.38
	TOTAL					1.00	48.38	2.00	67.52	115.90
*	CODTN24	2 B-eqoprmed + 2 Dozer, Cat D-9l, 460 Hp			PROD = 100%				CREW HOURS =	168
MIL *	B-EQOPRCRNL	Eq Oper, Crane/Shovl	2.00	HR	50.48	2.00	100.96			100.96
MIL *	XMIXX020 E	Small Tools	2.00	HR	1.45			2.00	2.90	2.90
MIL *	T10CA022 E	BLADE, UNIVERSAL,HYDR,FOR D9	2.00	HR	10.48			2.00	20.96	20.96
MIL *	T15CA017 E	DOZER,CWLR,CAT D-9N, (ADD BLADE	2.00	HR	92.11			2.00	184.21	184.21
	TOTAL					2.00	100.96	6.00	208.07	309.03
*	CODTN_3	4 B-eqoprmed + 4 Dozer, Cat D-9l, 460 Hp			PROD = 100%				CREW HOURS =	168
MIL *	B-EQOPRCRNL	Eq Oper, Crane/Shovl	4.00	HR	50.48	4.00	201.92			201.92
MIL *	XMIXX020 E	Small Tools	4.00	HR	1.45			4.00	5.80	5.80
MIL *	T10CA022 E	BLADE, UNIVERSAL,HYDR,FOR D9	4.00	HR	10.48			4.00	41.92	41.92
MIL *	T15CA017 E	DOZER,CWLR,CAT D-9N, (ADD BLADE	4.00	HR	92.11			4.00	368.42	368.42
	TOTAL					4.00	201.92	12.00	416.14	618.06
	COEMC1	1 B-eqoprmed + Forklift			PROD = 100%				CREW HOURS =	336
MIL *	B-EQOPRMEDL	Eq Oper, Medium (ENGI0825B	2.00	HR	48.38	2.00	96.75			96.75
MIL *	F10CA023 E	FKLFT 6000#@24"LC ROUGH TERRAIN	2.00	HR	11.57			2.00	23.13	23.13
MIL *	XMIXX020 E	Small Tools	2.00	HR	1.45			2.00	2.90	2.90
	TOTAL					2.00	96.75	4.00	26.03	122.79
	CPIDC	5 B-piledrvr + 1- 40 Ton Crane, Truck Mounted			PROD = 100%				CREW HOURS =	2480
MIL	A15XX014 E	AIR COMPR, 900 CFM, 100 PSI	1.00	HR	24.93			1.00	24.93	24.93
MIL	B-EQOPRCRNL	Eq Oper, Crane/Shovl	2.00	HR	50.48	2.00	100.96			100.96
MIL	B-EQOPROILL	Eq Oper, Oilers	1.00	HR	39.92	1.00	39.92			39.92
MIL	B-PILEDRVRF	Pile Drivers	1.00	HR	41.98	1.00	41.98			41.98
MIL	B-PILEDRVRA	Pile Drivers	2.00	HR	36.21	2.00	72.42			72.42
MIL	B-PILEDRVRL	Pile Drivers	2.00	HR	41.48	2.00	82.97			82.97
MIL	C80PH004 E	CRANE,HYD,TRKMTD, 40T W/106'BOO	1.00	HR	52.07			1.00	52.07	52.07
MIL	P10XX002 E	PILE LEADS, 8"X26", 60' LENGTH	1.00	HR	6.64			1.00	6.64	6.64
MIL	XMIXX020 E	Small Tools	0.90	HR	1.45			0.90	1.31	1.31
MIL	P25VU002 E	PILE HAMR,SNG,19500FT-#,ADD COM	1.00	HR	16.59			1.00	16.59	16.59
MIL	A20XX007 E	AIR HOSE, 3.0", 50', HARDROCK	2.00	HR	2.12			2.00	4.25	4.25
	TOTAL					8.00	338.25	6.90	105.78	444.04

SRC	ITEM ID		DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	**** LABOR **** COST	**** EQUIP **** HOURS	**** EQUIP **** COST	TOTAL COST
*	CPIDC-JET		5 B-piledrvr + 1- 40 Ton Crane, Truck Mounted			PROD = 100%				CREW HOURS =	144
MIL	A15XX014	E	AIR COMPR, 900 CFM, 100 PSI	1.00	HR	24.93			1.00	24.93	24.93
MIL	B-EQOPRCRNL		Eq Oper, Crane/Shovl	2.00	HR	50.48	2.00	100.96			100.96
MIL	B-EQOPROILL		Eq Oper, Oilers	1.00	HR	39.92	1.00	39.92			39.92
MIL	B-PILEDRVRF		Pile Drivers	1.00	HR	41.98	1.00	41.98			41.98
MIL	B-PILEDRVRA		Pile Drivers	2.00	HR	36.21	2.00	72.42			72.42
MIL	B-PILEDRVRL		Pile Drivers	2.00	HR	41.48	2.00	82.97			82.97
MIL	C80PH004	E	CRANE,HYD,TRKMTD, 40T W/106'BOO	1.00	HR	52.07			1.00	52.07	52.07
MIL	P10XX002	E	PILE LEADS, 8"X26", 60' LENGTH	1.00	HR	6.64			1.00	6.64	6.64
MIL	XMIXX020	E	Small Tools	0.90	HR	1.45			0.90	1.31	1.31
MIL	P25VU002	E	PILE HAMR,SNG,19500FT-#,ADD COM	1.00	HR	16.59			1.00	16.59	16.59
MIL	A20XX007	E	AIR HOSE, 3.0", 50', HARDROCK	2.00	HR	2.12			2.00	4.25	4.25
MIL *	P60GF004	E	PUMP,CENTRF,DW,8"D,1770GPM/60'H	1.00	HR	8.73			1.00	8.73	8.73
MIL *	W30S0001	E	WATER TANK,PORT, 8000GAL,10"PIP	1.00	HR	6.32			1.00	6.32	6.32
	TOTAL						8.00	338.25	8.90	120.84	459.09
	SIWSF		3 B-strsteel + 1- 22 Ton Crane, Hydraulic			PROD = 100%				CREW HOURS =	4330
MIL	B-STRSTEELL		Struct Stl Workers	2.00	HR	43.57	2.00	87.14			87.14
MIL	B-STRSTEELF		Struct Stl Workers	1.00	HR	44.07	1.00	44.07			44.07
MIL	B-EQOPRMEDL		Eq Oper, Medium	1.00	HR	48.38	1.00	48.38			48.38
MIL	C75PH004	E	CRANE,HYD,SELF, 22 TON	1.00	HR	37.60			1.00	37.60	37.60
MIL	XMIXX020	E	Small Tools	0.77	HR	1.45			0.77	1.12	1.12
	TOTAL						4.00	179.59	1.77	38.72	218.31
	ULABJ		3 B-laborer + 1-3/4 Ton Pickup Truck			PROD = 100%				CREW HOURS =	61
MIL	B-LABORER L		Laborer (Semi-Skilled)	2.00	HR	34.18	2.00	68.37			68.37
MIL	B-LABORER F		Laborer (Semi-Skilled)	1.00	HR	34.68	1.00	34.68			34.68
MIL	XMIXX020	E	Small Tools	0.25	HR	1.45			0.25	0.36	0.36
MIL	T50GM008	E	TRK,HWY,4X2 3500 PICKUP, 8600GV	0.40	HR	9.86			0.40	3.94	3.94
	TOTAL						3.00	103.05	0.65	4.31	107.36
	USRYA		Means A-7, Chief, Instru. & Rdmn			PROD = 100%				CREW HOURS =	336
USR *	X-CHFPARTYL		Chief of Party	1.00	HR	33.57	1.00	33.57			33.57
USR *	X-INSTRUMNL		Instrument Man	1.00	HR	30.06	1.00	30.06			30.06
USR	X-RODMEN	L	Rodmen/Chainman	1.00	HR	26.42	1.00	26.42			26.42
	TOTAL						3.00	90.05	0.00	0.00	90.05
*	UTDHA5		2 Trck Drivr + 2 Tractor & Lowbed Trailer, 40 To			PROD = 100%				CREW HOURS =	80
MIL *	B-LABORER L		Laborer (Semi-Skilled)	2.00	HR	34.18	2.00	68.37			68.37
MIL *	B-TRKDVRHVL		Truck Drivers, Heavy	2.00	HR	31.54	2.00	63.07			63.07
MIL *	XMIXX020	E	Small Tools	2.00	HR	1.45			2.00	2.90	2.90
MIL *	T45XX019	E	TRK TRLR,LOWBOY, 75 TON, 3 AXLE	2.00	HR	9.80			2.00	19.61	19.61
MIL *	T50KE004	E	TRK,HWY,3AXLE,50000GVW, 85000GC	2.00	HR	33.80			2.00	67.61	67.61
	TOTAL						4.00	131.44	6.00	90.11	221.56

