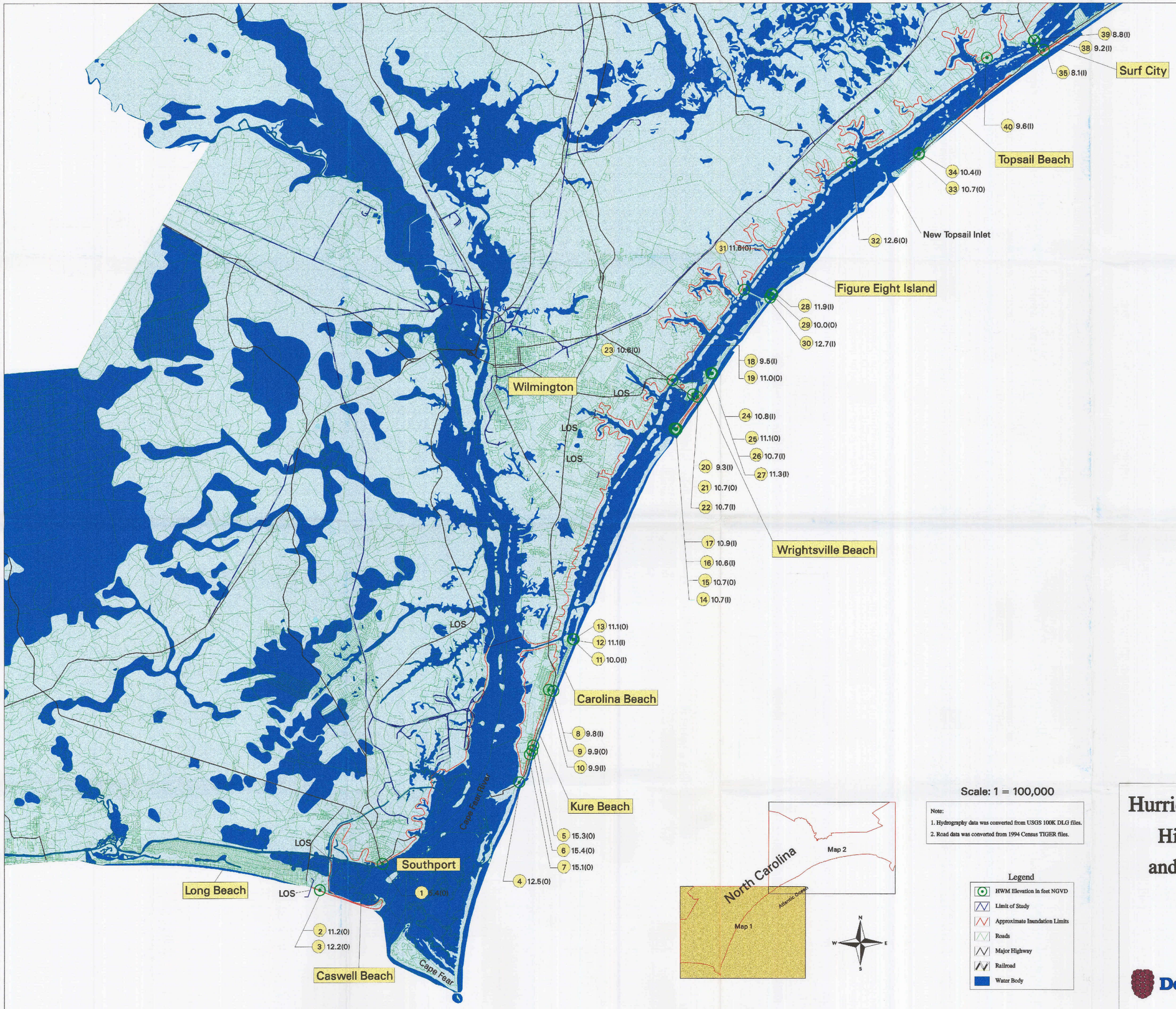
Hurricane Fran

North Carolina

High Water Mark Survey and Coastal Inundation Mapping

September 1996

Dewberry & Davis



Scale: 1 = 100,000

Note:

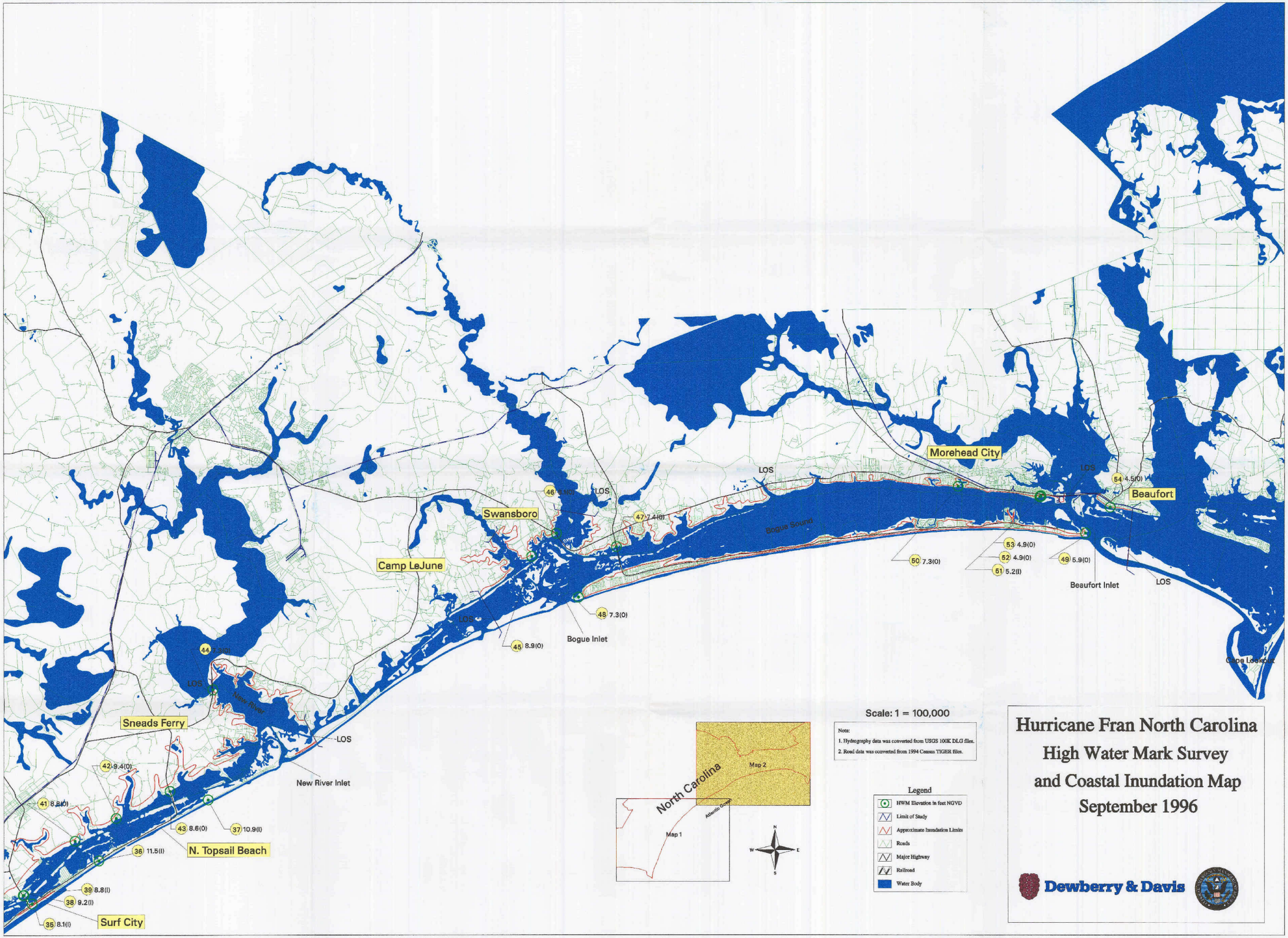
1. Hydrography data was converted from USGS 100K DLG files.
2. Road data was converted from 1994 Census TIGER files.

Legend

- HWM Elevation in feet NGVD
- Limit of Study
- Approximate Inundation Limits
- Roads
- Major Highway
- Railroad
- Water Body

Hurricane Fran North Carolina High Water Mark Survey and Coastal Inundation Map September 1996

Dewberry & Davis


Morehead City
Beaufort
Swansboro
Camp LeJune
Sneads Ferry
N. Topsail Beach
Surf City
Bogue Inlet
Beaufort Inlet
New River Inlet
Bogue Sound
New River
Cape Lookout
LOS
54 4.5(O)
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50 7.3(O)
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43 8.6(O)
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41 8.8(O)
39 8.8(I)
38 9.2(I)
37 10.9(I)
36 11.5(I)
35 8.1(I)
North Carolina
Map 1
Map 2
Atlantic Ocean
N
S
E
W
Scale: 1 = 100,000
Notes:
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HURRICANE FRAN

NORTH CAROLINA
HIGH WATER MARK SURVEY
and
COASTAL INUNDATION MAPPING

SEPTEMBER 1996

Prepared by

DEWBERRY & DAVIS
Fairfax, VA

for

Federal Emergency Management Agency
Mitigation Directorate
and
Federal Insurance Administration
Washington, D.C.

ACKNOWLEDGMENTS

Responding to the request for a high water mark survey and inland inundation flood map to document the approximate storm surge associated with Hurricane Fran required a cooperative effort between many individuals and agencies. We would like to thank all of those involved with this effort, and specifically the following individuals who provided assistance during the coordination, preparation, and deployment of the field survey teams and preparation of this report following the landfall of Hurricane Fran along the North Carolina shoreline on September 5, 1996:

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Tony Caudle	Town Manager, Town of Wrightsville Beach, NC
Arthur Poineau	Administrator, Figure Eight Homeowners' Association, Inc., Figure Eight Island, NC
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and	
Dewberry & Davis	Darryl Hatheway and Jim White (principal investigators), Management and Technical Services Division Staff of GeoDigital Services Group and Graphics Division

HURRICANE FRAN
HIGH WATER MARK SURVEY AND
COASTAL INUNDATION MAPPING

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COASTAL INUNDATION MAPPING

INTRODUCTION

Hurricane Fran made landfall in the vicinity of the Wrightsville-Wilmington area of North Carolina on September 5, 1996, at about 8:00 p.m., and, according to the Saffir-Simpson scale, was ranked as a Category 3 (major) tropical cyclone. Hurricane Fran was the sixth named storm of the 1996 hurricane season and the most intense hurricane to make landfall along the U.S. coastline this year. Although Hurricane Fran's destructive storm surge and winds of 115 miles per hour (mph) impacted the immediate coastal areas east and north of the Cape Fear headland, additional impacts from its high winds and heavy rainfall were felt well inland and resulted in severe wind damage and riverine flooding in North Carolina, Virginia, West Virginia, Maryland, and Pennsylvania.

Dewberry & Davis, on behalf of the Federal Emergency Management Agency (FEMA) Mitigation Directorate and Federal Insurance Administration (FIA), mobilized two field teams to conduct high water mark surveys of the Hurricane Fran landfall area along the coast of North Carolina from just west and south of Cape Fear to just west of Cape Lookout. This report presents the findings of the survey and maps depicting the approximate limits of the coastal areas inundated by the storm surge flooding.

Preliminary estimates by the Insurance Information Institute the day after Hurricane Fran's landfall on September 5, 1996, estimated the insured damages along the North Carolina coast to be approximately $625 million. Subsequent investigations of the coastal impact area and the inland areas affected by wind and riverine flood damages have adjusted those preliminary estimates, and now place the overall damages to insured and uninsured property from Hurricane Fran at close to $3 billion. In addition, 21 deaths have been reported as being directly attributable to Hurricane Fran.

SCOPE AND PURPOSE

The high water mark survey and coastal inundation study performed by the Dewberry & Davis field teams included all or portions of the coastal and inland bay/sound shorelines of Brunswick, New Hanover, Pender, Onslow, and Carteret Counties in North Carolina. Within these counties, the following communities and locations were impacted by Hurricane Fran and investigated by the field survey teams:

City of Caswell Beach	City of Southport
Town of Kure Beach	Town of Carolina Beach,
Town of Wrightsville Beach	Figure Eight Island
Howard Landing	Town of Topsail Beach
Town of Surf City	Town of North Topsail Beach
Northern Topsail Island	Watts Landing
Morris Landing	Thomas Landing
Sneads Ferry	Hammock Beach State Park
City of Swansboro	Bogue Island
Town of Emerald Isle	Mansfield
Town of Morehead City	Town of Atlantic Beach
Fort Macon State Park	Town of Beaufort

Hurricane Fran's winds caused storm surge flooding and high waves, both of which resulted in beach/dune erosion along many miles of North Carolina's Atlantic Ocean coastline. The storm surge also penetrated inland and resulted in flooding of the bays and sounds behind the barrier islands. This occurred as a result of overtopping of some of the barrier islands or passage through local river mouths or inlets, such as the Cape Fear River, New Inlet, Carolina Beach Inlet, Masonboro Inlet, Mason Inlet, Rich Inlet, Old and New Topsail Inlets, New River Inlet, Bogue Inlet, and Beaufort Inlet.

The goal of the investigation and study was to determine and map the approximate high water elevations of the stillwater storm surge and of the combined effects of storm surge and waves for the open coast and inland bay/sound areas affected by Hurricane Fran (see Appendix A - flood maps). The results of the survey help to establish an approximate coastal flood inundation limit and a wind/water line along the affected reaches, thereby documenting the inland inundation limits of the storm surge flooding and areas subject to both seawater flooding and wind damages or losses. Areas outside of the inundation zone would likely be subject to only wind damages or losses, along with potential rainfall/runoff flooding effects.

STORM HISTORY

Before Hurricane Fran, the 1996 hurricane season had only produced five named tropical storms and hurricanes. Less than two months earlier, on July 12, Hurricane Bertha had made landfall in the same Wilmington-Wrightsville Beach area of North Carolina as a Category 1 (minimal) hurricane, according to the Saffir-Simpson scale. That storm impacted the coastal areas with some flooding, but primarily caused storm-induced beach and dune erosion from Kure Beach to Emerald Isle. Although not as intense a hurricane as Fran, Bertha caused considerable damage within the coastal zone.

Hurricane Fran started as a tropical wave crossing the open Atlantic Ocean and became a named tropical storm on August 24. Prior to its landfall on September 5, the storm's intensity and winds fluctuated up and down, making it a Category 3 and 4 at different stages of its lifespan. Fran remained an intense hurricane after a close call with the Virgin Islands, and made a slow curve to the northwest over the warm waters of the Atlantic Ocean. A weak ridge of high pressure near Bermuda and trough of low pressure over the eastern U.S. kept the hurricane on a northwest track towards the North Carolina coast. At landfall on the evening of September 5, Hurricane Fran was classified as a Category 3 hurricane with winds of 115 mph, but its intensity was slowly diminishing due to effects of the proximity of the storm to the U.S. mainland and several other climatological factors.

Appendix B of this report includes information on the storm history and preliminary data collected by the National Weather Service (NWS) and Hurricane Research Division (HRD) offices of the National Oceanic and Atmospheric Administration. A collection of preliminary synoptic data, storm track positions, tide gage records and wave buoy measurements were supplied by NWS and HRD. The information provides only a preliminary look at the climatology of Hurricane Fran and will be finalized and published at a future date by NWS and HRD. In addition, a Weather Services Corporation track plot showing the location and dates of Hurricane Fran's path across the Atlantic Ocean was downloaded from America Online, reproduced for this report, and is also included in Appendix B.

HIGH WATER MARK SURVEY INVESTIGATION

Each high water mark (HWM) investigated and surveyed for this report throughout the Hurricane Fran impact area reflects either the stillwater elevation of the storm surge (areas outside the influence of breaking waves and wave runup) or the stillwater elevation plus some wave-effect component (areas in the surf or wave swash zone - either breaking wave crests or wave runup).

The stillwater-elevation HWMs are generally recovered inside (I) of commercial or residential structures and found as mud lines on walls or doors. Other flood elevations, with possible influence by wave setup or wave runup, are found as HWMs on the outside (O) perimeter of beachfront or inland structures, or along sloping terrain of shorelines/banks of the barrier island, bays, sounds, and rivers. The outside HWMs are generally located by clearly established debris or trash lines along the sloping shoreline Each HWM is marked and located on a map accordingly, providing another piece of the inundation-limit puzzle, and documenting the approximate water surface elevation used to establish a wind/water line. The information also assists in documenting and understanding the nature of the storm influence in the immediate area.

FIELD INVESTIGATION SUMMARY

Fortunately for the coastal and bay/sound residents in the land fall area near Cape Fear and Wrightsville Beach, the timing of Hurricane Fran's passage through the area coincided with low astronomic tide levels, and may have prevented the coastal areas from experiencing another two to four feet of seawater elevation. As mentioned previously, the barrier islands had already experienced storm-induced beach and dune erosion because of the impact of Hurricane Bertha. These impacts made it difficult for the barrier island beaches and dunes to be able to withstand the storm surge and wave impacts of a Category 3 hurricane, such as Hurricane Fran, and afford protection to landward coastal properties.

As a result of these preceding conditions, the resulting impacts of Hurricane Fran caused severe beach and primary frontal dune erosion, complete loss of long reaches of barrier island dune systems, and several breaches of the barrier island. The barrier islands from Kure Beach to Emerald Isle suffered severe impacts from the storm surge, wave heights, and wave runup caused by Hurricane Fran along the North Carolina coast, with Topsail Island experiencing the worst impacts along the entire coast area.

As mentioned, erosion of the beaches and dunes caused the collapse and failure of many dune systems along the barrier island shorelines of Kure Beach/Carolina Beach, Figure Eight Island, and Topsail Island. These areas previously had well-established dune fields of substantial height and width, but the slow process of shoreline recession and episodic erosion events had weakened the

dune ridge and increased the vulnerability of the residential and commercial areas behind or on top of the dunes to storm damages and flooding. Many of the collapsed and damaged structures found along the coast were located in areas where there was no remaining evidence of a protective primary frontal dune.

In addition to the wave damage on the open oceanfront barrier island shorelines, many of the low-lying areas on the backside of the barrier island and bay/sound shorelines of the mainland were inundated by the stillwater flooding from Hurricane Fran's storm surge. Some evidence of wave damage which may have accompanied the storm surge was found along the mainland shorelines of the bay/sound, but the backside areas of the barrier island were primarily impacted by stillwater flooding from the storm surge. The onshore winds caused storm surge and wave to setup against the barrier island coast and through the many natural inlets along the coast. In some cases, the rising storm surge completely overtopped the barrier island. The storm surge flood elevations along the North Carolina coast, documented as part of this investigation, ranged from about 5 feet above sea level, referenced to National Geodetic Vertical Datum (NGVD) 1929, at Southport, to 12 feet in and around the Topsail Island areas, and then back down to about 4 feet around Beaufort. A table of high water mark elevations obtained by the field survey teams are listed in Table 1 of this report.

HIGH WATER MARK SURVEY METHODOLOGY

The field team assembled by Dewberry & Davis included two coastal scientists/engineers and experienced survey teams from Scartz Surveys (two 2-man crews) equipped with dual-frequency Differential Geographic Positioning Systems (DGPS). The survey method employed for this investigation is commonly referred to as a Rapid Static DGPS Survey. After the base and remote stations were established and operational, spur surveys to the high water marks were then conducted and data collected for post-field processing in the office. Horizontal and vertical accuracies of plus or minus 0.2 feet were achieved, relative to survey control points/benchmarks used during the course of the field survey.

These survey methods had been successfully conducted in other applications and for past flood events, and proved to be especially valuable in areas where known bench mark locations had been damaged, covered with sand/debris or not conveniently located to the study area. The baseline for the DGPS network was established at known GPS-quality bench marks and U.S. Geological Survey horizontal and vertical control points. The network allowed for adjustments to the horizontal and vertical control for remote stations during post-processing in the office. The final adjusted results for the survey are included in Table 1. The vertical control accuracy for the HWM elevations in Table 1 is a function of the network and baseline adjustments, and, for the sake of this survey, are considered to be accurate to within 0.2 feet. The actual computed elevations from the post-processing by Scartz Surveys may have a higher degree of accuracy and are available to the nearest thousandths of a foot, if needed.

