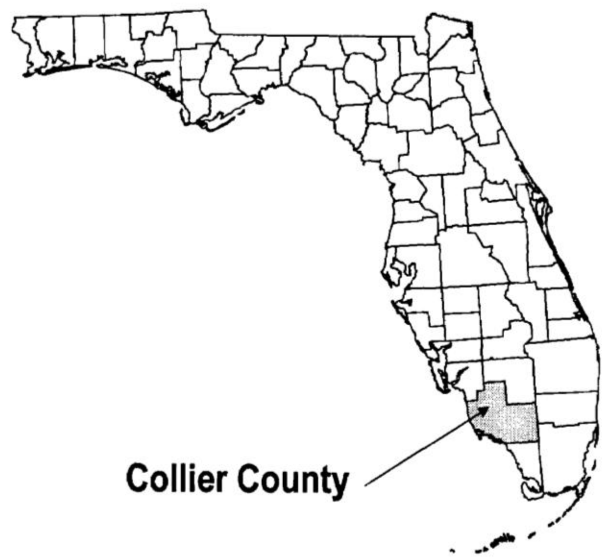
FLOOD INSURANCE STUDY

COLLIER COUNTY, FLORIDA

AND INCORPORATED AREAS



Community Name	Community Number
COLLIER COUNTY (UNINCORPORATED AREAS)	120067
EVERGLADES, CITY OF	125104
MARCO ISLAND, CITY OF	120426
NAPLES, CITY OF	125130
SEMINOLE TRIBE OF FLORIDA	120685

Revised:
May 16, 2012

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
12021CV000B

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FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Initial Countywide Effective Date: November 17, 2005
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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
COLLIER COUNTY, FLORIDA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Collier County, including the Cities of Everglades, Marco Island, and Naples, the Seminole Tribe of Florida Immokalee Reservation, and the unincorporated areas of Collier County (referred to collectively herein as Collier County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations (CFR) at 44 CFR 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence, and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS report are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Tomasello Consulting Engineers, Inc, for Collier County, Florida. Collier County, the City of Naples and the South Florida Water Management District (SFWMD) are Cooperating Technical Partners with the Federal Emergency Management Agency (FEMA). This study was completed in June 2009.

The hydraulic analyses for the Golden Gate Main West and Golden Gate Estates basins were subsequently updated by Collier County during the 90 day appeal period. This work was done by Tomasello Consulting Engineers for Collier County and was completed in July 2011. Additionally, the Seminole Tribe of Florida submitted updated hydrologic and hydraulic analyses for their property in Collier County. This new analysis was completed by Miller Legg for the Seminole Tribe of Florida and was completed in June 2011. Both of these analyses were incorporated into this study.

1.3 Coordination

The initial Consultation Coordination Officer (CCO) meeting was held on June 22, 2005, and attended by representatives from FEMA, Collier County, the City of Naples, Tomasello Consulting Engineers, and the SFWMD. After the initial CCO meeting, numerous meetings and conference calls were conducted to coordinate between FEMA, Tomasello Engineers, and the county.

Two final CCO meetings were held on August 16, 2010, and August 24, 2010. They were attended by representatives from FEMA, Collier County, the City of Naples, the City of Marco Island, the City of Everglades City, the Seminole Tribe of Florida, Tomasello Consulting Engineers, and the SFWMD.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Collier County, Florida, including the incorporated communities listed in Section 1.1.

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 2009. The scope of this restudy includes a new detailed study along the entire coastline of the Gulf of Mexico. A detailed study was also conducted for the non-coastal flooding in the county (herein referred to as riverine flooding). The riverine flooding is due to ponding from excess rainfall and slow-moving water.

Less detailed analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and Collier County.

2.2 Community Description

Collier County comprises approximately 2,100 square miles in the southwestern part of Florida. It is bounded by the Gulf of Mexico on the west and extends into the Everglades National Park to the east. Collier County is bordered on the north by Lee and Hendry Counties, on the east by Broward and Dade Counties, and on the south by Monroe County.

Collier County began developing extensively after the completion of the Tamiami Trail (U.S. Route 41) in 1928. Railroads leading into the Naples area were also completed about the same time. Additional development was encouraged by the beginning of construction of the Golden Gate Canal in the early 1960s. The Faka Union Canal was begun in 1968. Controlled drainage provided by these canal systems permitted the development of the Golden Gate Estates, east of Naples, and the Remuda Ranch, southeast of Naples.

According to the 2000 census, the population of Collier County is 251,377. Naples, with a population of 20,976, is the largest city in the county. The City of Everglades has a population of 379. The City of Marco Island has a population of 14,879. The Seminole Tribe of Florida’s Immokalee Reservation had a population of 175 (Reference 1).

Many residences are maintained as winter homes or retirement dwellings. The resort atmosphere of the region makes it attractive for tourists as well as a popular location for second homes. Tourism is the most important industry in Collier County, particularly near Everglades and Naples. Other major types of industry are agriculture and cattle, an oil field at Sunniland, and limestone quarrying for road and building materials.

Key features of the county related to flooding are the extremely flat topography, the groundwater system, and drainage introduced by the construction of canals. The general topography of Collier County is extremely flat, with land slopes on the order of 1 foot per mile to 0.5 foot per mile in the interior regions. There are no major natural streams, such as those found in areas of steeper topography. Instead, flow occurs over wide, flat areas, in sloughs, and through manmade canal systems. Natural well-drained drainage channels are apparent only close to the coast. Groundwater in Collier County is associated with a shallow, unconfined aquifer. It is composed of sands and limestones and is a major source of fresh water for municipal, industrial, domestic, and irrigation purposes. It reaches a maximum thickness of approximately 130 feet near Naples and thins to the northeast, east, and southeast. Hydraulic properties of the aquifer have been examined in the western half of the county, particularly in the Naples area (Reference 2).

One of the factors contributing to the development of the area is climate. Located in the subtropical climatic zone, Collier County has mild, dry winters and warm, rainy summers. The temperature, which is comfortably mild throughout the year, averages 75°F annually. The rainy season, extending from May to October, coincides with the hurricane season. During these months, the study area receives 80 percent of its annual 52-inch rainfall (Reference 3).

The lack of steep slopes precludes rapid runoff; therefore, water accumulates in ponded areas and slowly infiltrates the groundwater system or sluggishly drains over the land. The general drainage pattern is from north to south and west (Reference 4, 5). Much of the county is covered by ponded water during the rainy season.

Development has occurred in areas where measures such as drainage ditches, culverts, and elevated foundations are employed to minimize water damage. Development in these areas consists mainly of residential and commercial structures and can be found on the west coast of the county. Much of the inland area is undeveloped.

2.3 Principal Flood Problems

Flooding results from two major sources in Collier County. Coastal areas are subject to inundation from ocean surges, whereas inland areas become flooded when rainfall accumulates in low, flat areas. Rainfall occurs primarily during thunderstorms in the summer months, with additional rainfall resulting from the passage of hurricanes. A transition region near the coast is vulnerable to both rainfall and ocean surge flooding.

Coastal lands typically lie below an elevation of 9 feet, North American Vertical Datum of 1988 (NAVD88), and are subject to flooding from hurricanes and tropical storms. Surges of over 12.7 feet NAVD88 were reported just north of Collier County when the most severe historic storm hit in 1873. Floodwaters progressed as far as 10 miles inland in 1960.

Historical Flood Events

<u>Labor Day Hurricane, August 31 – September 8, 1935</u>

The Labor Day Hurricane was a severe tropical disturbance. Winds reached 65 miles per hour (mph) in the City of Everglades and 70 mph in Naples as the storm passed northward approximately 50 miles offshore.

October 13 – 21, 1944

The storm of October 1944 is among the most destructive recorded for the State of Florida, with damages estimated at $63 million. Flooding depths of up to 6 feet NAVD 88 were reported in the City of Everglades and in the low-lying areas of Naples. Severe beach erosion occurred along Naples Beach, where approximately 4 miles of bulkhead were destroyed.

Hurricane Donna, August 29 – September 13, 1960

Hurricane Donna ranks as one of the great storms of the 20th century. Its center traveled north, paralleling the Gulf Coast west of Collier County. At the City of Everglades, the tide ranged from a low of -2.1 feet NAVD88 to a high exceeding 8 feet NAVD 88 some 5 hours later. Flooding extended from 6 to 10 miles inland. U.S. Route 41, between the Cities of Everglades and Naples, was covered with tidal debris. As the center moved northward, southwesterly winds generated high tides that flooded most of Goodland, Marco, and Naples. In Collier County, over 300 homes and trailers suffered major damage. Reported high-water elevations are listed in Table 1.

Table 1. High-Water Elevations from the October 1944 Storm

Location	Elevation (feet NAVD88)
Everglades	8.4
Goodland	10.4
Marco	8.9
Naples	10.3
Fort Myers Beach	9.1

Hurricane Isabel, October 8-15, 1964

Hurricane Isabel entered the west coast of Florida near the City of Everglades as it traveled from its origin in the western Caribbean. At the City of Everglades, the minimum pressure was 973.6 millibars (mb), with winds reaching 80 knots.

Hurricane Dennis, August 17-21, 1981

On August 17, Dennis began as a tropical storm, striking the Gulf of Mexico coastline in southwest Florida with winds of more than 55 mph. Just after Dennis made landfall, it became stationary between Fort Myers and Lake Okeechobee, producing about 10 inches of rain in southeast Florida, with Homestead receiving almost 20 inches. After passing through central Florida and exiting by the Atlantic Coast, Dennis became a hurricane on August 20, just east of Cape Hatteras, North Carolina (Reference 6).

Hurricane Bob, July 21-25, 1985

Hurricane Bob made landfall near Fort Myers as a tropical storm on July 23, with winds between50 and 70 mph. It passed through central Florida and exited into the Atlantic Ocean near Daytona Beach on July 24, becoming a hurricane in the open ocean (Reference 6).

Hurricane Floyd, October 9-13, 1987

Hurricane Floyd made landfall in the northern Keys of Florida Bay, near Key Largo. Along with numerous tornadoes in the southwest Florida coastal areas, the central pressure was measured at 29.32 inches of mercury (or 993mb) with winds of 75 mph (Reference 6).

Hurricane Andrew, August 16-27, 1992

On the morning of August 24, Andrew cut a path of destruction across south Florida from its Atlantic Ocean landfall location south of Miami through Homestead and the Everglades. Andrew finally exited into the Gulf of Mexico in southern Collier County near Marco Island before heading north in the Gulf of Mexico to make landfall again in Louisiana. Andrew became a hurricane when it exited south of Marco Island and produced a storm tide elevation of 6 feet above mean low water, recorded at the City of Everglades, and 2 feet above mean sea level, National Geodetic Vertical Datum of 1929 (NGVD29), recorded at Fort Myers Beach. The peak gust recorded on August 24 at Collier County Emergency Operations Center was 87 mph. Only 30 million dollars in damages were incurred in Collier County due to Andrew, not nearly as severe as the estimated damages of 20 to 25 billion dollars in the major landfall area of Dade County, Florida. The Dade County damages were due to the 145-mph sustained winds and partly to the 17-foot peak storm surge in Biscayne Bay (Reference 7).

