Oct. 18, 1984

PRELIMINARY REPORT

HURRICANE DIANA

8 TO 16 SEPTEMBER 1984

by

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Hurricane Diana, with a central pressure of 949 mb and winds of 135 mph just 15 n. miles off the North Carolina coast, threatened to become the most intense storm to strike that coast since Hurricane Hazel in 1954. Fortunately, the hurricane lost much of its strength on a slow anticyclonic loop over the Atlantic just offshore from Wilmington and made landfall in the Cape Fear area as a borderline category 1/category 2 hurricane on the Saffir/Simpson scale.

The system that was to become Hurricane Diana formed just north of the Bahamas at the western end of a quasistationary frontal trough. Twenty-four hours earlier, a cold front oriented northeast/southwest moved into the Bahamas sweeping the remnants of Tropical Depression Arthur northeastward. The synoptic environment in the Bahamas was characterized by a cold low aloft up to 200 mb. Satellite imagery on September 7th documented increasing convection in the area but the system was not well organized. Early on September 8th the convection started to become better organized. A ship report in the area at 1200Z had 35-knot winds. Satellite meteorologists initiated cyclone classifications at 1600Z and recon reports during the afternoon indicated that the system had reached tropical storm strength.

The course of Diana thereafter was difficult to predict. Initially, the weak steering currents carried it toward the central portion of Florida's east coast where it threatened the Cape Canaveral area. About 50 miles offshore the storm turned northwestward on a course parallel to the Florida coastline. While abreast of Daytona Beach it took a jog to the left on a heading toward the Jacksonville area. Fifty miles east southeast of St. Augustine, the storm began a turn to the north and then northeast on a track toward the North Carolina coast. Diana reached hurricane strength soon after turning on that course (see Figure 1 and Table 1). During that period a Canadian frontal system was advancing toward the eastern United States and there was some uncertainty as to its steering effects on Diana even though the height falls aloft ahead of the storm were appreciable.

Height rises appeared ahead of the system as Diana was approaching the North Carolina coast. The system looped to the right and began a westward track to the coast in response to those rises. At the same time, weakening occurred with cold air intru-

sion into the storm. The center made landfall in the Cape Fear area near 3:00 a.m. EDT... 0700 GMT ... September 13th with a minimum central pressure of 979 mb (see Figures 2 and 3). That pressure corresponds to a minimal category 2 on the Saffir/Simpson scale. Within 12 hours, Diana weakened to a tropical storm while over land. The high pressure area ahead of the storm soon moved eastward and weakened. Meanwhile, the system resumed an easterly course across eastern North Carolina where it emerged off the coast near the Oregon Inlet and strengthened again to just below hurricane strength. The storm passed nearly over NOAA Data Buoys #44044 and #44011 and just north of Sable Island on its northeasterly course to the Newfoundland area where it became extratropical.

Throughout most of its history, Diana was embedded in a relatively cool environment. The typical outflow pattern aloft was not observed until near landfall because of cold trough conditions persisting aloft to the southwest of the system. Accordingly, and because of interacting with mid-latitude systems, the dynamic models yielded better forecasts than the other models.

Diana made landfall with highest sustained winds near 80 knots ... 92 m.p.h. The highest observed winds, however, occurred 24 to 30 hours earlier when the storm was beginning its anticyclonic loop just offshore from Wilmington. The Coast Guard station at Oak Island reported sustained winds of 115 m.p.h. and Ft. Fisher Air Force station had gusts exceeding that value (see table 2). Although Diana affected Cape Fear and perhaps the extreme southern tips of Brunswick and New Hanover Counties as a category 3 hurricane, those areas are sparsely populated and the main impact of the storm on the overall area was as a minimal category 2 hurricane after making the loop east of Wilmington.

The storm center passed over Green Swamp; Lake Waccamaw; just east of Elizabethtown, Warsaw and Kinston; between Belhaven and Swanquarter; over Lake Mattamuskeet; across Croaton Sound and the Oregon Inlet on the Outer Banks ... all sparsely populated areas. Thus, pressure, wind and rainfall conditions while the storm was inland must necessarily be based on sparse reports. Those reports indicate a marked decrease in wind speeds inland while storm winds persisted on the coast.

