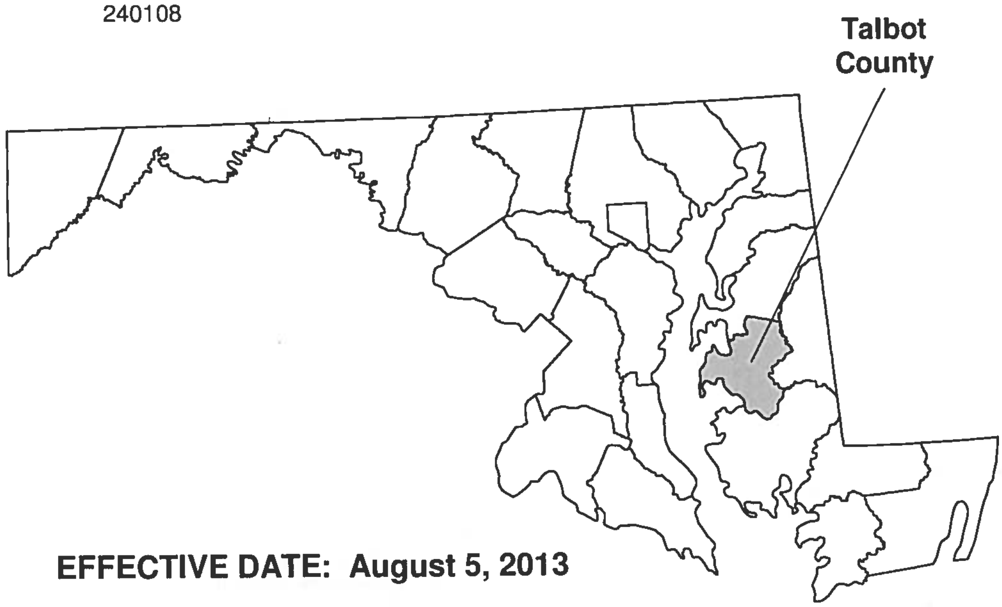
FLOOD INSURANCE STUDY

TALBOT COUNTY, MARYLAND AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
EASTON, TOWN OF	240067
OXFORD, TOWN OF	240068
ST. MICHAELS, TOWN OF	240069
TALBOT COUNTY (UNINCORPORATED AREAS)	240066
TRAPPE, TOWN OF	240108



EFFECTIVE DATE: August 5, 2013

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
24041CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program 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.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Selected Flood Insurance Rate Map panels for this community contain new flood zone designations. The flood hazard zones have been changed as follows:

Old Zones	New Zones
A1 through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date: August 5, 2013

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

Page

FIGURES

TABLES

EXHIBITS

EXHIBITS - continued

FLOOD INSURANCE STUDY
TALBOT COUNTY, MARYLAND AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FIS's / Flood Insurance Rate Maps (FIRMs) in the geographic area of Talbot County, Maryland, including the Towns of Easton, Oxford, St. Michaels and Trappe, and the unincorporated areas of Talbot County (referred to collectively herein as Talbot County) and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Talbot County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Town of Queen Anne is geographically located in Queen Anne's and Talbot Counties. Flood hazard information for the entire Town of Queen Anne is included in the Queen Anne's County FIS, and therefore not included in this countywide revision.

Please note that since the previously published FIRMs of May 15, 1985 for Talbot County, Maryland (Unincorporated Areas), the Town of Trappe has annexed land that has a 1-percent annual chance floodplain.

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) shall be able to explain them.

1.2 Authority and Acknowledgments

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

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, Talbot County in a countywide format FIS. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

The hydrologic and hydraulic analyses for the prior study of the unincorporated areas of Talbot County and the Towns of Easton, Oxford, and St. Michaels, were performed by the State of Maryland, Water Resources Administration for the Federal Emergency Management Agency, under Contract No. EMW-C-0274. This study was completed in February 1983.