Hurricane Gordon, November 8-21, 1994

Gordon was a hurricane while out at sea in the Florida Straits between Key West and Cuba, but made landfall near Fort Myers on November 16 as a tropical storm with sustained winds of 45 mph and heavy rainfall. Naples Airport recorded peak gusts of 29 mph, and the Naples Conservatory measured a total 2.43 inches of rainfall (Reference 6).

Hurricane Mitch, October 22 - November 5, 1998

Mitch was responsible for over 9,000 deaths, predominately from rain-induced flooding, in portions of Central America, mainly in Honduras and Nicaragua. This makes Mitch one of the deadliest Atlantic tropical cyclones in history, ranking only below the 1780 “Great Hurricane” in the Lesser Antilles, and comparable to the Galveston hurricane of 1900 and Hurricane Fifi of 1974, which primarily affected Honduras.

The 905mb minimum central pressure and estimated maximum sustained wind speed of 155 knots over the western Caribbean make Mitch the strongest October hurricane (records began in 1886). Mitch moved across the Yucatan Peninsula and southern Florida as a tropical storm. Hurricane Mitch made landfall near Naples as a tropical storm on November 5, with a wind speed of 64 mph and a pressure of 989mb.

Tropical Storm Harvey, September 19 - 22, 1999

Tropical Storm Harvey, which formed in the eastern Gulf of Mexico and moved across southern Florida, produced heavy rainfall over portions of southwest Florida. Tropical Storm Harvey made landfall near Everglades City, Florida as a tropical storm on September 21, with a wind speed of 58 mph and a pressure of 999mb.

Hurricane Charley, 9 - 14 August, 2004

Hurricane Charley strengthened rapidly just before striking the southwestern coast of Florida as a Category 4 hurricane on the Saffir-Simpson Hurricane Scale. Charley was the strongest hurricane to hit the United States since Andrew in 1992 and, although small in size, it caused catastrophic wind damage in Charlotte County, Florida. Serious damage occurred well inland over the Florida peninsula. Hurricane Charley made landfall near Cayo Costa, Florida and reached minimal pressure as a hurricane on August 13, with a wind speed of 150 mph and a pressure of 941mb. It also made landfall near Punta Gorda, Florida as a hurricane on August 13, with a wind speed of 144 mph and a pressure of 942mb.

Hurricane Wilma, October 15-25, 2005

Wilma formed and became an extremely intense hurricane over the northwestern Caribbean Sea. It had the all-time lowest central pressure for an Atlantic basin hurricane, and it devastated the northeastern Yucatan Peninsula. Wilma also inflicted extensive damage over southern Florida. Hurricane Wilma made landfall near Cape Romano, Florida as a hurricane on October 24, with a wind speed of 121 mph and a pressure of 950mb.

2.4 Flood Protection Measures

Flood protection measures include strict development regulations enforced by the communities, the Florida Department of Environmental Protection, and the SFWMD.

Canals have been constructed to remove excess rainfall from inland regions. Water may be ponded for several months in areas that do not drain readily. The canals serve as a path for flow and have increased the fraction of rainfall that runs off the land. They also tend to shorten the time required for water to travel from interior regions to the ocean. The major canal systems include the Cocohatchee River Canal, Golden Gate Canal, Henderson Creek Canal, and Faka Union Canal. The Barron River Canal parallels State Road 29 and drains from the north to south, ending near the City of Everglades. Some levees have been constructed to control the spread of water in sloughs draining swampy areas.

FEMA specifies that all levees must have a minimum of 3-foot freeboard against the 1-percent-annual-chance flood elevation to be considered a safe flood protection structure.

Levees in this study area provide the county with some degree of protection against flooding. However, it has been ascertained that some of these levees may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are: adequate design, including freeboard; structural stability, and proper operation and maintenance. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain. The levees in Collier County do not meet FEMA's freeboard requirements.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic methods were used to determine the flood- hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-percent, 2-percent, 1-percent, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic and Hydraulic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community. Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded half-foot elevations.

In Collier County, two types of analyses were carried out to establish the peak elevation-frequency relationships, one for each flooding source studied in detail. The coastal and riverine analyses are discussed in the following sections.

Coastal Analyses

The hydraulic characteristics of flooding from the sources studied were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown in the coastal data tables and flood profiles in the FIS report.

Storm Surge Analysis and Modeling

The determination of coastal inundation from the Gulf of Mexico caused by passage of storms (storm surge) was determined by the joint probability method (JPM). The original JPM application, while not called JPM, was developed by Larry Russell (Reference 8). The storm populations were described by probability distributions of five parameters that influence surge heights. The JPM approach is a simulation methodology that relies on the development of statistical distributions of key hurricane input variables, such as central pressure, radius to maximum wind speed, maximum wind speed, translation speed, track heading, etc., and sampling from these distributions to develop model hurricanes. The resulting simulation results in a family of modeled storms that preserves the relationships between the various input model components, but provides a means to model the effects and probabilities of storms that have not occurred historically. These characteristics were described statistically based on an analysis of observed storms in the vicinity of Collier County. The primary source of data for these parameters was an expanded National Weather Service (NWS-38) database, relying on the most recent version of the historic "best track" database of the National Hurricane Center (NHC) (References 9 and 10). The applied NHC best track database provided data on the intensity and position of each observed tropical cyclone on a 6-hour basis during the period from 1871 to 2006. Further details on the JPM approach are included in the Technical Support Data Notebook (TSDN).

FEMA's coastal surge model (Reference 11) was used to simulate the coastal surge generated by any chosen storm (that is, any combination of the five storm parameters discussed above). By performing such simulations for a large number of storms, each of known total probability, the frequency distribution of surge height can be established as a function of coastal location. These distributions incorporate the large-scale surge behavior, but do not include an analysis of the added effects associated with much finer scale wave phenomena, such as wave setup, wave height, or wave runup. As the final step in the calculations, the astronomic tide for the region is statistically combined with the computed storm surge to yield recurrence intervals of stillwater flood elevations.

The stillwater elevations (without wave setup) that have been determined for the 1-percent-annual-chance flood for the Gulf of Mexico are summarized in Table 2. Analyses of wave setup, wave heights, storm-induced erosion, and primary frontal dune criteria were performed using the stillwater elevations listed in Table 2.

The FEMA surge model was utilized to simulate the hydrodynamic behavior of the surge generated by the various synthetic storms. This model utilizes a grid pattern approximating the geographical features of the study area and the adjoining areas. Underwater depths for the model grid system were defined by National Oceanographic and Atmospheric Administration (NOAA) Navigational Charts. Land elevations were obtained from Collier County Light Detection and Ranging (LIDAR), U.S .Army Corps of Engineers (USACE) LIDAR, and the Southwest Florida Feasibility Study Composite Topography, in that order of priority, as neither the Collier County or the USACE LIDAR data covered the entire Collier County study area.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (NAS) (Reference 12). This method is based on three major concepts. The first concept is that depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth, and the wave crest is 70 percent the height of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by the dissipation of energy due to the presence of obstructions such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures described in the NAS report. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth. Overland propagation of waves was modeled for 67 coastal transects shown in Figure 1.

The wave setup calculation is based on wave behavior over a simple slope. Setup develops slowly as waves accumulate by wave mass transport. Also, as the propagation distance increases, setup is lost by lateral flows. A reasonable addition to the stillwater level was made to reflect the additional hazard due to wave setup. In general, a wave setup of 1.4 feet (as computed in Reference 13) was applied from the open Gulf Coast to the top of the eroded dune. The wave setup was then reduced to 0 over the next 1,400 feet of wave transect.

In many areas along the Collier County shoreline, existing dunes were found to be insufficient in size to sustain wave attack. Frontal dunes with reservoirs exceeding 540 square feet are considered to experience dune retreat, while those with reservoirs less than 540 square feet are considered to experience dune removal. Therefore, using the CHAMP analysis procedures as outlined in FEMA's *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update* (Reference 14), the protection afforded by the dunes with less than 540 square feet of reservoir was removed from the coastal analysis, resulting in a low beach profile slope. The complete inundation of the barrier island during the 1-percent-annual-chance coastal flood does not allow for the development of wave runup. As a result, wave runup was not considered in the coastal base flood elevations.