Rainfall approached 14 inches in the Wilmington area with, again, marked reductions inland. The center of Diana passed within 20 miles of a farm in Beaufort County owned by relatives of the writer and they had less than 4 inches of rain and winds no higher than 25 m.p.h. during the entire storm.

Widespread fresh water flooding occurred in New Hanover, Brunswick, Pender, Columbus, Bladen, Sampson, and Duplin Counties, with dam failures reported at Boiling Springs, Roseboro, and Faison.

Tidal flooding information is very sketchy at this point, but estimates of 4-5 feet above normal have been made for the

Wilmington, Ft. Macon, Myrtle Beach, and Carolina Beach areas. Beach erosion was minor along the affected coastal area except for southern Pender County south along New Hanover beaches where erosion was severe.

There were no confirmed tornadoes associated with Diana.

There were three deaths related to Diana. A Wrightsville Beach person suffered a heart attack while making hurricane preparations. The Brunswick County Shelter Manager was killed in an automobile accident. The third death occurred when a person drove his car into a concrete abutment at a flooded bridge in Sampson County. There were other traffic accidents related to flooded roads.

Most of the damages were from falling trees with some roof damage on the barrier islands. There was widespread power line damage in New Hanover County. About 4500 homes were without power in southeast North Carolina ... some for two to three days.

The Carolina Power and Light Brunswick Nuclear Power Plant experienced a direct hit by Diana, making it the the first nuclear power plant to be struck by a hurricane. Recorder charts from the site indicated sustained winds of 75 m.p.h. with gusts to 95 m.p.h. Although some yard damage was experienced, there was no damage to the plant.

Dollar losses in the Myrtle Beach and Wilmington areas are presently estimated at 65.5 million dollars.

Probabilities were issued beginning at 6:00 p.m. EDT on September 8th and terminated after the 6:00 a.m. EDT advisory on September 11th. They, coupled with the formal advisories during that 60-hour period, provided substantial lead times for planning. They were terminated after 6:00 a.m. on the 11th because all precautions should have been taken by then and landfall was anticipated. They were not resumed with the loop east of Wilmington, even though landfall actually did not occur for 45 more hours, since preparations were completed. Once the hurricane was downgraded to a storm inland, and with east to northeast steering established, it was not deemed necessary to resume probabilities again for east coast planning because of the track and the fact that re-strengthening to a hurricane was unlikely (see tables 3 and 4).

TABLE 1

PRELIMINARY BEST TRACK - HURRICANE DIANA
8 TO 16 SEPTEMBER 1984

DATE	TIME (GMT)	POSITION LAT.	POSITION LONG.	PRESSURE (MB)	WIND (KT)	STAGE
9/8	1200	28.5	77.4	1008	35	Tropical Storm
	1800	28.6	78.3	1006	40	"
9/9	0000	28.5	79.2	1004	45	"
	0600	28.6	79.7	1002	50	"
	1200	29.0	79.9	1000	55	"
	1800	29.4	80.1	995	60	"
9/10	0000	29.7	80.4	994	60	"
	0600	30.1	80.3	995	60	"
	1200	30.5	80.0	991	65	Hurricane
	1800	30.8	79.6	986	70	"
9/11	0000	31.3	79.1	980	80	"
	0600	31.8	78.7	973	85	"
	1200	32.6	78.4	960	100	"
	1800	33.4	78.0	952	110	"
9/12	0000	33.9	77.7	949	115	"
	0600	34.0	77.4	963	95	"
	1200	34.0	77.2	967	95	"
	1800	33.9	77.1	970	90	"
9/13	0000	33.8	77.4	972	85	"
	0600	33.9	77.9	978	80	"
	1200	34.0	78.3	990	65	"
	1800	34.3	78.5	999	55	Tropical Storm
9/14	0000	34.6	78.5	1003	45	"
	0600	35.0	78.0	1005	40	"
	1200	35.3	77.1	1003	45	"
	1800	35.6	76.0	1000	50	"
9/15	0000	36.2	74.4	997	55	"
	0600	37.2	72.7	994	60	"
	1200	38.5	70.3	992	60	"
	1800	41.0	66.0	992	60	"
9/16	0000	43.5	61.9	994	60	"
	0600	46.0	57.8	995	60	Extratropical
9/13	0700	33.9	78.0	979	80	Landfall Minimal Cat. 2
9/11	2355	33.8	77.7	949 Ext.	115	Minimum Pressure Strong Cat. 3