SRC	ITEM ID		DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	**** LABOR **** COST	**** EQUIP **** HOURS	**** EQUIP **** COST	TOTAL COST
	XLABC		3 X-laborer + Small Tools			PROD = 100%				CREW HOURS = 1167	
MIL	XMIXX020	E	Small Tools	1.00	HR	1.45			1.00	1.45	1.45
MIL	X-LABORER	L	Outside Laborer	3.00	HR	34.18	3.00	102.55			102.55
MIL	X-LABORER	F	Outside Laborer	0.34	HR	34.68	0.34	11.79			11.79
	TOTAL						3.34	114.35	1.00	1.45	115.80
	* XLABEB		2 + 1 X-Lab + Dvr + Pkup			PROD = 100%				CREW HOURS = 1269	
MIL	* X-LABORER	F	Outside Laborer (Semi-Skilled)	1.00	HR	34.68	1.00	34.68			34.68
MIL	* X-LABORER	L	Outside Laborer (Semi-Skilled)	2.00	HR	34.18	2.00	68.37			68.37
MIL	* X-TRKDVRLTL		Outside Truck Dr. Light	1.00	HR	31.06	1.00	31.06			31.06
MIL	T50F0004	E	TRK,HWY,4X4,F250,3/4T,8800 GVW	1.00	HR	7.76			1.00	7.76	7.76
	TOTAL						4.00	134.11	1.00	7.76	141.87
	XXPLB		4 X-laborer + 1- 12.5 Ton Crane, Hydraulic			PROD = 100%				CREW HOURS = 235	
MIL	C75BD003	E	CRANE,HYD,SELF 14T ROUGH TERRAI	1.00	HR	27.99			1.00	27.99	27.99
MIL	XMIXX020	E	Small Tools	2.00	HR	1.45			2.00	2.90	2.90
MIL	X-LABORER	L	Outside Laborer	4.00	HR	34.18	4.00	136.74			136.74
MIL	X-EQOPRMEDL		Outside Equip. Op. Medium	1.00	HR	48.38	1.00	48.38			48.38
MIL	X-PLUMBER	F	Outside Plumber	0.50	HR	44.15	0.50	22.08			22.08
MIL	X-PLUMBER	A	Outside Plumber	1.00	HR	37.40	1.00	37.40			37.40
MIL	X-PLUMBER	L	Outside Plumber	1.00	HR	43.65	1.00	43.65			43.65
	TOTAL						7.50	288.24	3.00	30.89	319.13

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
TWT	B-CARPNTER	Carpenters (CARP0001H)	25.94	0.0%	28.6%	9.60	0.00	42.95	HR	02/27/95	37.21	619
MIL	B-EQOPRCRN	Eq Oper, Crane/Shovl (ENGI0825B)	28.62	0.0%	28.5%	13.69	0.00	50.48	HR	09/06/95	33.06	6898
MIL	B-EQOPRMED	Eq Oper, Medium (ENGI0825B)	27.03	0.0%	28.6%	13.63	0.00	48.38	HR	09/06/95	30.73	6526
TWT	B-EQOPROIL	Eq Oper, Oilers (ENGI0825B)	20.63	0.0%	28.6%	13.40	0.00	39.92	HR	02/27/95	27.56	3265
MIL	B-LABORER	Laborer/Helper (LABO0172A)	19.70	0.0%	28.6%	8.86	0.00	34.18	HR	09/06/95	27.33	983
MIL	B-PILEDRVR	Pile Drivers	20.50	0.0%	28.6%	15.13	0.00	41.48	HR	02/27/95	34.76	13124
TWT	B-STRSTEEL	Struct Stl Workers (IRON0399A)	21.79	0.0%	28.5%	15.56	0.00	43.57	HR	07/24/95	40.72	12990
MIL	B-TRKDVRHV	Truck Drivers, Heavy (TEAM0331A)	19.85	0.0%	28.6%	6.02	0.00	31.54	HR	02/27/95	27.58	160
USR	X-CHFPARTY	Chief of Party	22.30	0.0%	25.5%	5.60	0.00	33.57	HR	07/28/92	0.00	336
MIL	X-EQOPRMED	Outside Equip.,Medium(ENGI0825B)	27.03	0.0%	28.6%	13.63	0.00	48.38	HR	09/06/95	30.73	235
USR	X-INSTRUMN	Instrument Man	19.90	0.0%	26.0%	4.99	0.00	30.06	HR	02/08/94	0.00	336
MIL	X-LABORER	Outside Laborer (LABO0172A)	19.70	0.0%	28.6%	8.86	0.00	34.18	HR	09/06/95	27.33	8644
MIL	X-PLUMBER	Outside Plumber (PLUM0322A)	24.31	0.0%	28.5%	12.40	0.00	43.65	HR	09/06/95	36.23	587
USR	X-RODMEN	Rodmen/Chainman	17.55	0.0%	25.5%	4.40	0.00	26.42	HR	07/28/92	0.00	336
TWT	X-TRKDVRLT	Outside Truck Dr. Light-TEAM0331	19.50	0.0%	28.6%	5.99	0.00	31.06	HR	02/27/95	27.71	1269

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL HOURS
MIL	A15XX014	AIR COMPR, 900 CFM, 100 PSI	6.10	2.01	7.68	2.28	0.19	0.03	6.64	24.93 HR	2625
UPB	A20XX007	AIR HOSE, 3.00", 100',HARDROCK	0.73	0.08					1.32	2.12 HR	5250
UPB	B25ES013	BKT,CLAM, 5.00CY,GEN PURP/SQNOSE	4.11	1.10					3.92	9.14 HR	640
MIL	C75BD003	CRANE,HYD,S/P,RT,4WD,14T/49'BOOM	5.93	2.23	9.38	3.18	0.60	0.09	6.58	27.99 HR	235
UPB	C75PH004	CRANE,HYD,S/P,RT,4WD,22T/72'BOOM	12.12	4.57	4.48	1.42	1.34	0.21	13.46	37.60 HR	4330
MIL	C85NO004	CRANE,DRAG/CLAM, 2.5CY / 50'BOOM	32.71	11.96	5.46	1.97			38.41	90.52 HR	640
MIL	F10CA023	FORK LIFT,R/T 6,000#,20.00'L-HT	3.68	1.13	2.01	0.51	0.29	0.05	3.91	11.57 HR	672
UPB	L40CA008	LDR,FE, WH, 7.00 CY, ARTIC, 988B	28.78	10.05	11.07	3.52	10.35	1.65	26.69	92.11 HR	640
UPB	P10XX002	PILE LEADS, 8"X 26", 60' LENGTH	1.78	0.44		2.00			2.42	6.64 HR	2625
UPB	P25VU002	PILE HAMMER,SNG, 19,500 FT-LBS	5.46	1.36		0.51			9.26	16.59 HR	2625
MIL	P60GF004	PUMP,CENTRF,DW,8"D,1770GPM/60'HD	1.97	0.53	2.50	1.01	0.04	0.01	2.67	8.73 HR	144
UPB	T10CA013	BLADE, UNIVERSAL, HYDR (FOR D7	2.50	0.74		0.08			2.82	6.14 HR	244
UPB	T10CA022	BLADE, UNIVERSAL, HYDR (FOR D9	4.25	1.25		0.19			4.79	10.48 HR	1008
UPB	T15CA013	DOZER,CWLR, D-7H,PS (ADD BLADE)	16.58	5.39	6.88	2.62			29.91	61.38 HR	244
UPB	T15CA017	DOZER,CWLR, D-9N,PS (ADD BLADE)	28.38	8.37	11.83	3.51			40.00	92.11 HR	1008
UPB	T45XX019	TRLR,LOWBOY, 75T, 3 AXLE(ADD TRK	3.64	1.48		0.13	1.30	0.21	3.04	9.80 HR	160
UPB	T50FO004	TRK,HWY, 8,800GVW,4X4, 3/4T-PKUP	1.68	0.41	2.72	0.81	0.30	0.05	1.80	7.76 HR	1269
MIL	T50GM008	TRK,HWY, 8,600GVW,4X2, 1T-PICKUP	1.42	0.35	4.86	1.44	0.23	0.04	1.52	9.86 HR	24
UPB	T50KE004	TRK,HWY, 50,000 GVW, 6X4, 3 AXLE	9.90	2.42	9.15	2.72	0.43	0.07	9.12	33.80 HR	160
MIL	W30SO001	WATER TANK,PORT, 8000GAL,10"PIPE	2.36	0.86	0.66	0.18	0.22	0.04	2.00	6.32 HR	144
UPB	XMIXX010	MISC. POWER TOOLS	2.00	0.70	0.55	0.25			2.40	5.90 HR	52
UPB	XMIXX020	SMALL TOOLS	0.46	0.20	0.15	0.06			0.58	1.45 HR	9356

A DESCRIPTION AND QUANTITY SUMMARY

1 PROJECT	>Selected Plan	DATE OF ESTIMATE	>03 Dec. 1995
2 LOCATION	>Absecon Island - Selected Plan	INVIT. OR CONTR. NO.	>
3 ESTIMATED BY	>S. Johnson	CHECKED BY	
4 TYPE OF DREDGE	7600 CYD HOPPER DREDGE	TYPE OF ESTIMATE	Planning Estimate
5 DESCRIPTION OF WORK			

6 EXCAVATION			REMARKS
A. REQUIRED		6,174,013 CY	11,717,640 s.f. of Dredging Area
B. PAY OVERDEPTH	+	0 CY	
C. MAX. PAY YARDAGE	=	6,174,013 CY	(YARDAGE USED ON BID FORM)
D. O.D. NOT DREDGED	-	0 CY	
E. NET PAY YARDAGE	=	6,174,013 CY	(YARDAGE USED TO FIGURE UNIT PRICE PER C.Y.)
F. NON-PAY YARDAGE	+	1,725,500 CY	4.0 Feet Average Overdigging Outside of Prism
G. GROSS YARDAGE	=	7,899,513 CY	(YARDAGE USED TO FIGURE PRODUCTION TIME & COST)