There is no previous FIS for the Town of Trappe; therefore the previous authority and acknowledgement information for this community is not included in this FIS.

For this countywide FIS, new hydrologic and hydraulic analyses were performed for portions of Tanyard Branch, Windmill Branch, and Tributary No. 3 to Windmill Branch. New approximate floodplains were also mapped for Talbot County and its incorporated areas. The criteria for these floodplains can be found in Section 2.0 of this Flood Insurance Study. In addition, coastal floodplains were redelineated using updated topographic data provided by the Talbot County Department of Public Works. All coastal base flood elevations are shown the nearest tenth of a foot and effective zone break locations have been adjusted to match shoreline changes that have occurred since the previous effective Flood Insurance Study.

Base map information shown on this FIRM was provided in digital format. Streamline files, road centerline and political boundary files were provided by the Talbot County Department of Public Works. Digital aerial photography tiles, published in 2006, were also provided by Talbot County. Adjustments were made to specific base map features to align them to 1:200 and 1:400 scale orthophotos.

The coordinate system used for the production of this FIRM is Universal Transverse Mercator (UTM), Zone 18 North, North American Datum of 1983 (NAD 83), GRS 80 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the UTM projection, NAD 83. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

The Digital Flood Insurance Rate Map (DFIRM) production for this study was performed by AMEC, Earth & Environmental, Inc. for FEMA, under Contract No. HSFE03-07-D-0030, Task Order HSFE03-08-J-0014.

1.3 Coordination

An initial Consultation and Coordination Officer's (CCO) meeting is held typically with representatives of Federal Emergency Management Agency (FEMA), the community, and the study contractor to explain the nature and purpose of a FIS and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

On May 31, 1979, time and cost allocations were discussed at an initial CCO meeting attended by representatives of FEMA, Talbot County, the Towns of Easton, Oxford, and St. Michaels, and the Study Contractor. Further coordination occurred with the U.S. Army Corps of Engineers (USACE), the U.S. Geological Survey (USGS), the U.S. Department of Agriculture, Soil Conservation Service (SCS , now the National Resources Conservation Service, NRCS), Talbot County officials and the officials of the Towns of Easton, Oxford and St. Michaels.

On November 22, 1983, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the communities.

The dates of the initial and final CCO meetings held for the incorporated communities within the boundaries of Talbot County are shown in the following tabulation:

TABLE 1 – INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Easton, Town of	May 31, 1979	November 22, 1983
Oxford, Town of	May 31, 1979	November 22, 1983
St. Michaels, Town of	May 31, 1979	November 22, 1983
Talbot County (Unincorporated Areas)	May 31, 1979	November 22, 1983

For this revision, Talbot County and the Towns of Easton, Oxford, St. Michaels and Trappe were notified by phone in August 2008 that the FIS would be updated and converted to countywide format.

For this countywide revision, a final CCO meeting was held on August 22, 2011, and was attended by representatives from FEMA, the Maryland State NFIP Office, the officials of Talbot County and the Towns of Easton, Oxford, St. Michaels and Trappe, and the study contractors. At this meeting the findings of the study and the potential impact of the study results on the community were discussed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Talbot County, Maryland, including the Towns of Easton, Oxford, St. Michaels and Trappe.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development.

The tidal portions of the Chesapeake Bay, Eastern Bay, Choptank River, Tred Avon River, Wye East River, Miles River, Harris Creek and Broad Creek were redelineated using updated topographic data provided by the Talbot County Department of Public Works. Stillwater elevations for these tidal areas were derived from effective coastal transect locations. Base flood elevations for the tidal portions of Talbot County and the Incorporated Areas of Talbot County are shown to the nearest tenth of a foot.

All or portions of the flooding sources listed in Table 2 "Riverine Flooding Sources Studied by Detailed Methods" were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRMs (Exhibit 2).