Table 1. Hurricane Fran - North Carolina Coastal High Water Marks: Location, description and elevations

HWM no.	D&D Sta. no.	Latitude NAD 1983	Longitude NAD 1983	HWM Elev. feet NGVD	Photo ID no.	HWM Type	Inside or Outside	Location or Nearest Town
1	hwm 2010	33:55'01.38282"	78:01'04.07487"	5.4	fr1018	Debris	O	Southport, NC
2	hwm 2011	33:53'59.41651"	78:03'51.12476"	11.2	fr1026	Debris	O	Caswell Beach, NC
3	hwm 2013	33:53'59.24127"	78:03'51.30939"	12.2	fr1021	Debris	O	Caswell Beach, NC
4	hwm 2014	33:58'10.66001"	77:55'08.05241"	12.5	fr1029	Debris	O	Kure Beach, NC
5	hwm 2015	33:59'32.48636"	77:54'33.77071"	15.3	fr1031	Debris	O	Kure Beach, NC
6	hwm 2017	33:59'21.23023"	77:54'36.26851"	15.4	fr1032	Debris	O	Kure Beach, NC
7	hwm 2018	33:59'12.64196"	77:54'42.01731"	15.1	fr1038	Debris	O	Kure Beach, NC
8	hwm 2021	34:01'34.57467"	77:53'44.43306"	9.8	fr1041	Mudline	I	Carolina Beach, NC
9	hwm 2022	34:01'34.57480"	77:53'44.43260"	9.9	fr1042	Mudline	O	Carolina Beach, NC
10	hwm 2023	34:01'36.52508"	77:53'56.32880"	9.9	fr1044	Mudline	I	Carolina Beach, NC
11	hwm 2026	34:03'29.32635"	77:52'56.16151"	10.0	fr1051	Mudline	I	Carolina Beach, NC
12	hwm 2027	34:03'29.46301"	77:52'53.85263"	11.1	fr1052	Mudline	I	Carolina Beach, NC
13	hwm 2028	34:03'29.59386"	77:52'53.87509"	11.1	fr1053	Mudline	O	Carolina Beach, NC
14	wr 1011	34:11'20.35347"	77:48'36.80383"	10.7	fr2009	Mudline	I	Wrightsville Beach, NC
15	wr 1012	34:11'19.79831"	77:48'35.41748"	10.7	fr2008	Debris	O	Wrightsville Beach, NC
16	wr 1013	34:11'21.13817"	77:48'34.49076"	10.6	na	Mudline	I	Wrightsville Beach, NC
17	wr 1014	34:11'21.60020"	77:48'40.29231"	10.9	na	Mudline	I	Wrightsville Beach, NC
18	wr 1003	34:12'38.61291"	77:47'54.07096"	9.5	fr1002	Mudline	I	Wrightsville Beach, NC
19	wr 1004	34:12'38.61507"	77:47'54.07158"	11.0	fr1003	Mudline	O	Wrightsville Beach, NC
20	wr 1005	34:12'33.25027"	77:47'41.57267"	9.3	na	Mudline	I	Wrightsville Beach, NC
21	wr 1006	34:12'33.10967"	77:47'41.68870"	10.7	fr1007	Mudline	O	Wrightsville Beach, NC
22	wr 1007	34:12'33.36276"	77:47'42.29988"	10.7	na	Mudline	I	Wrightsville Beach, NC
23	wr 2007	34:13'08.96461"	77:48'49.95187"	10.6	fr1014	Debris	O	Wrightsville, NC
24	wr 2003	34:13'25.61844"	77:47'06.58416"	10.8	fr1009	Mudline	I	Wrightsville Beach, NC
25	wr 2004	34:13'25.61910"	77:47'06.58427"	11.1	fr1010	Mudline	O	Wrightsville Beach, NC
26	wr 2005	34:13'26.76112"	77:47'06.62424"	10.7	fr1011	Mudline	I	Wrightsville Beach, NC
27	wr 2006	34:13'26.48461"	77:47'03.90724"	11.3	fr1012	Mudline	I	Wrightsville Beach, NC
28	f8i 1016	34:16'24.98817"	77:44'27.11464"	11.9	fr2033	Mudline	I	Figure Eight Island, NC

Table 1. (cont.) Hurricane Fran - North Carolina Coastal High Water Marks: Location, description and elevations

HWM no.	D&D Sta. no.	Latitude NAD 1983	Longitude NAD 1983	HWM Elev. feet NGVD	Photo ID no.	HWM Type	Inside or Outside	Location or Nearest Town
29	f8i 1017	34:16'23.57256"	77:44'28.91051"	10.0	na	Debris	O	Figure Eight Island, NC
30	f8i 1018	34:16'16.74826"	77:44'32.64324"	12.7	na	Mudline	I	Figure Eight Island, NC
31	f8i 1019	34:16'32.34257"	77:45'42.57412"	11.6	fr2043	Debris	O	Figure Eight Island, NC
32	hmp 1015	34:21'20.89775"	77:41'06.10811"	12.6	fr2010	Debris	O	Howard Landing, NC
33	tsl 1023	34:21'42.66183"	77:38'06.31168"	10.7	na	Debris	O	Topsail Beach, NC
34	tsl 1022	34:21'45.90405"	77:38'06.01514"	10.4	fr2110	Mudline	I	Topsail Beach, NC
35	tsl 1024	34:25'39.73530"	77:32'39.02698"	8.1	fr2111	Mudline	I	Surf City, NC
36	tsl 1020	34:27'29.73729"	77:29'23.99367"	11.5	fr2049	Mudline	I	N. Topsail Island, NC
37	tsl 1021	34:30'05.69617"	77:24'03.15934"	10.9	fr2080	Mudline	I	N. Topsail Island, NC
38	tsl 1302	34:26'00.04332"	77:33'06.37888"	9.2	fr2047	Mudline	I	Surf City, NC
39	tsl 1301	34:26'00.46678"	77:33'04.50006"	8.8	fr2048	Mudline	I	Surf City, NC
40	tsl 1303	34:25'19.84188"	77:35'10.85800"	9.6	na	Debris	O	Watts Landing, NC
41	tsl 1304	34:28'16.70391"	77:30'36.34420"	8.8	na	Debris	O	Morris Landing
42	tsl 1305	34:29'14.99212"	77:28'35.56652"	9.4	na	Debris	O	Thomas Landing
43	tsl 1306	34:30'24.30156"	77:25'57.43703"	8.6	na	Debris	O	N. Topsail Island, NC
44	tsl 1307	34:34'36.41389"	77:23'56.52506"	7.3	na	Debris	O	Sneads Ferry, NC
45	hwm 3000	34:40'19.00739"	77:08'14.29337"	8.9	na	Debris	O	Hubert, NC
46	hwm 3001	34:41'16.16202"	77:07'01.83573"	8.1	fr1065	Debris	O	Swansboro, NC
47	hwm 2029	34:40'46.85708"	77:04'02.43145"	7.4	fr1061	Debris	O	Bogue Sound, NC
48	hwm 2030	34:38'41.69710"	77:05'52.30890"	7.3	fr1063	Debris	O	Bogue Inlet, NC
49	ftm 1029	34:41'42.53932"	76:40'40.97776"	5.9	fr3008	Debris	O	Fort Macon, NC
50	mhc 1030	34:43'31.45305"	76:47'04.70947"	7.3	fr3011	Debris	O	Morehead City, NC
51	mc 1025	34:43'10.46738"	76:42'55.78974"	5.2	fr3006	Mudline	I	Morehead City, NC
52	mc 1026	34:43'11.97029"	76:42'56.68453"	4.8	na	Debris	O	Morehead City, NC
53	mc 1027	34:43'09.27416"	76:42'59.16731"	4.9	fr3005	Debris	O	Morehead City, NC
54	buf 1028	34:42'46.93747"	76:39'28.83090"	4.5	fr3007	Debris	O	Beaufort, NC

COASTAL INUNDATION MAPPING

A total of 54 HWMs caused by the storm surge from Hurricane Fran were investigated and surveyed for this work effort. Utilizing the location and elevation of the HWMs investigated and surveyed for Hurricane Fran during the period of September 7 to 10, a Geographic Information System (GIS) map of the inundation was produced at a scale of 1:100,000 (see Appendix A - flood maps). The maps depict the location, type, and elevation (feet NGVD) of each HWM, and the approximate coastal inundation limits of storm surge flooding. The GIS maps are based on detailed delineations from U.S. Geological Survey 7.5-minute topographic quadrangle maps at a scale of 1:24,000 with 5 foot contour intervals.

The North Carolina coastal area with the greatest storm surge impacts and damages to structures and beaches was located along the 22-mile reach of Topsail Island. Topsail Island had large amounts of beach and dune erosion combined with storm surge flooding over the barrier island. This has resulted in significant topographic changes to the barrier island and may leave the area vulnerable to future coastal flood or storm-induced erosion events. Other areas impacted and damaged by the storm surge flooding and storm-induced erosion were found along Figure Eight Island, Wrightsville Beach, Carolina Beach, and Kure Beach. The inland bays and sounds behind the barrier island experienced significant storm surge flooding effects and some evidence of wave damages. Storm surge penetration was found along the rivers, creeks, and streams with confluence to the bays and sounds, but investigations to locate the inland extent of the coastal flooding along these waterways were not conducted as part of this survey.

MISCELLANEOUS

A collection of photographs of storm damage and storm related impacts in the coastal and inland areas is presented in Appendix C of this report, and a summary of the survey data collected and digital photographs taken by Dewberry & Davis at each of the HWM survey locations is provided in Appendix D.

APPENDIX A

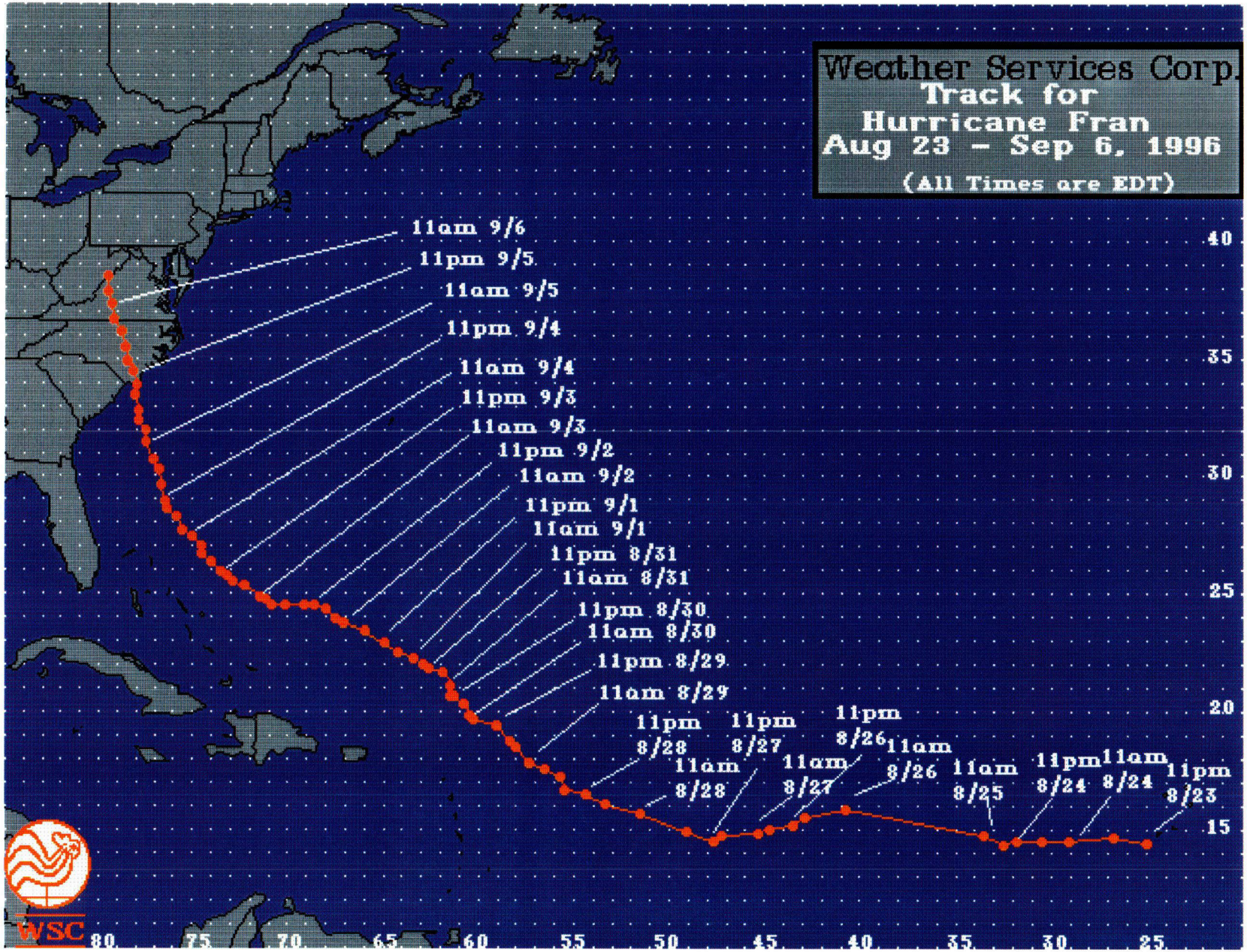
COASTAL INUNDATION MAPS

(Map 1 of 2 and Map 2 of 2 - GIS maps)

APPENDIX B

PRELIMINARY STORM DATA

(Source: WSC and NOAA,NWS & NOAA, HRD)


Weather Services Corp.
Track for
Hurricane Fran
Aug 23 - Sep 6, 1996
(All Times are EDT)
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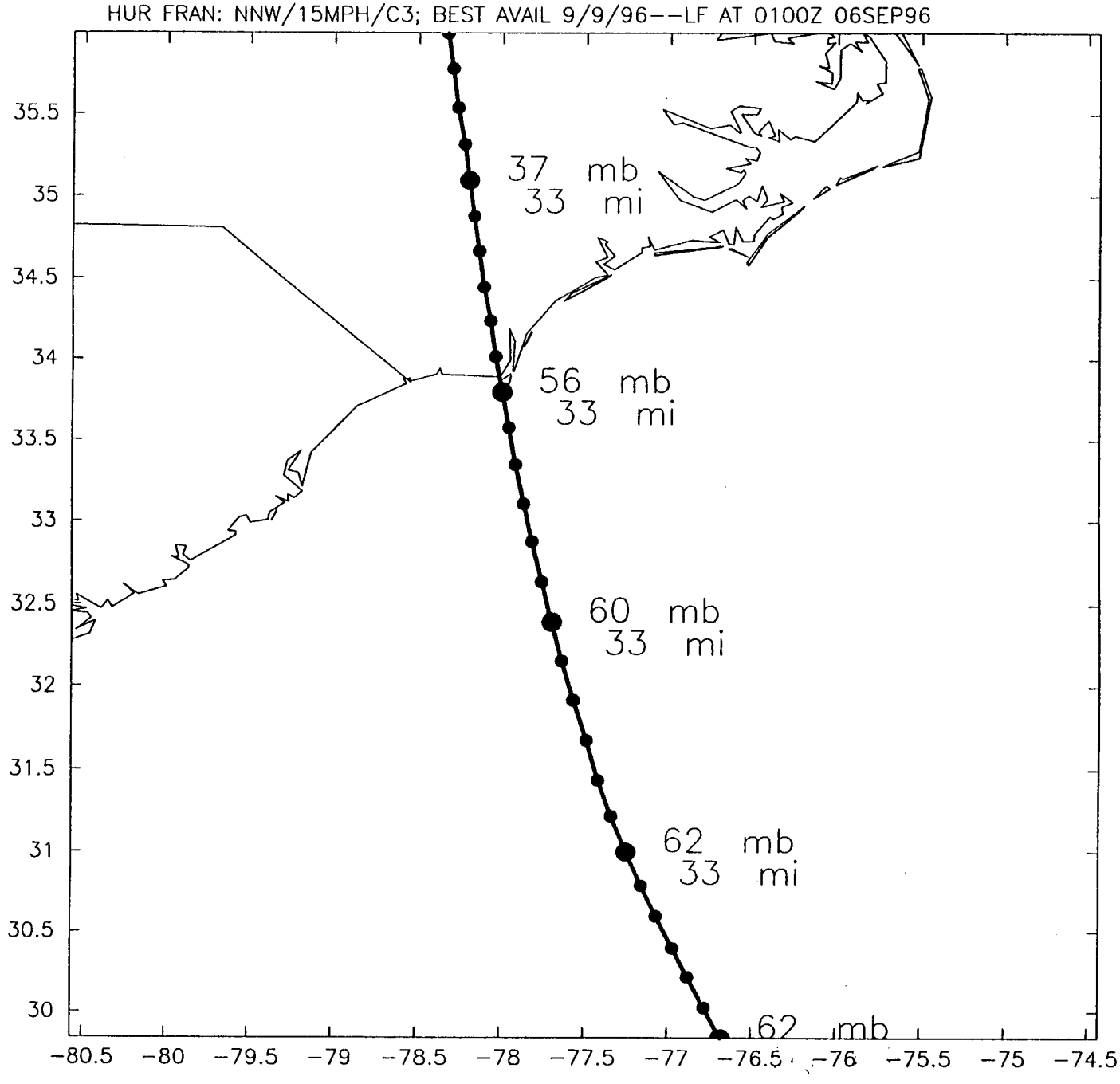
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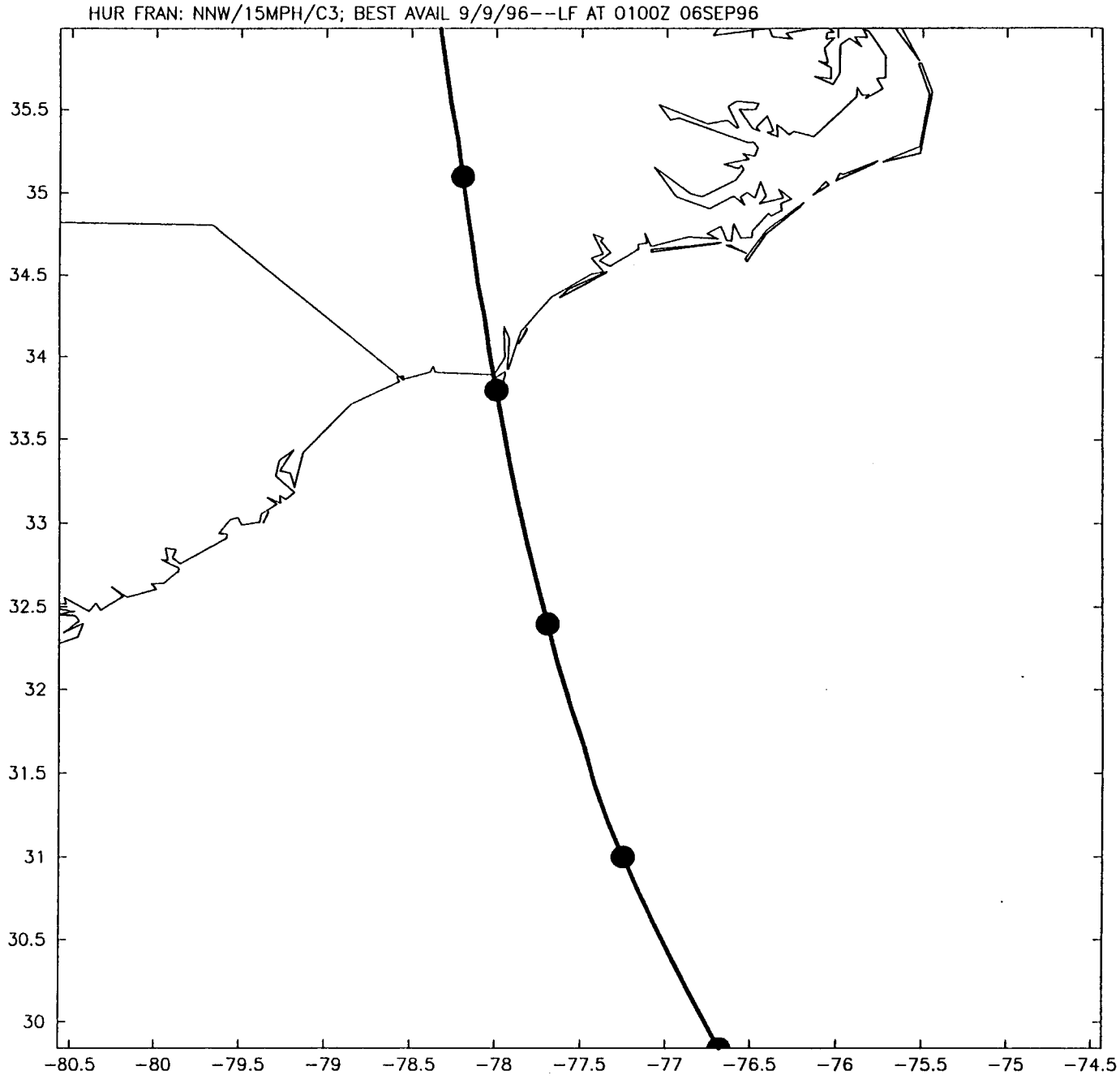
HUR FRAN: NNW/15MPH/C3; BEST AVAIL 9/9/96--LF AT 0100Z 06SEP96
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33.5
33
32.5
32
31.5
31
30.5
30
-80.5
-80
-79.5
-79
-78.5
-78
-77.5
-77
-76.5
-76
-75.5
-75
-74.5