HURRICANE DIANA

8-16 SEPTEMBER 1984

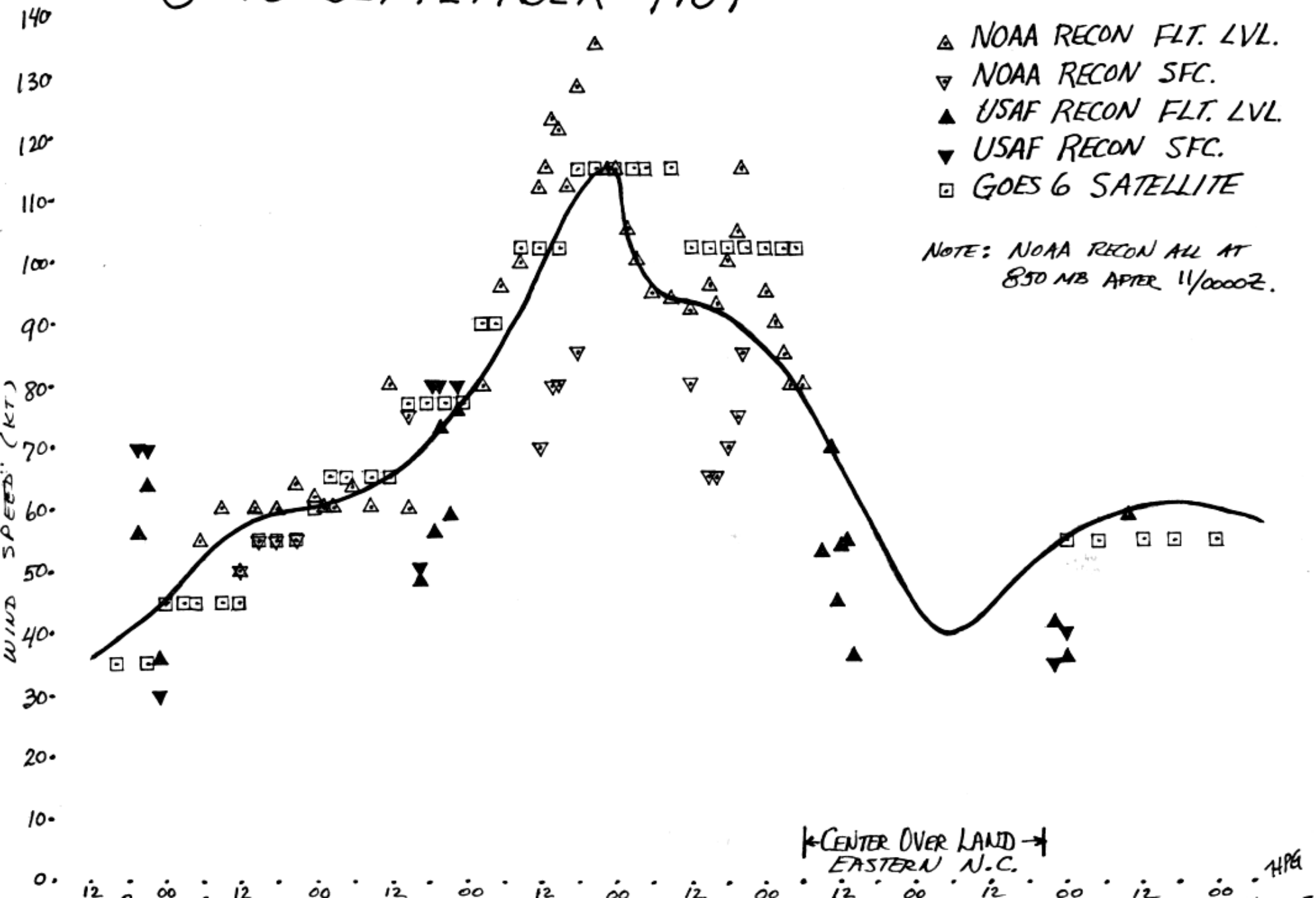

FIG. 2. HURRICANE DIANA