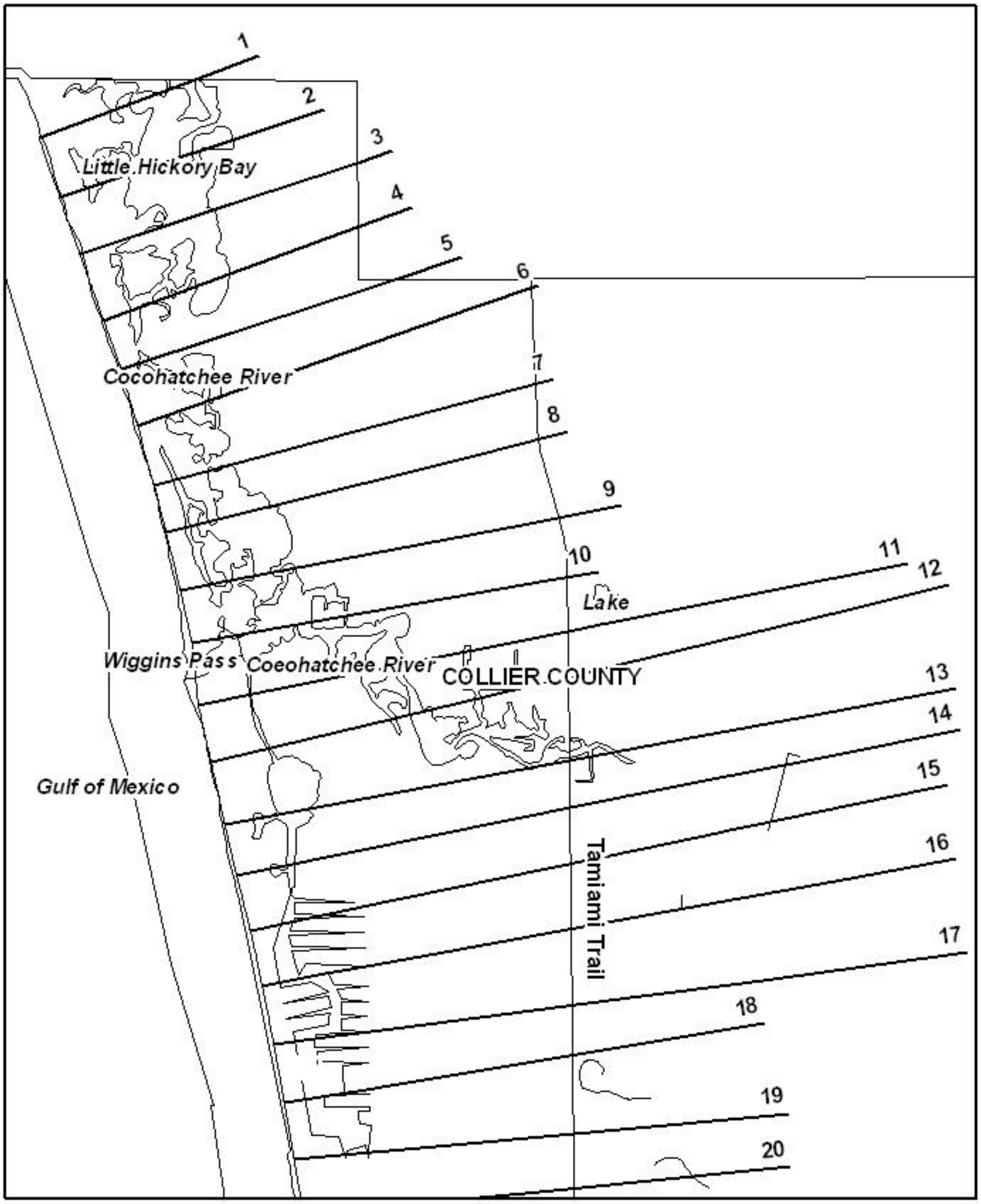


FIGURE 1.A

FEDERAL EMERGENCY MANAGEMENT AGENCY
COLLIER COUNTY, FL
AND INCORPORATED AREAS

Approximate Scale
0 0.2 0.4 0.8 1.2 1.6 Miles

TRANSECT LOCATION MAP

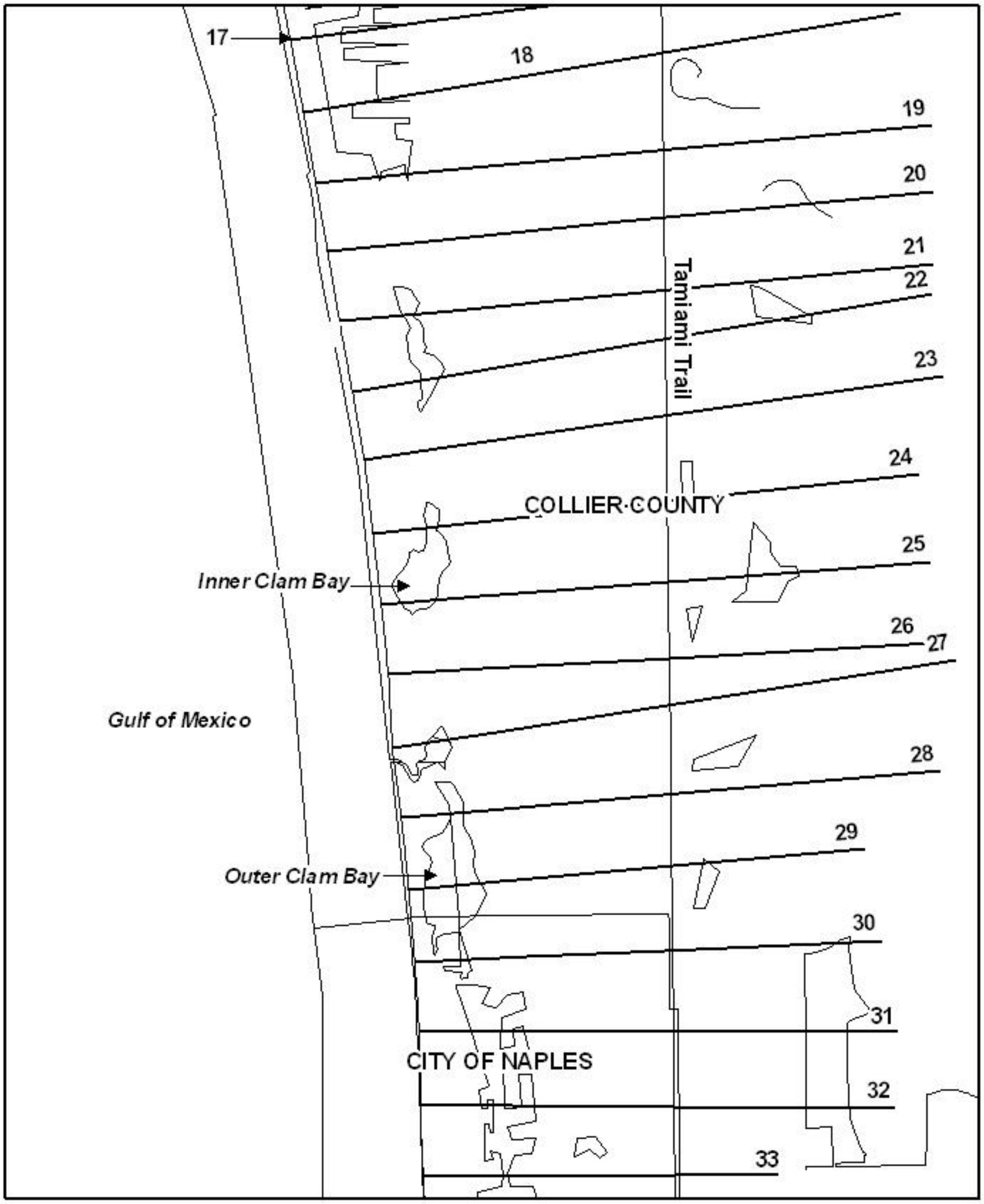


FIGURE 1.B

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLLIER COUNTY, FL
AND INCORPORATED AREAS