HURRICANE FRAN

No.	Date	Time	00-hr		12-hr		24-hr		36-hr		48-hr		7
1	82496	3	14.4	25.1	14.7	27.0	15.1	29.4	15.3	31.7	15.7	34.3	16.0
2	82496	9	14.8	26.7	15.1	28.7	15.4	31.5	15.6	34.1	15.7	36.5	16.0
3	82496	15	i4.5	29.2	14.5	31.5	14.5	34.0	14.5	36.5	14.5	39.0	14.5
4	82496	21	14.5	30.5	14.5	32.5	14.5	35.0	14.5	37.5	14.5	40.5	14.5
5	82596	3	14.5	31.9	14.5	34.0	14.7	36.4	15.0	38.8	15.2	41.0	15.5
6	82596	9	14.4	32.6	14.4	34.5	14.5	37.0	14.7	39.4	14.8	41.7	15.0
7	82596	15	14.8	33.5	15.0	35.3	.0	.0	.0	.0	.0	.0	.0
8	82696	15	15.9	40.8	16.0	43.3	16.3	46.5	16.5	49.5	.0	.0	.0
9	82696	21	15.4	42.9	15.6	45.5	15.9	48.9	16.2	52.4	16.5	55.4	17.0
10	82796	3	15.2	43..6	15.3	46.1	15.3	49.5	15.7	52.8	16.2	55.9	17.5
11	82796	9	15.0	44.7	15.0	46.8	15.2	50.0	15.8	53.0	16.5	56.0	18.0
12	82796	15	14.8	45.3	14.7	46.9	14.9	49.8	15.7	53.2	16.5	56.7	18.0
13	82796	21	14.7	47.2	15.0	49.0	15.0	51.5	15.5	54.5	16.0	56.7	16.5
14	82896	3	14.4	47.7	14.3	49.5	14.4	51.9	14.6	54.4	15.0	56.9	16.1
15	82896	9	15.0	49.0	15.0	50.8	'15.0	53.0	15.5	55.3	15.9	57.8	18.0
16	82896	15	15.8	51.5	16.1	53.5	16.8	56.0	17.5	58.1	18.2	60.3	19.4
17	82896	21	16.1	53.6	16.7	56.0	17.4	58.5	18.3	60.9	19.4	62.9	21.8.
18	82996	3	16.6	54.6	17.2	56.6	18.2	59.2	19.1	61.1	20.2	62.9	23.0
19	82996	9	17.2	55.8	17.8	57.7	18.7	60.2	19.6	62.5	20.7	64.6	23.0
20	82996	15	17.9	57.2	18.5	59.2	19.5	61.5	20.5	63.5	21.5	65.0	23.0
21	82996	21	18.8	58.2	19.5	60.0	20.5	61.5	21.5	63.5	22.3	65.0	23.5
22	83096	3	19.5	59.2	20.3	60.7	21.3	62.5	22.4	64.1	23.3	65.8	24.5
23	83096	9	19.7	60.2	20.4	61.9	21.5	63.5	22.5	65.0	23.0	66.5	24.0
24	83096	15	19.9	60.5	20.6	61.5	21.4	62.9	22.3	64.5	23.0	66.0	24.3
25	83096	21	20.3	60.9	20.9	61.8	21.7	63.3	22.4	64.8	23.3	66.4	25.0
26	83196	3	20.8	61.2	21.4	61.8	22.4	63.2	23.3	64.6	24.3	66.3	26.5
27	83196	9	20.8	61.4	21.1	61.9	21.5	62.5	22.0	63.5	23.0	65.5	24.5
28	83196	15	21.3	61.6	21.8	62.2	22.7	63.2	23.5	64.4	24.4	65.9	26.0
29	'83196	21	21.7	61.9	22.4	62.6	23.1	63.6	23.9	64.8	24.9	66.6	26.5
30	90196	3	21.9	62.4	22.5	63.2	23.3	64.4	24.0	66.0	24.8	68.0	26.5
31	90196	9	22.0	62.9	22.1	63.5	23.0	65.0	23.5	66.5	24.0	68.0	25.0
32	90196	15	22.2	63.4	22.6	64.4	23.0	65.8	23.5	67.3	24.1	69.0	25.5
33	90196	21	22.5	64.2	22.8	65.3	23.4	66.9	23.9	68.4	24.6	70.4	26.0
34	90296	3	23.0	64.9	23.5	66.1	24.2	68.0	24.7	69.8	25.0	71.5	26.0
35	90296	9	23.4	66.0	23.8	67.4	24.3	69.3	24.8	71.2	25.2	73.2	26.3
36	90296	15	23.8	67.1	24.2	68.7	24.6	70.9	25.0	72.7	25.4	74.7	27.0
37	90296	21	24.1	68.6	24.4	70.5	25.1	73.0	25.8	75.4	26.8	77.7	29.5
38	90396	3	24.4	69.6	24.8	71.3	25.4	73.6	26.2	76.0	27.4	78.0	30.5
39	90396	9	24.5	70.8	24.8	72.5	25.9	74.5	27.3	76.3	28.8	78.0	33.0
40	90396	15	24.9	71.6	25.4	73.1	26.5	75.2	28.0	76.9	29.9	78.7	34.0
41	90396	21	25.4	72.9	26.1	74.5	27.4	76.4	29.0	78.1	30.9	79.8	35.0
42	90496	3	26.0	73.5	26.7	75.1	28.2	76.8	29.9	78.8	31.9	80.4	35.5
43	90496	9	26.7	74.5	27.5	76.0	29.0	77.5	30.5	79.0	32.5	80.5	35.0
44	90496	15	27.4	75.0	28.4	76.2	30.3	77.8	32.3	79.4	34.0	80.7	37.0
45	90496	21	28.2	75.8	29.2	76.9	31.2	78.3	33.4	79.6	35.5	81.0	39.0
46	90596	3	29.1	76.4	30.5	77.4	32.5	78.8	34.7	80.0	36.5	81.0	39.5
47	90596	9	30.3	76.9	31.3	78.0	33.5	79.0	35.0	80.0	36.5	80.0	39.0
48	90596	15	31.5	77.4	33.5	78.4	35.7	79.7	37.3	80.0	38.7	80.5	41.5
49	90596	21	32.9	77.9	34.8	78.7	37.3	79.5	39.4	79.9	41.5	80.0	43.5
49a	90596	23	34.2	78.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
50	090696	03	34.5	78.1	36.5	78.1	38.6	78.0	40.4	78.0	41.7	78.0	43.5
51	090696	09	36.1	~~78.9~~ 79.5	38.2	79.5	40.0	80.0	41.5	80.0	43.0	79.0	45.0

Date ↑ Time (UTC) Lat Long | ← Fcst lat/long →

Taken directly from NHC Marine Advisories
Central pressure ~ 957mb at landfall ($\Delta p = 56$ mb)
$R_{max} \sim 33.5$ mi

x - Failed Wind-Wave Algorithm Lower Limit (Wave
y - Failed Wind-Wave Algorithm Upper Limit (Wave
z - Failed Delta Time Variability Test
C-man + - Data has been scaled.

TIMETAB FOR NDBC STATION: FPSN7 LAT = 33°29 6 N LONG = 77°35 24 W FOR TIMES

TIME	WVHGT (m)	DOMPD T_p sec	AVGPD $\bar{T}$	WSPD1	WDIR1	ATMP1	BARO1
090500	2.94(a)	14.29( )	7.09( )	11.84( )	66.00( )	-26.10(D)	1011.30
090501	2.94(u)	14.29( )	7.16( )	12.05( )	77.00( )	-26.50(D)	1011.10
090502	3.56(u)	14.29( )	8.18( )	13.54(a)	86.00( )	-27.10(D)	1011.00
090503	4.11(u)	14.29( )	8.41( )	14.21(a)	80.00( )	-27.10(D)	1010.70
090504	4.09(u)	14.29( )	8.16( )	11.38( )	72.00( )	-27.00(D)	1010.20
090505	4.71(u)	14.29( )	8.68( )	12.35( )	67.00( )	-27.10(D)	1010.30
090506	5.48(a)	14.29( )	9.34( )	12.56( )	68.00( )	-27.00(D)	1010.00
090507	4.70(a)	14.29( )	8.68( )	13.54(a)	68.00( )	-27.20(D)	1009.40
090508	4.99(a)	16.67(a)	8.77( )	12.66(a)	60.00( )	-27.20(D)	1008.40
090509	5.30(a)	14.29( )	9.00( )	13.74(a)	56.00( )	-27.20(D)	1007.50
090510	6.32(a)	16.67(a)	9.14( )	16.06(a)	56.00( )	-27.30(D)	1007.50
090511	6.29(y)	14.29( )	8.67( )	18.17(a)	59.00( )	-26.70(D)	1007.10
090512	6.51(a)	14.29( )	8.80( )	17.76(a)	50.00( )	-26.80(D)	1006.40
090513	6.29(a)	14.29( )	8.35( )	21.11(a)	44.00( )	-26.90(D)	1004.70
090514	7.37(y)	14.29( )	8.17( )	23.78(a)	48.00( )	-27.10(D)	1004.20
090515	7.49(y)	14.29( )	8.29( )	23.01(a)	47.00( )	-26.50(D)	1002.40
090516	8.99(y)	14.29( )	7.62( )	25.59(a)	42.00( )	-26.00(D)	999.30
090517	8.98(y)	14.29( )	8.37( )	24.35(a)	61.00( )	-24.70(D)	997.40
090518	9.38(y)	14.29( )	8.15( )	29.60(a)	61.00( )	-24.70(D)	992.20
090519	9.17(y)	16.67(a)	8.47( )	31.40(a)	63.00( )	-24.50(D)	986.60
090520	9.64(y)	14.29( )	8.33( )	36.09(a)	81.00( )	-24.10(D)	980.10
090521	9.49(y)	14.29( )	8.18( )	40.82(a)	79.00( )	-23.70(D)	972.60
090522	11.64 (E)	14.29(R)	6.38(R)	37.53(a)	93.00( )	-24.90(D)	963.60
090523 landfall	7.39(a)	14.29( )	8.01( )	29.50(a)	137.00( )	-25.80(D)	960.60
090600	7.38(a)	12.50( )	8.13( )	29.55(a)	180.00( )	-26.60(D)	962.90
090601	7.20(a)	12.50( )	7.85( )	32.33(a)	201.00( )	-24.70(D)	976.40
090602	6.95(a)	10.00( )	8.08( )	28.06(a)	203.00( )	-25.30(D)	985.90
090603	5.87(a)	9.09( )	7.36( )	30.06(a)	195.00( )	-23.20(D)	992.30
090604	6.19(a)	10.00( )	7.54( )	29.29(a)	193.00( )	-23.30(D)	996.70
090605	5.36(a)	9.09( )	7.05( )	25.07(a)	201.00( )	-24.30(D)	999.40
090606	4.97(a)	9.09( )	6.82( )	25.79(a)	201.00( )	-25.50(D)	1001.70
090607	4.93(a)	9.09( )	6.76( )	20.80(a)	213.00( )	-26.30(D)	1003.10
090608	4.49(a)	9.09( )	6.84( )	21.31(a)	215.00( )	-26.80(D)	1004.30
090609	4.47(a)	9.09( )	6.72( )	18.84(a)	214.00( )	-26.90(D)	1006.00
090610	4.26(a)	9.09( )	7.00( )	18.28(a)	224.00( )	-26.80(D)	1007.20
090611	3.97(a)	8.33( )	6.86( )	15.70(a)	213.00( )	-26.90(D)	1008.70
090612	3.48(a)	10.00( )	6.37( )	15.34(a)	211.00( )	-26.70(D)	1009.60
090613	3.49(a)	9.09( )	6.39( )	15.03(a)	203.00( )	-26.80(D)	1010.50
090614	3.50(a)	9.09( )	6.41( )	14.00(a)	196.00( )	-27.00(D)	1011.20
090615	3.07(a)	8.33( )	6.06( )	13.44(a)	194.00( )	-27.00(D)	1011.70
090616	2.84(a)	7.14( )	5.87( )	13.49(a)	188.00( )	-27.00(D)	1011.90
090617	2.64( )	8.33( )	5.70( )	13.90(a)	193.00( )	-26.90(D)	1012.00
090618	2.60( )	7.69( )	5.79( )	12.15( )	185.00( )	-26.80(D)	1012.10
090619	2.34( )	7.69( )	5.62( )	11.94( )	192.00( )	-26.80(D)	1012.10
090620	2.20( )	7.69( )	5.42( )	12.15( )	190.00( )	-27.00(D)	1012.00
090621	2.07( )	8.33( )	5.37( )	10.91( )	196.00( )	-27.20(D)	1012.00
090622	2.06( )	7.69( )	5.30( )	11.17( )	197.00( )	-27.50(D)	1011.90
090623	1.91( )	7.14( )	5.29( )	10.45( )	184.00( )	-26.80(D)	1012.10

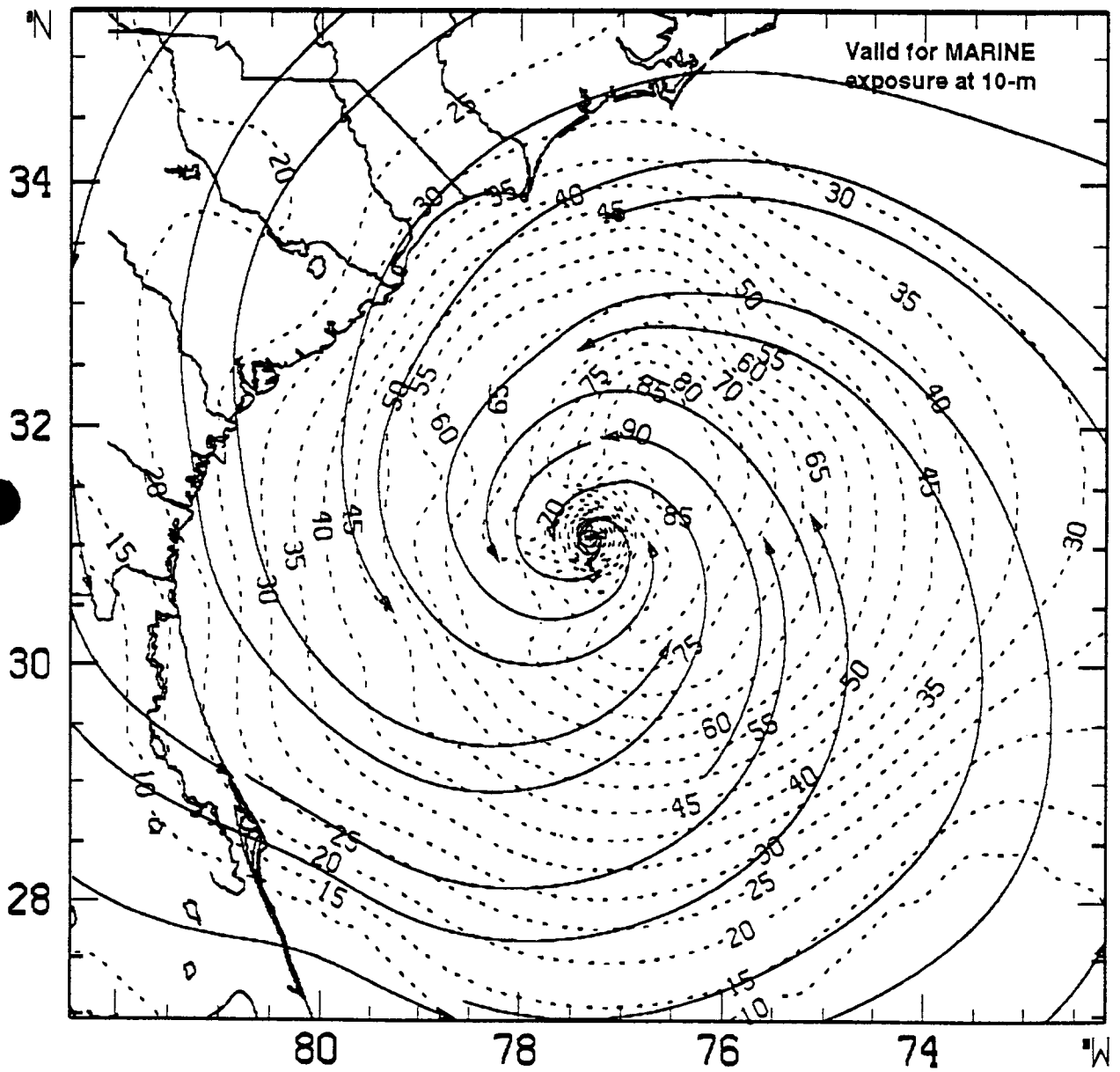
The coastal waves are around 10 m, 14 sec after landfall, it drops to 7 m, and wind

The graph can be seen on SEABOARD.ndbc.gov

Hurricane Fran 1300 UTC 5 Sept. 1996

Maximum sustained 1-min surface winds

Streamlines and Isotachs (kt) using: US Air Force Reserve recon. data adjusted to the surface from 700 mb during 0611-1245 z, buoys, drifters 06-12z, ships, C-MAN from 06-12Z. 1300Z position extrapolated from 1237Z fix using 330 deg at 12 kts



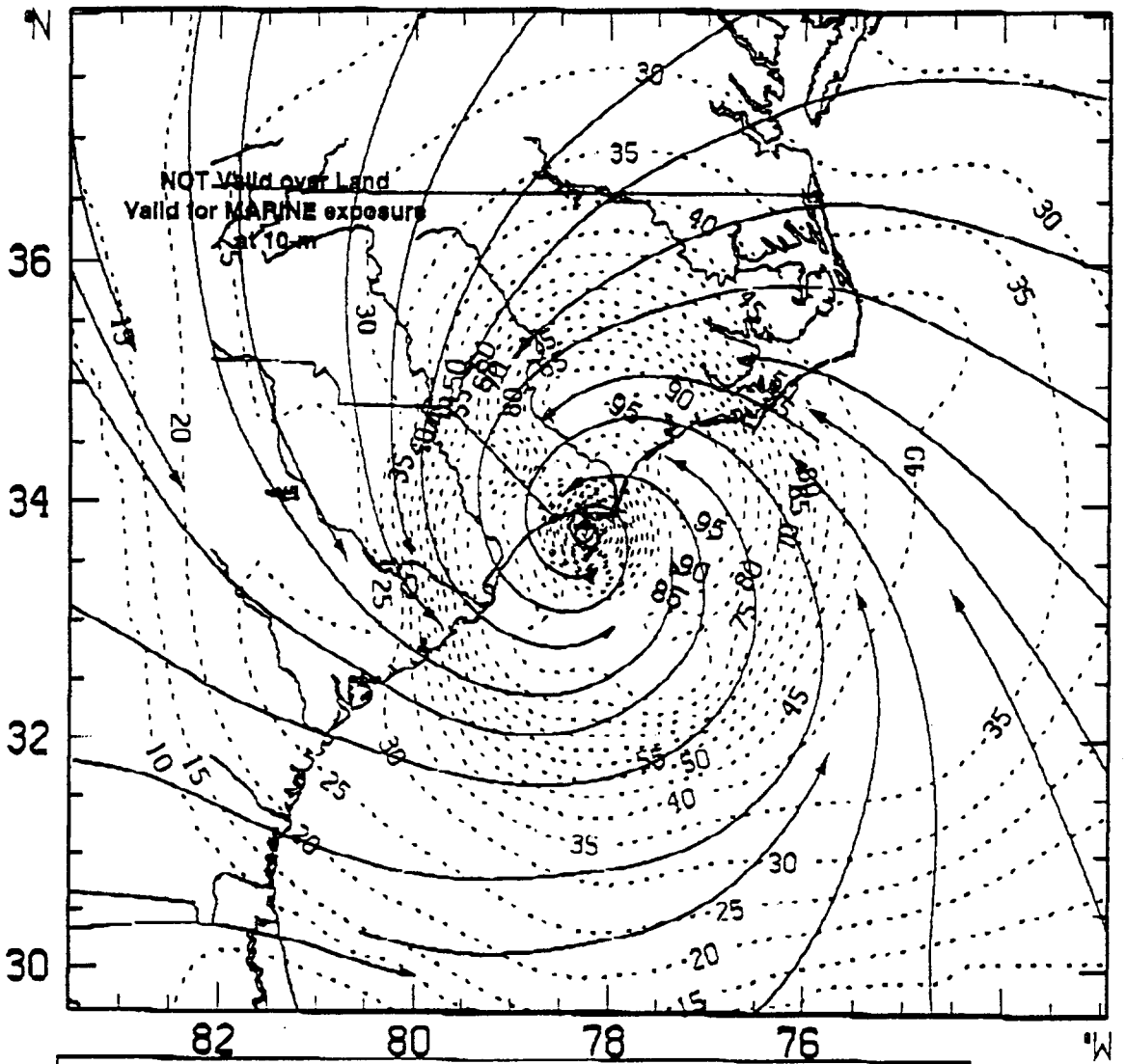
Experimental research product of :