8-16 SEPTEMBER 1984

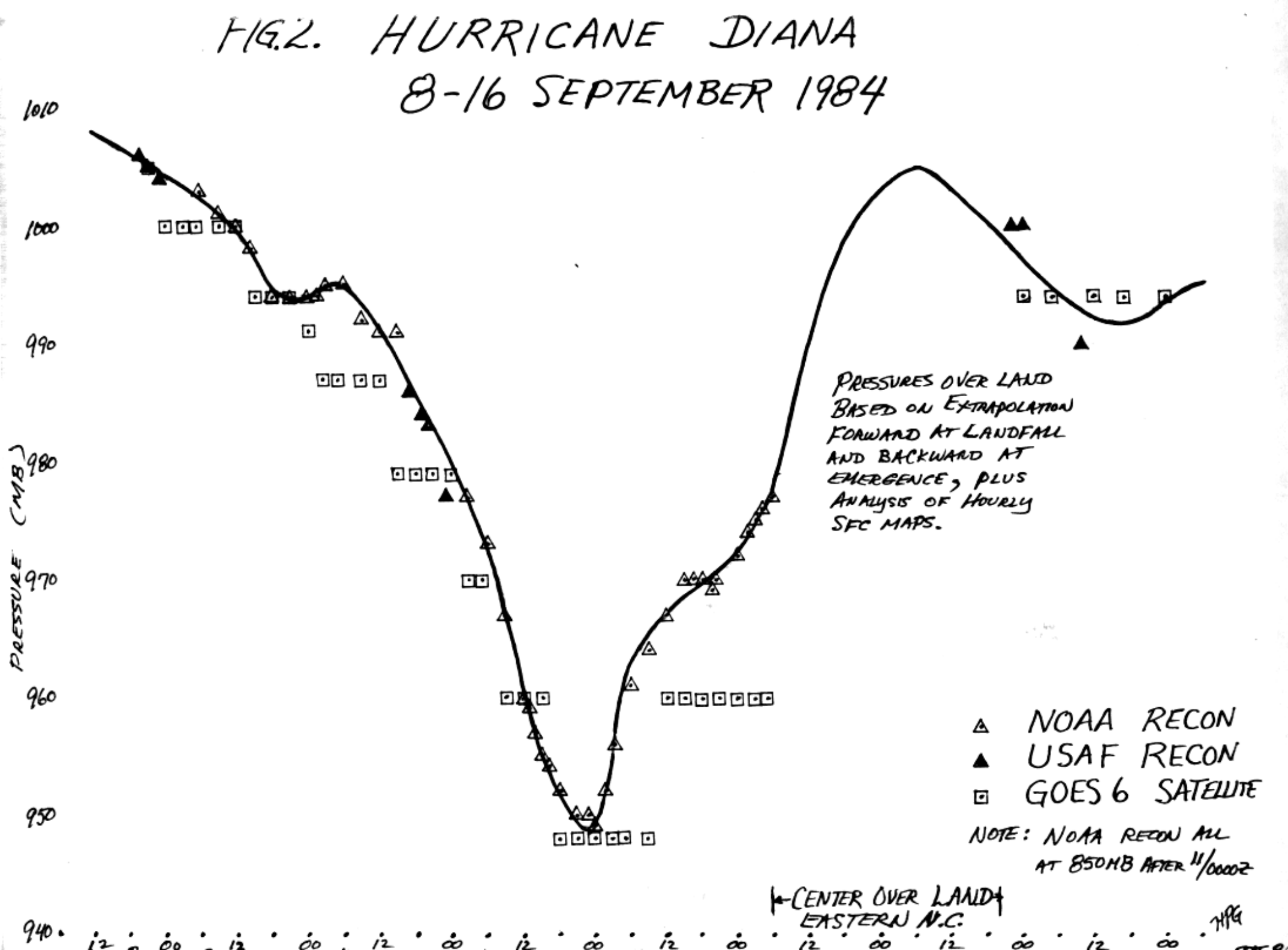

TABLE 2 (Cont'd)

