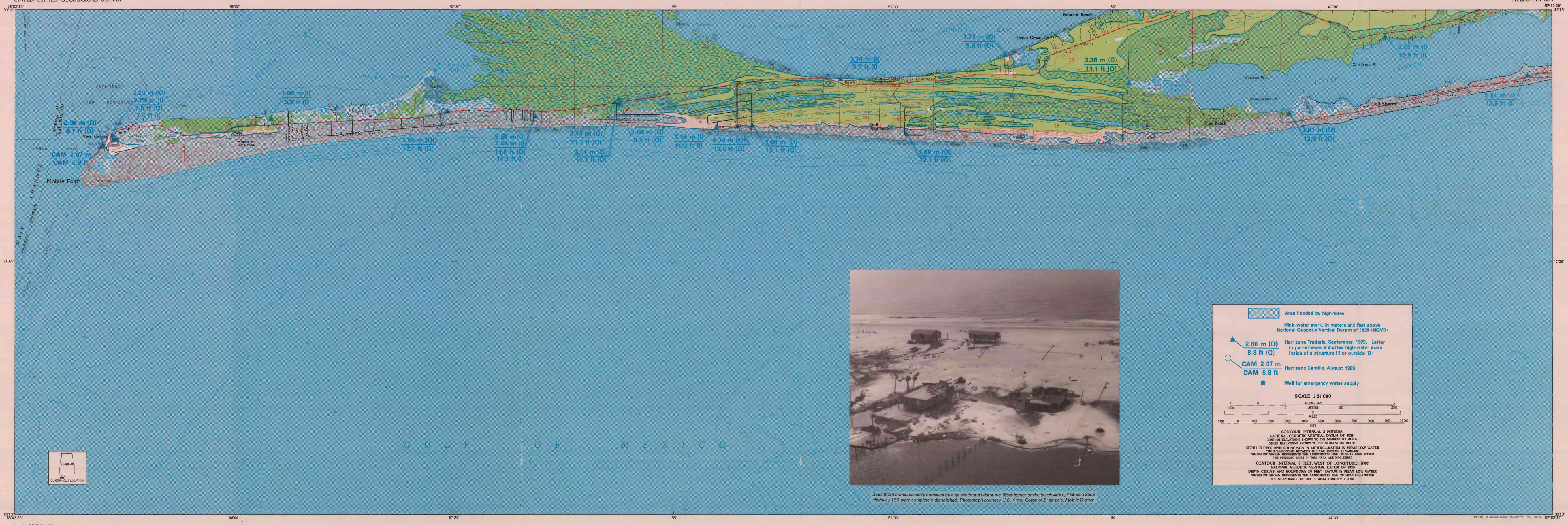

Base from U.S. Geological Survey Pine Beach 1980, St. Andrews Bay, 1980, and Fort Morgan, 1956

Area flooded by high-tides

High-water mark, in meters and feet above National Geodetic Vertical Datum of 1929 (NGVD)

2.68 m (O) 8.8 ft (O) — Hurricane Frederic, September, 1979. Letter in parentheses indicates high-water mark inside of a structure (I) or outside (O)

CAM 2.07 m CAM 6.8 ft — Hurricane Camille, August 1969

Well for emergency water supply

SCALE 1:24 000

CONTOUR INTERVAL 2 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
CONTOUR ELEVATIONS SHOWN TO THE NEAREST 0.1 METER
OTHER ELEVATIONS SHOWN TO THE NEAREST 0.5 METER
DEPTH CURVES AND SOUNDINGS IN METERS—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE PERIODIC TIDES IN THIS AREA ARE NEGLIGIBLE

CONTOUR INTERVAL 5 FEET, WEST OF LONGITUDE 3°00'
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOT

Beachfront homes severely damaged by high winds and tidal surge. Most homes on the beach side of Alabama State Highway 180 were completely demolished. Photograph courtesy U.S. Army Corps of Engineers, Mobile District.

Introduction.—The approximate areas flooded by Hurricane Frederic tides of September 12–13, 1979, along coastal areas of Alabama, Florida, and Mississippi are shown in a series of hydrologic atlases. The atlases (fig. 1) are listed below. The area covered by the atlases extends from about 8 miles west of Fort Walton Beach, Fla., westward along the Gulf Coast through Alabama to Moss Point, Miss., a distance of about 115 miles.

Elevations shown are referred to National Geodetic Vertical Datum of 1929 (NGVD).

The Pine Beach—St. Andrews Bay—Fort Morgan map shows the areas flooded along the shores of St. Andrews Bay, Mobile Bay, and Bon Secour Bay from Fort Morgan eastward to about four miles east of Gasque, Ala. The storm tide went completely across the land between the beach and Mobile Bay throughout much of the area. Most homes on the beach side of Alabama State Highway 180 were completely destroyed, and the highway was washed out in several places. Damage to homes and other structures on the bay side was not as great.