B DREDGING COST BID ITEM # >

				REMARKS
1 GROSS YARDAGE			7,899,513 CY	FROM SHEET A, ITEM 6 G.
2 PRODUCTION RATE		/	477,856 CY/MO	FROM SHEET C, ITEM 9.
3 DREDGING TIME		=	16.53 MONTHS	6,174,013 Net Pay CY / 16.53 MO = 373,504 Pay CY/MO
4 TOTAL MONTHLY COST		x	$1,687,066	FROM SHEET D
SUBTOTAL.....		=	$27,887,203	
5 FIXED COSTS		+	$0	FROM SHEET E
SUBTOTAL.....		=	$27,887,203	
6 OVERHEAD	12.0%	+	$3,346,464	
SUBTOTAL.....		=	$31,233,667	
7 PROFIT	10.0%	+	$3,123,367	
SUBTOTAL.....		=	$34,357,034	
8 BOND	1.0%	+	$343,570	
9 GROSS PRODUCTION COSTS		=	$34,700,604	
10 NET PAY YARDAGE		/	6,174,013 CY	FROM SHEET A, ITEM 6 E.
11 UNIT COST		=	$5.62 /CY	
12 MAX PAY YARDAGE		x	6,174,013 CY	FROM SHEET A, ITEM 6 C.
13 DREDGING COST		=	$34,697,953	

C MONTHLY PRODUCTION SUMMARY BID ITEM # >

			REMARKS
1 AVERAGE UNADJUSTED CYCLE TIME		228 min/load	SEE SHEET C \ 1, ITEM 3.
2 CLEANUP FACTOR	/	0.91	10% ADDITIONAL DREDGING TIME (100% / 110%)
3 AVERAGE CYCLE TIME		251 min/load	
4 CONVERSION TO HOURS		60 min/hr	
5 AVERAGE CYCLE TIME	/	251 min/load	THIS SHEET, ITEM 3.
6 EFFECTIVE HOPPER CAPACITY	x	3,648 cy/load	
7 GROSS PRODUCTION	=	872 CY/HR	

8 OPERATING TIME:			REMARKS
A. TIME EFFICIENCY		75.0%	% OF EFFECTIVE WORKING TIME
B. MAX DREDGE TIME	x	730 HRS/MO	
C. OPERATING TIME	=	548 HRS/MO	
9 PRODUCTION RATE	=	477,856 CY/MO	872 CY/HR x 548 HRS/MO
10 LOADS PER DAY		4.3	(1440 MIN/DAY / 251 MIN/LOAD) X 75.0% EWT
11 PROJECT DURATION		16.53 MONTHS	

D \ 1 LABOR COSTS BID ITEM # >

Last Update Oct-93

DREDGE SIZE: 7600 CYD HOPPER DREDGE

		Social Security Tax	7.65%
		Employ. Liability Tax	11.20%
Overtime %	28.00%	Workers comp.	2.40%
Vacation & Holiday %	8.64%	Unemployment tax	7.30%
COMPOSITE.....	36.64%	COMPOSITE.....	28.55%

EA	CREW	BASIC HOURLY WAGE		O.T. VACATION & HOLIDAY 36.64% AMOUNT	=	SUB-TOTAL AMOUNT		TAXES INSUR 28.55% AMOUNT	=	SUB-TOTAL AMOUNT		FRINGE BENEFITS $3.11 AMOUNT	=	HRLY COST AMOUNT		HOURS PER MONTH	=	MONTHLY COST
	Dredgecrew...																	
2	CAPTAIN	37.33	+	13.68	=	51.01	+	14.56	=	65.57	+	3.11	=	68.68	x	730	=	$50,136
2	1st ENG	18.67	+	6.84	=	25.51	+	7.28	=	32.79	+	3.11	=	35.90	x	730	=	$26,207
2	3rd ENG	14.58	+	5.34	=	19.92	+	5.69	=	25.61	+	3.11	=	28.72	x	730	=	$20,966
2	3rd MATE	14.58	+	5.34	=	19.92	+	5.69	=	25.61	+	3.11	=	28.72	x	730	=	$20,966
2	DRAGTENDER	13.42	+	4.92	=	18.34	+	5.24	=	23.58	+	3.11	=	26.69	x	730	=	$19,484
2	OILER	11.75	+	4.31	=	16.06	+	4.59	=	20.65	+	3.11	=	23.76	x	730	=	$17,345
1	COOK	13.08	+	4.79	=	17.87	+	5.10	=	22.97	+	3.11	=	26.08	x	365	=	$9,519
1	ELECTRICIAN	13.42	+	4.92	=	18.34	+	5.24	=	23.58	+	3.11	=	26.69	x	365	=	$9,742
4	AB - DH	11.75	+	4.31	=	16.06	+	4.59	=	20.65	+	3.11	=	23.76	x	1460	=	$34,690
2	OS - DH	9.75	+	3.57	=	13.32	+	3.80	=	17.12	+	3.11	=	20.23	x	730	=	$14,768
2	BOAT OP.	13.17	+	4.83	=	18.00	+	5.14	=	23.14	+	3.11	=	26.25	x	730	=	$19,163
0	OTHER	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
22	Crew on Dredge													TOTAL DREDGE MONTHLY LABOR COST =				$242,986
	Shorecrew...																	
0	SUPERINT	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
0	DUMP FOREMN	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
0	EQUIP OPER	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
0	SHOREMAN	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
0	OTHER	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
0	OTHER	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
0	OTHER	0.00	+	0.00	=	0.00	+	0.00	=	0.00	+	3.11	=	3.11	x	0	=	$0
22	Total Crew													TOTAL MONTHLY LABOR COST =				$242,986

(Average Gross Wage = $30.26 per manhour)

D \ 2 DREDGE OWNERSHIP & OPERATING COST SUMMARY BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

1. OWNERSHIP COSTS:		RATES		MOB/DEMOB RATES
Ownership Elements	$	287,440 /MO	$	287,440 /MO
Facilities Capitol Cost of Money (FCCM)	$	123,431 /MO	$	123,431 /MO
TOTAL	$	410,871 /MO	$	410,871 /MO

2. OPERATING COSTS:				
Fuel	$	268.90 /HR	$	404.00 /HR
Lubricants	$	21.80 /HR	$	21.80 /HR
Repairs and Maintenance	$	318.00 /HR		
Pump and Pipe Wear & Repairs	$	448.90 /HR		
Provisions and Supplies	$	18.30 /HR	$	13.75 /HR
SUBTOTAL (For Mobilization)	$	1,076 /HR	$	440 /HR
Effective Working Time = (730 HRS/MO x 75.0% EWT)	x	548 HRS/MO		
Calendar Time per Month (Mob/Demob uses Calendar Time)			x	730 HRS/MO
TOTAL	$	589,648 /MO	$	321,200 /MO

3. TOTAL OWNERSHIP & OPERATING COSTS:				
Total Ownership Costs	$	410,871 /MO	$	410,871 /MO
Total Operating Costs	$	589,648 /MO	$	321,200 /MO
TOTAL	$	1,000,519 /MO	$	732,071 /MO

D \ 2A DREDGE OWNERSHIP COSTS BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

ACQUISITION COST (A):	$35,000,000
CAPITAL IMPROVEMENTS (I) @ 10% OF (A):	$3,500,000
(A + I)	$38,500,000

COST OF MONEY RATE (FULL RATE):	7.000%	USE MONTHS PER YEAR (UMPY):	10 months
DISCOUNTED MONEY RATE:	5.600%	MARINE INSURANCE (MI):	1.50%
SALVAGE VALUE FACTOR (S):	10%	TAXES (TA):	1.00%
ECONOMIC LIFE (N):	20 yrs	LAYUP (LU):	$51,000 per layup month
YEAR COMMISSIONED:	1981	YARD COST (Y):	$10,700 per month

CALCULATIONS

1. OWNERSHIP ELEMENTS:

A. DEPRECIATION = (A+I)*[1-S]/N	=	($38,500,000) x [1 - 10%] / 20 yrs	= $	1,732,500	/YR
B. MARINE INSURANCE = MI(A+I)	=	1.50% x ($38,500,000)	= $	577,500	/YR
C. TAXES = TA(A+I)	=	1.00% x ($38,500,000)	= $	385,000	/YR
E. LAYUP = (LU)(12-1-UMPY)	=	($51,000 per mo) x (12 mo/yr - 1 mo - 10 mo	= $	51,000	/YR
F. YARD = 12(Y)	=	12 mo x ($10,700 per mo)	= $	128,400	/YR
G. YEARLY OWNERSHIP	=	(Sum of Items 1.a. thru 1.f.)	= $	2,874,400	/YR
H. MONTHLY OWNERSHIP = (yrly Ownership / UMPY)	=	($2,874,400 / 10 mo)	= $	287,440	/MO

2. FACILITIES CAPITAL COST OF MONEY (FCCM):

A. YEARLY FCCM = (A+I)[(N-1)(1+S)+2] x Discounted Money Rate / 2N

= ($38,500,000) [(20 yrs - 1)(1 + 10%) + 2] x (5.60%) / [(2)(20 yrs)] = $ 1,234,310 /YR

B. MONTHLY FCCM = (yrly FCCM / UMPY) = ($1,234,310 / 10 mo) = $ 123,431 /MO

165

D \ 2B OPERATING COSTS - FUEL BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

1 FUEL

A. TABLE A. FUEL CONSUMPTION FACTORS:

Type of Work	Propulsion %	Propulsion factor	Pumps %	Pumps factor	Aux & Misc %	Aux & Misc factor
	FUEL FACTOR (GAL/BHP-HR)					
Excavating	45	0.024	50	0.027	30	0.016
Haul and Return	80	0.042	0	0.000	25	0.013
Pumpout	0	0.000	80	0.042	25	0.013
Non-Effective	0	0.000	0	0.000	25	0.013

B. POWER REQUIREMENTS FOR FUEL CONSUMPTION FOR THE DREDGE (From Database):

DESCRIPTION	SUMMARY OF RATED HP (1) ELECTRIC	SUMMARY OF RATED HP (1) DIESEL	TOTAL REQUIRED HP (2) DIESEL
Propulsion	0	9,000	9,000
Dredge Pump(s)	0	3,000	3,000
Jet Pump	0	0	0
Pumpout Pump(s)	0	3,000	3,000
Auxillary & Misc	1,000	765	2,000

(1). Rated hp is the output power of drive engines or motors or equivalent hp of other misc electrical loads.