MISCELLANEOUS WIND REPORTS:

	DATE/ TIME		SUSTAINED MPH	SUSTAINED KT	GUSTS MPH	GUSTS KT
Ft. Macon	Unk		~~35-58~~ 40	~~30-50~~ 35	58	50
Diamond Shoals	14/1200Z		~~45~~ 49	~~39~~ 43	~~64~~66	56
Duck DARC	15/0000Z		28	24	53	46
Ft. Fisher AF Station	12/0610Z		69-92	60-80	> 115	> 100
Shallotte, NC	13/0905Z		50-~~70~~	43-~~61~~	70	61
Brunswick County	13/1030Z				<120	<104
New Hanover County	13/0640Z	1 mi. N of Ogden	35	30	75	65
	13/0653Z	County Airport	44	38	74	64
Carolina Beach	13/0345Z		86	75		
Holden Beach	11/2250Z		70	61		
Wilmington CG Loran Sta.	12/0610Z		> 91	> 79		
Wrightsville Beach	13/0100Z		35	30	58	50
Kure Beach	12/0423Z		69-81	60-70		
15 NW Beaufort (unoff.)	Unk				75	65
Supply, NC	11/2327Z		50-60	43-52		

MISCELLANEOUS TIDE REPORTS:

	FT. ABV. NORMAL
Ft. Macon	4
New River	2
Frisco Pier	1.4
Oriental, NC	2
Lower Chesapeake Bay	2
Myrtle Beach	3-5

MISCELLANEOUS PRESSURE REPORTS:

	IN.	MB
Holden Beach	29.56	1001
Suppey, NC	29.62	1003

TABLE 3

CHANCES OF DIANA PASSING WITHIN 65 MILES OF THE LISTED LOCATIONS BY SEPTEMBER 1984 DATE AND INDICATED TIME. 72-HOUR TOTAL PROBABILITIES IN PERCENT

	ADVISORY DATE/TIME (EDT)												
	8/ 6P	8/ 1030P	9/ 6A	9/ Noon	9/ 4P	9/ 6P	9/ Midnt.	10/ 6A	10/ 9A	10/ Noon	10/ 6P	10/ Midnt.	11/ 6A
West Palm Bch., FL	9	8		4									
Ft. Pierce, FL	22	30	NONE	7									
Cocoa Bch., FL	37	64		18									
Daytona Bch., FL	45	72	ISSUED	56				19	19				
Jacksonville, FL	34	37		36	36	70	38	27	27	15			
Savannah, GA	20	20		29	29	45	31	31	31	25	18	15	12
Charleston, SC	17	17		25	25	28	27	36	36	32	25	27	24
Myrtle Bch., SC	15	14		20	20	21	21	29	29	24	23	26	38
Wilmington, NC	14	13		18	18	19	19	23	23	20	20	22	35
Moorehead City, NC	12	11		16	16	17	17	19	19	18	18	19	27
Cape Hatteras, NC	11	10		14	14	15	15	17	17	15	16	16	20
Norfolk, VA	9	9		12	12	13	13	15	15	12	12	13	16
Ocean City, MD	7	7		9	9	10	10	12	12	10	9	10	12
Atlantic City, NJ	6	5		7	7	8	8	10	10	7	7	8	9
*30.5N 80.5W					70								
*31.0N 80.5W						75	80						
*31.5N 79.8W								75	75				
31.5N 79.5W										75			
*32.5N 78.5W											75		
*32.1N 78.6W												75	
*33.0N 78.0W													75