Approximate Scale
0 0.15 0.3 0.6 0.9 1.2 Miles

TRANSECT LOCATION MAP

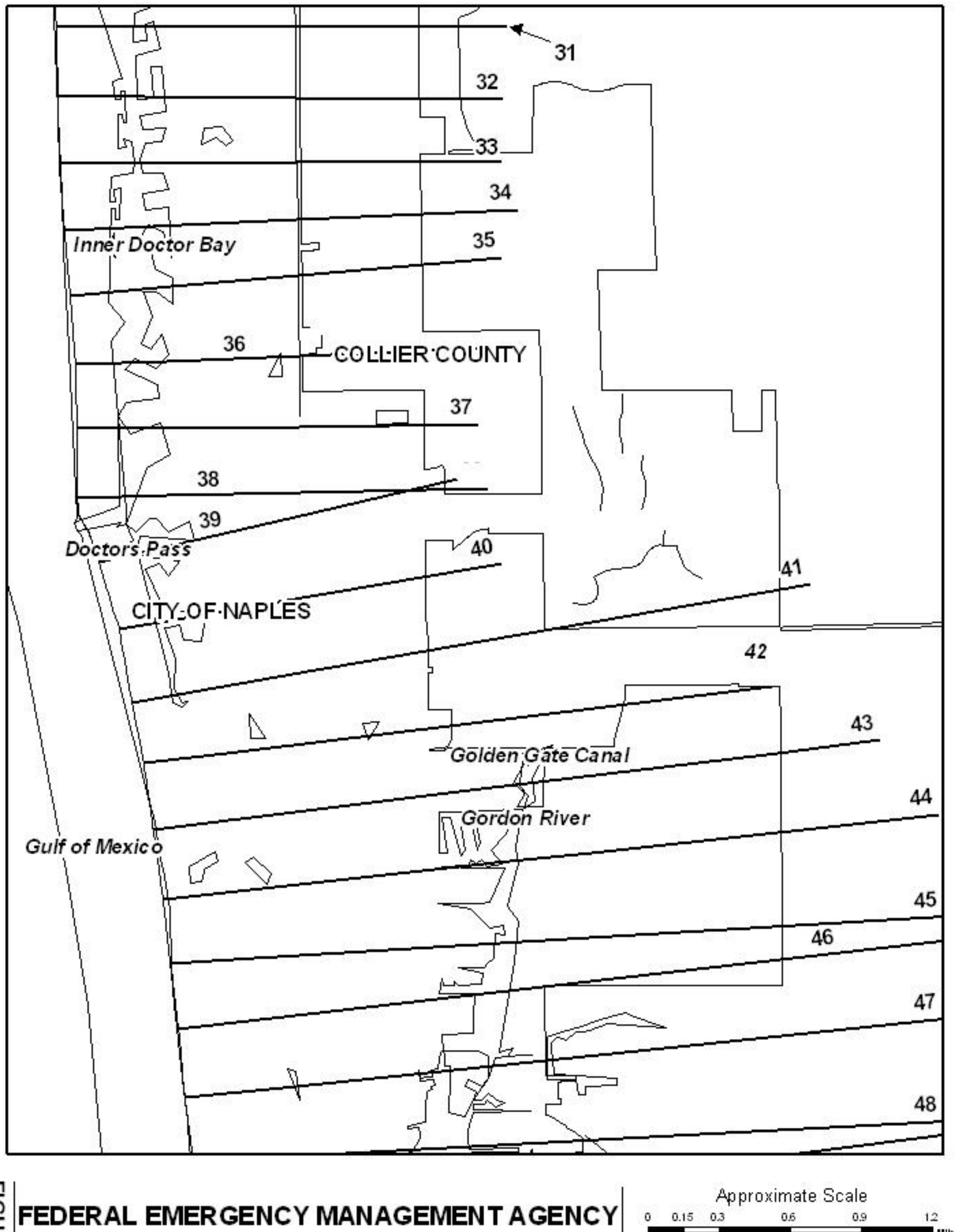


FIGURE 1.C

FEDERAL EMERGENCY MANAGEMENT AGENCY
COLLIER COUNTY, FL
AND INCORPORATED AREAS

TRANSECT LOCATION MAP

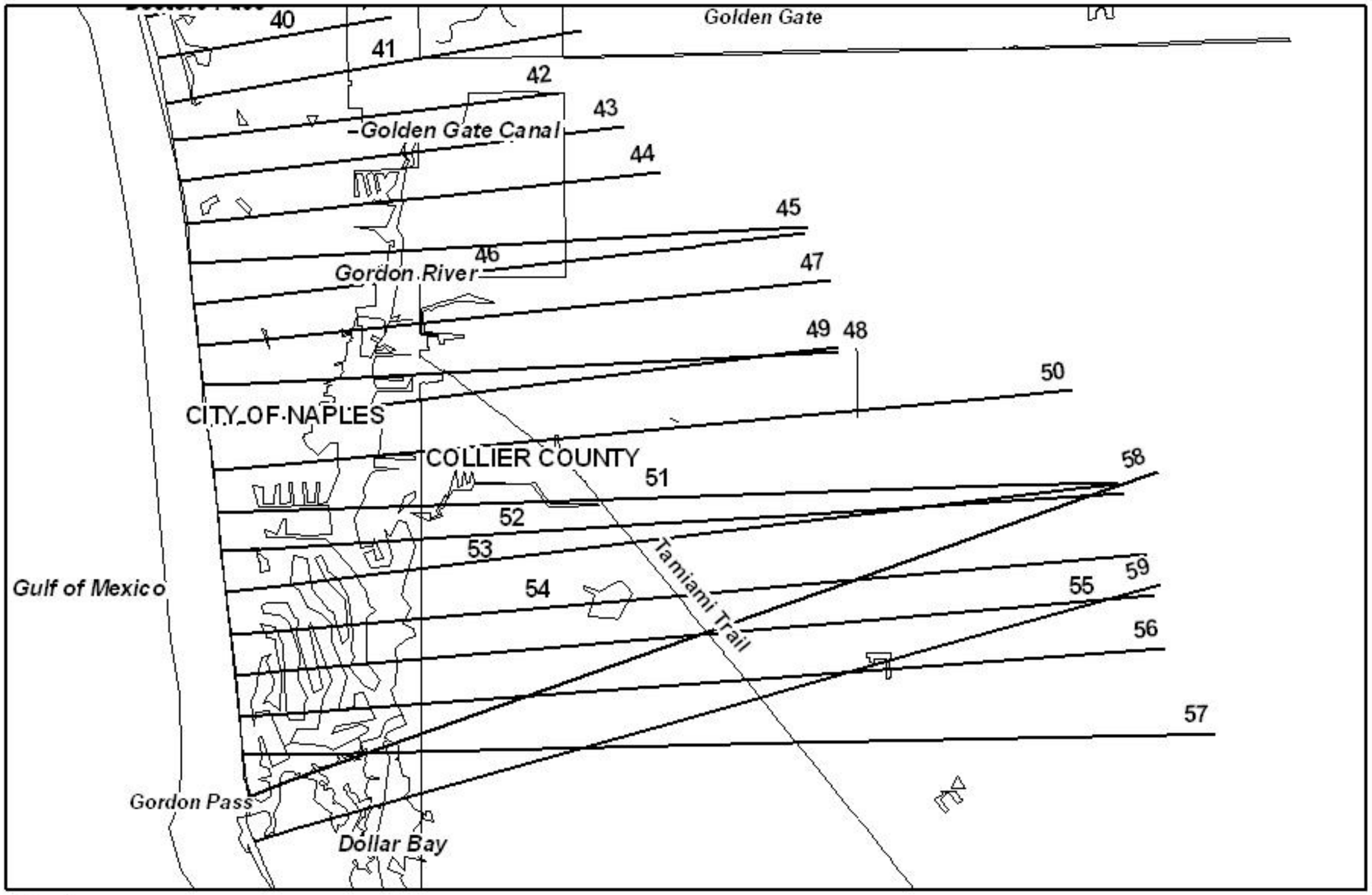
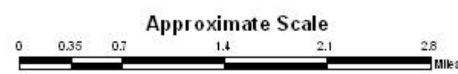


FIGURE 1.D

FEDERAL EMERGENCY MANAGEMENT AGENCY
COLLIER COUNTY, FL
AND INCORPORATED AREAS



TRANSECT LOCATION MAP

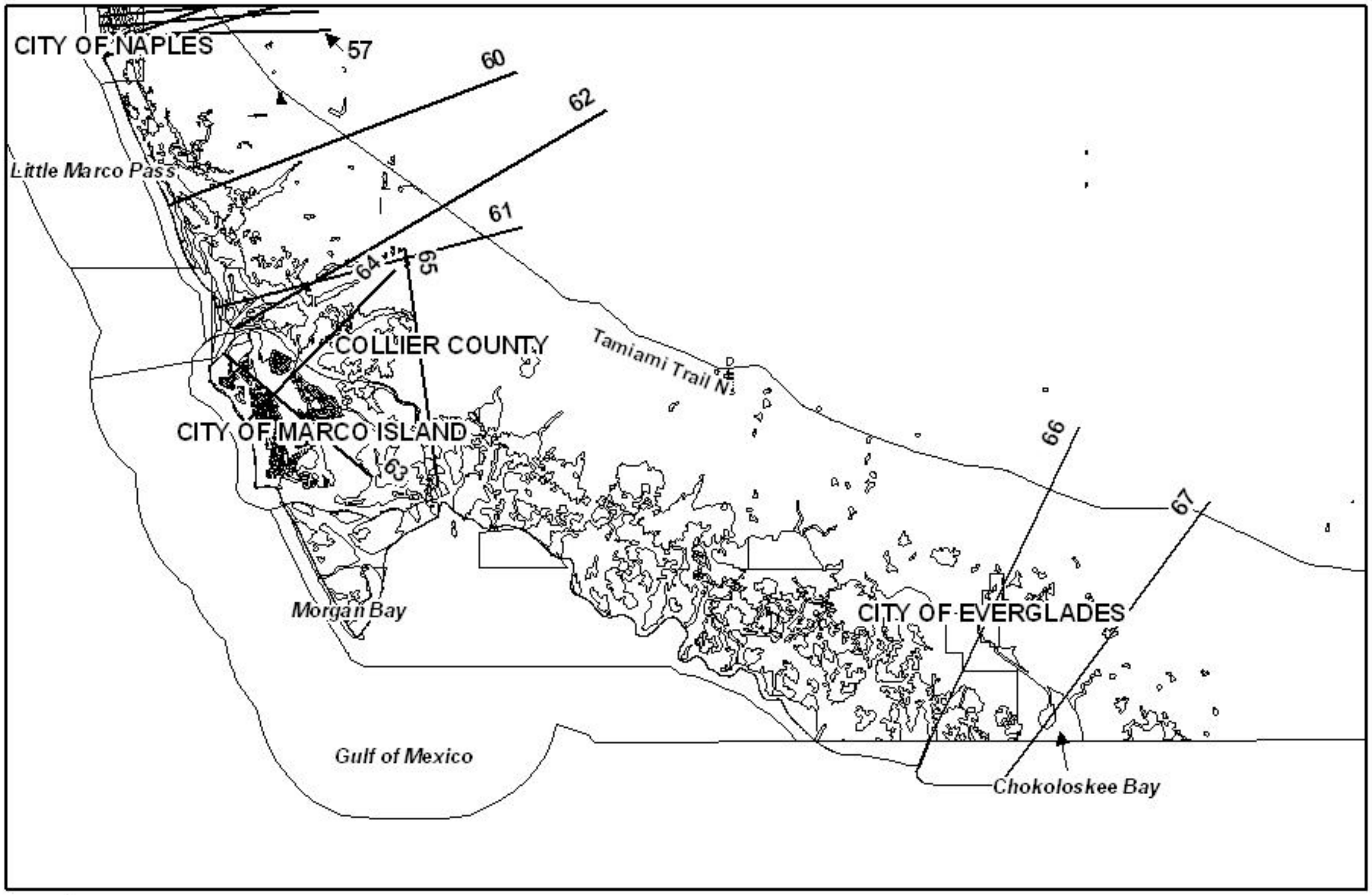


FIGURE 1.E

FEDERAL EMERGENCY MANAGEMENT AGENCY
COLLIER COUNTY, FL
AND INCORPORATED AREAS

Approximate Scale
0 1.5 3 6 9 12 Miles

TRANSECT LOCATION MAP

Table 2. Summary of Stillwater Elevations

Transecct Number	Flooding Source and Location	Starting Stillwater (without wave setup) Elevations (NAVD88)			
		10 percent-annual-chance	2 percent-annual-chance	1 percent-annual-chance	0.2 percent-annual-chance
	Gulf of Mexico				
1	In the vicinity of 107 Dominica Lane	3.73[1]	8.06[1]	9.61[1]	12.38[1]
2	Approximately 350' west of 112 Inagua Lane	3.74	8.06	9.60	12.32
3	Approximately 90' south of 255 Barefoot Beach Blvd	3.76[1]	8.09[1]	9.62[1]	12.33[1]
4	Approximately 70' north of 267 Barefoot Beach Blvd	3.78	8.12	9.63	12.34
5	Approximately 20' north of 345 Shell Drive	3.78[1]	8.07[1]	9.57[1]	12.24[1]
6	Approximately 450' north of Barefoot Beach Blvd	3.78[1]	8.07[1]	9.57[1]	12.24[1]
7	Approximately 700' north of south end of loop of Barefoot Beach Blvd.	3.78	8.02	9.50	12.14
8	Approximately 560' south of south end of loop of Barefoot Beach Blvd.	3.79[1]	7.98[1]	9.44[1]	12.05[1]
9	Approximately 1800' north of north side of Wiggins Pass	3.79[1]	7.98[1]	9.44[1]	12.05[1]
10	Approximately 300' north of north side of Wiggins Pass	3.80	7.94	9.37	11.95
11	Approximately 800' south of south side of Wiggins Pass	3.81[1]	7.93[1]	9.36[1]	11.91[1]
12	Approximately 2400' south of south side of Wiggins Pass	3.81	7.92	9.34	11.87
13	Approximately 1900' north of Bluebill Ave (Transect 13)	3.87[1]	7.93[1]	9.35[1]	11.86[1]
14	Approximately 600' north Bluebill Ave	3.93	7.94	9.35	11.84
15	In the vicinity of 10851 Gulfshore Drive	3.91[1]	7.90[1]	9.30[1]	11.79[1]
16	In the vicinity of 10381 Gulfshore Drive	3.90[1]	7.86[1]	9.26[1]	11.74[1]
17	In the vicinity of 9891 Gulfshore Drive	3.88	7.82	9.21	11.69
18	In the vicinity of 9439 Gulfshore Drive	3.89[1]	7.81[1]	9.18[1]	11.64[1]
19	Approximately 150' south of intersection of Gulfshore Drive and Vanderbilt Beach Road	3.90[1]	7.80[1]	9.15[1]	11.58[1]
20	In the vicinity of 8553 Colony Bay Drive	3.90[1]	7.78[1]	9.13[1]	11.53[1]
21	Between 8171 and 8111 Bay Colony Drive	3.91[1]	7.77[1]	9.10[1]	11.47[1]
22	Between 7591 and 7599 Bay Colony Drive	3.92	7.76	9.07	11.42

Table 2. Summary of Stillwater Elevations cont.