(2). Total required hp is the rated bhp of engines when the type of power is diesel, or the rated bhp of generator engines providing the power when the type of power is electric.

PRODUCTION WORK SHEET

C \ 1 BID ITEM # >

CYCLE TIME

1 DREDGE USED:

A. DESCRIPTION OF DREDGE		7600 CYD HOPPER DREDGE		
B. EFFECTIVE HOPPER CAPACITY		3,648 cy/load		
				REMARKS
2 TIME PER AVERAGE LOAD CYCLE:				
A. EXCAVATING		83 min	(3,648 cy /	2,625 cy/hr) x 60 min/hr.
B. TURNING	+	10 min	1 turns at	10 minutes per turn.
C. TO DISPOSAL OR MOORING	+	33 min	(5.0 miles /	9.0 mph) x 60 min/hr.
D. DUMPING OR CONNECT TO PIPELINE	+	20 min	TYPE OF DISPOSAL---->	PUMPOUT
E. PUMPOUT THROUGH PIPELINE	+	52 min	(3,648 cy /	4,200 cy/hr) x 60 min/hr.
F. FROM DISPOSAL OR MOORING	+	30 min	(5 miles /	10 mph) x 60 min/hr.
3 AVERAGE UNADJUSTED CYCLE TIME	=	228 min/load		

D MONTHLY COST SUMMARY BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

			REMARKS
1 LABOR COSTS		$242,986 /MO	FROM SHEET D \ 1
2 EQUIPMENT			
A. DREDGE	+	$1,000,519 /MO	FROM SHEET D \ 2
PROPULSION TUG	+	self prop./MO	
B. CREW/SURVEY VESSEL	+	$0 /MO	
C. BOOSTER	+	$150,000 /MO	
D. CRANE BARGE	+	$0 /MO	
E. TENDER TUG	+	$0 /MO	
F. OTHER MARINE	+	$150,000 /MO	
G. SHORE EQUIPMENT	+	$0 /MO	
3 TRAVEL EXPENSE	+	$2,390 /MO	(30.42 dys/mo / 28 dys x $100 rt x 22 ea)
4 OTHER MONTHLY COSTS	+	$141,171 /MO	FROM SHEET D \ 3
5 TOTAL MONTHLY COST	=	$1,687,066	

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D \ 2E OPERATING COSTS - PUMP & PIPELINE BID ITEM # >

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DREDGE SIZE: 7600 CYD HOPPER DREDGE

	DREDGED QUANTITIES:		PUMPOUT QUANTITIES:	
TYPE	%	TOTAL CY	%	TOTAL CY
Mud:	10%	789,951	100%	789,951
Sand:	90%	7,109,562	100%	7,109,562
Gravel:	0%	0	100%	0
Combined:	100%	7,899,513	100%	7,899,513

TABLE C. COST DATA FOR PUMP & PIPE WEAR AND REPAIRS

PUMP WEAR COST / CY OF MATERIAL PUMPED

DISCHARGE DIAM.	MUD	SAND	GRAVEL
16	$0.011	$0.034	$0.096
18	$0.012	$0.039	$0.110
20	$0.013	$0.045	$0.123
24	$0.017	$0.054	$0.149
28	$0.019	$0.065	$0.175
34	$0.024	$0.081	$0.214

PUMPOUT PIPE WEAR COST PER (CY PUMPED x LF OF PUMPOUT PIPE)

DISCHARGE DIAM.	MUD	SAND	GRAVEL
12	$0.000024	$0.000031	$0.000048
14	$0.000022	$0.000028	$0.000042
16	$0.000018	$0.000024	$0.000037
18	$0.000017	$0.000022	$0.000032
22	$0.000014	$0.000019	$0.000029
27	$0.000013	$0.000017	$0.000025
30	$0.000012	$0.000013	$0.000022

D \ 2F OPERATING COSTS - PUMP & PIPELINE BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

4 PUMP AND PIPE WEAR AND REPAIRS

DESCRIPTION	TOTAL WEAR AND REPAIRS COST		
	MUD	SAND	GRAVEL
PUMP SIZE: 34''			
QUANTITY DREDGED (CY)	789,951 CY	7,109,562 CY	0 CY
% PUMPOUT	100%	100%	100%
PUMPS: (From Table C.)			
Dredge Pumps	$ 15,009	$ 462,122	$ 0
Pumpout Pumps	$ 15,009	$ 462,122	$ 0
SUBTOTALS: PUMPS -	30,018	924,243	$ 0
TOTAL PUMP WEAR.....			$ 954,261
DISCHARGE PIPES:			
Pumpout Line Length	30,500 LF	30,500 LF	30,500 LF
Pipe Wear Cost	$ 289,122	$ 2,818,941	$ 0
SUBTOTALS: DISCHARGE PIPES -	$ 289,122	$ 2,818,941	$ 0
TOTAL PIPE WEAR.....			$ 3,108,063

TOTAL COST FOR PUMP AND PIPE WEAR AND REPAIRS: $ 4,062,324 TOTAL

AVERAGE COST PER CY EXCAVATED: $ 0.51 /CY

TOTAL COST/HR = TOTAL WEAR COST/(TOTAL JOB EFFECTIVE HRS) =
= $4062,324 / (16.53 mo x 730 hrs/mo x 75.0% EWT) = $ 448.90 /HR

5 PROVISIONS & SUPPLIES

ACTUAL CREW = 22 EA

GOVERNMENT PERSONNEL ON DREDGE = 0 EA

TOTAL PROVISIONS @ ($15.00/ MAN-DAY x 22 ea) / 24 HRS/DAY = $ 13.75 /HR

PROV & SUPPL RATE (Adjusted to Effective Time Basis: $13.75 / 75.0%) = $ 18.30 /HR

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D \ 2G DREDGE INFO FROM DATABASE BID ITEM # >

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DREDGE SIZE: 7600 CYD HOPPER DREDGE

Name Of Plant	GENERIC LARGE	
Acquistion Cost	$35,000,000	
Capital Improvements	10% Added Cost	
Year Commisioned	1981	
Economic Life	20	years
Salvage Factor	0.10	
Propulsion Tug Needed ?	NO	
Propulsion Tug Cost	self prop.	
Layup Cost	$51,000	/mo
Yard Cost	$10,700	/mo
Water Volume of Hopper	7,600	cy
Max. Safe Load (Sand)	4,500	cy
Mud Capacity of Hopper	2,280	cy
Sand Capacity of Hopper	3,800	cy
Gravel Capacity of Hopper	3,040	cy
Mud Production Rate	4,200	cy/hr
Sand Production Rate	2,520	cy/hr
Gravel Production Rate	840	cy/hr
# Of Dragheads Available	2	
Suction Pipe Diam.	33.5	inches
Discharge Pipe Diam.	33.5	inches
Min. Digging Depth	18	ft
Max. Digging Depth	80	ft
Draft Loaded	22.4	ft
Speed Loaded (knots)	13	(15.0 mph)
Speed Light (knots)	15	(17.3 mph)
Pumpout Available	YES	
Pumpout Pipe Diam.	33.5	inches
Max. Pumpout Length	6,000	lf
Pumpout Rate	4,200	cy/hr
Total Installed Horsepower	14,000	
Propulsion Horsepower	9000	(Diesel)
Dredge Pump Horsepower	3000	(Diesel)
Pumpout Horsepower	3000	(Diesel)
Jet Pump Not Available		
Auxiliary Engine Horsepower	1000	(Electric)
Auxiliary Engine Horsepower	765	(Diesel)
Main Generator Horsepower	1235	(Diesel)
Survey Vessel Cost	$0	/mo
Pumpout Booster Cost	$150,000	/mo
Crane Barge Cost	$7,000	/mo
Tender Tug Cost	$0	/mo
Crew Size	22	

D \ 3 OTHER MONTHLY COSTS BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

			REMARKS
1 >Beach Rehandling w/ Dune		$141,171 /MO	
2 >	+	$0 /MO	
3 >	+	$0 /MO	
4 >	+	$0 /MO	
5 >	+	$0 /MO	
6 >	+	$0 /MO	
7 >	+	$0 /MO	
8 >	+	$0 /MO	
9 >	+	$0 /MO	
10 >	+	$0 /MO	
11 >	+	$0 /MO	
12 >	+	$0 /MO	
13 >	+	$0 /MO	
14 >	+	$0 /MO	
15 TOTAL OTHER MONTHLY COSTS	=	$141,171 /MO	

E FIXED COSTS BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

			REMARKS
1 >		$0	
2 >	+	$0	
3 >	+	$0	
4 >	+	$0	
5 >	+	$0	
6 >	+	$0	
7 >	+	$0	
8 >	+	$0	
9 >	+	$0	
10 >	+	$0	
11 >	+	$0	
12 >	+	$0	
13 >	+	$0	
14 >	+	$0	
15 FIXED COSTS	=	$0	

M MOB & DEMOB BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

	MOBILIZATION # DAYS		$/DAY		TOTAL	DEMOBILIZATION # DAYS		$/DAY		TOTAL
1. PREPARE DREDGE FOR TRANSFER	2	x	$41,915	=	$83,830	1	x	$41,915	=	$41,915
2. TRANSFER ALL PLANT 200 MILES @ 110 miles/day =	1.8	x	$41,915	=	$75,447	1.8	x	$41,915	=	$75,447
3. PERMANENT PERSONNEL & MISC.	L.S.			=	$7,526	L.S.			=	$7,526
4. PREPARE DREDGE AFTER TRANSFER	2	x	$41,915	=	$83,830	1	x	$41,915	=	$41,915
5. OTHER	>			=	$0	>			=	$0
SUBTOTAL MOBILIZATION					$250,633	SUBTOTAL DEMOBILIZATION				$166,[illegible]