*Indicates over-water location

TABLE 4

WATCHES AND WARNINGS FOR HURRICANE DIANA 1984

LOCATION	TYPE	EFFECTIVE	DISCONTINUED
South of Virginia Beach, VA to Cape Canaveral, FL	Gale Warnings	9/8/1900Z	
Cape Canaveral, FL to St. Augustine, FL	Gale Warnings		9/9/1600Z
St. Augustine, FL to Oregon Inlet, NC	Hurricane Watch	9/9/2200Z	
North of Brunswick, GA to Oregon Inlet, NC, including Pamlico Sound	Hurricane Warnings	9/10/1300Z	
St. Augustine, FL to Brunswick, GA	Hurricane Watch & Gale Warnings		9/10/1300Z
North of Brunswick, GA to Savannah, GA	Hurricane Warnings		9/11/1200Z
Savannah, GA to Cape Romain, SC	All Warnings		9/11/2000Z
Cape Romain, SC to Myrtle Beach, SC	All Warnings		9/12/1000Z
Myrtle Beach, SC to Cape Romain, SC	Gale Warnings	9/13/0600Z	
Wilmington, NC to Oregon Inlet, NC	Hurricane Warnings		9/13/1000Z
Cape Lookout, NC to South of Virginia Beach, VA	Gale Warnings		9/13/1000Z
North of Wilmington, NC through Cape Lookout, NC	Gale Warnings	9/13/1000Z	
	All Warnings		9/13/2200Z
Cape Lookout, NC to Chincoteague, VA	Gale Warnings	9/14/1000Z	9/15/0400Z

Hurricane Diana Meteorological Data

TABLE 2

METEOROLOGICAL AND HYDROLOGICAL STATISTICS,
HURRICANE DIANA, SEPTEMBER 1984

	STRONGEST WIND							MINIMUM PRESSURE				RAINFALL (IN.)							TIDES
				SUSTAINED		GUSTS											STORM	TOR-	FT. ABV.
LOCATION	STATE	DATE	TIME	MPH	KTS	MPH	KTS	DATE	TIME	IN	MB	DATE	1 HR.	6 HR.	12 HR.	24 HR.	TOTAL	NADOES	(NORMAL)
Vero Beach	FL	8	1656Z	-	-	30	26	9	0851Z	29.84	1011								
Melbourne	FL	9	0000Z	-	-	32	28	9	1000Z	29.83	1010								
Daytona Beach	FL	9	2145Z	25	22	-	-	10	0000Z	29.77	1008	9-10	0.40	1.21	1.90	2.57	2.70	0	2
		9	2329Z	-	-	35	30												
St. Augustine Inlet	FL	10	0110Z	40	35	69	60												
Jacksonville Beach	FL	10	0130Z	29	25	46	40												
Jacksonville WSO	FL	9	1916Z	20	17	25	22	10	0948Z	29.78	1009		1.25	2.64	2.95	3.13		0	2.7
Savannah WSO	GA	9	2145Z	21	18	29	25	-	-	29.83	1010		0.21	0.34	0.36	0.36		0	2.5
USCGS Tybee	GA	10	2200Z	25	22	35	30												
Charleston WSO	SC	11	1803Z	27	23	-	-	11	0800Z	29.75	1008								
Downtown Charleston	SC	11	2100Z	32	28	-	-												1.1
Myrtle Beach AFB	SC	13	1420Z	37	32	-	-	13	-	29.77	1008								
Crescent Beach FSS	SC	13	1550Z	45	39	-	-	13	1550Z	29.71	1006								
Florence FSS	SC	13	1149Z	18	16	30	26	11	1851Z	29.83	1010								
Pee Dee	SC											13		0.69	1.39				
Dillon	SC											13-14				2.00			
Wilmington WSO	NC	13	0640Z	46	40	74	64	12	0050Z	29.53	1000	11-14	1.03	4.93	6.49	7.51	13.72	0	5
Oak Island CGS	NC	11	2345Z	115	100	-	-												
Patrick Henry AP	VA																0.25		
Norfolk Int'l AP	VA	14	1957Z	-	-	38	33										1.08		
Elizabeth City USCG	NC																3.72		
Elizabeth City FSS	NC	14	1900Z	-	-	35	30												
Cape Hatteras	NC	14	1350Z	32	28	45	39	14	1800Z	29.60	1002	14	0.50	1.06	1.28	1.30	1.30	0	1