TABLE 2 – RIVERINE FLOODING SOURCES STUDIED BY DETAILED METHODS

Tanyard Branch	Tributary No. 3 to Windmill Branch
Windmill Branch	

Numerous streams were studied by approximate methods. Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by FEMA and Talbot County. Table 3, "Flooding Sources Studied by Approximate Methods", lists the streams studied by approximate methods.

TABLE 3 – RIVERINE FLOODING SOURCES
STUDIED BY APPROXIMATE METHODS

Barker Creek	Tributary 2A to Beaverdam Branch
Beaverdam Branch	Tributary 2A to Choptank River
Deep Branch	Tributary 2A to Goldsborough Creek
Galloway Run	Tributary 2A to Peachblossom Creek
Goldsborough Creek	Tributary 2A to Potts Mill Creek
Kings Creek	Tributary 2A to Skipton Creek
Miles Creek	Tributary 2A to Turkey Creek
Miles River	Tributary 2A to Wye East River
Miles Ton Creek	Tributary 2B to Peachblossom Creek
Mill Creek	Tributary 2B to Skipton Creek
Norwich Creek	Tributary 3 to Beaverdam Branch
Peachblossom Creek	Tributary 3 to Choptank River
Potts Mill Creek	Tributary 3 to Kings Creek
Skipton Creek	Tributary 3 to Miles Creek
Tanyard Branch	Tributary 3 to Mill Creek
Tributary 1 to Barker Creek	Tributary 3 to Peachblossom Creek
Tributary 1 to Beaverdam Branch	Tributary 3 to Potts Mill Creek
Tributary 1 to Choptank River	Tributary 3 to Skipton Creek
Tributary 1 to Deep Branch	Tributary 3 to Trippe Creek
Tributary 1 to Goldsborough Creek	Tributary 3 to Tuckahoe Creek
Tributary 1 to Kings Creek	Tributary 3 to Windmill Branch
Tributary 1 to Miles Creek	Tributary 3A to Choptank River
Tributary 1 to Miles River	Tributary 3A to Mill Creek
Tributary 1 to Miles Ton Creek	Tributary 3A to Kings Creek
Tributary 1 to Mill Creek	Tributary 4 to Beaverdam Branch
Tributary 1 to Norwich Creek	Tributary 4 to Choptank River
Tributary 1 to Peach Blossom	Tributary 4 to Kings Creek
Tributary 1 to Potts Mill Creek	Tributary 4 to Miles Creek
Tributary 1 to Skipton Creek	Tributary 4 to Mill Creek
Tributary 1 to Trippe Creek	Tributary 4 to Potts Mill Creek
Tributary 1 to Tuckahoe Creek	Tributary 4 to Skipton Creek
Tributary 1 to Turkey Creek	Tributary 4 to Tuckahoe Creek
Tributary 1 to Windmill Branch	Tributary 4 to Windmill Branch
Tributary 1 to Wootenaux Creek	Tributary 4A to Potts Mill Creek
Tributary 1 to Wye East River	Tributary 4A to Tuckahoe Creek
Tributary 1A to Beaverdam Branch	Tributary 5 to Choptank River
Tributary 1A to Kings Creek	Tributary 5 to Kings Creek
Tributary 1A to Mill Creek	Tributary 5 to Miles Creek
Tributary 1A to Trippe Creek	Tributary 5 to Mill Creek

TABLE 3 – RIVERINE FLOODING SOURCES
STUDIED BY APPROXIMATE METHODS – (CONTINUED)