				REMARKS
6. SUBTOTAL MOBILIZATION & DEMOBILIZATION		=	$417,436	
7. OVERHEAD	12.0%	+	$50,092	
SUBTOTAL		=	$467,528	
8. PROFIT	10.0%	+	$46,753	
SUBTOTAL		=	$514,281	
9. BOND	1.0%	+	$5,143	
10. TOTAL MOBILIZATION & DEMOBILIZATI		=	$519,424	

M \ 1 MOBIL MONTHLY COST SUMMARY BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

			REMARKS
1 LABOR COSTS		$242,986 /MO	FROM SHEET D \ 1
2 EQUIPMENT			
A. DREDGE	+	$732,071 /MO	FROM SHEET D \ 3
PROPULSION TUG	+	self prop/MO	
B. CREW/SURVEY VESSEL	+	$0 /MO	
C. BOOSTER	+	$150,000 /MO	
D. CRANE BARGE	+	$0 /MO	
E. TENDER TUG	+	$0 /MO	
F. OTHER MARINE	+	$150,000 /MO	
G. SHORE EQUIPMENT	+	$0 /MO	
3 TOTAL MONTHLY RATE	=	$1,275,057 /MO	
4 CONVERSION TO DAILY RATE	/	30.42 dys/mo	
5 DAILY RATE	=	$41,915 /day	

PERMANENT PERSONNEL & MISC.			MOBILIZATION	DEMOBILIZATION
22 men @	8 hrs/day	$30.26 per hour @ 1 DAY	$5,326	$5,326
Travel Expenses	$100 per man		$2,200	$2,200
		TOTAL	$7,526	$7,526

MOBIL & DEMOB COST: $519,424

>Selected Plan

CHECKLIST FOR INPUT DATA.

BID QUANTITY 6,174,013 C.Y.
UNIT COST... $5.62 PER C.Y.
EXCAV. COST. $34,697,953
TIME..... 16.53 MONTHS

PG 1 OF 11: PROJECT TITLES

FILENAME - HO_BRW1
PROJECT - >Selected Plan
LOCATION - >Absecon Island - Selected Plan
INVIT # - >
DATE OF EST. - >03 Dec. 1995
EST. BY - >S. Johnson
MOB. BID ITEM # - >
EXCAV. BID ITEM # - >
TYPE OF EST. - Planning Estimate

PG 2 OF 11: EXCAVATION QTY'S

DREDGING AREA - 11,717,640 sf
REQ'D EXCAVATION - 6,174,013 cyds
PAY OVERDEPTH - 0 cyds
CONTRACT AMOUNT - 6,174,013 cyds
NOT DREDGED - 0 cyds
NONPAY YARDAGE - 1,725,500 cyds
GROSS YARDAGE - 7,899,513 cyds
NONPAY HEIGHT - 4.0 ft overdig.
TOTAL BANK HEIGHT - 18.2 ft

PG 3 OF 11: PRODUCTION - PART 1 OF 3

TYPE OF MATERIAL - 10% MUD
- 90% SAND
- 0% GRAVEL
HOPPER CAPACITY - 7,600 cyds
EFF. HOPPER CAP. - 3,648 cyds
ACT. DRAGHDS USED - 2 ea
DRDGE RATE USED - 2,625 cy/hr

PG 4 OF 11: PRODUCTION - PART 2 OF 3

TURNS/CYCLE - 1 ea
MIN. PER TURN - 10 min
DISPOSAL DIST - 5 mi
TRVL SPD TO DISP - 9.0 mph
TRVL SPD FROM DISP - 10.0 mph

PG 5 OF 11: PRODUCTION - PART 3 OF 3

DUMP/CONNECT TIME - 20 min
PUMPOUT RATE - 4200 cy/hr
PIPELINE USED - 30500 lf
CLEANUP - 10% More Time
% EFF WORK TIME - 75.0%

DREDGE SELECTED - GENERIC LARGE

LOADS PER DAY - 4.3
PAY PRODUCTION - 373,504 pay cy per month

PG 6 & 7 OF 14: PLANT OWN. & OPER.

DREDGE ACQUIS COST - $35,000,000
DREDGE CAPITAL IMPROV - 10%
PROPULSION TUG - self prop./mo
SURVEY VESSEL - $0 /mo
BOOSTER - $150,000 /mo
CRANE BARGE - $0 /mo
TENDER TUG - $0 /mo
OTHER MARINE - $150,000 /mo
SHORE EQUIP - $0 /mo

PG 8 OF 11: TRAVEL & PROVISIONS

GOVERNMENT PERSON - 0 ea
FRE. PD TRAVEL - 28 days
RT TRAVEL COST - $100
PROVISIONS & SUPP - $15 /man

PG 9 OF 11: TAXES, INS & LOCAL AREA FACTORS:

MARINE INSUR - 1.50%
TAXES - 1.00%
PRESENT YEAR - 1993
ECONOMIC INDEX - 4718
LAF - 1.06
INTEREST RATE - 7.000% /yr
TIME PERIOD - July to December 1995
PLANT AVAILABLE - 10 mos/yr
FUEL PRICE - $0.82 /gal

PG 10 OF 11: OTHER ADJUSTMENTS

SPECIAL COST/MO - $141,171 >Beach Rehandling w/
SPECIAL COST LS - $0 >
CONTRACTOR'S O.H. - 12.0%
CONTRACTOR'S PROFIT - 10.0%
CONTRACTOR'S BOND - 1.0%

PG 11 OF 11: DREDGE OPERATING ADJUSTMENT FACTORS

PUMP LOAD FACTOR - 50%
RPR & MAINT. ADJ - 1.00
JET PUMP USEAGE - 0%

D \ 2C OPERATING COSTS - FUEL BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

1 FUEL (CONT.)

C. FUEL USE DURING DREDGING: F U E L U S E C O N S U M P T I O N S U M M A R Y

DESCRIPTION	EXCAVATING	TURNING, SAILING & DISPOSAL	PUMPOUT	TOTAL NON-EFFECTIVE TIME	TOTALS	JET @ 0% OF EXCAV TIME
Cycle Time In Min.	83	93	52	76	304	0
% Of Total Cycle Time	27.3%	30.6%	17.1%	25.0%	100.0%	0.0%
FUEL CONSUMPTION IN GAL/HR (1)						
Propulsion	59.0	115.7	0.0		174.7	
Pumps (2 dragheads used)	22.1	0.0	21.5		43.6	0.0
Auxillary & Misc.	8.7	8.0	4.4	6.5	27.6	
Subtotals:	89.8	123.7	25.9	6.5	245.9	0.0

Average Hourly Fuel Consumption (Effective and Non-Effective Time): 245.9 GAL/HR

Historical Fuel Consumption DATA Not Available or Not Used.....

Average Hourly Fuel Cost @ $0.82 per gallon = $ 201.64 /HR

FUEL RATE (Adjusted to Effective Time Basis: $201.64 / 75.0%) = $ 268.90 /HR

D. DURING MOB & DEMOB OPERATION:

Propulsion = (Propulsion hp x Propulsion factor during sailing) = 378.0 GAL/HR

Aux. & Misc. = (Aux. & Misc. hp x Aux. & Misc. factor during Mob & Demob) = 26.0 GAL/HR

Average Hourly Fuel Consumption (During Mob & Demob): 404.0 GAL/HR

FUEL RATE (Average Hourly Fuel Cost @ $0.82 per gallon) = $ 331.30 /HR

NOTES: (1). Computations = (% of Total Cycle Time) x (Fuel Factor from Table A.) x (Horsepower).

D \ 2D OPERATING COSTS - LUBRICANTS BID ITEM # >

DREDGE SIZE: 7600 CYD HOPPER DREDGE

Base Price Level (Cost in Tables B & C)	1988
Base Index (EP 1110-1-8, App E, EK 105)	3920
Current Price Level (Cost in Tables B & C)	1993
Current Index (EP 1110-1-8, App E, EK 105)	4718

TABLE B. LUBRICANTS, REPAIRS AND MAINTENANCE.

TOTAL INSTALLED HP OF DREDGE	LUBE $/HR (1)	REPAIRS & MAINTENANCE $/HR (2)
0 - 3999 HP	$5.30	$131.00
4000 - 4999 HP	$6.80	$147.00
5000 - 5999 HP	$8.30	$162.00
6000 - 6999 HP	$9.80	$182.00
7000 - 7999 HP	$11.30	$199.00
8000 - 8999 HP	$12.80	$215.00
9000 - 9999 HP	$14.30	$232.00
10000 - 10999 HP	$15.80	$249.00
11000 - 11999 HP	$17.30	$266.00
12000 - 12999 HP	$18.80	$283.00
13000 - 13999 HP	$20.30	$300.00
14000 - 14999 HP	$21.80	$318.00
15000 - 15999 HP	$23.30	$332.00
16000 - 16999 HP	$24.90	$351.00
17000 - 17999 HP	$26.40	$368.00

(1) LUBRICANTS Includes materials only.

(2) Includes all repairs and maintenance to all components except pumps and discharge piping for pumpout, including parts, labor, small tools, equipment and drydocking.