NOAA / AOML / Hurricane Research Division

Hurricane Fran 0100 UTC 6 Sept. 1996

Maximum sustained 1-min surface winds

Streamlines and isotachs (kt) using: NOAA P3 Research Aircraft data adjusted to the surface from 820 mb during 2135-0000 z; buoys, drifters , ships, C-MAN from 20-00Z. 0100Z position extrapolated from 2300 Z fix using 335 deg at 14 kts



Experimental research product of :

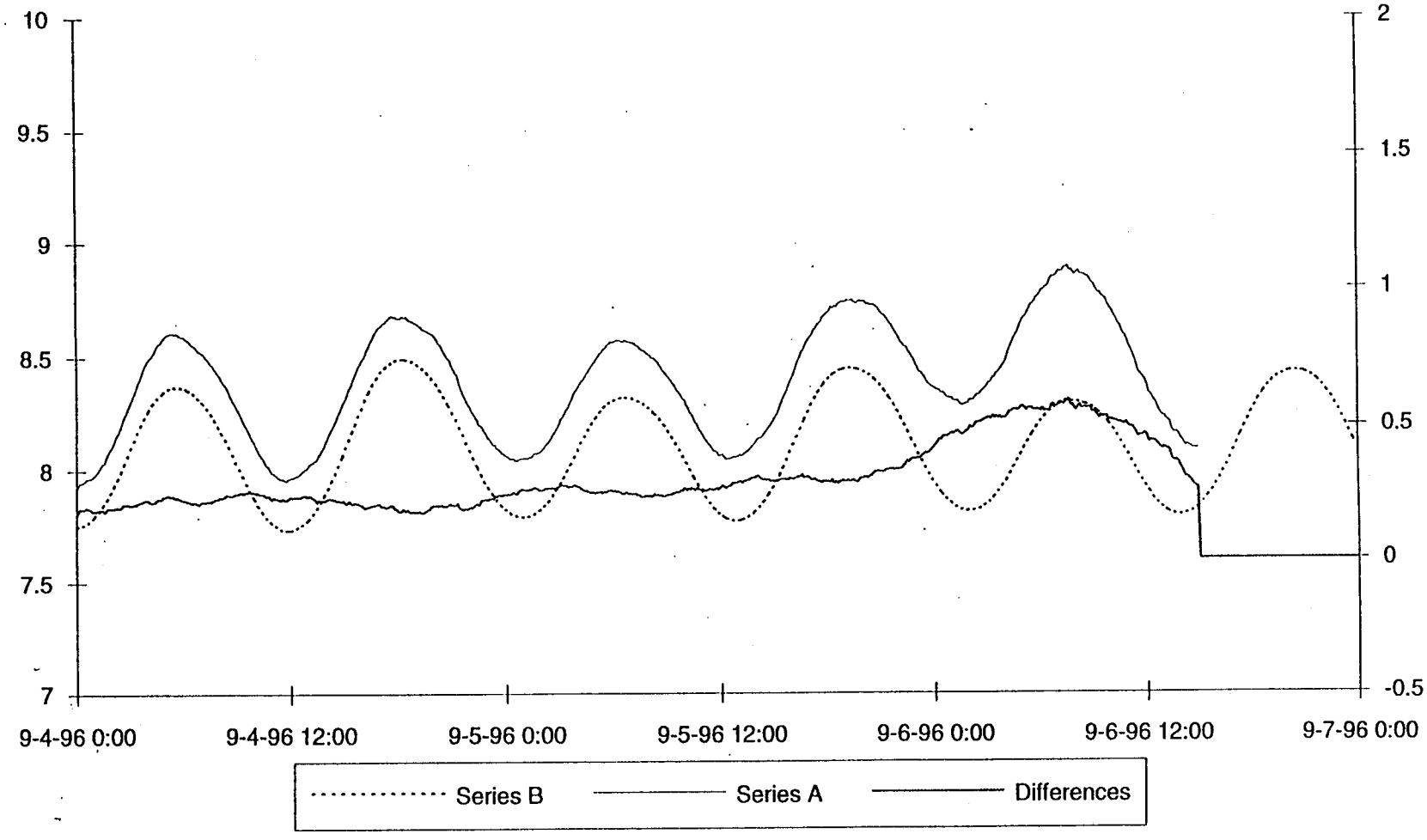
NOAA / AOML / Hurricane Research Division

MAXIMUM STORM SURGE INFORMATION

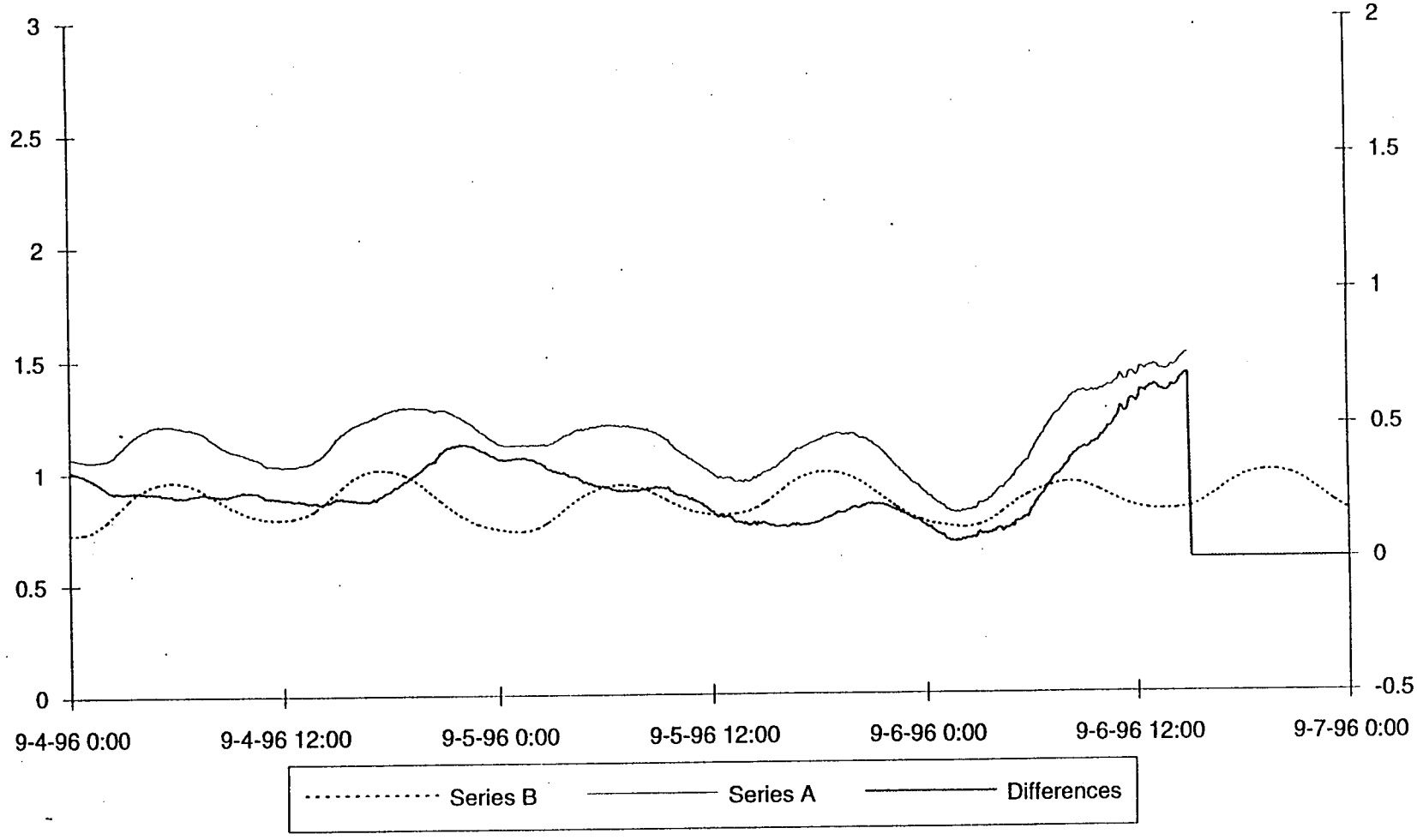
HURRICANE FRAN

STATION	DATE/TIME (UTC)	STORM SURGE (meters)	
Ches. Bay Brdg. Tnl., VA	9-6-96 7:36	0.596	
Oregon Inlet, NC	9-6-96 14:54	0.689	Still rising
Cape Hatteras, NC	9-6-96 1:12	0.827	
Duke Marine Lab, Beaufort, NC	9-6-96 1:54	1.644	
Wilmington, NC	9-6-96 3:48	1.717	
Springmaid Pier, SC	9-5-96 22:24	1.083	
Charleston, SC	9-5-96 12:06	0.339	

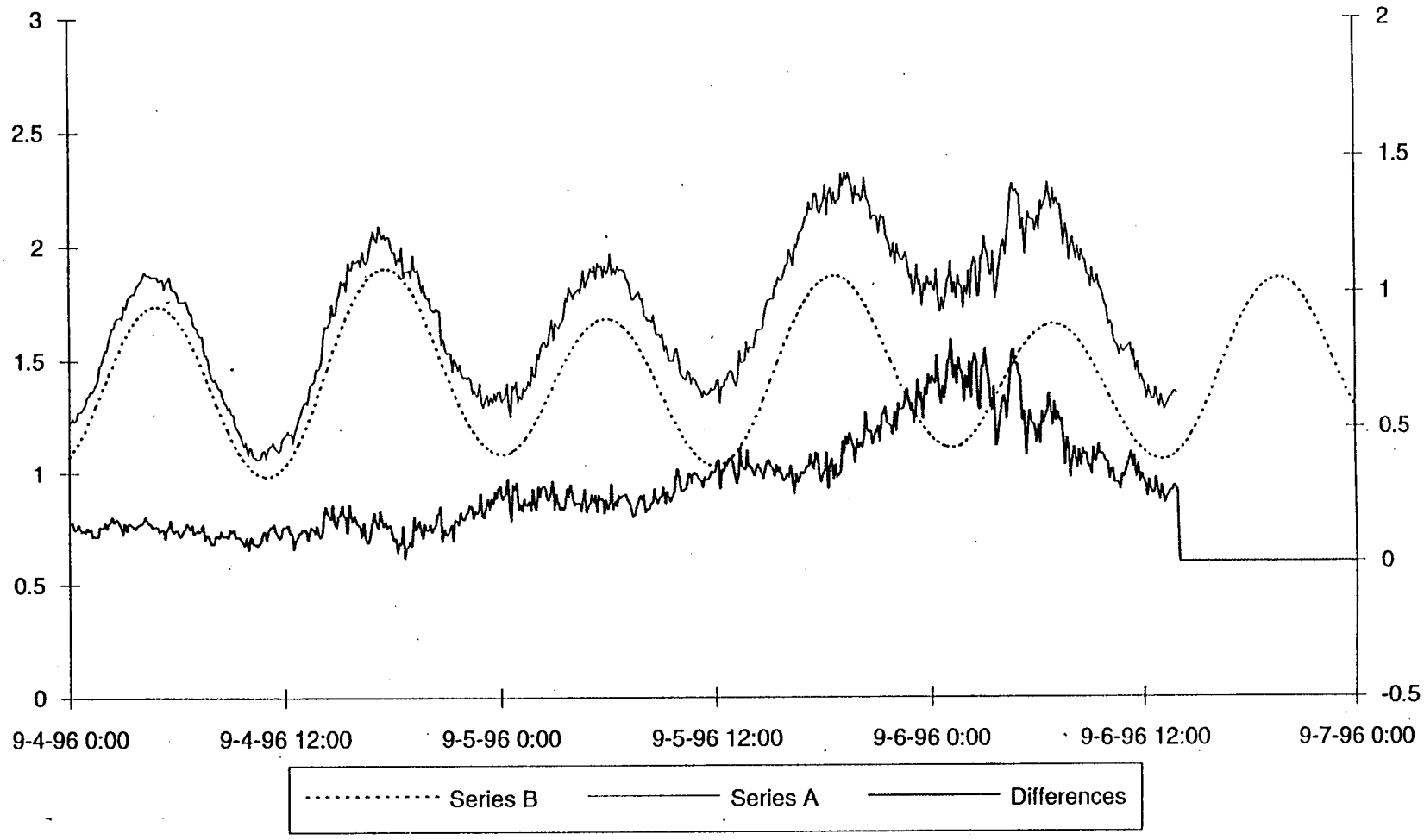
A= 8638863 CHESAPEAKE BAY BRIDGE TUNNEL VA (A1 - Acoustic WL)
B= 8638863 CHESAPEAKE BAY BRIDGE TUNNEL VA (P0 - Predicted WL)



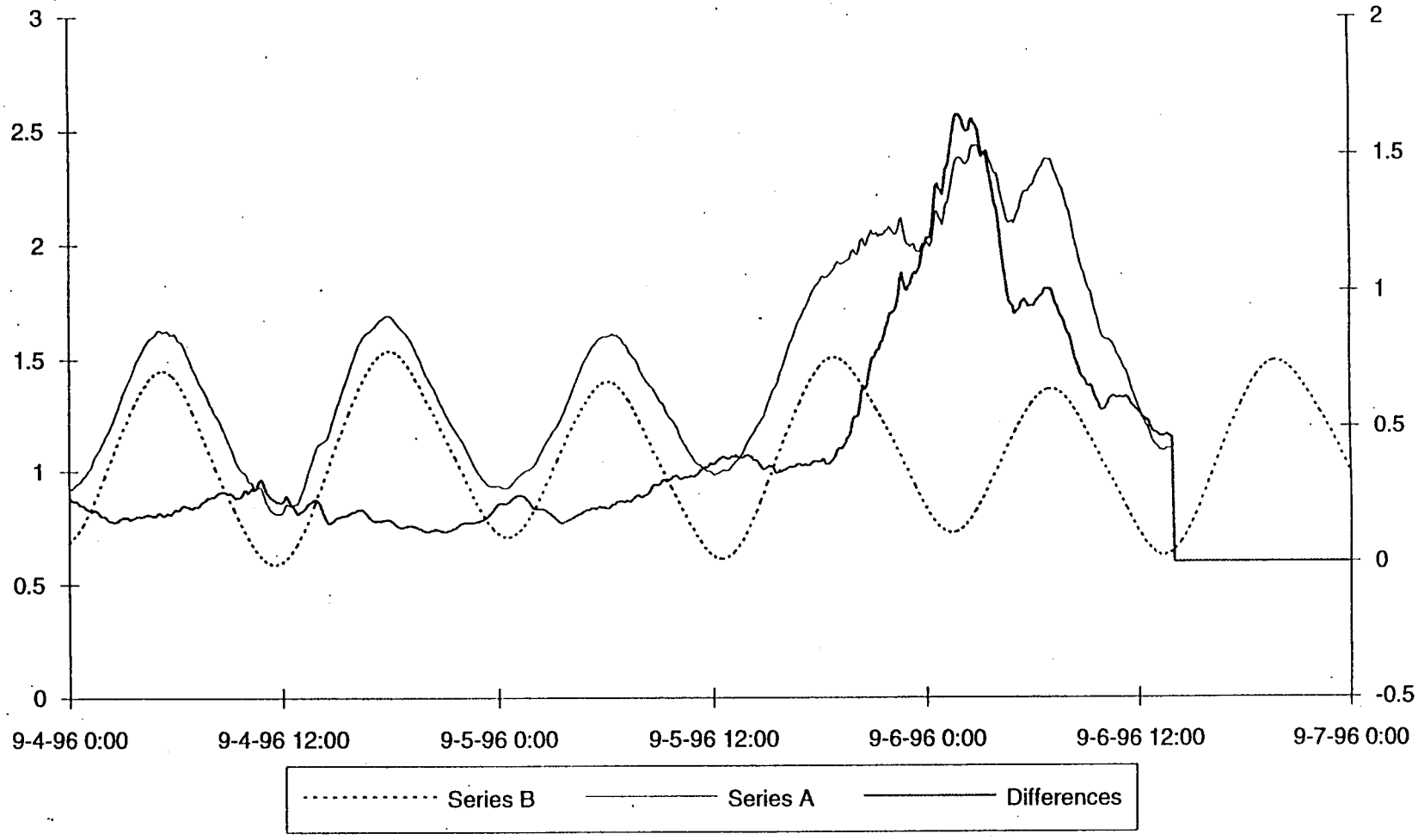
A= 8652587 OREGON INLET MARINA NC (A1 - Acoustic WL)
B= 8652587 OREGON INLET MARINA NC (P0 - Predicted WL)



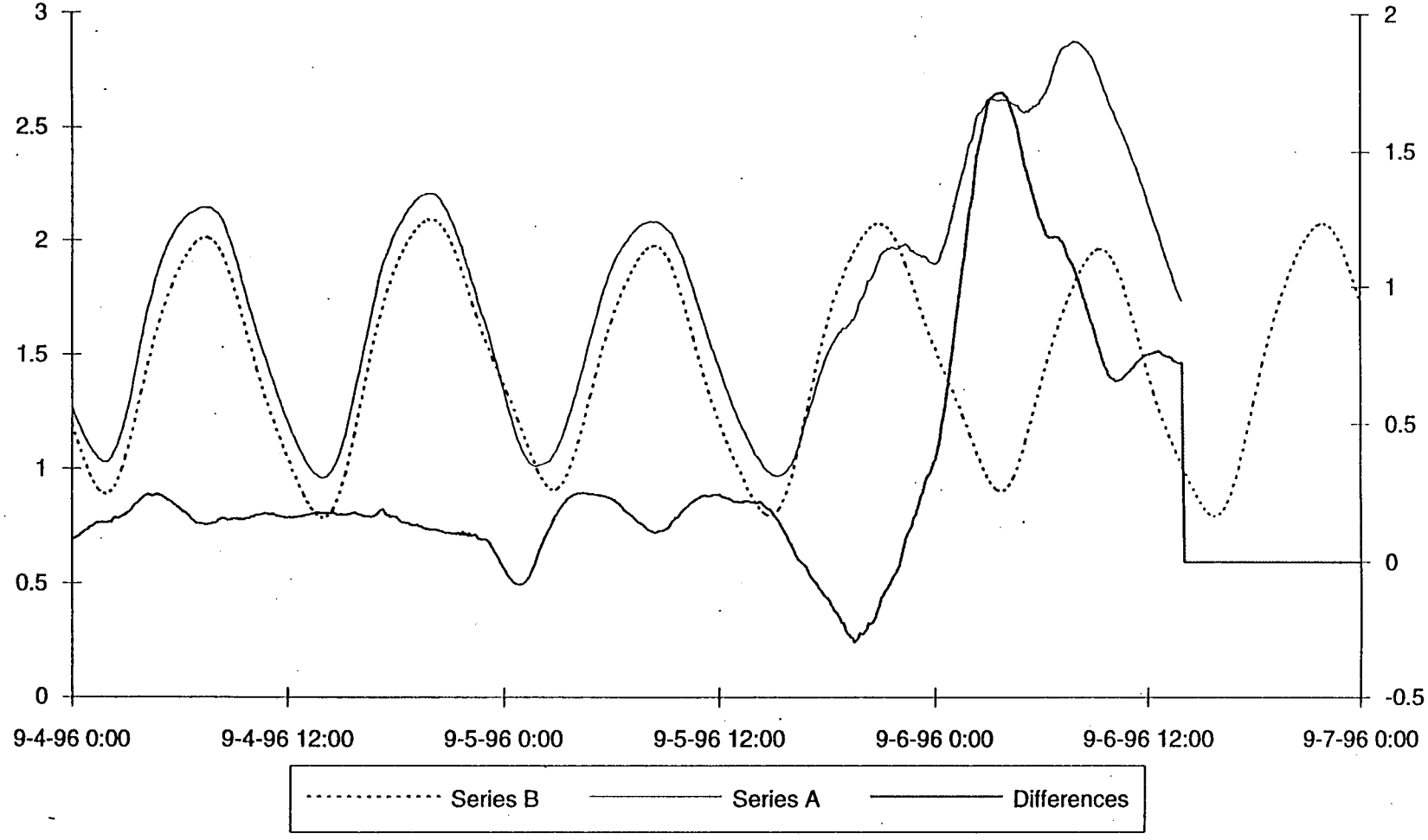
A= 8654400 CAPE HATTERAS FISHING PIER NC (A1 - Acoustic WL)
B= 8654400 CAPE HATTERAS FISHING PIER NC (P0 - Predicted WL)



