HURRICANE CAMILLE ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MISSISSIPPI

Publication authorized by The Director of U.S. Geological Survey

by

James W. Hudson
U.S. Geological Survey

INTRODUCTION

On November 10, 1969, 12 weeks after Hurricane Camille hit the Mississippi gulf coast the U.S. Geological Survey made public distribution of 14 Hydrologic Atlases showing highwater elevations and the area inundated by the floodwater accompanying the hurricane. These atlases are the culmination of effort that began within 12 hours after the hurricane came ashore in the Bay St. Louis-Pass Christian area. Excluding printing, the cost of the atlases was about $14,000. Behind the Geological Survey's effort to get this information to the public as quickly as possible was the realization that any realistic and effective settlement of insurance claims and the plans for rebuilding in the devastated area would require the delineation of land area flooded. Through close cooperation at all levels, the Survey was able to produce in three months a series of maps that normally requires one to two years to complete.

DEVELOPMENT AND DESCRIPTION OF THE HURRICANE

On Thursday morning, August 14, 1969, the National Hurricane Center in Miami requested that a Navy reconnaissance plane investigate a suspicious low-pressure tropical disturbance in the western Caribbean. At 1 p.m. the same day, advisory no. 1 on Camille was issued. The storm was located near latitude 19.3° north and longitude 82.3° west, moving west-northwest at about 13 mph (miles per hour) with highest winds about 60 mph. It was predicted to reach the extreme west tip of Cuba by early the following morning. By afternoon of August 15, Camille moved across western Cuba with winds of about 100 mph and 10 inches of rain. Once Camille had entered the Gulf of Mexico, her strength intensified. At 9 a.m. August 16, special advisory no. 9 set up a hurricane watch from Biloxi, Miss., to St. Marks, Fla. By 7 p.m. Saturday, August 16, Camille was moving north-northwest at about 12 mph with winds up to 160 mph near her center and hurricane-force winds extending 50 miles in all directions. On Sunday, August 17 at 5 a.m. Camille was located 250 miles south of Mobile, Ala., and was labelled as being extremely dangerous. The 1 p.m. bulletin indicated a central barometric pressure in Camille of 26.61 inches, lowest ever recorded on the gulf coast, and maximum winds were estimated at 190 mph near the center. Tides as great as 20 feet above normal were forecast from Gulfport to Pascagoula. The eye of Camille moved inland just east of Bay St. Louis, Miss., about 11:30 p.m. Sunday night, accompanying winds and water demolishing almost everything in its path. High tides accompanying Camille were as much as 25 feet above mean sea level.

The great volume of water moving inland up the Jourdan River flood plain was typical of other estuary streams along the coast. The discharge flowing inland at the tide crest was estimated to have been at least 90,000 cfs, based on the differential water surface elevations on the north and south sides of the Interstate 10 bridge over Jourdan River. This discharge rate created by the hurricane tide is more than three times the flood discharge that may be expected on the Jourdan River on the average of once in 50 years.

Some statistics reported by the Red Cross provide evidence of the destruction of the storm. The death toll in September stood at 140 in Mississippi and southeastern Louisiana, with 76 persons missing. There were 5,238 homes destroyed, 11,667 suffered major damage; 1,007 trailer homes, 569 small businesses, and 32 boats were destroyed or severely damaged; at least 5 trucking terminals were completely destroyed, with damage to highways, bridges, railways, and waterways running into millions of dollars. The Port of Gulfport suffered severe damage, and at least 94 vessels were sunk or grounded in the Mississippi River. Oil rigs were foundered, pipelines were smashed, and land bases were destroyed; there were enormous agricultural losses in crops, timberland, tung and pecan trees, with some 5,000 cattle drowned.

Land area inundated along the Mississippi gulf coast was more than 320 square miles, an area about 7 times the size of the city of Jackson or the combined areas of the Ross Barnett, Sardis, Enid, Arkabutla, and Grenada Reservoirs. According to figures by the Corps of Engineers, the volume of debris in Mississippi alone was estimated to be 1-1/4 million tons, enough to fill 25,000 freight cars. These cars lined end to end would extend from Gulfport to Winona, Miss., a distance of 250 miles. Cost figures for cleanup of debris in Mississippi stand at $18,570,000.