Tributary 1A to Tuckahoe Creek	Tributary 5 to Tuckahoe Creek
Tributary 1A to Wootenaux Creek	Tributary 5A to Tributary to Miles Creek
Tributary 1B to Kings Creek	Tributary 6 to Choptank River
Tributary 1B to Tuckahoe Creek	Tributary 6 to Kings Creek
Tributary 2 to Beaverdam Branch	Tributary 6 to Mill Creek
Tributary 2 to Choptank River	Tributary 7 to Choptank River
Tributary 2 to Deep Branch	Tributary 7 to Kings Creek
Tributary 2 to Goldsborough Creek	Tributary 7A to Choptank River
Tributary 2 to Kings Creek	Tributary 7A to Kings Creek
Tributary 2 to MilesCreek	Tributary 7B to Choptank River
Tributary 2 to MillCreek	Tributary 7B to Kings Creek
Tributary 2 to Norwich Creek	Tributary 8 to Choptank River
Tributary 2 to Peachblossom Creek	Tributary 8A to Choptank River
Tributary 2 to Potts Mill Creek	Tributary 9 to Choptank River
Tributary 2 to Skipton Creek	Tributary 9A to Choptank River
Tributary 2 to Trippe Creek	Tributary 10 to Choptank River
Tributary 2 to Tuckahoe Creek	Trippe Creek
Tributary 2 to Turkey Creek	Tuckahoe Creek
Tributary 2 to Windmill Branch	Turkey Creek
Tributary 2 to Wootenaux Creek	Williams Creek
Tributary 2 to Wye East River	Windmill Branch
	Wootenaux Creek

Portions of the approximate study areas were found to be inundated by tidal flooding of the Chesapeake Bay. For these areas, the detailed tidal surge elevation is shown.

No Letters of Map Revision (LOMRs) were recorded for this countywide study.

2.2 Community Description

Talbot County is located on the Eastern Shore of Maryland and is bordered by Queen Anne's County on the north, Caroline County on the east (Tuckahoe Creek and the Choptank River), Dorchester County on the south (the Choptank River and the Chesapeake Bay), and Chesapeake Bay, Eastern Bay and Wye East River on the west. The population for Talbot County as determined by the 2000 Census is 33,812, and the 2010 Census population is 37,782, an increase of 7.2% (Reference 1). Easton is the county seat of Talbot County and has many commercial and retail establishments including seafood canning, manufacturing, and printing and publishing industries. Local rural industries include farming, fishing, and service trades.

The continental type of climate of Talbot County is moderated by effects from the Chesapeake Bay and Atlantic Ocean. The highest temperature recorded in the Town of Easton was 104 degrees Fahrenheit (°F) on July 21, 1930 and again on July 10, 1936. The lowest temperature of -15°F occurred on February 11, 1899. The average summer temperature is 76.6°F; the average winter temperature is 38.5 °F. The average annual precipitation is 45.9 inches and the average annual snowfall is 14.2 inches. On November 2, 1956, a total of 8.90 inches of rainfall was recorded, the most from a single storm. The prevailing winds are southwesterly, switching to northwesterly during the winter months (References 2 and 3). The maximum elevation of Talbot County is 72 feet above mean sea level. This area is located approximately 3 miles east of Easton (Reference 4).

The underlying unconsolidated sediments slope gently toward the southeast at approximately 10 to 95 feet per mile. These unconsolidated deposits were the result of the deposition of sediment from meltwater of the continental glaciers and the terracing effect of several sea level oscillations. Beneath the coastal plain sediments lie older Paleozoic crystalline rocks at an average depth of 3,000 feet. Abundant ground water is available throughout Talbot County with the depth of the water table generally less than 25 feet.

There are 3 major drainage areas in Talbot County. The eastern and southern portions of the county drain into the Choptank River. The northwestern portion drains west into the Wye East River. The central portion from Easton west drains into the Miles River (Reference 4). Talbot County's irregular shoreline is a result of drowned river valleys formed by the gradually sinking land mass. This has led to a change in the overall drainage pattern due to widening rivers and creeks. Extensive estuaries and tidal basins have resulted, producing a myriad of waterways.

Flood plain development in Talbot County primarily consists of single family residential homes with some commercial and industrial development interspersed.

Town of Easton

The Town of Easton is located on the Eastern Shore of Maryland with a maximum elevation of 69 feet (Reference 4) and is bordered by the unincorporated areas of Talbot County. The population for the Town of Easton as determined by the 2010 Census is 15,945 (Reference 1). The Town of Easton is the county seat of Talbot County and has many commercial and retail establishments, including manufacturing, printing and publishing industries.