2 LUBRICANTS (From Table B.)

TOTAL INSTALLED POWER = 14,000 HP $ 21.80 /HR

3 REPAIRS AND MAINTENANCE (From Table B.)

TOTAL INSTALLED POWER = 14,000 HP $ 318.00 /HR

A_02. PCB Transformer Replacement	QUANTY UOM CREW ID	OUTPUT	LABOR	EQUIPMNT	MATERIAL	OTHER	MANHRS	TOTAL COST
A_02.12.09. HVAC								
A_02.12.09_ 04. Distribution Systems								
(15864 2000 Curtain Type Ul Listed Folding Fire Damper)								
MIL CV <15864 2008 > Fire Dampers			40.86	0.38	27.00	0.00	1.00	68.23
	-3.00 EA MSHMA	1.25	-144	-1	-95	0	-3	-241
TOTAL Distribution Systems			-144	-1	-95	0	-3	-241
TOTAL HVAC			-144	-1	-95	0	-3	-241

Table 1 - Total First Cost - Selected Plan- October 1995 Price Level

Account Code	Description of Item	Qty	Unit	Unit Price	Estimated Amount	Contingency	Total Amount
01	Lands and Damages						
01.B	Post Authorization Planning						
01.B.2	Required Easements	----------	Job	LS	$0	$0	$0
01.B.8	Surveys Appraisal & Admin	----------	Job	LS	$93,675	$14,053	$107,728
	Total Lands and Damages				$93,675	$14,053	$107,728
02	Relocations						
02.03	Cemetery, Utilities, & Structure						
02.03.18	Utilities						
02.03.18 15	Mechanical						
02.03.18 15 01	Outfalls	----------	Job	LS	$684,482	$102,672	$787,154
	Total Relocations				$684,482	$102,672	$787,154
16	Bank Stabilization						
16.00	Bank Stabilization						
16.00.85	Pile Dike Protection						
16.00.85.02	Site Work						
16.00.85.02.02	Wood Piles Treated	1,680	LF	$1,934.54	$3,250,030	$487,505	$3,737,535
16.00.85.02.04	Stone along Pile Structure	15,273	Ton	$49.31	$753,085	$112,963	$866,048
16.00.85.02.99	Sand Fill	42,458	CY	$10.78	$457,891	$68,684	$526,575
	Total Bank Stabilization				$4,461,006	$669,152	$5,130,158
17	Beach Replenishment						
17.00.01	Mobilization, Demobilization and Preparatory Work	----------	Job	LS	$378,515	$45,422	$423,937
17.00.17	Hopper Dredging						
17.00.17.02	Site Work						
17.00.17.02.01	Sand Fill Placement	6,174,013	CY	$5.64	$34,821,433	$5,223,215	$40,044,648
17.00.99	Associated General Items						
17.00.99.02.01	Dune Grass	440,440	SY	$2.41	$1,061,460	$159,219	$1,220,679
17.00.99.02.02	Sand Fence	63,675	LF	$3.89	$247,696	$37,154	$284,850
	Total Beach Replenishment				$36,509,104	$5,465,010	$41,974,114
30.	Planning, Engineering and Design (P.E. & D.)	----------	Job	LS	$1,105,000	$165,750	$1,270,750
31.	Construction Management (S & A)	----------	Job	LS	$2,500,959	$375,144	$2,876,103
	Total Project First Cost				$45,354,226	$6,791,781	$52,146,007
	(Rounded)				$45,354,000	$6,792,000	$52,146,000

			QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ZB/ 1. Absecon Inlet Frontage											
	L MIL AA <	> (2) Laborer/Helper	416.00	HR	B-LABORER	1.00	2.00 832	34.18 14,221	0.00 0	0.00 0	34.18 14,221
	USR AA <02261 1005	> Capstone - Random, Dumped from Truck	10000	TON	N/A	0.00	0.00 0	0.00 0	0.00 0	21.25 212,500	21.25 212,500
	L CIV AA <02535 1016	> Geotextile Fabric, 105 Mil Thick Non-Woven Polypropylene - placed in (3) 15' wide rolls for a distance of 1100'.	5500.00	SY	ULABJ	137.50	0.02 120	0.75 4,122	0.03 172	1.12 6,160	1.90 10,454
	TOTAL	Toe Protectn:2-9 Tn Quarry Stone					2,616	96,407	79,946	218,660	395,013
ZB/ 1. 5. Sand Fill - Trucked											
	L USR AA <02221 6002	> Sprd Dumped Fill 12" Layers Without Compaction	27800	CY	CODTG-1	173.75	0.01 161	0.28 7,740	0.39 10,803	8.00 222,400	8.67 240,943
	TOTAL	Sand Fill - Trucked					161	7,740	10,803	222,400	240,943
	TOTAL	Absecon Inlet Frontage					24,990	1,072,814	345,655	927,635	2,346,105

ZB/ 2. Hackney's Frontage			QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ZB/ 2. Hackney's Frontage											
ZB/ 2. 1. Bulkhead											
L USR AA <02318 1001 >	14" Butt x 8" Tip Wood Piles 210 @ 20' & 210 @ 30', Treated Jetted		5979.28	LF	CPIDC-JET	120.00	0.07 399	2.82 16,854	1.01 6,021	4.00 23,917	7.83 46,793
USR AA <02318 2001 >	Walers - 8"x10" @ 2150'= 14,333 BF 8"x 8" @ 1100'= 5,867 BF 8"x 6" @ 4250'= 17,000 BF 6"x 4" @ 1100'= 2,200 BF 6"x 6" @ 2150'= 6,450 BF 45,850 BF		24175	BF	CPIDC	144.00	0.06 1,344	2.35 56,788	0.73 17,759	0.80 19,340	3.88 93,888
M MIL AA <06311 1001 >	Creosote Treat, Dosage to 8 #/CF Preservative Treated Lumber		24175	BF	N/A	0.00	0.00 0	0.00 0	0.00 0	0.20 4,835	0.20 4,835
B USR AA <06710 1004 >	Threaded Anch Bolt,3/4"Dia x44"L Threaded on Two Ends w/Two Nuts		458.75	EA	N/A	0.00	0.00 0	0.00 0	0.00 0	8.50 3,899	8.50 3,899
B CIV AA <02318 3002 >	Add for Mobilization - 25,000 LF Pile Job		5979.28	VLF	CPIDC	300.00	0.03 160	1.13 6,742	0.35 2,108	0.50 2,990	1.98 11,840
B USR AA <06710 1004 >	Threaded Tie Rods 1-3/4"D x 45'L Galvanized, 210 rods @ 45'/EA		4982.72	LF	SIWSF	3.33	1.20 5,980	53.88 268,481	11.62 57,887	22.00 109,620	87.50 435,988
USR AA <02318 1001 >	4" x 10" Wood Sheeting 20', Treated Quantity:60" per 6' or 6 Sheets @ 20' per 6 l.f.		84364	BF	CPIDC	176.25	0.05 3,830	1.92 161,911	0.60 50,635	0.89 75,084	3.41 287,629
M MIL AA <06311 1001 >	Creosote Treat, Dosage to 8 #/CF Preservative Treated Lumber		84364	BF	N/A	0.00	0.00 0	0.00 0	0.00 0	0.20 16,873	0.20 16,873
TOTAL Bulkhead							11,712	510,776	134,411	256,558	901,744

ZB/ 2. Hackney's Frontage			QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ZB/ 2.	3. Toe Protectn:2-9 Tn Quarry Stone Work consist of placing a capstone revetment. Capstone shall consist of quarried rock each weighing between 2 and 9 tons. Capstone shall be selected for placement and placed as to produce a minimum of voids in the surface. Stone shall be closely fitted together and interlocked in a staggered pattern to prevent continuous joint in the revetment surface. A tolerance of plus or minus 6 inches measured vertically from the top and side slope elevation is allowed. Assume contractor will use a 80 ton crawler crane with a grapple/clamshell bucket, a 7 CY rubber tired front-end loader will assist during the placement of the capstone. Production includes a 75% efficiency factor and all production is rounded to the nearest day.										
MIL AA <	> BKT,CLAM,5CY, GEN PURP/SQ NOSE 5.000 CY, GEN. PURPOSE/SQUARE NO		224.00	HR	B25ES013	1.00	0.00 0	0.00 0	9.14 2,047	0.00 0	9.14 2,047
MIL AA <	> CRA,DRAG/CLAM,2.5CY,50'B,ADD BKT 2.5 CY,DRAGLINE/CLAM (ADD BUCKET		224.00	HR	C85NO004	1.00	0.00 0	0.00 0	90.52 20,277	0.00 0	90.52 20,277
MIL AA <	> LDR,FE,WH, 7 CY, ARTIC, 988-B 7 CY, ARTICULATED		224.00	HR	L40CA008	1.00	0.00 0	0.00 0	92.11 20,632	0.00 0	92.11 20,632
MIL AA <	> Eq Oper, Crane/Shovl		224.00	HR	B-EQOPRCRN	1.00	1.00 224	50.48 11,308	0.00 0	0.00 0	50.48 11,308
MIL AA <	> Eq Oper, Medium		224.00	HR	B-EQOPRMED	1.00	1.00 224	48.38 10,836	0.00 0	0.00 0	48.38 10,836
MIL AA <	> Foreman - Eq Oper, Medium		224.00	HR	B-EQOPRMED	1.00	1.00 224	48.88 10,948	0.00 0	0.00 0	48.88 10,948
TWT AA <	> Eq Oper, Oilers		224.00	HR	B-EQOPROIL	1.00	1.00 224	39.92 8,942	0.00 0	0.00 0	39.92 8,942
L MIL AA <	> (2) Laborer/Helper		224.00	HR	B-LABORER	1.00	2.00 448	34.18 7,657	0.00 0	0.00 0	34.18 7,657
USR AA <02261 1005	> Capstone - Random, Dumped from Truck		5272.72	TON	N/A	0.00	0.00 0	0.00 0	0.00 0	21.25 112,045	21.25 112,045
L CIV AA <02535 1016	> Geotextile Fabric, 105 Mil Thick Non-Woven Polypropylene - placed in (3) 15' wide rolls for a distance of 1100'.		2900.00	SY	ULABJ	137.50	0.02 63	0.75 2,174	0.03 91	1.12 3,248	1.90 5,512
	TOTAL Toe Protectn:2-9 Tn Quarry Stone						1,407	51,866	43,046	115,293	210,205