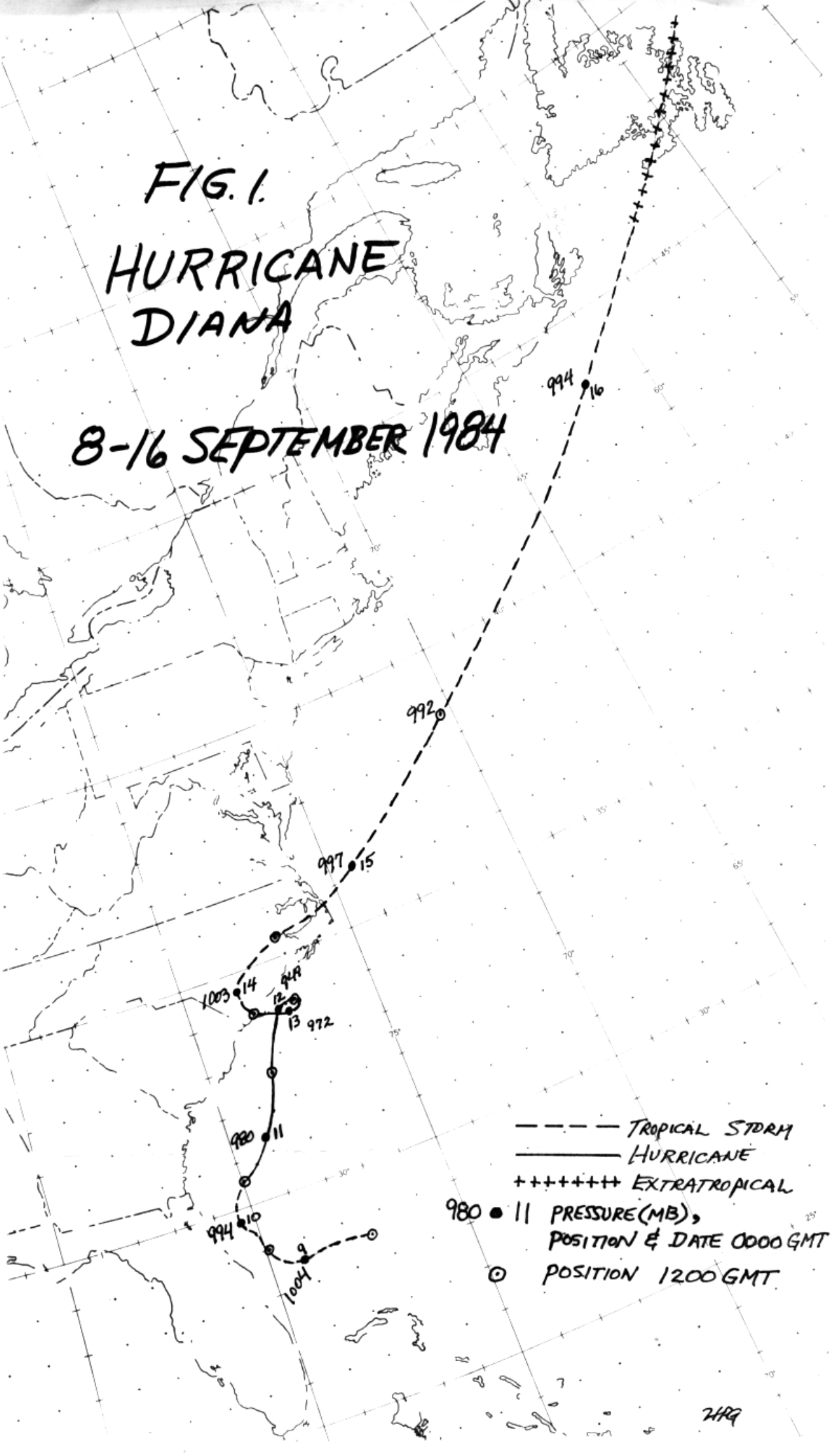
FIG. 1.
HURRICANE
DIANA
8-16 SEPTEMBER 1984
994
16
992
997
15
1003
14
948
12
13
972
980
11
994
10
9
1004
TROPICAL STORM
HURRICANE
EXTRATROPICAL
980 ● 11 PRESSURE(MB), POSITION & DATE 0000 GMT
POSITION 1200 GMT
HRG