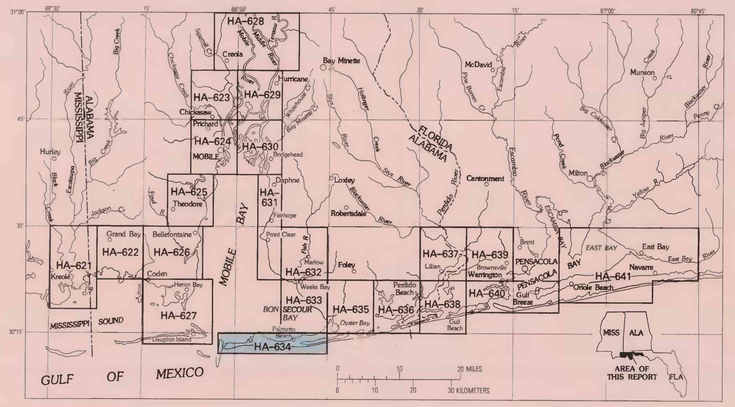

FIGURE 1—Index map of the Mississippi, Alabama, and Florida gulf coast showing location of quadrangles for which flood boundaries of Hurricane Frederic are delineated

HYDROLOGIC INVESTIGATIONS ATLAS NUMBER

MISSISSIPPI	
Keesler-Grand Bay SW	HA–621
ALABAMA	
Grand Bay	HA–622
Chickasaw	623
Mobile	624
Hollingers Island-Theodore	625
Coden-Bellefontaine	626
Heron Bay, Little Dauphin Island, Fort Morgan, and Fort Morgan NW	627
The Basin, Bay Minette North, and Creola NE[1]	628
Hurricane	629
Bridgehead	630
Daphne-Point Clear	631
ALABAMA (Cont.)	
Magnolia Springs[2]	HA–632
Bon Secour Bay[1]	633
Pine Beach, St. Andrews Bay,[3] and Fort Morgan	634
Gulf Shores[1]	635
Orange Beach[4]	636
Lillian	637
FLORIDA	
Perdido Bay	HA–638
West Pensacola	639
Gulf Breeze-Fort Barrancas	640
Oriole Beach, Garcon Point, Holley, South of Holley, and Navarre	641

[1]formerly named Bay Minette NE and Elsanor NE
[2]formerly named Weeks Bay NE
[3]formerly named Weeks Bay SE
[4]formerly named Foley SW
[5]formerly named St. Andrews Bay NE, St. Andrews Bay NW, and Fort Morgan
[6]formerly named Foley SW
[7]formerly named Foley SE

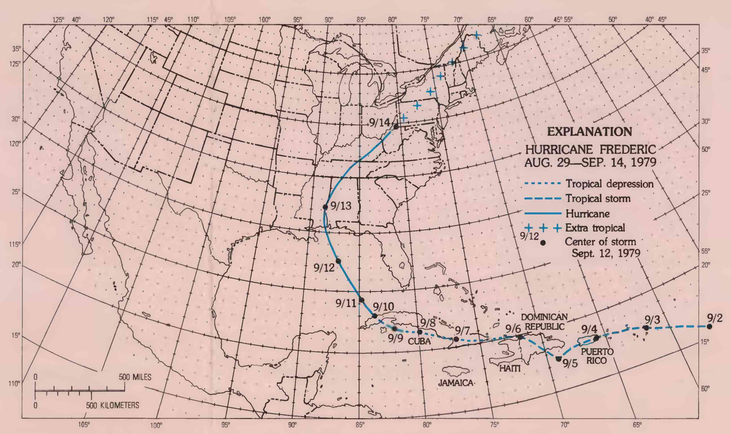

FIGURE 2—The track of Hurricane Frederic, September 2–14, 1979 (from track of Hurricane Frederic, August 29 to September 14, 1979, furnished by National Weather Service)

Hurricane Frederic was one of the most intense hurricanes of record to enter the United States mainland. A National Weather Service (NWS), National Oceanic and Atmospheric Administration (NOAA) research aircraft reported a flight-level wind of 138 knots (about 160 miles per hour) a short time prior to landfall. A wind velocity gage maintained by the NWS near Dauphin Island, Ala., recorded a maximum wind speed of about 126 knots (145 miles per hour). Lowest central pressure recorded, 943 millibars (about 27.8 inches of mercury), was that reported aboard an Air Force Reconnaissance Aircraft; unofficial central pressure reported at Grand Bay, Ala., was 931 millibars (about 27.5 inches of mercury). The maximum recorded precipitation along the coast during the passage of the hurricane was about 8.5 inches at Dauphin Island, Ala. A map of the storm track furnished by NWS is shown below. (See fig. 2.)