ZB/ 2. Hackney's Frontage	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	TOTAL COST
ZB/ 2. 5. Sand Fill - Trucked									
L USR AA <02221 6002 > Sprd Dumped Fill 12" Layers Without Compaction	14658	CY	CODTG-1	173.75	0.01 85	0.28 4,081	0.39 5,696	8.00 117,265	8.67 127,042
TOTAL Sand Fill - Trucked					85	4,081	5,696	117,265	127,042
TOTAL Hackney's Frontage					13,205	566,722	183,153	489,116	1,238,991
TOTAL Bulkhead Construction					38,194	1,639,537	528,808	1,416,752	3,585,096

New Jersey Coast - Brigantine Inlet to Great Egg Harbor Inlet,
Absecon Island Interim Feasibility Study

APPENDIX A, SECTION 16 - COST ESTIMATES

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Appendix A. Section 16 - Cost Estimates

1. General. This section presents detailed cost estimates for initial construction, nourishment, maintenance, monitoring and major rehabilitation resulting in total and annualized project costs for alternative storm damage reduction plans for the subject project. The nine alternative plans developed from Brigantine Inlet to Great Egg Harbor Inlet include: (1) Plan 1 - 75' wide berm and +12.5' NGVD dune, (2) Plan 2 - 100' wide berm and 14' NGVD dune, (3) Plan 3 - 150' wide berm, (4) Plan 4 - 150' wide berm and +14' NGVD dune, (5) Plan 5 - 150' wide berm and +16' NGVD dune, (6) Plan 6 - 200' wide berm and 14' NGVD dune, (7) Plan 7 - 200' wide berm and 16' NGVD dune, (8) Plan 8 - 200' wide berm and 18' NGVD dune, and Plan (9) - 250' wide berm and 16' NGVD dune. The dune for all alternatives has 1 on 5 side slopes and a top berm crest of 25' wide. Included in the initial construction of all the above plans is design and advanced nourishment beach fill. Also included are provisions for periodic nourishment at 3 year intervals, monitoring and major rehabilitation to restore the design beach profile damaged by significant storm events beyond that designed for in the nourishment cycle volumes. The plan layout of the NED plan with typical improved beach sections is displayed in the section of the Feasibility Study, Main Report describing the NED Plan.

2. Basis of Cost. Cost estimates presented herein are based on October 1995 price levels. Initial beach fill costs are based on beach surveys taken in 1993 and 1994. The unit prices were developed on the basis that construction procedures will be as outlined herein. All first and annual costs presented in this appendix are NED costs.

3. Initial and periodic nourishment fill costs are based on the use of a large hopper dredge for placement of the beach fill. The location of the borrow area is displayed in the section of the Feasibility Study, Main Report describing the NED Plan.

4. Real estate costs as displayed in Table 1 are included as NED costs and reflect acquisition of easements on private beach between Brigantine Inlet and Great Egg Harbor Inlet. For more information, refer to the Real Estate Appendix.

5. Alternatives Considered. Alternative plans were developed in two phases for the plan selection process. In the first phase, the alternative plans were compared during the Cycle 1 and Cycle 2 screening process. For more information on these plans refer to the section of the Feasibility Study, Main Report describing the NED Plan. Based on an analysis of these annual costs with their associated benefits, the beach restoration only plan was selected for the second phase for final plan optimization and selection.

6. The costs for the eleven alternative plans as described in paragraph 1 for this second phase of plan selection are displayed in Table 2.

7. Estimated First Cost. The estimated project first cost is for the selected plan - a berm extending seaward 100' from the design line at an elevation of *+8.5 NGVD* for Ventnor, Margate and Longport and a berm extending seaward 200' from the design line at an elevation of *8' NGVD* for Atlantic City. Ventnor's, Margate's, and Longport's berms support a dune with a top

+14' NGVD and a width of 25'. Atlantic City's berm support a dune with a top elevation of +16' NGVD and a width of 25'. This includes the placement of 6,174,013 C.Y. of hopper placed design and advance nourishment beach fill, and the placement of 440,440 S.Y.(91 acres) of dune grass, 63,675 L.F. of sand fence, 1,680 L.F. of bulkhead, the extension of outfalls, NED real estate acquisition costs and pertinent contingency, engineering and design and construction management costs. Details of the first cost estimate are shown on Table 1.

8. Contingency, Engineering and Design and Construction Management.

Engineering and design costs include preparation of the plans and specifications, coastal and environmental pre-construction data collecting and the development of the PCA. Engineering and design costs are $1,271,000. Construction management costs are 6% ($2,876,000) and are based on the total construction cost. Pertaining to contingencies: 15% was applied to beach placement work to account for larger required beach fill quantities at the time of construction due to future pre-construction erosion; 12% was applied to Mobilization, demobilization and preparatory work to account for variances in the travel distance for a dredge plant and 15% was applied to dune grass and sand fencing to account for variances in the beach profile at the dune location due to future pre-construction shifting and/or eroding beach conditions.

ANNUAL CHARGES

9. General. The estimates of annual charges for all alternatives are based on an economic project life of 50 years and an interest rate of 7.625%. The annual charges include annualized first cost and interest during construction, the annualized periodic nourishment costs, and post construction monitoring costs. It is noted that interest during construction was developed for the first cost of the project constructed over a six month period. For the selected plan, the total annualized cost is *$ 1,842,000.*

10. Periodic Nourishment. The periodic nourishment volume to be placed at 3 year cycles subsequent to commencement of construction and throughout the 50 year economic life is 1,666,000 C.Y. which includes overfill and tolerance. The placement of this material will follow the constructability outlines in paragraph 3. For more details on the development of the periodic nourishment quantity refer to the section of the Feasibility Study, Main Report describing the NED Plan. The borrow area for periodic nourishment is also shown in the section of the Feasibility Study, Main Report describing the NED Plan. Periodic nourishment costs are developed in Table 3.

11. Major Rehabilitation Costs. Major rehabilitation costs are included as an additional cost for significant storm events beyond that designed for in the renourishment cycle to restore the design profile. The major rehabilitation losses are computed as the losses that would occur from the 50% risk event over the project life. For more detail on the development of the major rehabilitation quantity refer to the section of the Feasibility Study, Main Report describing the NED Plan. Major rehabilitation costs are shown in Table 4.

12. Monitoring Costs. Post construction monitoring costs include coastal and environmental monitoring over the 50 year project life. Annualized monitoring costs are $286,768.

CONSTRUCTION AND FUNDING SCHEDULE

13. General. The construction and pre-construction sequence and time schedule of the selected plan are given in the Project Management Plan (PMP). The schedule is based on the timeliness of the report's approval and allocation of funds by Congress, the foregoing construction procedures, and the ability of local interests to implement the necessary items of local cooperation. These items of local cooperation are principally the furnishing of offshore borrow easements by the State of New Jersey as well as required real estate easements, and the relocation of items for beach access.

Table 4 - Major Replacement Costs

		Cost	Contingency	Total Amount
Sand				
	633,680 c.y. @ $4.90/c.y.	$3,105,522	$465,828	$3,571,350
Mob & Demob		$674,039	$80,885	$754,924
		$3,779,561	$546,713	$4,326,274
E&D		$390,000	$58,500	$448,500
Construction Management		$356,592	$53,489	$410,081
Periodic Nourishment Costs Total		$4,526,153	$658,702	$5,184,855

Absecon Island Feasibility Study

Corps of Engineers, Phila. Dist.

Designed By: Gigi Geissele, Civil/Structural
Estimated By: Cost Engineering Branch

Prepared By: Sterling Johnson

Preparation Date: 10/13/95
Effective Date of Pricing: 09/27/95

Sales Tax: 0.00%

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Table 2 - C - Total First Cost

Plan 3 (No Dune/150' Berm)

Account Code	Description	Estimated Amount	Contingency	Total Amount
01	Lands and Damages	$0	$0	$0
17	Beach Replenishment			
	Mob & Demob	$797,079	$95,649	$892,728
	Placement of 7,161,753 c.y. of sand	$31,983,125	$4,797,469	$36,780,594
	Subtotal	$32,780,204	$4,893,118	$37,673,322
	E&D	$391,304	$58,696	$450,000
	Construction Management	$2,404,541	$360,681	$2,765,222
	Total Cost	$35,576,049	$5,312,495	$40,888,544
	(Rounded)	$35,576,000	$5,313,000	$40,889,000

Table 2 - D - Total First Cost

Plan 4 (14' Dune/150' Berm)

Account Code	Description		Estimated Amount	Contingency	Total Amount
01	Lands and Damages		$0	$0	$0
17	Beach Replenishment				
	Mob & Demob		$804,127	$96,495	$900,622
	Placement of 7,440,871 c.y. of sand		$34,156,029	$5,123,404	$39,279,433
	Subtotal		$34,960,156	$5,219,899	$40,180,055
	E&D		$391,304	$58,696	$450,000
	Construction Management		$2,564,537	$384,680	$2,949,217
		Total Cost	$37,915,997	$5,663,275	$43,579,272
		(Rounded)	$37,916,000	$5,663,000	$43,579,000