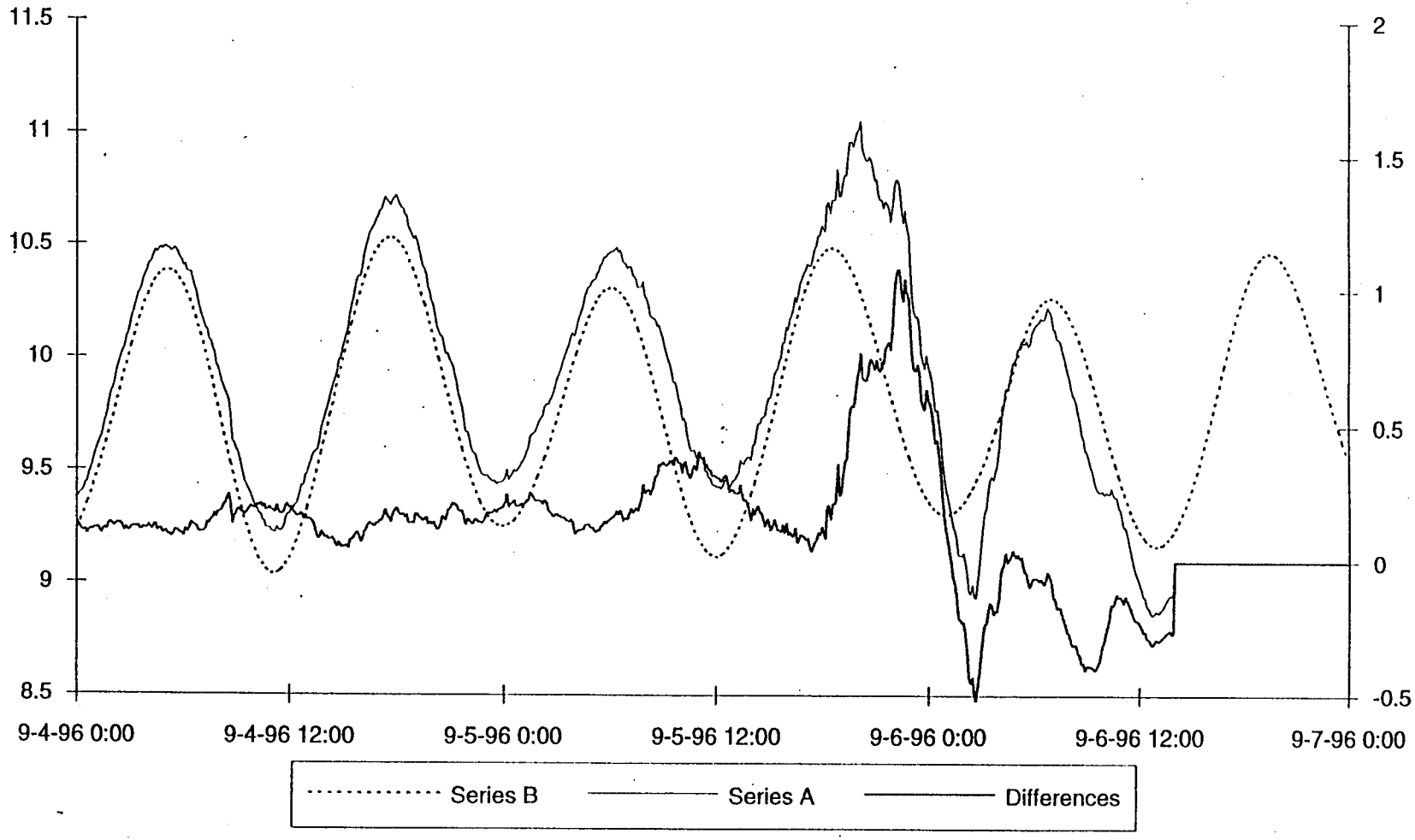
A= 8656483 BEAUFORT, DUKE MARINE LAB NC (WL - Product)
B= 8656483 BEAUFORT, DUKE MARINE LAB NC (P0 - Predicted WL)



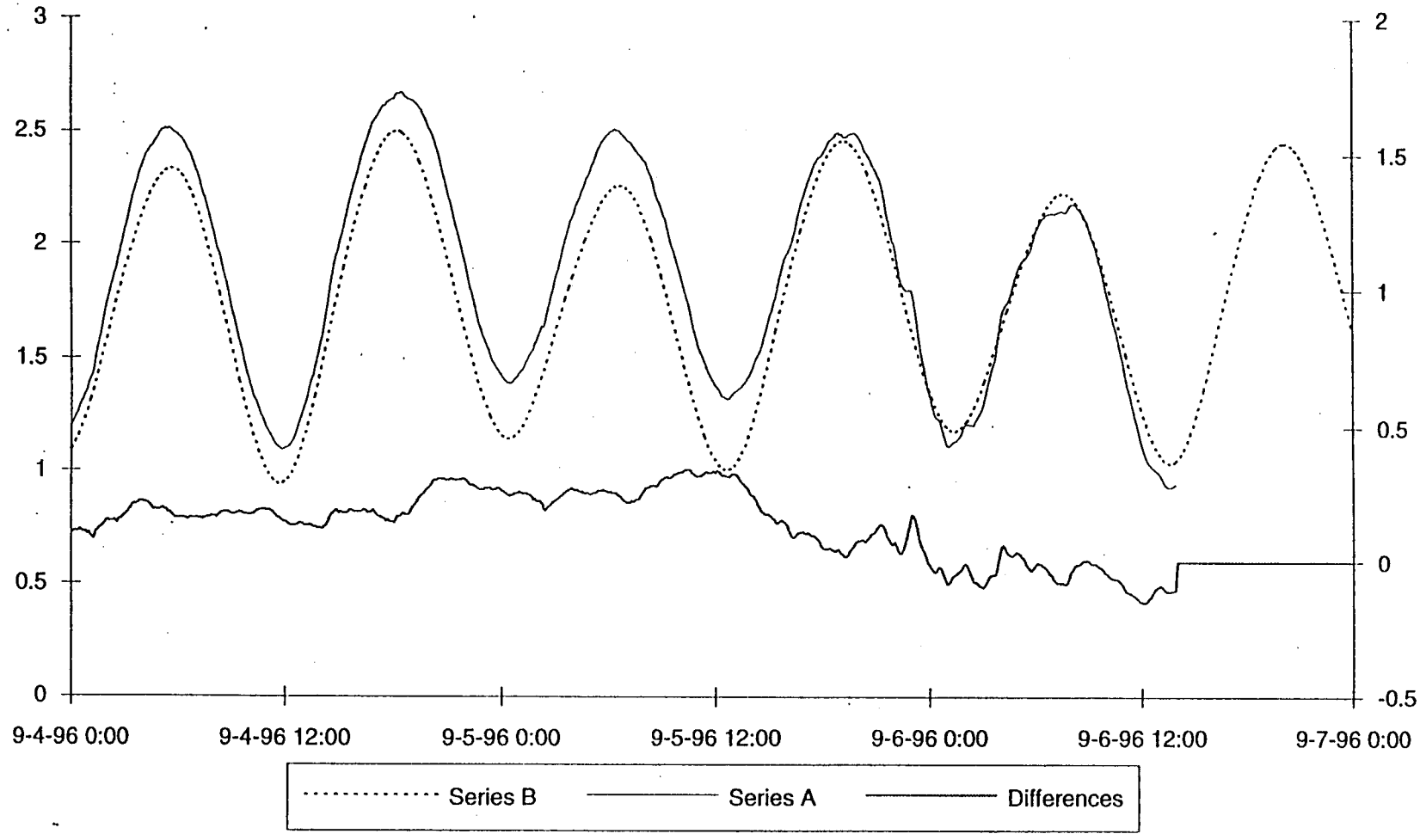
A= 8658120 WILMINGTON NC (WL - Product)
B= 8658120 WILMINGTON NC (P0 - Predicted WL)



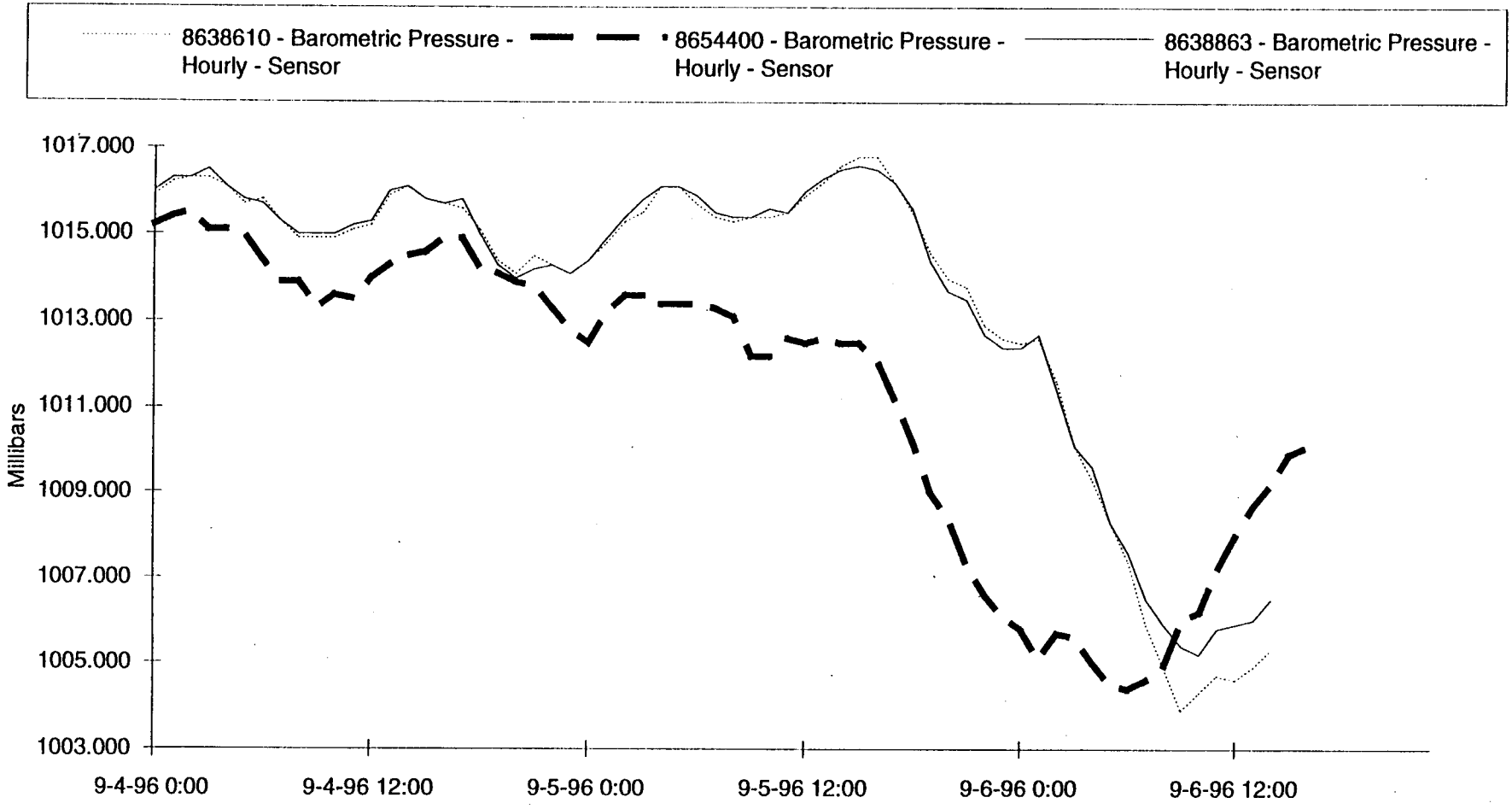
A= 8661070 SPRINGMAID PIER SC (A1 - Acoustic WL)
B= 8661070 SPRINGMAID PIER SC (P0 - Predicted WL)

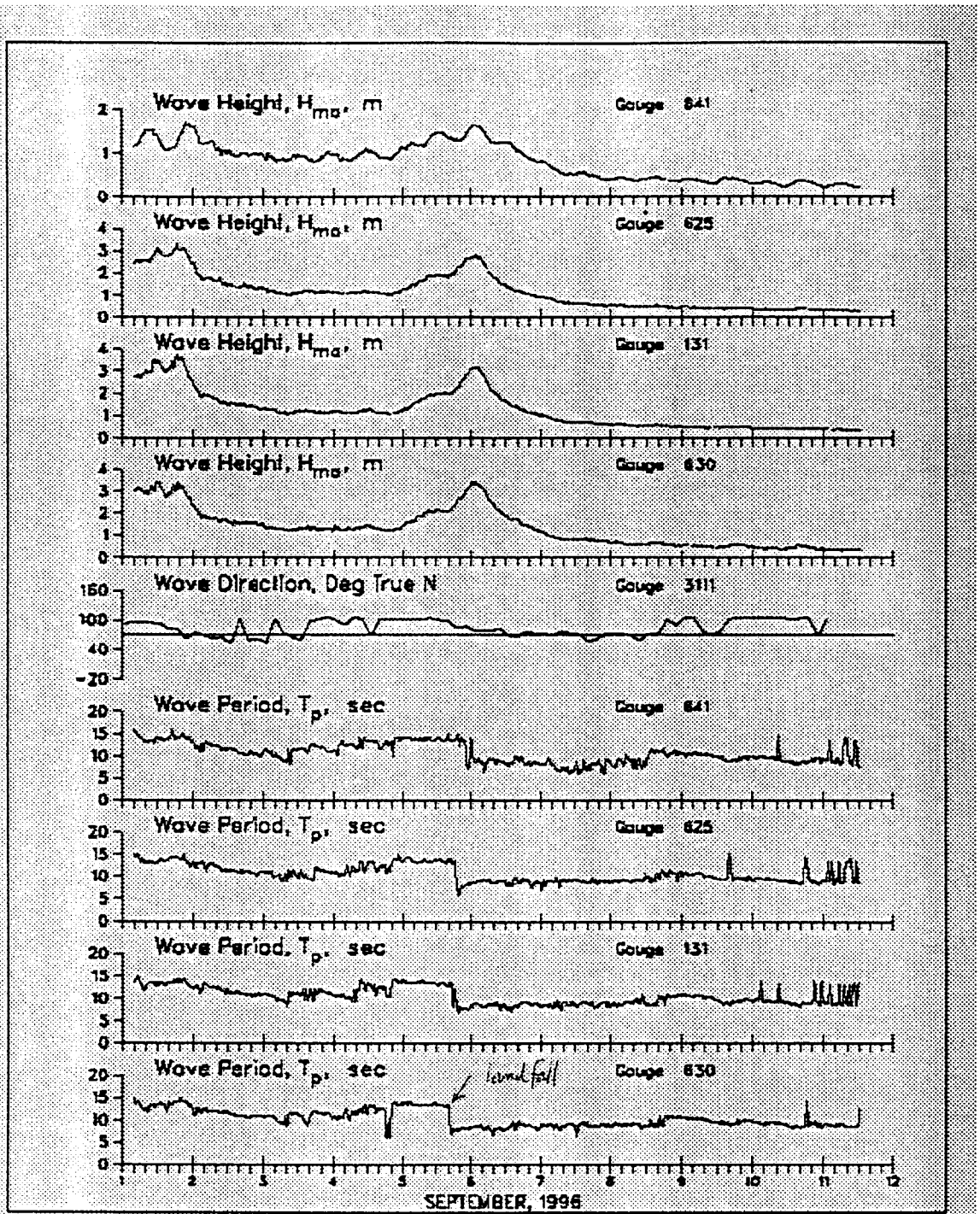


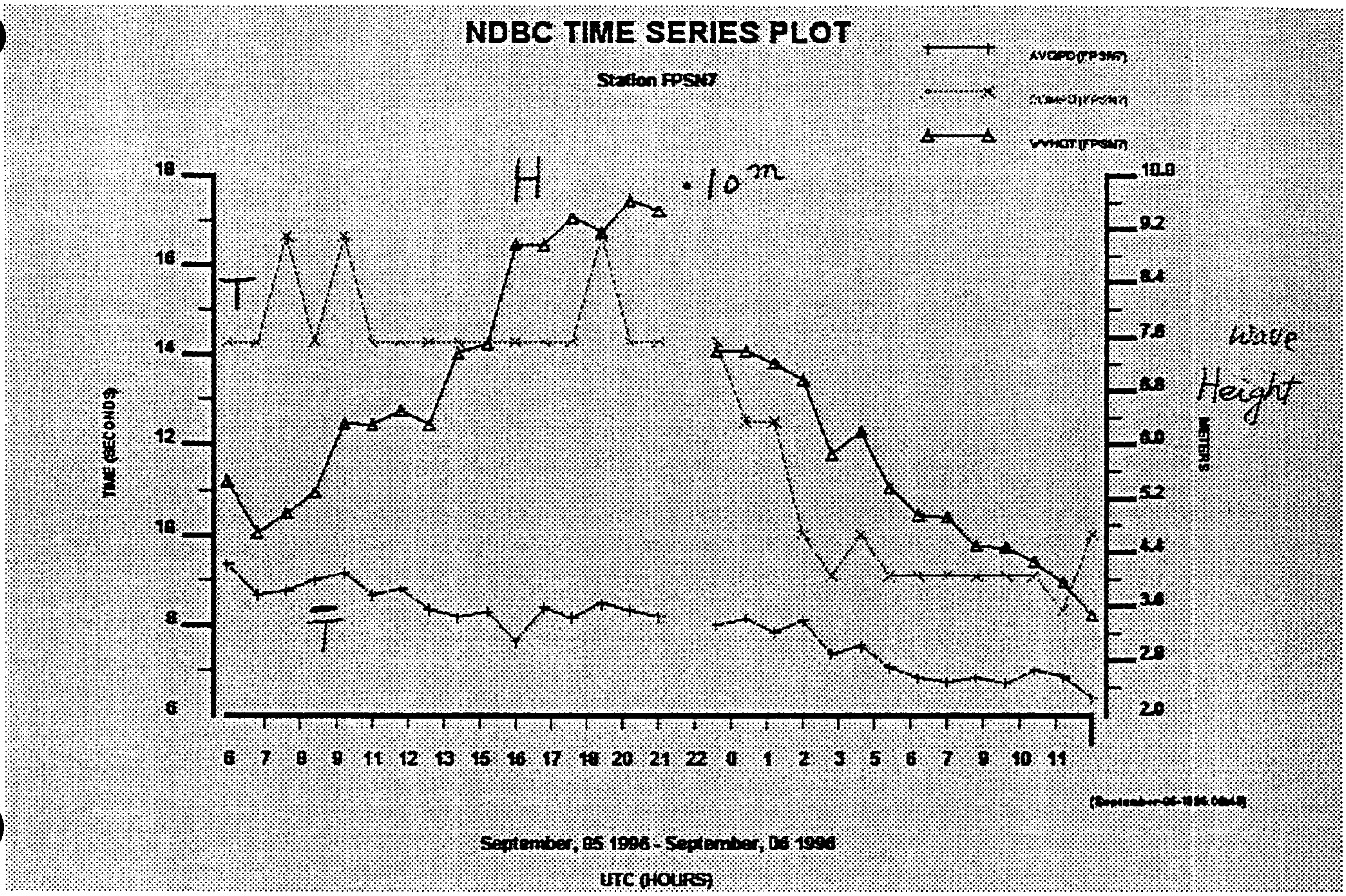
A= 8665530 CHARLESTON, COOPER RIVER ENTRANCE SC (A1 - Acoustic WL)
B= 8665530 CHARLESTON, COOPER RIVER ENTRANCE SC (P0 - Predicted WL)