Transect Number	Flooding Source and Location	Starting Stillwater (without wave setup) Elevations (NAVD88) 10 percent-annual-chance	2 percent-annual-chance	1 percent-annual-chance	0.2 percent-annual-chance
	Gulf of Mexico				
23	Approximately 200' south of 7401 Bay Colony Dr.	3.86[1]	7.71[1]	9.03[1]	11.39[1]
24	Approximately 1000' south of 6903 Pelican Bay Blvd	3.79	7.66	8.98	11.35
25	Approximately 1500' south of Transect #24, Transect #25 begins approximately 2300' west and 170' north of 6585 Nicholas Blvd	3.74[1]	7.61[1]	8.93[1]	11.30[1]
26	In the vicinity of 6300 Pelican Bay Blvd	3.70[1]	7.57[1]	8.89[1]	11.25[1]
27	Approximately 325' south 0f 6089 Pelican Bay Blvd	3.65	7.52	8.84	11.20
28	Approximately 1120' south of Clam Pass	3.66[1]	7.50[1]	8.81[1]	11.16[1]
29	Approximately 675' north of Seagate Drive	3.66	7.47	8.78	11.11
30	In the vicinity of 80 Seagate Drive	3.71[1]	7.47[1]	8.76[1]	11.06[1]
31	Between 4351 and 4301 Gulfshore Blvd	3.77[1]	7.47[1]	8.75[1]	11.02[1]
32	Between 4351 and 4301 Gulfshore Blvd	3.82	7.47	8.73	10.97
33	In the vicinity of 4051 Gulfshore Blvd	3.91[1]	7.43[1]	8.68[1]	10.93[1]
34	Between 4001 and 3991 Gulfshore Blvd	3.74[1]	7.39[1]	8.64[1]	10.88[1]
35	In the vicinity of3443 Gulfshore Blvd	3.70	7.35	8.59	10.84
36	Between 3215 and 3100 Gulfshore Blvd	3.73[1]	7.34[1]	8.56[1]	10.79[1]
37	Between 2885 and 2885 Gulfshore Blvd	3.76[1]	7.33[1]	8.54[1]	10.75[1]
38	Approximately 400' north of north side of Doctors Pass	3.79	7.32	8.51	10.70
39	In the vicinity of 2121 Gulfshore Drive	3.73[1]	7.33[1]	8.52[1]	10.71[1]
40	In the vicinity of 1851 Gulfshore Blvd.	3.67	7.33	8.53	10.72
41	In the vicinity of Loudermilk Park and Beach	3.68[1]	7.31[1]	8.49[1]	10.68[1]
42	In the vicinity of 1121 Gulfshore Blvd	3.68	7.29	8.45	10.63
43	In the vicinity of 777 Gulfshore Blvd	3.68[1]	7.28[1]	8.44[1]	10.60[1]
44	In the vicinity of 455 Gulfshore Blvd	3.68	7.26	8.42	10.57
45	In the vicinity of 635 Gulfshore Blvd	3.69[1]	7.25[1]	8.41[1]	10.53[1]
46	In the vicinity of 378 Fair Lawn Ave.	3.71[1]	7.23[1]	8.39[1]	10.49[1]
47	In the vicinity of 5th Ave. South	3.72	7.22	8.38	10.45

Table 2. Summary of Stillwater Elevations cont.

Transect Number	Flooding Source and Location	Starting Stillwater (without wave setup) Elevations (NAVD88) 10 percent-annual-chance	2 percent-annual-chance	1 percent-annual-chance	0.2 percent-annual-chance
48	In the vicinity of 32 10th Ave. South	3.80[1]	7.25[1]	8.40[1]	10.43[1]
49	Approximately 370' South of Naples Pier	3.87	7.28	8.41	10.41
50	In the vicinity of 1680 Gulfshore Blvd	3.80[1]	7.24[1]	8.37[1]	10.37[1]
51	In the vicinity of 2050 Gordon Drive	3.77[1]	7.19[1]	8.34[1]	10.37[1]
52	In the vicinity of 2490 Gordon Drive	3.72	7.15	8.30	10.33
53	In the vicinity of 2790 Gordon Drive	3.70[1]	7.12[1]	8.27[1]	10.31[1]
54	In the vicinity of 3170 Gordon Drive	3.67[1]	7.09[1]	8.24[1]	10.28[1]
55	In the vicinity of 3550 Gordon Drive	3.65	7.06	8.21	10.26
56	In the vicinity of 3944 Gordon Drive	3.53	6.97	8.12	10.19
57	In the vicinity of 4348 Gordon Drive	3.53	6.97	8.12	10.19
58	Approximately 250' north of north side of Gordon Pass	3.53	6.97	8.12	10.19
59	Approximately 925' south of south side of Gordon Pass	3.53[1]	6.95[1]	8.11[1]	10.20[1]
60	Approximately 14,000' north o f the south tip of Keewaydin Island	3.46	6.71	7.91	10.06
61	Approximately 2700' south of the south tip of Keewaydin Island	3.67[1]	6.59[1]	7.66[1]	9.60[1]
62	Approximately 0 LA Peninsula Blvd	3.38[1]	6.24[1]	7.28[1]	9.30[1]
63	Transect starts approximately in the middle of Hideway Beach at the north end of Marco Island. Transect runs from north to south.	3.92[1]	6.09[1]	7.15[1]	9.19[1]
64	Marco Island - Transect crosses Collier Blvd approximately 450' north of intersection with San Marco Drive	3.66	6.65	7.80	9.88
65	Goodland- approximately 2,200' south of 751 Palm Point Drive. Transect runs south to north	4.76	7.83	8.94	11.22
66	Everglades City- Transect begins approximately 22,600' south west of middle of airport. Transect runs south to north	4.56	7.99	9.28	11.80
67	Everglades City- Transect begins approximately 1,000' south west of Chockoloskee. Transect runs south to north	4.56	7.99	9.28	11.80

[1] Stillwater have been interpolated, based on distance from PROBs evaluation points

Wave heights were computed along the CHAMP eroded transects. The transects were oriented perpendicular to the average shoreline on which wave propagation is determined. Consideration was also given to the physical and cultural characteristics of the land, so that they would closely represent conditions of their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced as larger intervals. It was also necessary to locate transects in areas where unique flooding existed and where computed wave heights varied significantly between adjacent transects. Calculations along the transects were continued inland until the waves were substantially dissipated or until flooding from another source with an equal water-surface elevation (WSEL) could be reached. Table 3 lists the stillwater flood elevations including wave setup, the flood zones, and wave-influenced Base Flood Elevations (BFEs) along each transect. Figure 2 is a profile for a typical transect, illustrating the effects of energy dissipation and regeneration of a wave as it moves inland.

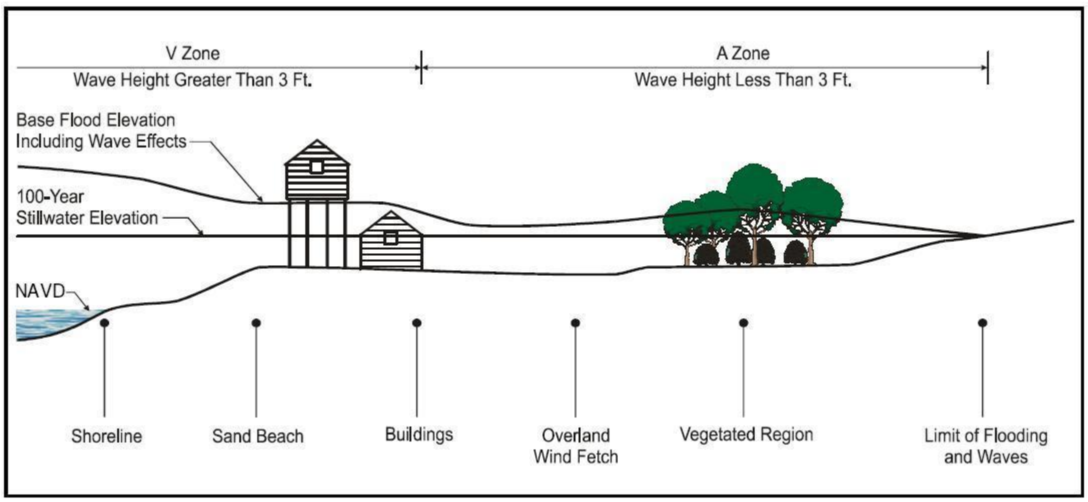


Figure 2. Transect Schematic

FEMA defines the Zone V or coastal high hazard area as an area of special flood hazards extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave action (i.e., wave heights greater than or equal to 3 feet) from storms or seismic sources. The "primary frontal dune" is defined as a continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms such as hurricanes. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from relatively steep to relatively mild slope. Where appropriate, Zone V was revised to include the primary frontal dune.

Table 3. Transect Data

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 1	3.73[2]	8.06[2]	11.01[1,2]	12.38[2]	VE	13-16
					AE	10-12
	3.73[2]	8.06[2]	9.61[2,3]	12.38[2]	AE	9-10
	3.42	7.03	8.47	11.72	AE	9-10
Transect 2	3.74	8.06	11.00[1]	12.32	VE	13-16
					AE	10-12
	3.74	8.06	9.60[3]	12.32	AE	9-10
	3.52[2]	7.07[2]	8.49[2]	11.68[2]	VE	11
					AE	9-10
Transect 3	3.76[2]	8.09[2]	11.02[1,2]	12.33[2]	VE	13-16
					AE	10-12
	3.76[2]	8.09[2]	9.62[2,3]	12.33[2]	VE	11
					AE	10-11
Transect 4	3.78	8.12	11.03[1]	12.34	VE	13-16
					AE	10-12
	3.78	8.12	9.63[3]	12.34	AE	10
	3.62	7.10	8.51	11.63	AE	10
Transect 5	3.78[2]	8.07[2]	10.97[1,2]	12.24[2]	VE	13-16
					AE	10-12
	3.78[2]	8.07[2]	9.57[2,3]	12.24[2]	AE	10
Transect 6	3.78[2]	8.07[2]	10.97[1,2]	12.24[2]	VE	13-16
					AE	10-12
	3.78[2]	8.07[2]	9.57[2,3]	12.24[2]	VE	10
	3.54[2]	7.17[2]	8.59[2]	11.63[2]	AE	9-10
Transect 7	3.78	8.02	10.90[1]	12.14	VE	13-16
					AE	10-12
	3.78	8.02	9.50[3]	12.14	AE	9-10
Transect 8	3.79[2]	7.98[2]	10.84[1,2]	12.05[2]	VE	13-16
					AE	10-12
	3.79[2]	7.98[2]	9.44[2,3]	12.05[2]	AE	9-10
Transect 9	3.79[2]	7.98[2]	10.84[1,2]	12.05[2]	VE	12-16
					AE	10-12
	3.79[2]	7.98[2]	9.44[2,3]	12.05[2]	AE	10
	3.61[2]	7.40[2]	8.78[2]	11.59[2]	AE	9-10

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 10	3.80	7.94	10.77[1]	11.95	VE	12-16
					AE	10-12
	3.80	7.94	9.37[3]	11.95	AE	11
	3.76	7.56	8.89	11.56	AE	10-11
	3.75	7.62	8.93	11.60	AE	9-10
Transect 11	3.81[2]	7.93[2]	10.76[1,2]	11.91[2]	VE	13-16
					AE	11-12
	3.81[2]	7.93[2]	9.36[2,3]	11.91[2]	AE	9-11
	3.73[2]	7.55[2]	8.86[2]	11.48[2]	AE	9
Transect 12	3.81	7.92	10.74[1]	11.87	VE	13-16
					AE	10-12
	3.81	7.92	9.34[3]	11.87	AE	9-10
	3.71	7.47	8.78	11.36	AE	9
Transect 13	3.87[2]	7.93[2]	10.75[1,2]	11.86[2]	VE	13-16
					AE	11-12
	3.87[2]	7.93[2]	9.35[2,3]	11.86[2]	AE	9-11
	3.71	7.47	8.78	11.36	AE	9
	3.69	7.40	8.67	11.10	AE	9
Transect 14	3.93	7.94	10.75[1]	11.84	VE	13-16
					AE	11-12
	3.93	7.94	9.35[3]	11.84	AE	9-11
	3.71	7.47	8.78	11.36	AE	9
	3.69	7.40	8.67	11.10	AE	9
	3.66	7.00	8.10	10.32	AE	9
Transect 15	3.91[2]	7.90[2]	10.70[1,2]	11.79[2]	VE	13-16
					AE	10-12
	3.91[2]	7.90[2]	9.30[2,3]	11.79[2]	AE	9-10
	3.71	7.47	8.78	11.36	AE	9
	3.66	7.00	8.10	10.32	AE	9
Transect 16	3.90[2]	7.86[2]	10.66[1,2]	11.74[2]	VE	13-16
					AE	11-12
	3.90[2]	7.86[2]	9.26[2,3]	11.74[2]	VE	12
					AE	9-11
	3.58	6.70	7.67	10.06	AE	9
Transect 17	3.88	7.82	10.61[1]	11.69	VE	13-16
					AE	11-12
	3.88	7.82	9.21[3]	11.69	AE	9-11