Flooding and water-related damages were most severe at Dauphin Island and Gulf Shores, Ala. However, significant flooding and damage occurred as far east as Pensacola Beach, Fla., and as far west as Moss Point, Miss. Maximum prevailing flood elevations were about 9.7 ft at Dauphin Island, Ala., about 10.3 ft at the U.S. Highway 98 Causeway across Mobile Bay, Ala., and about 14.3 ft at Gulf Shores, Ala.

American Red Cross casualty figures list 10 known deaths in Alabama, 1 in Florida, and 2 in Mississippi. The total number of storm-related injuries and illnesses for the three States is 4,711. Estimates indicate that the total damage caused the Hurricane Frederic probably will exceed $2 billion. In comparison, the total damage for Hurricane Camille (1969) was $1.3 billion.

Past tide records were furnished by the U.S. Army Corps of Engineers, Mobile District, and the Mississippi District of the U.S. Geological Survey. Floodmark elevations and other data for Hurricane Frederic were compiled jointly by the Alabama, Florida, and Mississippi Districts of the Geological Survey and the Corps of Engineers.

Acknowledgments.—We greatly appreciate the cooperation of the National Weather Service, National Oceanic and Atmospheric Administration; the U.S. Army Corps of Engineers; the U.S. Air Force; the U.S. Coast Guard; the Alabama Health Department, Division of Public Water Supplies; The American Red Cross; and others who furnished information.

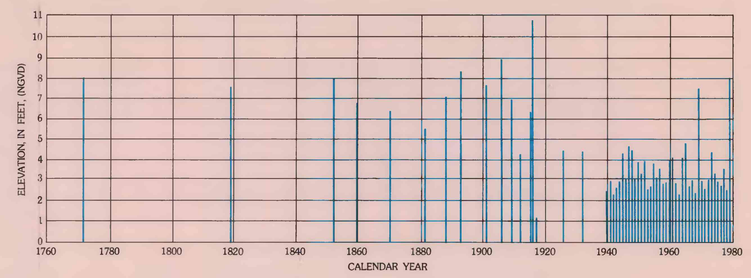

FIGURE 3—Known annual maximum tides at Mobile, Alabama, 1772–1979 (Gage at Alabama State Docks)

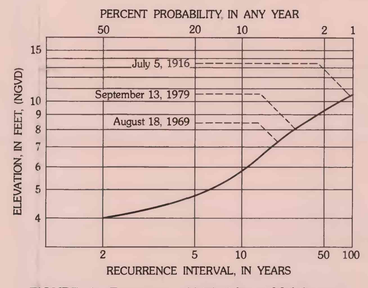

FIGURE 4—Frequency of high tides at Mobile gage (Mobile River at Alabama State Docks)

Variations in maximum tide elevations.—Water-surface elevations of maximum tides of Hurricane Frederic varied from place to place, especially along beach fronts. High-water marks for Hurricane Frederic are identified on atlases as "inside" or "outside." Marks found within a building or structure are labeled "inside;" those located outside of any enclosure are identified as "outside." Where two or more outside marks are shown at one location, the lower marks are considered to be the prevailing high tide; the higher marks are maximum wave height or runup. The maximum documented wave height above the prevailing tide for Hurricane Frederic is about 7 feet. Where the elevation of several high-water marks at a location varied slightly, the average elevation of the marks is shown.

Extent of flooding.—Approximate flood boundaries of Hurricane Frederic are delineated on U.S. Geological Survey topographic maps. Driftlines along streets, roads, dunes, and other landmarks were used to define the boundaries.

Depth of flooding.—The depth of flooding at any point can be estimated by subtracting the ground-surface elevation from the water-surface elevation determined by interpolating between maximum tide elevations shown on the map. Approximate ground elevations can be estimated from contours on the map, although more accurate elevations can be obtained by leveling to bench marks. The elevations of contour lines on some maps are in meters. Elevations of high-water marks shown on these maps are given both in meters and in feet.

Emergency water supplies.—Some water wells identified by the Alabama Health Department, Division of Public Water Supplies, as either approved or potential emergency water supplies, are shown on the map.

TABLE 1—Hurricane tide elevations at selected locations along the Gulf of Mexico coast, 1772–1979; in feet above National Geodetic Vertical Datum of 1929

Date	Bayou La Batre, Ala.	Coden, Ala.	Dauphin Island, Ala.	Mobile, Ala.	Gulf Shores, Ala.	Pensacola Beach, Fla.
	Pascagoula, Miss.					
September 4, 1772	—	—	—	—	8.2	—
August 23, 1852	—	—	—	—	8.0	—
October 2, 1893	—	—	—	—	8.4	4.9
September 27, 1906	—	—	10.8	—	9.1	11.8
July 5, 1916	—	—	10.8	8.0	10.8	11.3
August 18, 1969	11.2	8.5	8.3	5.7	7.3	6.0
September 13, 1979	5.9	9.9	9.0	7.4	8.0	11.4

Note: Records furnished by U.S. Army Corps of Engineers, Mobile District.