Flood plain development in the Town of Easton primarily consists of single family residential homes with some commercial and industrial development interspersed.

Town of Oxford

The Town of Oxford is located on the Eastern Shore of Maryland with a maximum elevation of 11 feet (Reference 4) and is bordered on the west and north by the Tred Avon River, on the east by Town Creek, and on the east and south by unincorporated portions of Talbot County. The population for the Town of Oxford as determined by the 2010 Census is 651 (Reference 1).

Over 300 years old, the Town of Oxford remains an important boating center for the Chesapeake Bay. Commercial marinas, boat builders, and yacht clubs form an important segment of the Oxford economy. Several restaurants attract visiting boating enthusiasts.

Town of St. Michaels

The Town of St. Michaels is bordered on the east by the Miles River and on the north, west and south by the unincorporated areas of Talbot County, with a maximum elevation of approximately 12 feet. This area is located along a ridge west of Talbot Street (Reference 4). The population for the Town of St. Michaels as determined by the 2010 Census is 1,029 (Reference 1). Primary industries in St. Michaels include fishing, seafood processing and marketing, boating marinas, and commercial and retail sales establishments.

Town of Trappe

Trappe District consists of roughly one-third of the county, although the actual incorporated town of Trappe is a tiny portion of that area, with only about 1,000 residents. The town became an incorporated municipality in 1827 but did not actually function as such until 1856. The population for the Town of Trappe as determined by the 2010 Census is 1,077 (Reference 1).

Trappe has been described as a small town on the Eastern Shore "where nothing has ever happened for 300 years." That's not quite true, but the residents are happy to foster the image and let travelers on their way to the beach pass them by (Reference 5).

2.3 Principal Flood Problems

The low lying, relatively undisturbed topography, high seasonal water tables, poor drainage and high runoff characteristics of the soils combine to provide a high flooding potential. When heavy rainfall and a high river discharge combine with storm tides, low lying areas adjacent to rivers and estuaries become inundated with saltwater. Major floods in the Talbot County area have occurred in 1876, 1933, 1935, 1954, 1955, 1960, 1962, 1967, 1972, and 1975. Few detailed records of historical flood damage are available.

The great storm of August 1933 caused extensive damage throughout the county. The storm dropped 7.16 inches of rain and was the storm that washed away Devils Island (Reference 6).

On Tilghman Island, the waters of the Chesapeake Bay and the Choptank River met in 5 separate places. Workboats were piled high on the shore by heavy winds and high waves. In all, 35 boats were damaged, most beyond repair. The bridge connecting the mainland with the island was washed away. The Tilghman Packing Company, Faulkner Company, and Roe Company buildings, all located in Avalon, suffered extensive structural damage. Sinclair's Store and the Post Office had several inches of water inside. A conservative estimate of damage for Tilghman Island was placed at $50,000 (Reference 6).

Throughout the county, many roads were flooded. The bridge over Papermill Pond Road was covered by water waist deep. Water reportedly was just a few inches below the Old Dover Bridge girders on the Choptank River. Approximately 30 percent of the sweet corn and 40 percent of the tomato crop was damaged, which was only a portion of the $200,000 total county crop damage expected (Reference 6).

It was described then as the "worst storm in ten years" where one "could not describe the damage done" to Oxford (Reference 6). A later newspaper article stated that the tide was over the causeway, houses were flooded, and considerable damage occurred near Town Point. The Chesapeake and Potomac Telephone Company's building had 2 feet of water above the first floor. Approximately $3,000 worth of damage resulted to the roads and wharfs (Reference 6).

In St. Michaels, the homes of the Dodson and Dryden families on Navy Point were flooded. The local newspaper reported that the "water was high in front of the fire house" prompting the firemen to park the fire engines on higher ground (Reference 6).