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 18	3.89[2]	7.81[2]	10.58[1,2]	11.64[2]		
					AE	10-12
	3.89[2]	7.81[2]	9.18[2,3]	11.64[2]	AE	9-10
Transect 19	3.90[2]	7.80[2]	10.55[1,2]	11.58[2]	VE	13-16
					AE	10-12
	3.90[2]	7.80[2]	9.15[2,3]	11.58[2]	AE	9-10
Transect 20	3.90[2]	7.78[2]	10.53[1,2]	11.53[2]	VE	12-16
					AE	10-12
	3.90[2]	7.78[2]	9.13[2,3]	11.53[2]	AE	9-10
Transect 21	3.91[2]	7.77[2]	10.50[1,2]	11.47[2]	VE	12-16
					AE	10-11
	3.91[2]	7.77[2]	9.10[2,3]	11.47[2]	AE	9-10
Transect 22	3.92	7.76	10.47[1]	11.42	VE	12-16
					AE	10-12
	3.92	7.76	9.07[3]	11.42	AE	9-10
Transect 23	3.86[2]	7.71[2]	10.43[1,2]	11.39[2]	VE	13-16
					AE	10-12
	3.86[2]	7.71[2]	9.03[2,3]	11.39[2]	AE	9-10
Transect 24	3.79	7.66	10.38[1]	11.35	VE	13-16
					AE	10-12
	3.79	7.66	8.98[3]	11.35	AE	9-10
Transect 25	3.74[2]	7.61[2]	10.33[1,2]	11.30[2]	VE	12-16
					AE	10-11
	3.74[2]	7.61[2]	8.93[2,3]	11.30[2]	AE	9-10
Transect 26	3.70[2]	7.57[2]	10.29[1,2]	11.25[2]	VE	12-16
					AE	10-11
	3.70[2]	7.57[2]	8.89[2,3]	11.25[2]	AE	9-10
Transect 27	3.65	7.52	10.24[1]	11.20	VE	13-16
					AE	10-11
	3.65	7.52	8.84[3]	11.20	AE	9-10
Transect 28	3.66[2]	7.50[2]	10.21[1,2]	11. [2]16	VE	12-16
					AE	10-11
	3.66[2]	7.50[2]	8.81[2,3]	11.16[2]	AE	9-10
Transect 29	3.66	7.47	10.18[1]	11.11	VE	11-16
					AE	11-12
	3.66	7.47	8.78[3]	11.11	AE	9-11

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 30	3.71[2]	7.47[2]	10.16[1,2]	11.06[2]	VE	12-16
					AE	10-12
	3.71[2]	7.47[2]	8.76[2,3]	11.06[2]	AE	9-10
Transect 31	3.77[2]	7.47[2]	10.15[1,2]	11.02[2]	VE	12-16
					AE	11-12
	6.14	8.48	9.23[4]	11.88	AE	10-11
	6.14	8.48	9.23	11.88	AE	9-10
Transect 32	3.82	7.47	10.13[1]	10.97	VE	12-16
					AE	11
	5.41[2]	8.13[2]	9.23[2,4]	10.94[2]	AE	11
	5.41[2]	8.13[2]	9.23[2]	10.94[2]	AE	9-11
Transect 33	3.78[2]	7.43[2]	10.08[1,2]	10.93[2]	VE	12-16
					AE	10-11
	4.67	7.78	8.92[4]	11.00	AE	10
	4.67	7.78	8.92	11.00	AE	9-10
Transect 34	2.34[2]	5.99[2]	10.04[1,2]	9.48[2]	VE	12-16
					AE	11
	4.58[2]	7.72[2]	8.87[2,4]	10.94[2]	AE	10-11
	4.58[2]	7.72[2]	8.87[2]	10.94[2]	AE	9-10
Transect 35	3.70	7.35	9.99[1]	10.84	VE	12-16
					AE	10-12
	4.49	7.65	8.81[4]	10.88	AE	10
	4.49	7.65	8.81	10.88	AE	9-10
Transect 36	3.73[2]	7.34[2]	9.96[1,2]	10.79[2]	VE	12-16
					AE	10-12
	4.24[2]	7.54[2]	8.72[2,4]	10.81[2]	AE	9-10
Transect 37	3.76[2]	7.33[2]	9.94[1,2]	10.75[2]	VE	12-16
					AE	10-11
	4.36[2]	7.60[2]	8.72[2,4]	10.85[2]	AE	9-11
Transect 38	3.79	7.32	9.91[1]	10.70	VE	12-16
					AE	9-12
	4.11	7.49	8.67[4]	10.78	AE	9
Transect 39	3.73[2]	7.33[2]	9.92[1,2]	10.71[2]	VE	13-16
					AE	9-12
	3.73[2]	7.33[2]	8.52[2,3]	10.71[2]	AE	9

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 40	3.67	7.33	9.93[1]	10.72	VE	13-16
					AE	9-12
	3.67	7.33	8.53[3]	10.72	AE	9-10
Transect 41	3.68[2]	7.31[2]	9.89[1,2]	10.68[2]	VE	12-16
					AE	9-12
	3.68[2]	7.31[2]	8.49[2,3]	10.68[2]	AE	7-9
	3.38	5.73	6.73	8.73	AE	7-8
Transect 42	3.68	7.29	9.85[1]	10.63	VE	13-16
					AE	8-12
	3.68	7.29	8.45[3]	10.63	AE	7-8
	3.38	5.73	6.73	8.73	AE	7-8
Transect 43	3.68[2]	7.28[2]	9.84[1,2]	10.60[2]	VE	13-16
					AE	8-12
	3.68[2]	7.28[2]	8.44[2,3]	10.60[2]	AE	7-8
	3.21	5.71	6.75	8.76	AE	7-8
	3.34[2]	5.71[2]	6.73[2]	8.73[2]	AE	7-8
Transect 44	3.68	7.26	9.82[1]	10.57	VE	13-16
					AE	8-12
	3.68	7.26	8.42[3]	10.57	AE	7-8
	3.29	5.69	6.72	8.72	AE	7-8
Transect 45	3.69[2]	7.25[2]	9.81[1,2]	10.53[2]	VE	13-16
					AE	8-12
	3.69[2]	7.25[2]	8.41[2,3]	10.53[2]	AE	8
	4.48	5.84	6.84	8.71	AE	7-8
	3.21	5.71	6.75	8.76	AE	7-8
Transect 46	3.71[2]	7.23[2]	9.79[1,2]	10.49[2]	VE	12-16
					AE	8-12
	3.71[2]	7.23[2]	8.39[2,3]	10.49[2]	AE	8
	4.48	5.84	6.84	8.71	AE	7-8
	3.16[2]	5.76[2]	6.83[2]	8.87[2]	AE	7-8
Transect 47	3.72	7.22	9.78[1]	10.45	VE	12-16
					AE	9-12
	3.72	7.22	8.38[3]	10.45	AE	8-9
	4.48	5.84	6.84	8.71	AE	7-8
	3.10	5.81	6.90	8.98	AE	7-8

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 48	3.80[2]	7.25[2]	9.80[1,2]	10.43[2]	VE	12-16
					AE	8-12
	3.80[2]	7.25[2]	8.40[2,3]	10.43[2]	AE	7-8
	4.14[2]	5.82[2]	6.69[2]	8.46[2]	AE	7
	3.07	5.82	6.92	9.00	AE	7-8
	5.48	6.23	6.99	8.61	AE	7
Transect 49	3.87	7.28	9.81[1]	10.41	VE	12-16
					AE	9-12
	3.87	7.28	8.41[3]	10.41	AE	7-9
	3.79	5.79	6.54	8.20	AE	7
	3.07	5.82	6.92	9.00	VE	9
					AE	6-8
	3.50	5.32	6.31	8.40	AE	6-8
	5.48	6.23	6.99	8.61	AE	7
Transect 50	3.80[2]	7.24[2]	9.77[1,2]	10.37[2]	VE	12-16
					AE	9-12
	3.80[2]	7.24[2]	8.37[2,3]	10.37[2]	AE	7-9
	3.04	5.79	6.89	8.92	AE	7-9
	4.98	5.94	6.72	8.20	AE	7-8
	4.98	5.84	6.64	8.30	AE	7
Transect 51	3.77[2]	7.19[2]	9.74[1,2]	10.37[2]	VE	11-16
					AE	8-11
	3.77[2]	7.19[2]	8.34[2,3]	10.37[2]	AE	7-8
	3.03[2]	5.79[2]	6.89[2]	8.95[2]	AE	7-9
	3.60	5.87	6.78	8.43	AE	7-8
	4.98	5.84	6.64	8.30	AE	7
Transect 52	3.72	7.15	9.70[1]	10.33	VE	11-16
					AE	9-11
	3.72	7.15	8.30[3]	10.33	AE	7-9
	3.01	5.79	6.89	8.98	AE	7-9
	3.60	5.87	6.78	8.43	AE	7
	4.98	5.84	6.64	8.30	AE	7
Transect 53	3.70[2]	7.12[2]	9.67[1,2]	10.31[2]	VE	13-16
					AE	9-11
	3.70[2]	7.12[2]	8.27[2,3]	10.31[2]	AE	7-9
	3.01	5.79	6.89	8.98	AE	7-9
	3.60	5.87	6.78	8.43	AE	7
	4.98	5.84	6.64	8.30	AE	7

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 54	3.67[2]	7.09[2]	9.64[1,2]	10.28[2]	VE	12-16
					AE	9-12
	3.67[2]	7.09[2]	8.24[2,3]	10.28[2]	AE	7-9
	3.01	5.79	6.89	8.98	VE	8
					AE	7-9
	4.03	5.40	6.30	8.26	VE	8
					AE	7
Transect 55	3.65	7.06	9.61[1]	10.26	VE	12-16
					AE	9-12
	3.65	7.06	8.21[3]	10.26	AE	7-9
	3.01	5.79	6.89	8.98	AE	7-8
	3.54	5.31	6.25	8.30	AE	7
	4.03	5.40	6.30	8.26	AE	7
Transect 56	3.53	6.97	9.52[1]	10.19	VE	12-16
					AE	9-11
	3.53	6.97	8.12[3]	10.19	AE	7-9
	3.01	5.79	6.89	8.98	AE	6-8
	3.54	5.31	6.25	8.33	AE	6-8
	4.03	5.40	6.30	8.26	AE	6-8
Transect 57	3.53	6.97	9.52[1]	10.19	VE	12-16
					AE	8-11
	3.53	6.97	8.12[3]	10.19	VE	10
					AE	6-9
	3.88	5.55	6.36	8.36	AE	6
	3.39	5.08	5.85	7.74	AE	6-7
	5.86	6.26	6.78	8.12	AE	6-7
	7.35	7.43	7.69	8.49	AE	7
Transect 58	3.53	6.97	9.52[1]	10.19	VE	10-16
					AE	9-11
	3.53	6.97	8.12[3]	10.19	VE	10
					AE	7-9
	3.54	5.31	6.25	8.33	AE	6-8
	4.03	5.40	6.30	8.26	AE	7-8
Transect 59	3.53[2]	6.95[2]	9.51[1,2]	10.20[2]	VE	11-16
					AE	8-10
	3.53[2]	6.95[2]	8.11[2,3]	10.20[2]	AE	8
	3.61	6.01	7.04	9.02	VE	10
					AE	6-8
	3.88	5.55	6.36	8.36	AE	6
	4.03	5.40	6.30	8.26	AE	6-7

Table 3. Transect Data cont.