Storm-tide frequency.—Frequency of high storm tides in Mobile Bay was derived from a statistical evaluation of the tidal records of the gage at Mobile, Ala. The frequency, expressed as the relation of recurrence interval to elevation of high tide at the Mobile gage, is shown in figure 4. The recurrence interval is inversely related to the percent probability of an event being equaled or exceeded in any one year. The percent probability of high-tide elevations at the Mobile gage is also indicated. At the Mobile gage, Hurricane Frederic's maximum tide was estimated to have a recurrence interval of about 25 to 30 years; that is, it may be equaled or exceeded on the average of about 40 times in a thousand-year period. The maximum tide at Biloxi, Miss., during Hurricane Camille (1969) was estimated to have a recurrence interval of about 170 years.

Because tidal waves dissipate as they move into the bays and estuaries, the frequency data at the Mobile gage are applicable only at the gage site and at nearby points.

Tidal records.—Records of storm tides along the Gulf Coast have been documented since 1772 at Mobile, Ala., by the Corps of Engineers and others, and continuous tide records have been compiled by the Corps of Engineers since 1940. A tide gage is located at the Alabama State Docks, Mobile, Ala. Elevations of the annual maximum tides at this gage are shown in figure 3. Significant tide elevations at various points along the Gulf Coast for more than 20 hurricanes since 1893 have been recorded by the Corps of Engineers, the Geological Survey, and others. Data pertaining to some of the highest tides of record are shown in table 1. Additional data for Hurricane Camille (1969) tides are shown on some of the maps.

ROAD CLASSIFICATION

Primary highway, hard surface — Light-duty road, hard or improved surface

Secondary highway, hard surface — Unimproved road

Interstate Route — U. S. Route — State Route

International system of units (S.I.).—Most units of measurement used in this atlas are inch-pound units. The following factors may be used to convert inch-pound units to Standard International (S.I.) units:

Multiply inch-pound units	*By*	*To obtain S.I. units*
inch (in)	2.54	centimeter (cm)
	25.4	millimeter (mm)
foot (ft)	.3048	meter (m)
	.0003048	kilometer (km)
mile (mi)	1.609	kilometer (km)
knot (kt)	.5148	meter per second (m/s)
mile per hour (mi/h)	1.609	kilometer per hour (km/h)
millibar (mb)	.1	kilopascal (kPa)

Additional information.—Other information pertaining to floods along the Gulf Coast may be obtained at the district offices of the U.S. Geological Survey, Tuscaloosa, Alabama, Tallahassee, Florida, and Jackson, Mississippi. Descriptions of tidal characteristics, tidal records, and tidal data may be obtained from the following published reports:

Harris, D. L., and Lindsay, C. V., 1957, An index of tide gages and tide gage records for the Atlantic and Gulf Coasts of the United States, U.S. Department of Commerce, Weather Bureau National Hurricane Research Project, report 7.

Wilson, K. V., and Hudson, J. W., 1969, Hurricane Camille tidal flood of August 1969 along the Gulf Coast, U.S. Geological Survey Hydrologic Investigations Atlas (name of quadrangle), Mississippi.

HA–395 Logtown.
HA–396 English Lookout, La.-Miss.
HA–397 Kiln.
HA–398 Waveland-Grand Island Pass.
HA–399 Vidalia.
HA–400 Bay St. Louis.
HA–401 Gulfport NW.
HA–402 Pass Christian.
HA–403 Gulfport North-South.
HA–404 Biloxi.
HA–405 Ocean Springs-Deer Island.
HA–406 Pascagoula. (Scale 1:62,500.)
HA–407 Keesler-Grand Bay SW., Miss.-Ala.

U.S. Department of the Army, Corps of Engineers, Mobile District, 1965, Report on Hurricane survey of Mississippi Coast: 49 p.
———1965, Report on Hurricane survey of Northwest Florida, 49 p.
———1966, Report on Hurricane survey of the Alabama Gulf Coast, 40 p.
———1967, Hurricane Betsy, 8–11 September 1965: 65 p.
———1970, Hurricane Camille, 14–22 August 1969, 80 p.
———1976, Hurricane Eloise, 16–23 September 1975, 89 p.

HURRICANE FREDERIC TIDAL FLOODS OF SEPTEMBER 12–13, 1979, ALONG THE GULF COAST, PINE BEACH, ST. ANDREWS BAY AND, FORT MORGAN QUADRANGLES, ALABAMA

By
John C. Scott and Larry R. Bohman

1980

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