8638863 CHESAPEAKE BAY BRIDGE TUNNEL VA
8654400 CAPE HATTERAS FISHING PIER NC
8638610 SEWELLS POINT, HAMPTON ROADS VA




Wave Height, H_{mo}, m
Gauge 841
Wave Height, H_{mo}, m
Gauge 625
Wave Height, H_{mo}, m
Gauge 131
Wave Height, H_{mo}, m
Gauge 630
Wave Direction, Deg True N
Gauge 3111
Wave Period, T_p, sec
Gauge 841
Wave Period, T_p, sec
Gauge 625
Wave Period, T_p, sec
Gauge 131
Wave Period, T_p, sec
landfall
Gauge 630
SEPTEMBER, 1996


NDBC TIME SERIES PLOT
Station FPSN7
H
· 10 m
T
Wave
Height
TIME (SECONDS)
18
16
14
12
10
8
6
METERS
10.0
9.2
8.4
7.6
6.8
6.0
5.2
4.4
3.6
2.8
2.0
6 7 8 9 11 12 13 15 16 17 18 20 21 22 0 1 2 3 5 6 7 9 10 11
September, 05 1996 - September, 06 1996
UTC (HOURS)

APPENDIX C

SELECTED DIGITAL PHOTOGRAPHS OF STORM DAMAGE & IMPACTS

Hurricane Fran, North Carolina

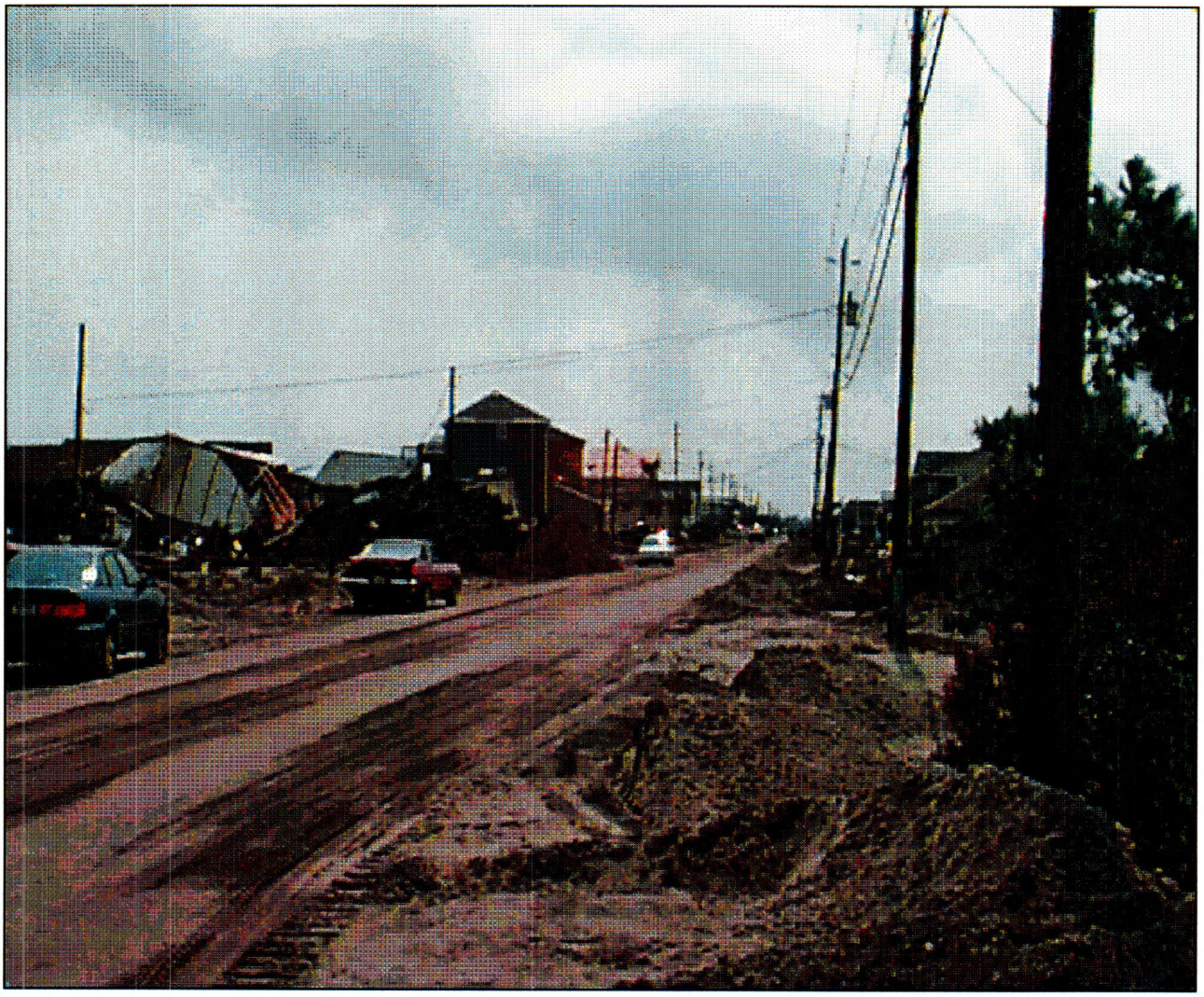
Town or Street	Caswell Beach, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Ft. Fisher/Kure Beach, NC
Date	September 8, 1996

Dewberry & Davis



Hurricane Fran, North Carolina

Town or Street	Kure Beach, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Kure Beach, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Carolina Beach, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Carolina Beach, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Wrightsville Beach, NC
Date	September 7, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Wrightsville Beach, NC
Date	September 7, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Howard Landing, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Figure Eight Island, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Figure Eight Island, NC
Date	September 8, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Surf City, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	N. Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	N. Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	N. Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	N. Topsail Beach, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	N. Topsail Island, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	N. Topsail Island, NC
Date	September 9, 1996

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Emerald Isle, NC
Date	September 10, 1996

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, North Carolina

Town or Street	Atlantic Beach, NC
Date	September 10, 1996

Dewberry & Davis

APPENDIX D

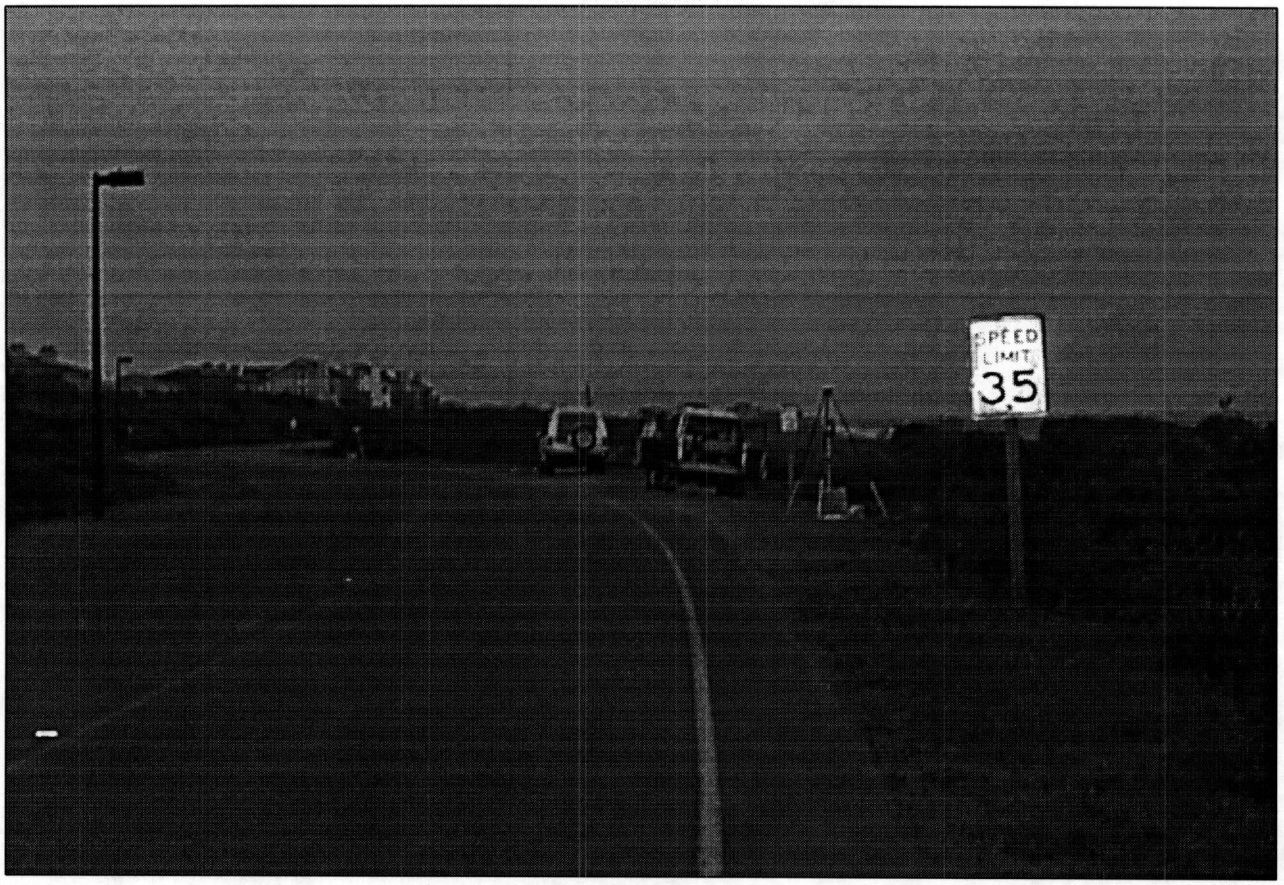
HIGH WATER MARK INFORMATION SHEETS
with
LOCATION, DESCRIPTION
& DIGITAL PHOTOGRAPHS

Hurricane Fran, September 1996

Mark No.	1	D&D Station No.	hwm 2010
Latitude	33:55'01.38282"		
Longitude	78:01'04.07487"		
HWM Elevation(ft)	5.4	Date	September 8, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Southport, NC		
Address	Intersection of N. Davis St. and East Bay St.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

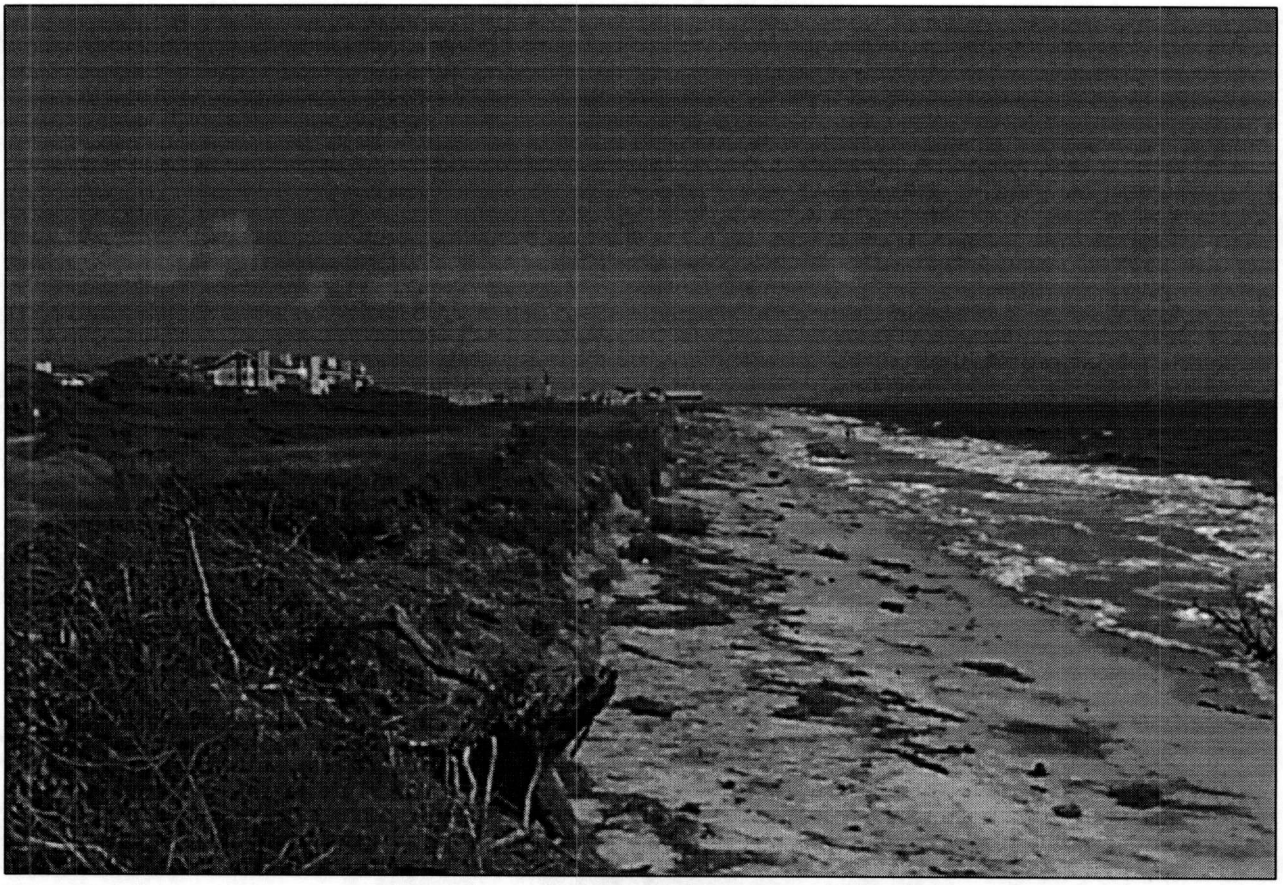


Hurricane Fran, September 1996

Mark No.	2	D&D Station No.	hwm 2011
Latitude	33:53'59.41651"		
Longitude	78:03'51.12476"		
HWM Elevation(ft)	11.2	Date	September 8, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Caswell Beach, NC		
Address	Beach Access along Country Club Dr.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

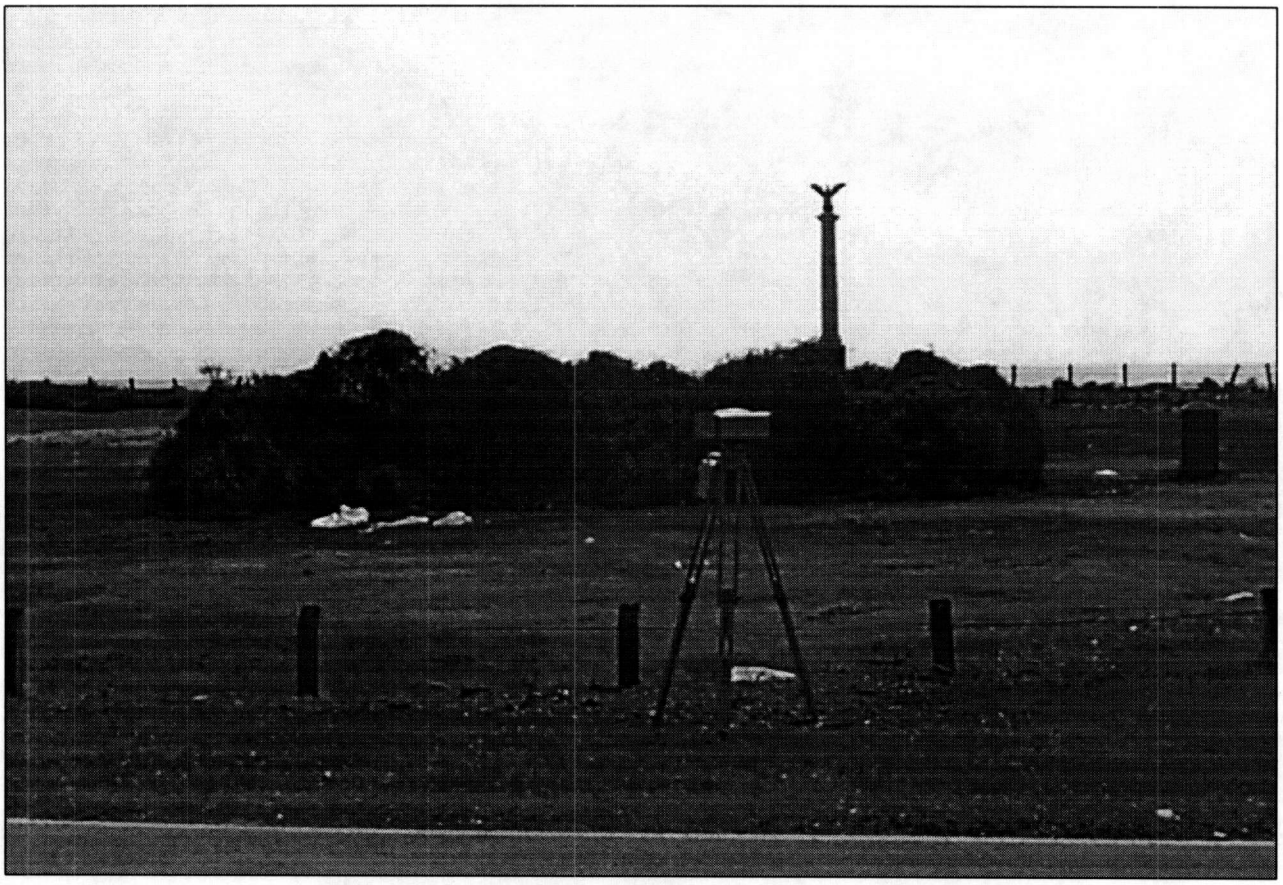


Hurricane Fran, September 1996

Mark No.	3	D&D Station No.	hwm 2013
Latitude	33:53'59.24127"		
Longitude	78:03'51.30939"		
HWM Elevation(ft)	12.2	Date	September 8, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Caswell Beach, NC		
Address	Dune ridge along Country Club Dr.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