Flooding Source Gulf of Mexico	Stillwater Elevation (NAVD88) 10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 60	3.46	6.71	9.31[1]	10.06	VE	11-16
					AE	9-10
	3.46	6.71	7.91[3]	10.06	AE	8-9
	3.04[2]	5.29[2]	6.34[2]	8.35[2]	VE	9
					AE	7-8
	3.18[2]	5.32[2]	6.28[2]	8.30[2]	AE	6-7
	4.11	4.79	5.45	6.69	AE	7
Transect 61	3.67[2]	6.59[2]	9.06[1,2]	9.60[2]	VE	11-16
					AE	8-10
	3.67[2]	6.59[2]	7.66[2,3]	9.60[2]	AE	8
	2.78	5.27	6.27	8.19	AE	8
	2.78	4.53	5.34	7.01	AE	7-8
	2.61	4.49	5.45	7.36	AE	6-7
	3.96	4.42	5.25	6.94	AE	6
	1.32	3.32	4.23	6.28	AE	6
	2.72	3.62	4.27	5.73	AE	6-7
Transect 62	3.38[2]	6.24[2]	8.68[1,2]	9.30[2]	VE	11-16
					AE	8-9
	3.38[2]	6.24[2]	7.28[2,3]	9.30[2]	AE	8
	3.48	5.61	6.43	8.12	AE	7-8
	2.61	4.49	5.45	7.36	AE	6-7
	3.96	4.42	5.25	6.94	AE	6
	2.81	4.57	5.27	6.74	AE	6
	4.21	4.52	4.98	6.16	AE	6
	4.20	4.25	4.83	6.10	AE	6
	4.78	5.28	5.92	7.69	AE	6-7
Transect 63	3.92[2]	6.09[2]	8.55[1,2]	9.19[2]	VE	9-16
					AE	8-10
	3.92[2]	6.09[2]	7.15[2,3]	9.19[2]	VE	9-10
					AE	7-8
	5.09	6.07	6.94	8.44	VE	11
					AE	7-10
Transect 64	3.66	8.05	9.20[1]	9.88	VE	11-16
					AE	9-10
	3.66	6.65	7.80[3]	9.88	AE	7-9
	3.68	5.69	6.61	8.46	VE	9
					AE	7-8
	3.66	5.62	6.55	8.34	AE	6-8
	1.32	3.32	4.23	6.28	AE	6

Table 3. Transect Data cont.

Flooding Source	Stillwater Elevation (NAVD88)					
Gulf of Mexico	10-percent-annual-chance	2-percent-annual-chance	1-percent-annual-chance	0.2-percent-annual-chance	Zone	BFE (NAVD88)
Transect 65	4.76	7.83	10.34[1]	11.22	VE	11-16
					AE	10
	4.76	7.83	8.94[3]	11.22	AE	9-10
	4.29	6.73	7.70	9.68	AE	7-10
	3.86	6.02	7.00	8.92	AE	7
	4.06	6.20	7.11	8.90	AE	6-7
	3.50	5.24	6.06	7.76	AE	6
Transect 66	4.56	7.99	9.28[3]	11.80	VE	11-13
					AE	10-11
	4.30	7.38	8.64	10.93	VE	11
					AE	9-10
	2.86	5.68	6.89	9.02	AE	8-9
	3.46	5.89	6.99	9.11	AE	6-8
	2.17	3.63	4.51	6.23	AE	6
Transect 67	4.56	7.99	9.28[3]	11.80	VE	11-13
					AE	9-10
	4.90[2]	7.17[2]	8.12[2]	9.97[2]	VE	11
					AE	9-10
	2.86	5.68	6.89	9.02	VE	11
					AE	6-10
	2.17	3.63	4.51	6.23	AE	7

[1] Wave setup of 1.4 feet included landward to the dune crest.
[2] Stillwaters have been interpolated based on distance from PROBs evaluation points
[3] 1.4 feet:1400 feet reduction slope
[4] Higher than the 1.4 feet:1400 feet reduction slope, at a point closer to the Gulf shoreline

Riverine Analyses

The riverine analysis was conducted using two-dimensional hydrologic/hydrodynamic modeling. At the beginning of the project, the seven major basins that cover the middle and western portions of Collier County were defined based on topography and on the basin delineations provided by the SFWMD. Each basin was then modeled using the S2DMM program (Reference 15), which is a two-dimensional, grid-based hydrologic/hydrodynamic model. The grid sizes for each basin varied between 500 feet by 500 feet to 1,000 feet by 1,000 feet, depending on the size of the basin, level of development, and resolution needed. The grid size of each basin is summarized in Table 4.

The less-developed area of eastern Collier County was modeled by two larger-sized grid models (2,640 feet by 2,640 feet); output from these models was used to provide input values to the smaller-sized grids for populated areas within the basins. Results from the larger grid models were not used to establish flood elevations. Twelve basin models were developed (see Figure 3).

Each model was calibrated and validated by comparing the modeled stages and discharge hydrographs to recorded stages, high water marks, and discharges where available. Observed well elevations were also used to calibrate rainfall loss to groundwater. Calibration and verification used rainfall data for major storms during the wet season to best represent basin behavior in flood events. The periods of data used in the calibration and validation for each model are summarized in Table 4.

Table 4. Basin Grid Sizes, Calibration, and Verification Dates

Basin	Grid Size (ft)	Calibration Period	Verification Period
Ave Maria	1000 x 1000	5/2005 – 9/2005	5/2006 – 9/2006
Cocohatchee A	2640 x 2640	5/2006 – 9/2006	5/2005 – 9/2005
Cocohatchee B/C	1000 x 1000	5/2006 – 9/2006	5/2005 – 9/2005
Golden Gate Estate	660 x 660	8/1995	9/1999 [1]
Golden Gage West Main	500 x 500	8/1995	9/1999
Henderson	1000 x 1000	8/1995	9/1999
District 6	500 x 500	8/1995	9/1999
Southern Coastal	1000 x 1000	7/2001	9/1999
Faka Union/Miller Canal	660 x 660	5/2005 – 7/2005	6/2006 – 9/2006
Faka Union/Fakahatchee Strand	2640 x 2640	5/2005 – 9/2005	5/2006 – 9/2006
Copeland	1000 x 1000	No observed data available for calibration	

[1]August 1995 rainfall data are from Tropical Storm Jerry; September 1999 data are from Tropical Storm Harvey.

The calibrated watershed model was used to simulate the 10-percent, 2-percent, 1-percent, and 0.2-percent-annual-chance floods. The starting conditions for each basin model were established by running the models for 14 days with the average daily rainfall for the months of August and September (wet season). The resulting water levels throughout the basins were used as the antecedent condition.

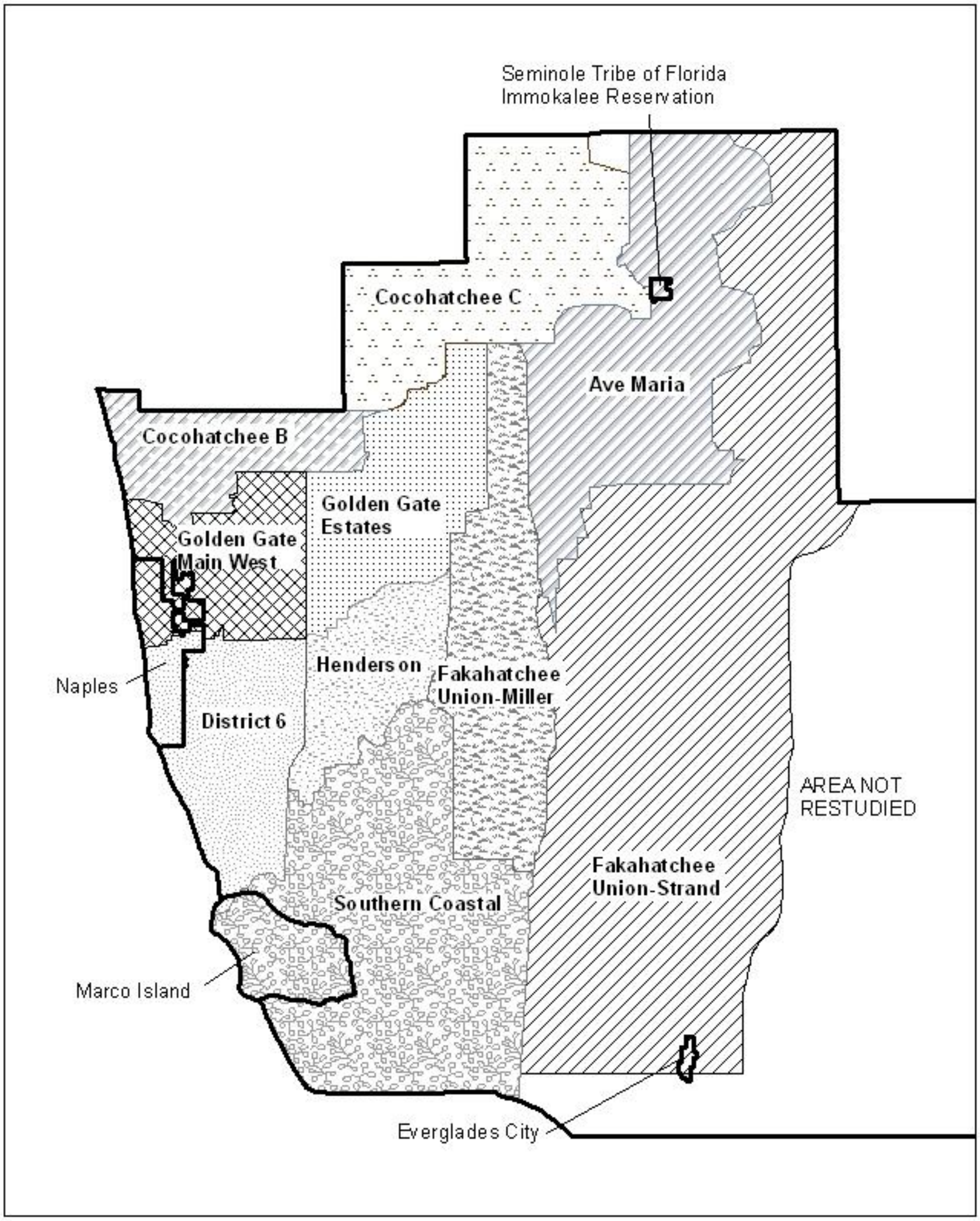


FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLLIER COUNTY, FL
AND INCORPORATED AREAS

MAJOR BASIN LOCATION MAP

The WSELs were estimated using rainfall data from the SFWMD, which provide rainfall isohytes for 10-percent, 25-percent and 1-percent-annual-chance events. Depths for the 2-percent and 0.2-percent-annual-chance storms were derived graphically from log-log relationship of depth and frequency. Depths varied from basin to basin as defined in the SFWMD's Environmental Resource Permit Information Manual (Reference 16) and rainfall was distributed temporally according to the SFWMD 3-day temporal distribution. Table 5 lists the calculated discharges.