Table 2 - A - Total First Cost

Plan 1 (12.5' Dune/75' Berm)

Account Code	Description		Estimated Amount	Contingency	Total Amount
01	Lands and Damages		$0	$0	$0
17	Beach Replenishment				
	Mob & Demob		$674,039	$80,885	$754,924
	Placement of 3,488,833 c.y. of sand		$16,286,945	$2,443,042	$18,729,987
	Subtotal		$16,960,984	$2,523,927	$19,484,911
	E&D		$391,304	$58,696	$450,000
	Construction Management		$1,350,389	$202,558	$1,552,947
		Total Cost	$18,702,677	$2,785,181	$21,487,858
		(Rounded)	$18,703,000	$2,785,000	$21,488,000

Table 2 - B - Total First Cost

Plan 2 (14' Dune/100' Berm)

Account Code	Description	Estimated Amount	Conti-gency	Total Amount
01	Lands and Damages	$0	$0	$0
17	Beach Replenishment			
	Mob & Demob	$674,039	$80,885	$754,924
	Placement of 3,979,097 c.y. of sand	$18,627,241	$2,794,086	$21,421,327
	Subtotal	$19,301,280	$2,874,971	$22,176,251
	E&D	$391,304	$58,696	$450,000
	Construction Management	$1,496,415	$224,462	$1,720,877
	Total Cost	$21,188,999	$3,158,129	$24,347,128
	(Rounded)	$21,189,000	$3,158,000	$24,347,000

Table 2 - I - Total First Cost

Plan 9 (16' Dune/250' Berm)

Account Code	Description		Estimated Amount	Contingency	Total Amount
01	Lands and Damages		$0	$0	$0
17	Beach Replenishment				
	Mob & Demob		$529,995	$63,599	$593,594
	Placement of 3,149,588 c.y. of sand		$13,795,195	$2,069,279	$15,864,474
	Subtotal		$14,325,190	$2,132,878	$16,458,068
	E&D		$391,304	$58,696	$450,000
	Construction Management		$1,140,617	$171,092	$1,311,709
		Total Cost	$15,857,111	$2,362,666	$18,219,777
		(Rounded)	$15,857,000	$2,363,000	$18,220,000

Table 3 - Periodic Nourishment Costs

		Cost	Contingency	Total Amount
Sand				
	1,666,000 c.y. @ $5.34/c.y.	$8,896,440	$1,334,466	$10,230,906
Mob & Demob		$529,995	$63,599	$593,594
		$9,426,435	$1,398,065	$10,824,500
E&D		$390,000	$58,500	$448,500
Construction Management		$793,995	$119,099	$913,095
Periodic Nourishment Costs Total		$10,610,430	$1,575,664	$12,186,095

Table 2 - G - Total First Cost

Plan 7 (16' Dune/200' Berm)

Account Code	Description	Estimated Amount	Contingency	Total Amount
01	Lands and Damages	$0	$0	$0
17	Beach Replenishment			
	Mob & Demob	$807,651	$96,918	$904,569
	Placement of 9,567,060 c.y. of sand	$44,291,062	$6,643,659	$50,934,721
	Subtotal	$45,098,713	$6,740,577	$51,839,290
	E&D	$391,304	$58,696	$450,000
	Construction Management	$3,214,037	$482,105	$3,696,142
	Total Cost	$48,704,054	$7,281,378	$55,985,432
	(Rounded)	$48,704,000	$7,281,000	$55,985,000

Table 2 - H - Total First Cost

Plan 8 (18' Dune/200' Berm)

Account Code	Description	Estimated Amount	Contingency	Total Amount
01	Lands and Damages	$0	$0	$0
17	Beach Replenishment			
	Mob & Demob	$529,995	$63,599	$593,594
	Placement of 2,380,614 c.y. of sand	$10,427,085	$1,564,063	$11,991,148
	Subtotal	$10,957,080	$1,627,662	$12,584,742
	E&D	$391,304	$58,696	$450,000
	Construction Management	$900,630	$135,094	$1,035,724
	Total Cost	$12,249,014	$1,821,452	$14,070,466
	(Rounded)	$12,249,000	$1,821,000	$14,070,000

SECTION 17

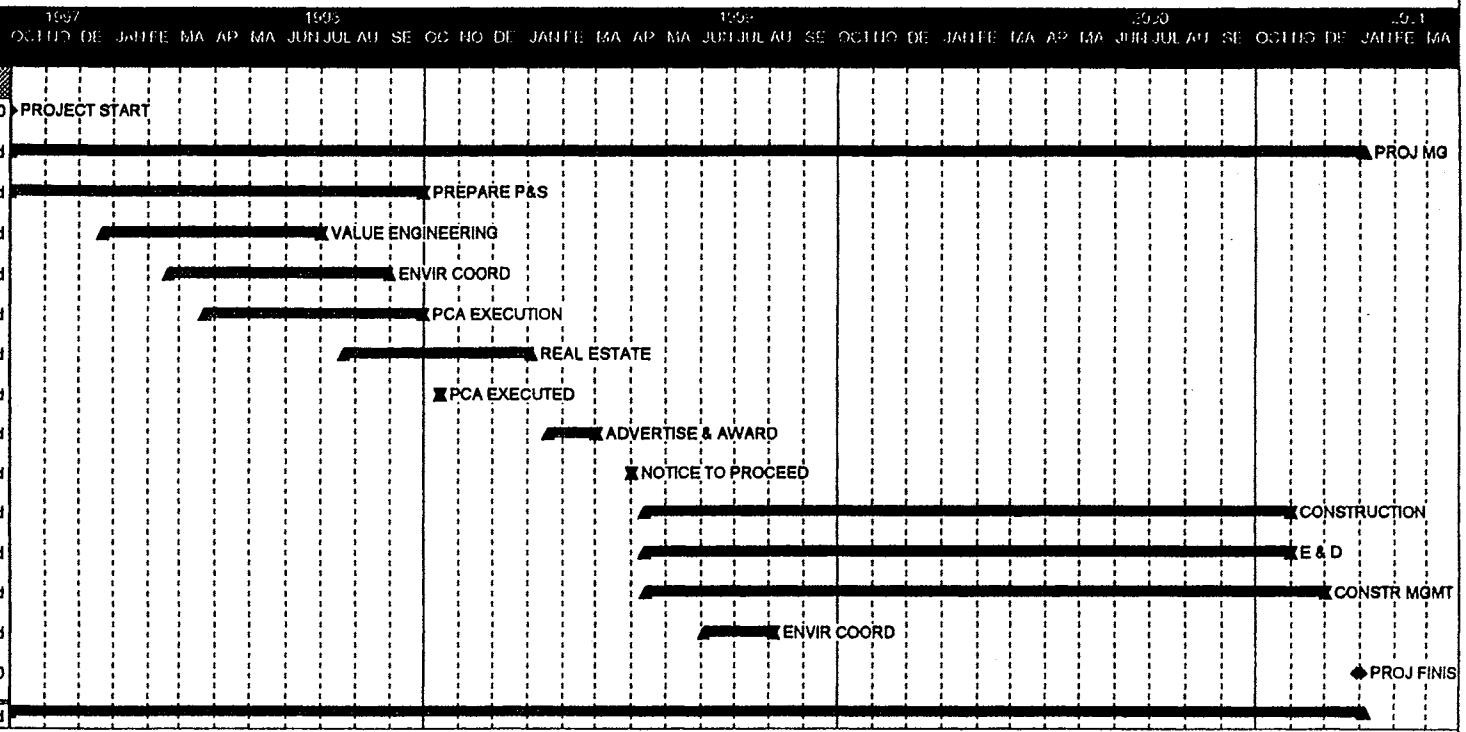
SCHEDULE FOR DESIGN AND CONSTRUCTION

Report: Classic Gantt
Layout: Shows budgeted costs
Filter: All Activities

SureTrak Project Manager
ABSECON ISLAND

U.S. ARMY CORPS OF ENGINEERS
Report Date: 06DEC95
Page 1A of 1B

Act ID	Activity Description	Rem Dur
	ABSECON ISLAND	
10	PROJECT START	0
15	PROJ MGMT	840d
20	PREPARE P&S	255d
25	VALUE ENGINEERING	135d
30	ENVIR COORD	135d
35	PCA EXECUTION	135d
40	REAL ESTATE	115d
45	PCA EXECUTED	1d
50	ADVERTISE & AWARD	30d
55	NOTICE TO PROCEED	1d
60	CONSTRUCTION	405d
65	E & D	405d
70	CONSTR MGMT	427d
75	ENVIR COORD	45d
80	PROJ FINISH	0
		840d



- Early start point
- Early finish point
- Early bar
- Late finish point
- Total float bar
- Progress bar
- Critical bar
- Summary bar
- Progress point
- Critical point
- Summary point
- Start milestone point
- Finish milestone point

Data date	01OCT97
Start date	01OCT97
Finish date	05JAN01

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Figure F-1
Absecon Island Funding Schedule by Task

Initial Construction
October 1995 Price Level

Date	Revision	Checked	Approved

SECTION 18

SPECIAL STUDIES

The borrow areas have been defined, and a quantity of available material was established during the Feasibility Study. Initital enviromental studies indicate that additional borrow area investigations may be required in the plans and specifications (P&S) phase. Once all borrow areas are determined borings will be required for final quantitiy determination and exact site location of dredging area(s) within the identified borrow area limits.

Final environmental coordination with various resource agencies will be completed during the P&S phase. An updated Section 7, Endangered Species Act consultation will be necessary during P&S for initial construction and for each periodic nourishment. A Water Quality Certificate will be required from the State of New Jersey. Consistency with the New Jersey Coastal Zone Managemnet Program must be assured. No compensatory mitigation is required with the project.