ACTIVITIES OF U.S. GEOLOGICAL SURVEY

On the morning of August 18, five field parties of the Geological Survey were dispatched to the storm-hit area, expecting to measure flood discharges and to collect other flood data resulting from the predicted 10 inches of rain accompanying Camille. The nearer the coast we came, the more difficult it was to travel on the highways because of the tremendous amount of trees and debris across the highway. It was necessary to carry extra gasoline because all power lines south of Hattiesburg had been destroyed or badly damaged and gasoline pumps were inoperative. Broken glass, debris with nails, and other sharp objects caused many tire punctures. Once we were in the area, it was apparent that the coast had experienced an unprecedented and catastrophic tidal flood. One of our first undertakings was to determine an accurate elevation of the high-tide marks along the coast. The determination of the elevations proved to be more than just another simple job of running levels from a bench mark to the usual good seed or foam line left on trees, bridges, or buildings by river floods with which we normally work. One had the feeling of awe and utter helplessness when he first looked at such destruction. A postal employee at Gulfport stated that water from waves lapped over the third step of the post office. The elevation of this step was determined to be 21.3 feet, yet excellent

seed lines in the boiler room of the post office were found to be 19.68 feet. A protected water mark in a building across the street and about 200 feet south of the post office was determined to be 20.1 feet. Variations in elevations between highwater marks recovered in exposed and protected locations due to wave surge was common along the entire coast area. However, the static levels indicated by marks recovered from the protected areas of buildings seldom varied more than a few tenths of a foot. The maximum tidal elevations ranged from about 9 feet at Bayou LaBatre to a maximum of 24 feet at Pass Christian and decreased gradually to about 9 feet at the mouth of Pearl River. Previous to Camille the highest hurricane induced tides observed on the Mississippi gulf coast since at least 1893 were 15.2 feet at Bay St. Louis. Because of the extreme high tides and destruction to the area, on August 19 our office arranged for the Air National Guard to make aerial photographs to aid us in delineating the flooded area. Conferences on August 20 between the Survey's district office and its higher headquarters in St. Louis and Washington resulted in the decision to prepare Hydrologic Atlases of the area. It was then necessary to determine tide elevations at enough selected locations to outline the flooded areas on contour maps.

This proved to be a major task for various reasons. As mentioned earlier, traffic and maneuverability was a real problem after the storm. Most motels and restaurants had been destroyed or forced to close because of lack of electric power, water, gas, etc. It was necessary for us to provide our own food and lodging. This was accomplished by the use of a camping trailer and equipment. Flowing wells in the storm area were utilized for our water supply. One of the greater problems following the storm was a temporary lack of uncontaminated water in parts of the area. There are many capped wells that would flow and could have been used during this emergency. Many of the public-supply and domestic wells flow under their own pressure. The locations of major wells along the coast were determined and are shown on the atlases for future emergency planning.

Tide elevations were determined by level surveys at about 200 different locations by the Geological Survey and the Mobile District, U.S. Army Corps of Engineers. Judgment had to be exercised in determining the tide elevations in certain areas because of drift and debris left by water and high winds. Most of the highwater marks were recovered in areas that were sufficiently protected to reflect the static-water elevation rather than the top of the wave surge. The map elevations used were generally an average of several marks at each site. Locations and elevations of the marks were plotted on 19 quadrangle maps and the flooded area was outlined. These topographic maps were then taken to the field and the delineation checked at almost every road and street crossing the flood-line boundary.

Accuracy of the flood boundaries on these atlases should be catagorized in three degrees. Field-checked boundaries supplemented by surveyed highwater marks are considered reliable. Field checked boundaries in areas where elevations were interpolated between surveyed highwater marks are nearly as reliable. Boundaries based on interpolated elevations and map contours in remote areas that could not be field checked should be as accurate as the base map.

In order to enhance the value of the maps some indication of the probability of another Camille occurring in the future is needed. Based on a statistical evaluation of the tide-gage records at Biloxi since 1892, Hurricane Camille tides are estimated to have a recurrence interval of once in about 170 years at Biloxi. Stated in probability terms there is about 6 tenths of 1 percent chance of such an event occurring any year.