Table 5. Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location[1]	Drainage Area (square miles)	10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Cocohatchee Canal					
At CC-1	214.1	684	827	881	1114
At CC-2	212.4	615	751	784	966
At CC-3	204.0	194	274	302	400
CR951 Canal					
At CR951 #1 (ARS)	2.7	422	463	473	440
Faka Union Canal					
At FU-1	210.4	3140	4119	4347	5238
At FU-2	48.8	1239	2112	2276	2778
At FU-3	31.3	948	1593	1683	2266
At FU-4	23.1	522	1218	1223	2208
At FU-5	12.5	552	912	1039	1465
At FU-6	7.7	383	685	838	1229
At FU-7	3.9	362	577	686	989
Golden Gate Main Canal					
GG-1	115.7	2702	3145	3272	3706
GG-2	98.5	2408	2700	2795	3065
GG-3	61.5	1262	1290	1309	1384
GG-4	25.7	815	950	1001	1128
GG-5	15.2	606	788	870	1079
GG-6	4.2	256	317	346	426
GG-7	4.6	91	112	120	145
Cypress Canal					
CYP 1	40.0	242	258	262	294
Harvey Canal[2]					
Harvey 1	8.3	600	777	779	781

Table 5. Summary of Discharges cont.

Flooding Source and Location[1]	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Henderson Canal					
HEN CR-1	47.2	434	614	692	894
I-75 Canal					
I-75-1	25.0	862	1105	1199	1436
I-75-2	9.2	271	369	404	525
I-75-3	4.3	167	230	250	312
Merrit Canal					
MER-1	93.5	909	918	923	933
Lucky Lakes	86.1	651	702	729	828
Miller Canal					
MIL -1	25.4	1033	1102	1140	1194
MIL- 2	11.6	547	629	686	730
MIL -3	-	245	288	305	327
Prairie Canal					
PRA-1	8.0	22	27	30	63
SR 29 Canal					
SR29-1	255.6	94	93	93	94
SR29-2	237.6	271	274	274	348
SR29-3	236.7	361	365	367	556
SR29-4	234.3	143	167	184	386
SR29-5	232.4	153	151	149	650
SR29-6a	231.0	63	82	93	128
SR29-7	223.2	206	230	240	268
SR29-8	216.1	318	346	362	469

[1]These discharges are at control structures along canals. Locations and descriptions of the structures can be found in Reference 17, except for CR951, which is described in Reference 18.
[2]The flow for the Harvey Canal is from the Green Canal at the Harvey 1 location.

The peak stage was calculated for each grid cell. The grid cells represented uplands as well as water bodies, including lakes, canals, rivers and bays. In basin models, canals were typically represented as "offset channels" that allowed the hydrodynamics to be computed separately from the upland runoff dynamics. The offset channels were connected to the upland runoff areas via actual structures such as pipes and weirs or effective structures to represent bank overtoppings.

Combined Coastal/Riverine Analyses

For the areas of the county that would be impacted by both coastal surge/hurricane flooding events and large rainfall flooding, a combined effects analysis was conducted. The 1-percent-annual-chance riverine flood elevations were compared to the 1-percent-annual-chance coastal flood elevation in each riverine grid cell along this transition zone. If one flood elevation statistically dominated, it became the recorded 1-percent-annual-chance elevation. For most of these transitional grids, it was necessary to estimate the combined effects to determine the correct BFE. The methods specified in Appendix D of FEMA's *Guidelines and Specifications* (Reference 19) were applied to estimate the combined effects from coastal and riverine flooding. The following equation was used:

$$R_{P,T}(Z) = R_{P,R}(Z) + R_{P,S}(Z)$$

Where:
Z – flood level at point P
$R_{P,T}(Z)$ – total rate (occurrences per year) that Z is exceeded, irrespective of flood source
$R_{P,R}(Z)$ – rate that Z is exceeded for rainfall events (riverine impact)
$R_{P,S(}Z)$ – rate that Z is exceeded for surge events (coastal impact)

After the flood elevations in the transition zone were adjusted, it was decided that those areas would be mapped in the riverine portion of the watershed. The coastal portion of each watershed was mapped with whole-foot BFEs, while the riverine portion was mapped with half-foot BFEs. Including the transition zone areas with the riverine portion provides those areas with more detailed BFE information.

3.2 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was NGVD29. With the completion of NAVD88, many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

All flood elevations in this FIS report are referenced to NAVD88. Flood elevations on the FIRM are referenced to both NAVD88 and NGVD29. The NAVD88 BFEs on the FIRM are presented to half-foot rounded values and should be used for NFIP purposes. These flood elevations must be compared to structure and ground elevations referenced in the same vertical datum. The NGVD29 elevations presented on the FIRM to the one-tenth-foot increment are presented for informational purposes only. Figure X illustrates the differences in BFEs due to the datum conversion. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in BFEs across corporate limits between communities.

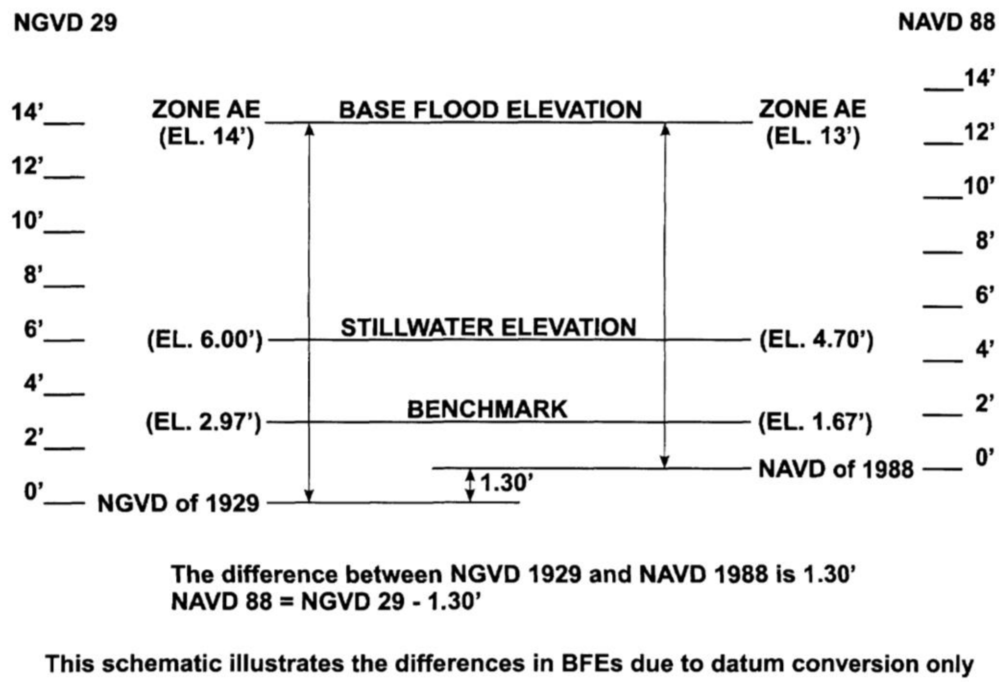


Figure 4. Collier County Vertical Datum Conversion

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-percent, 2-percent, 1-percent, and 0.2-percent-annual-chance flood elevations; delineations of the 1-percent and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in the Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report, as well as additional information that may be available at the local community map repository, before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For riverine areas, the 1-percent and 0.2-percent-annual-chance flood elevations were computed at each individual model grid cell. These values were used to create a raster surface of the WSEL at the grid scale. This raster surface was compared to a digital elevation model (DEM) created from LIDAR topographic data collected by 3001, Inc. in 2002 (Reference 20). A comparison of the rasters was conducted using a Geographic Information System (GIS), and all areas where the WSEL was above the ground surface elevation were designated as a 1-percent-annual-chance floodplain or 0.2-percent-annual-chance floodplain, as appropriate. To determine the boundaries between Zone AE and Zone AH, the model's depth results were used. If the flood depth was determined to be 3 feet or more above the raster ground elevation, the area was designated Zone AE. If the flood depth was less than 3 feet, the area was designated Zone AH.

To determine the floodplain boundaries in the coastal areas, the WSELs were processed to create Triangular Irregular Networks (TINs). These were compared to the ground surface raster using GIS techniques. Whenever the TIN flood elevation was above the ground surface elevation, that area was designated either Zone AE or Zone VE, depending on the designation along the transect. If the stillwater elevation was less than the raster ground surface elevation, the area was determined to be above the 0.2-percent-annual-chance flood and was designated Zone X (unshaded).

The 1-percent and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the Special Flood Hazard Areas, Zones A, AE, AH, V, and VE, and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations, but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For areas of the county studied by less detailed methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazards. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

Due to the nature of flooding in Collier County (coastal flooding and ponding), no floodways were computed.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by less detailed methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Because less detailed hydraulic analyses are performed for such areas, no BFEs are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications. For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1-percent and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Collier County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county that were identified as floodprone. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 6, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Collier County (Unincorporated Areas)	September 14, 1979	None	September 14, 1979	October 1, 1983 December 18, 1984 June 3, 1986 August 3, 1992 February 16, 1995 July 20, 1998
Everglades, City of	July 17, 1970	None	October 6, 1972	July 1, 1974 May 23, 1975 November 28, 1975 June 3, 1986
Marco Island, City of (unincorporated Collier County, prior to November 17, 2005)	September 14, 1979	None	September 14, 1979	October 1, 1983 December 18, 1984 June 3, 1986 August 3, 1992 February 16, 1995 July 20, 1998
Naples, City of	May 5, 1970	August 7, 1970	July 2, 1971	July 1, 1974 February 13, 1976 July 16, 1980 June 3,1986 November 4, 1992
Seminole Tribe of Florida (unincorporated Collier County, prior to November 17, 2005)	May 16, 2012	N/A	May 16, 2012	N/A

Table 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

COLLIER COUNTY, FL
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Mitigation Division, FEMA Region IV, Koger-Center — Rutgers Building, 3003 Chamblee Tucker Road, Atlanta, GA 30341.

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