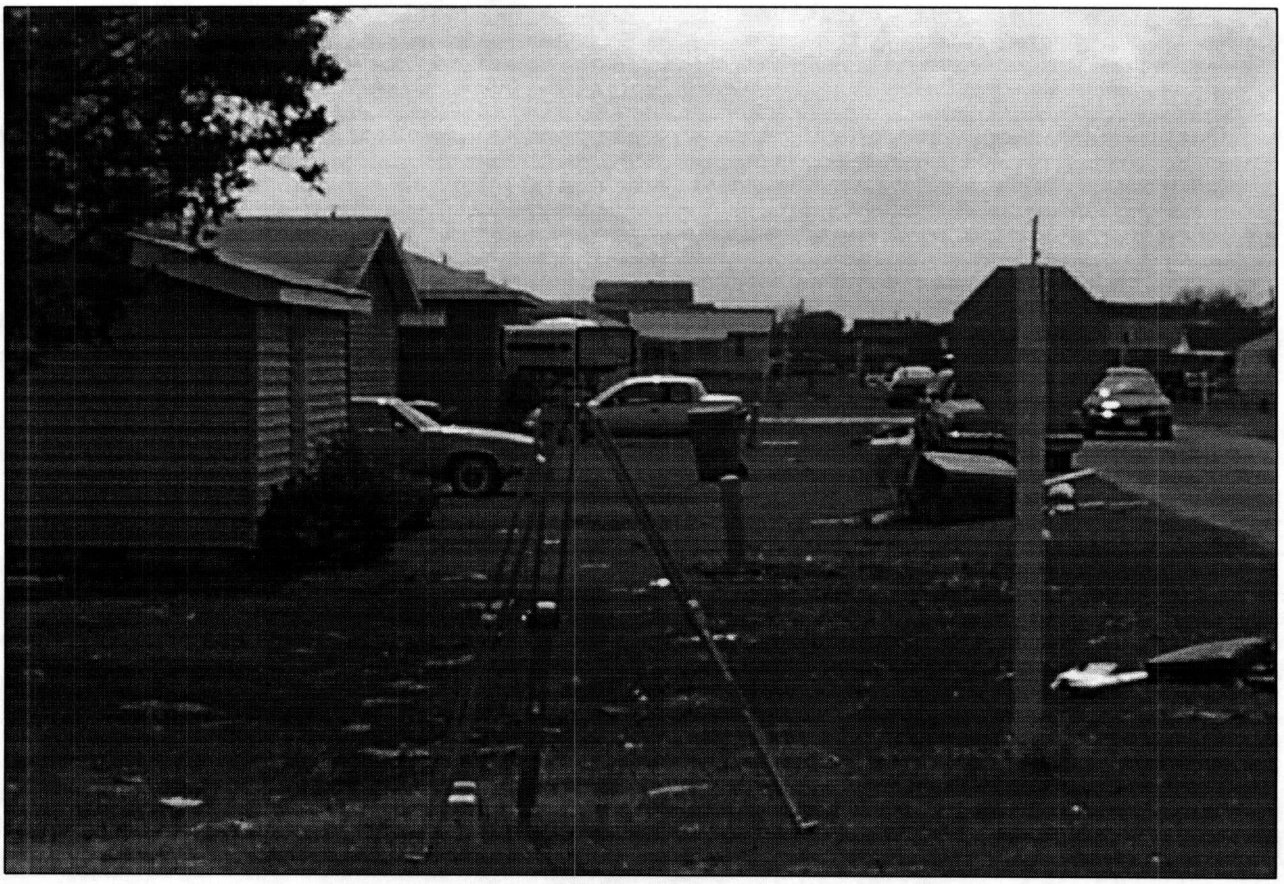


Hurricane Fran, September 1996

Mark No.	4	D&D Station No.	hwm 2014
Latitude	33:58'10.66001"		
Longitude	77:55'08.05241"		
HWM Elevation(ft)	12.5	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Kure Beach, NC		
Address	Ft. Fisher Blvd. near Unknown Confederate Soldier memorial		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis



Hurricane Fran, September 1996

Mark No.	5	D&D Station No.	hwm 2015
Latitude	33:59'32.48636"		
Longitude	77:54'33.77071"		
HWM Elevation(ft)	15.3	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Kure Beach, NC		
Address	Intersection of G Ave. and Third St.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

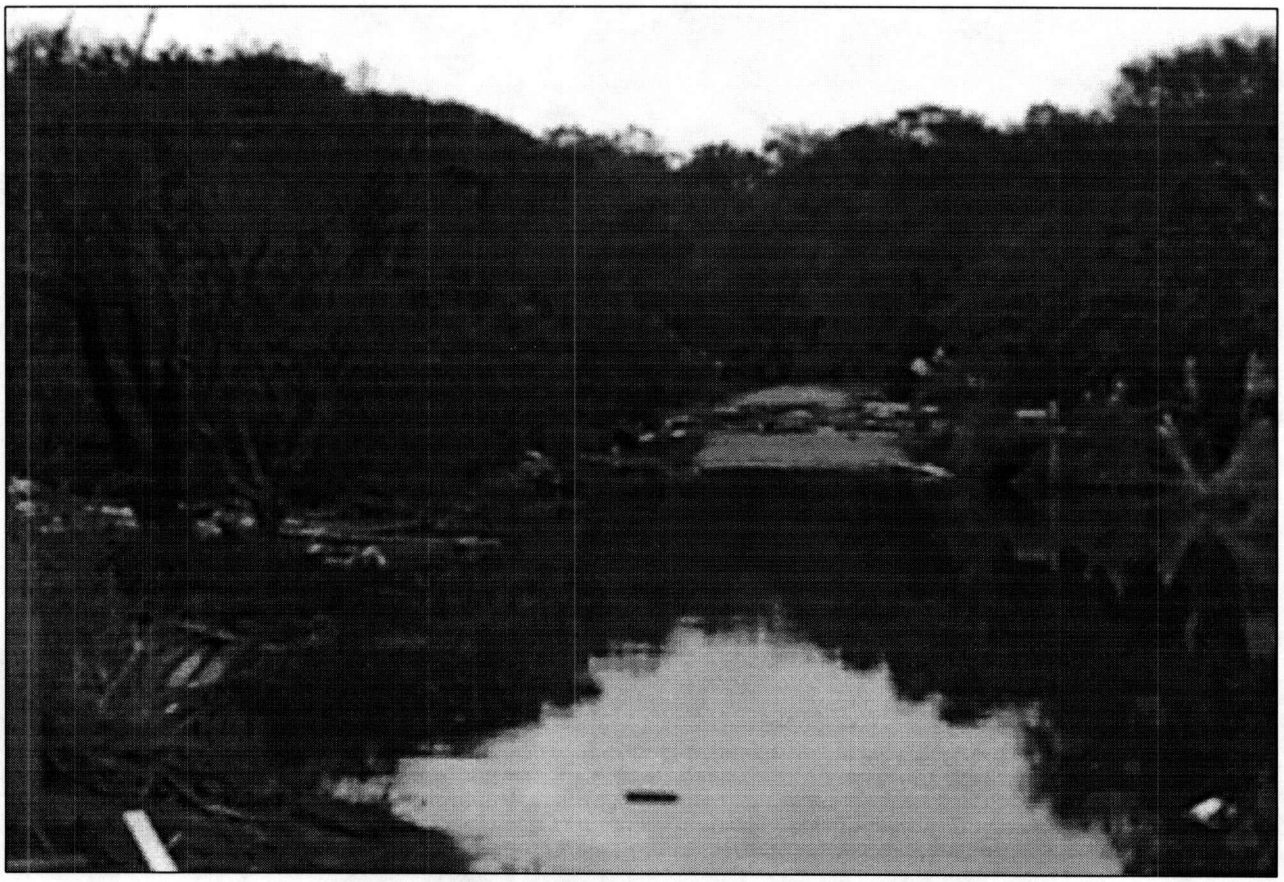
Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	6	D&D Station No.	hwm 2017
Latitude	33:59'21.23023"		
Longitude	77:54'36.26851"		
HWM Elevation(ft)	15.4	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Kure Beach, NC		
Address	Intersection of Ft. Fisher Blvd. and E Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis



Hurricane Fran, September 1996

Mark No.	7	D&D Station No.	hwm 2018
Latitude	33:59'12.64196"		
Longitude	77:54'42.01731"		
HWM Elevation(ft)	15.1	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Kure Beach, NC		
Address	Intersection of Ft. Fisher Blvd. and White Oak Ct.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	8	D&D Station No.	hwm 2021
Latitude	34:01'34.57467"		
Longitude	77:53'44.43306"		
HWM Elevation(ft)	9.8	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Carolina Beach, NC		
Address	809 Lake Park Blvd. South		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	9	D&D Station No.	hwm 2022
Latitude	34:01'34.57480"		
Longitude	77:53'44.43260"		
HWM Elevation(ft)	9.9	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	O
Street or Town	Carolina Beach, NC		
Address	809 Lake Park Blvd. South		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	10	D&D Station No.	hwm 2023
Latitude	34:01'36.52508"		
Longitude	77:53'56.32880		
HWM Elevation(ft)	9.9	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Carolina Beach, NC		
Address	300 Third St.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	11	D&D Station No.	hwm 2026
Latitude	34:03'29.32635"		
Longitude	77:52'56.16151"		
HWM Elevation(ft)	10	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Carolina Beach, NC		
Address	Canal Dr. at Breakers Apartments - Building A / Apt. 4		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	12	D&D Station No.	hwm 2027
Latitude	34:03'29.46301"		
Longitude	77:52'53.85263"		
HWM Elevation(ft)	11.1	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Carolina Beach, NC		
Address	1818 Canal Dr.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	13	D&D Station No.	hwm 2028
Latitude	34:03'29.59386"		
Longitude	77:52'53.87509"		
HWM Elevation(ft)	11.1	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	O
Street or Town	Carolina Beach, NC		
Address	1818 Canal Dr.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	14	D&D Station No.	wr 1011
Latitude	34:11'20.35347"		
Longitude	77:48'36.80383"		
HWM Elevation(ft)	10.7	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	838 S. Lumina Ave. and intersection with Northrup St.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	15	D&D Station No.	wr 1012
Latitude	34:11'19.79831"		
Longitude	77:48'35.41748"		
HWM Elevation(ft)	10.7	Date	September 7, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Wrightsville Beach, NC		
Address	841 S. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	16	D&D Station No.	wr 1013
Latitude	34:11'21.13817"		
Longitude	77:48'34.49076"		
HWM Elevation(ft)	10.6	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	835 S. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	17	D&D Station No.	wr 1014
Latitude	34:11'21.60020"		
Longitude	77:48'40.29231"		
HWM Elevation(ft)	10.9	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	900 Schloss St. and intersection with Northrup St.		

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	18	D&D Station No.	wr 1003
Latitude	34:12'38.61291"		
Longitude	77:47'54.07096"		
HWM Elevation(ft)	9.5	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	14 Channel Dr. (Harbour Island)		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	19	D&D Station No.	wr 1004
Latitude	34:12'38.61507"		
Longitude	77:47'54.07518"		
HWM Elevation(ft)	11	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	O
Street or Town	Wrightsville Beach, NC		
Address	16 Channel Dr. (Harbour Island)		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	20	D&D Station No.	wr 1005
Latitude	34:12'33.25027"		
Longitude	77:47'41.57267"		
HWM Elevation(ft)	9.3	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	Jerry Allen's Bar & Grill on N. Lumina Ave.		

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	21	D&D Station No.	wr 1006
Latitude	34:12'33.10967"		
Longitude	77:47'41.68870"		
HWM Elevation(ft)	10.7	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	O
Street or Town	Wrightsville Beach, NC		
Address	Jerry Allen's Bar & Grill on N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	22	D&D Station No.	wr 1007
Latitude	34:12'33.36276"		
Longitude	77:47'42.29988"		
HWM Elevation(ft)	10.7	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	Buddy's Crabhouse at 35 N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

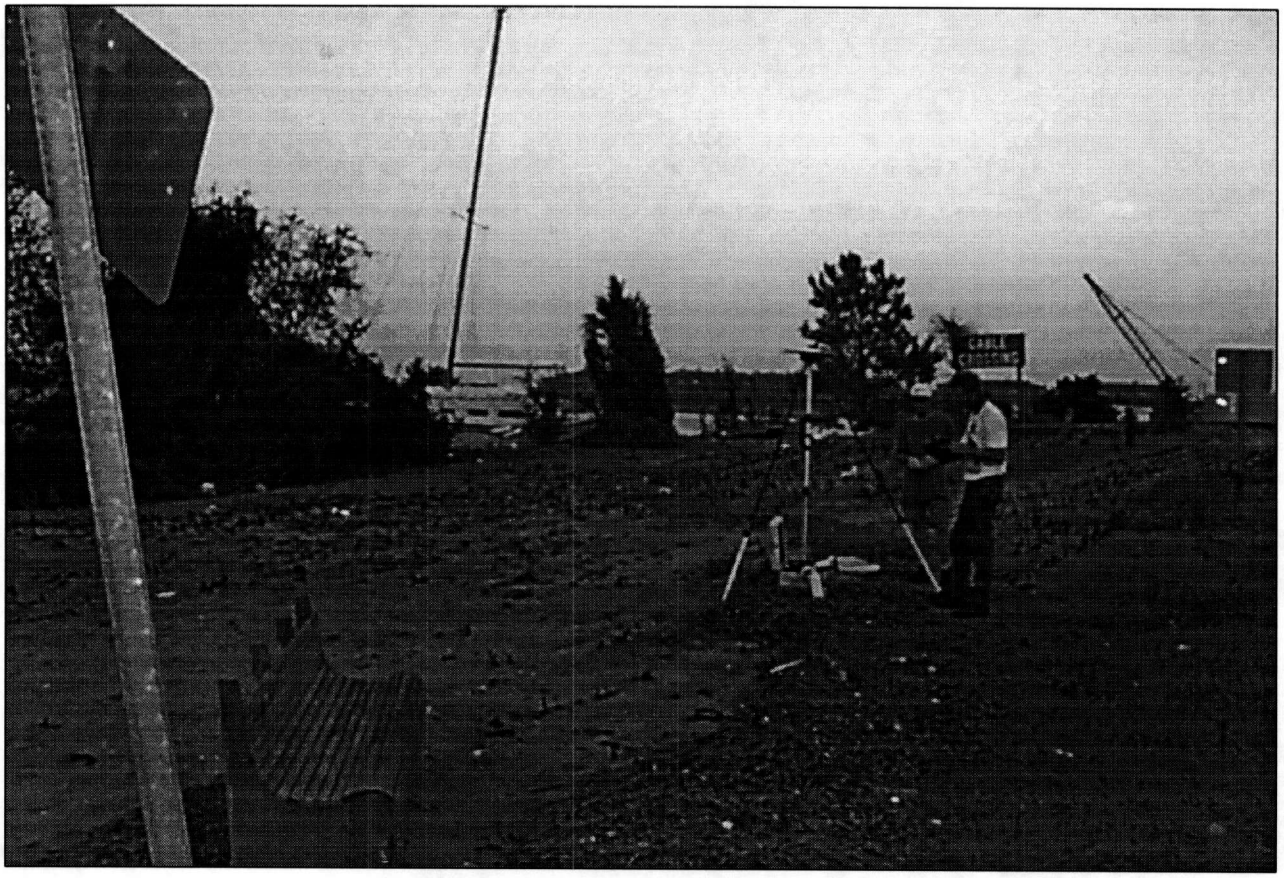
Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	22	D&D Station No.	wr 1007
Latitude	34:12'33.36276"		
Longitude	77:47'42.29988"		
HWM Elevation(ft)	10.7	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	Buddy's Crabhouse at 35 N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis



Hurricane Fran, September 1996

Mark No.	23	D&D Station No.	wr 2007
Latitude	34:13'08.96461"		
Longitude	77:48'49.95187"		
HWM Elevation(ft)	10.6	Date	September 7, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Wrightsville, NC		
Address	Intersection Wrightsville Ave (SR 74) and Airlie Rd.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	24	D&D Station No.	wr 2003
Latitude	34:13'25.61844"		
Longitude	77:47'06.58416"		
HWM Elevation(ft)	10.8	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	2101 N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

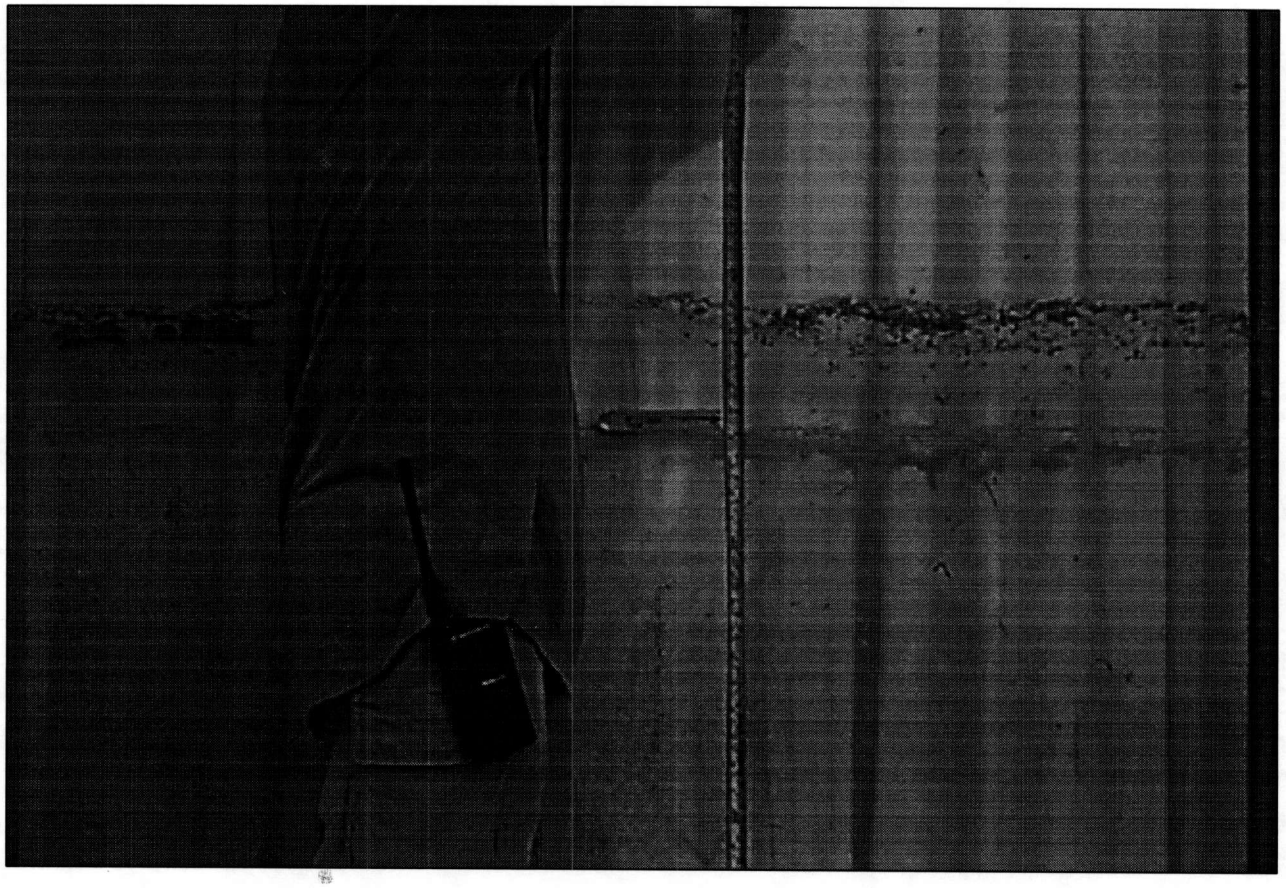
Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	25	D&D Station No.	wr 2004
Latitude	34:13'25.61910"		
Longitude	77:47'06.58427"		
HWM Elevation(ft)	11.1	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	O
Street or Town	Wrightsville Beach, NC		
Address	2101 N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

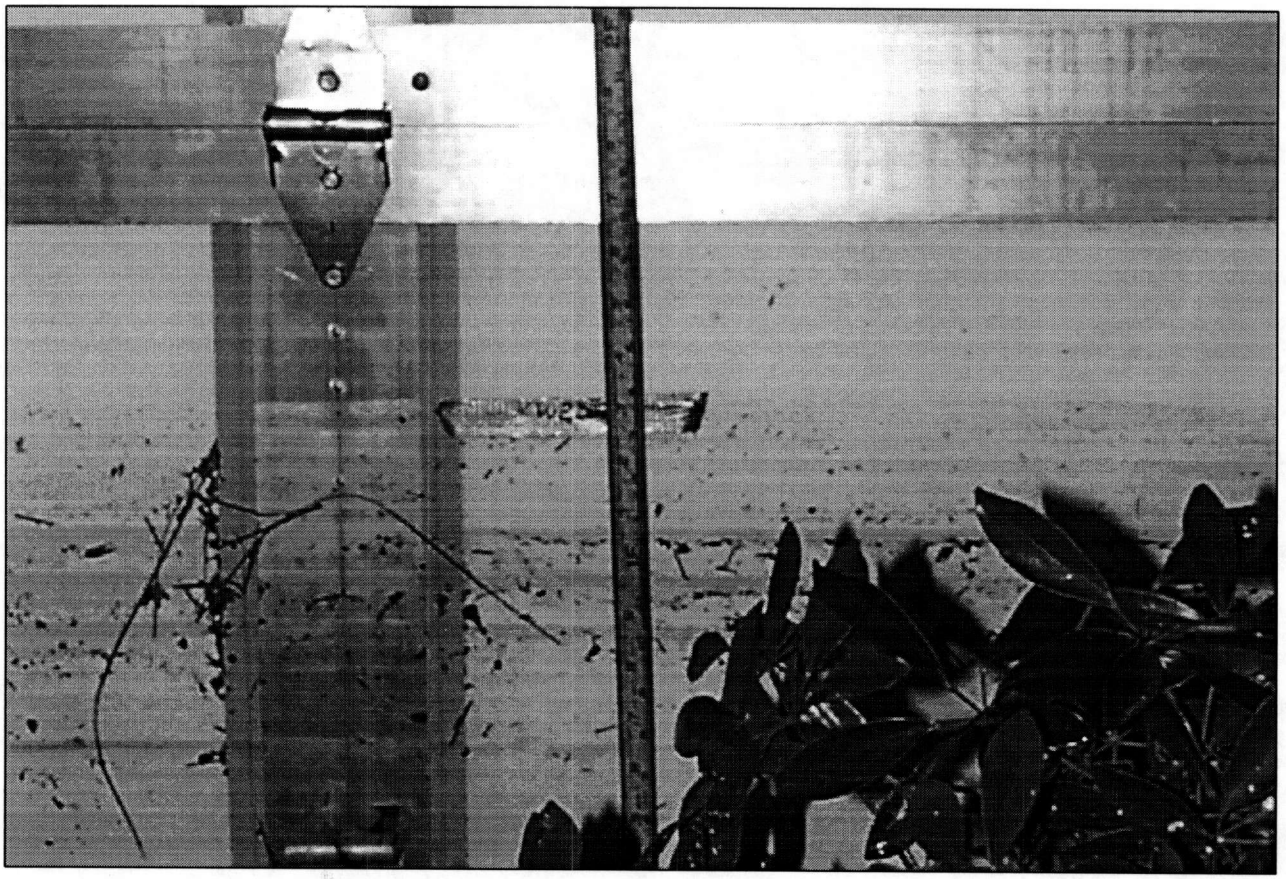


Hurricane Fran, September 1996

Mark No.	26	D&D Station No.	wr 2005
Latitude	34:13'26.76112"		
Longitude	77:47'06.62424"		
HWM Elevation(ft)	10.7	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	2103 N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis



Hurricane Fran, September 1996

Mark No.	27	D&D Station No.	wr 2006
Latitude	34:13'26.48461"		
Longitude	77:47'03.90724"		
HWM Elevation(ft)	11.3	Date	September 7, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Wrightsville Beach, NC		
Address	2104 N. Lumina Ave.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	28	D&D Station No.	f8i 1016
Latitude	34:16'24.98817"		
Longitude	77:44'27.11464"		
HWM Elevation(ft)	11.9	Date	September 8, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Figure Eight Island, NC		
Address	217 Beach Road North		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	29	D&D Station No.	f8i 1017
Latitude	34:16'23.57256"		
Longitude	77:44'28.91051"		
HWM Elevation(ft)	10	Date	September 8, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Figure Eight Island, NC		
Address	213 Beach Road North		

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	30	D&D Station No.	f8i 1018
Latitude	34:16'16.74826		
Longitude	77:44'32.64324"		
HWM Elevation(ft)	12.7	Date	September 8, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Figure Eight Island, NC		
Address	200 Beach Road North		

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	31	D&D Station No.	f8i 1019
Latitude	34:16'32.34257"		
Longitude	77:45'42.57412"		
HWM Elevation(ft)	11.6	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Figure Eight Island, NC		
Address	Bridge Road at entrance gate and ICW drawbridge		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	32	D&D Station No.	hmp 1015
Latitude	34:21'20.89775"		
Longitude	77:41'06.10811"		
HWM Elevation(ft)	12.6	Date	September 8, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Howard Landing, NC		
Address	Howard Marina boat ramp access road		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	33	D&D Station No.	tsl 1023
Latitude	34:21'42.66183"		
Longitude	77:38'06.31168"		
HWM Elevation(ft)	10.7	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Topsail Beach, NC		
Address	Intersection Scott Ave. and SR 50 at Emma Anderson Memorial Chapel		

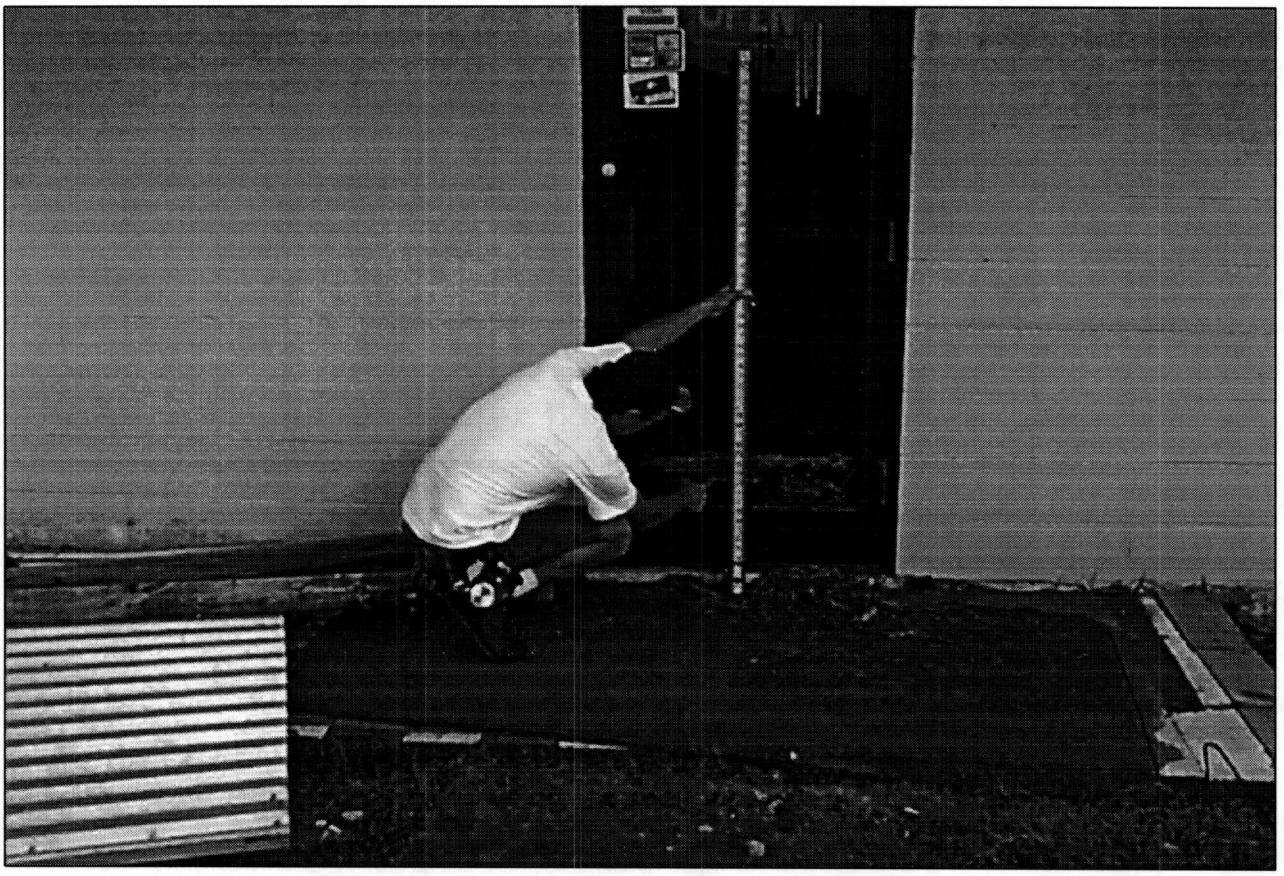
Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	34	D&D Station No.	tsl 1022
Latitude	34:21'45.90405"		
Longitude	77:38'06.01514"		
HWM Elevation(ft)	10.4	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Topsail Beach, NC		
Address	1034 Channel Blvd.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis



Hurricane Fran, September 1996

Mark No.	35	D&D Station No.	tsl 1024
Latitude	34:25'39.73530"		
Longitude	77:32'39.02698"		
HWM Elevation(ft)	8.1	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Surf City, NC		
Address	100 N. New River Rd. (SR 210) at Dragon Garden restaurant		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	36	D&D Station No.	tsl 1020
Latitude	34:27'29.73729"		
Longitude	77:29'23.99367"		
HWM Elevation(ft)	11.5	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	North Topsail Beach, NC		
Address	2810 N. New River Rd./Island Dr. (SR 210)		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	37	D&D Station No.	tsl 1021
Latitude	34:30'05.69617"		
Longitude	77:24'03.15934"		
HWM Elevation(ft)	10.9	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	north Topsail Island, NC		
Address	790 New River Inlet Rd. at Villa Capriani resort		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	38	D&D Station No.	tsl 1302
Latitude	34:26'00.04332"		
Longitude	77:33'06.37888"		
HWM Elevation(ft)	9.2	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Surf City, NC		
Address	N. side SR 50 access road to Surf City at Thomas Seafood		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	39	D&D Station No.	tsl 1301
Latitude	34:26'00.46678"		
Longitude	77:33'04.50006"		
HWM Elevation(ft)	8.8	Date	September 9, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Surf City, NC		
Address	S. side SR 50 access road to Surf City at One Stop Bait & Tackle Shop		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	40	D&D Station No.	tsl 1303
Latitude	34:25'19.84188"		
Longitude	77:35'10.85800"		
HWM Elevation(ft)	9.6	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Watts Landing, NC		
Address	Watts Landing Road		

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	41	D&D Station No.	tsl 1304
Latitude	34:28'16.70391"		
Longitude	77:30'36.34420"		
HWM Elevation(ft)	8.8	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Morris Landing, NC		
Address	access road to Morris Landing		

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	42	D&D Station No.	tsl 1305
Latitude	34:29'14.99212"		
Longitude	77:28'35.56652"		
HWM Elevation(ft)	9.4	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Thomas Landing, NC		
Address	access road to Thomas Landing		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	43	D&D Station No.	tsl 1306
Latitude	34:30'24.30156"		
Longitude	77:25'57.43703"		
HWM Elevation(ft)	8.6	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	North Topsail Island, NC		
Address	W. side SR 210 access road to north Topsail Island		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	44	D&D Station No.	tsl 1307
Latitude	34:34'36.41389"		
Longitude	77:23'56.52506"		
HWM Elevation(ft)	7.3	Date	September 9, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Sneads Ferry, NC		
Address	E. side SR 210 at New River bridge and Ferry Point		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	45	D&D Station No.	hwm 3000
Latitude	34:40'19.00739"		
Longitude	77:08'14.29337"		
HWM Elevation(ft)	8.9	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Hubert, NC		
Address	103 John L. Hurst Dr. at Hammock Beach State Park		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	46	D&D Station No.	hwm 3001
Latitude	34:41'16.16202"		
Longitude	77:07'01.83573"		
HWM Elevation(ft)	8.1	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Swansboro, NC		
Address	108 W. Corbett Ave. (SR 24) at Swansboro Bicentennial Park		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	47	D&D Station No.	hwm 2029
Latitude	34:40'46.85708"		
Longitude	77:04'02.43145"		
HWM Elevation(ft)	7.4	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Bogue Sound, NC		
Address	N.W. side of B. Cameron Langston Bridge (SR 58)		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	48	D&D Station No.	hwm 2030
Latitude	34:38'41.69710"		
Longitude	77:05'52.30890"		
HWM Elevation(ft)	7.3	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Bogue Inlet, NC		
Address	14803 Inlet Drive on Bogue Island		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	49	D&D Station No.	ftm 1029
Latitude	34:41'42.53932"		
Longitude	76:40'40.97776"		
HWM Elevation(ft)	5.9	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Fort Macon, NC		
Address	E. Ft. Macon Rd. at Ft. Macon State Park and Beaufort Inlet		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	50	D&D Station No.	mhc 1030
Latitude	34:43'31.45305"		
Longitude	76:47'04.70947"		
HWM Elevation(ft)	7.3	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Morehead City, NC		
Address	4801 S. Shore Dr. (The Bluffs) and intersection with Mansfield Parkwa		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	51	D&D Station No.	mc 1025
Latitude	34:43'10.46738"		
Longitude	76:42'55.78974"		
HWM Elevation(ft)	5.2	Date	September 10, 1996
HWM Type	Mudline	Outside or Inside	I
Street or Town	Morehead City, NC		
Address	913 Sheppard St. and intersection with S. 10th St.		

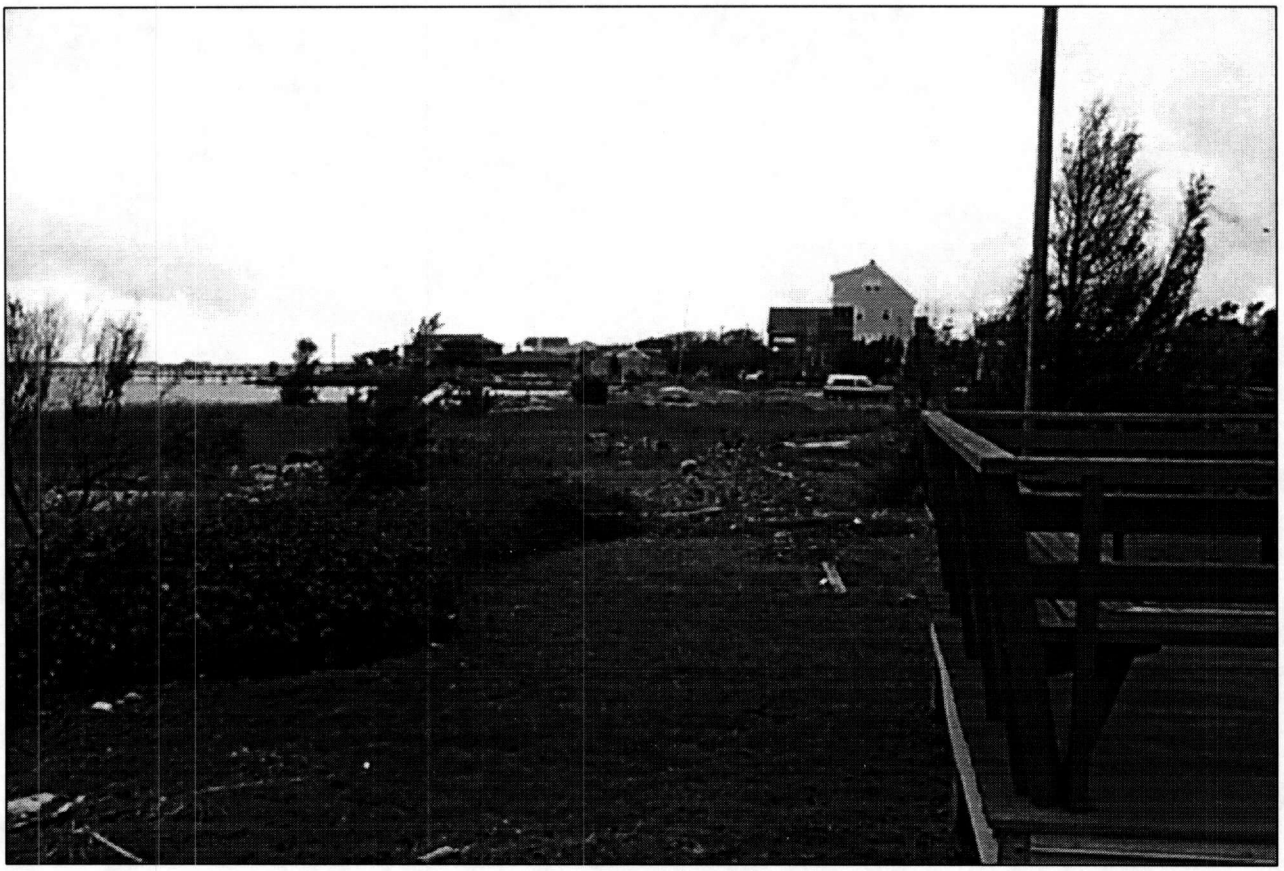
FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis

Hurricane Fran, September 1996

Mark No.	52	D&D Station No.	mc 1026
Latitude	34:43'11.97029"		
Longitude	76:42'56.68453"		
HWM Elevation(ft)	4.8	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Morehead City, NC		
Address	200 S. 10th St. and intersection with Sheppard St.		

Dewberry & Davis

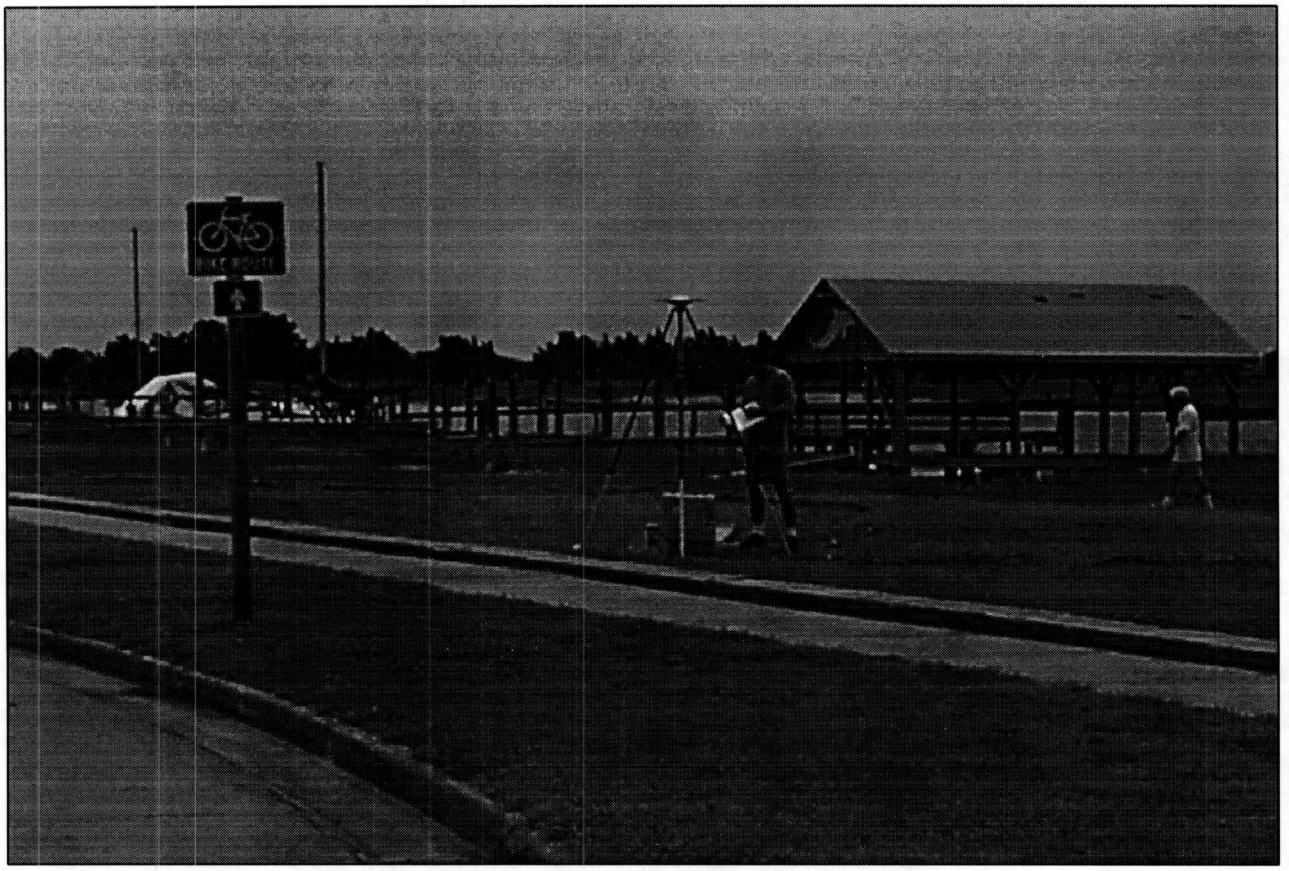


Hurricane Fran, September 1996

Mark No.	53	D&D Station No.	mc 1027
Latitude	34:43'09.27416"		
Longitude	76:42'59.16731"		
HWM Elevation(ft)	4.9	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Morehead City, NC		
Address	1007 Sheppard St.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis



Hurricane Fran, September 1996

Mark No.	54	D&D Station No.	buf 1028
Latitude	34:42'46.93747"		
Longitude	76:39'28.83090"		
HWM Elevation(ft)	4.5	Date	September 10, 1996
HWM Type	Debris	Outside or Inside	O
Street or Town	Beaufort, NC		
Address	1001 Front St. and intersection with Gordon St.		

FEDERAL EMERGENCY MANAGEMENT AGENCY

Dewberry & Davis