In October 1954, Hurricane Hazel struck the Eastern Shore with winds up to 100 miles per hour. Tidal surges were reported at 5.5 to 6.0 feet by *The Banner*, a Cambridge newspaper (Reference 7). The resulting damage was the worst in history, prompting President Eisenhower to declare Talbot County a critical disaster area. Damage estimates exceeded 1 million dollars (Reference 6).

The high winds fell numerous old trees, blew roofs off buildings, and washed many small boats up onto land, into pilings and against bridges. Three county telephone offices (St. Michaels, Oxford, and Tilghman

Island) were sandbagged to stop the high water. The Oxford telephone office was inundated with waist deep water. The Sherwood public wharf was swept away leaving only the pilings intact. The Faulkner Packing House on Tilghman Island was partially destroyed by winds and high tides (Reference 6).

Hurricane Connie dropped 8.88 inches of rain in August 1955. Winds of 60 miles per hour leveled corn. Tides ran 3 feet above normal. The Tred Avon Yacht Club clubhouse missed flooding by 6 inches. The lower end of Cherry Street in St. Michaels was completely flooded. Hurricane Diane followed several days later (Reference 6).

On August 17, 1955, Hurricane Diane brought tides of 1.5 to 2.5 feet above normal (Reference 7). The Tred Avon Yacht Club building missed flooding by 6 inches (Reference 8). The full force of the hurricane missed the Delmarva Peninsula and Talbot County.

Hurricane Donna struck on September 16, 1960, causing approximately $100,000 of road damage. The bridge at Three Bridge Branch near the Village of Longwoods was completely washed out and Rabbit Hill Road, near the Village of Longwoods, was reportedly under water. Between 15 and 30 percent of the corn crop was damaged. The storm produced 6.17 inches of rain (Reference 6).

Damage from the March 6-7, 1962, northeaster in Talbot County accompanied a high overnight tide. The tide was 4 feet above normal, putting the Easton Point dock under 3 feet of water. Approximately 40 percent of Tilghman Island was flooded. Cooperstown Road (the eastern extension) on Tilghman Island was hip deep under water. St. Michaels reported tides 2 feet above normal with no flooding (Reference 8). However, in Oxford the firemen were called out in the middle of the night to help move furniture out of several houses in the low lying areas. Approximately 30-40 percent of the town was under water at one time. The causeway was between 1 and 4 feet under water (Reference 8).

Tropical Storm Agnes brought winds up to 55 miles per hour during late June 1972 (Reference 4). Some local flooding occurred but damage was primarily restricted to crops. In the Town of Oxford, 11 yachts were grounded by high winds. Many crab pots were carried away by tremendous amounts of debris (Reference 8).

The remnants of Hurricane Fran moved through West Virginia on the September 6, 1996, reaching northwest Pennsylvania the morning of the September 7th. The strong south to southeast winds accompanying it caused tidal flooding along Chesapeake Bay. In Talbot County, flooding was reported in St. Michael's. Flooding in Oxford was reported as the worst since Hurricane Hazel in 1954. Town Creek spilled over as did the Tred Avon River. Waterfront restaurants and homes in low lying areas were flooded. Many persons were encouraged to evacuate to the second floor of their establishments. Bank Street was closed. A few people were evacuated. In Easton, the Easton Point Marina parking lot was flooded with two feet of water (Reference 9).

An intense northeaster pounded the Maryland Eastern Shore with heavy rain, strong winds and some minor tidal flooding on January 28, 1998. Heavy rain moved into the southern part of the Maryland Eastern Shore shortly after midnight on the 28th and continued through the early afternoon. In Talbot County, several roads had considerable flooding and a culvert was washed out from another roadway. Storm totals ranged to around 3.5 inches in southern parts of Talbot County. The heavy rain and the strong onshore flow in the lower part of Chesapeake Bay helped combine to produce some minor tidal flooding at the times of high tide on the 28th. In Talbot County, bay flooding in some yards was reported in Oxford. Also in Oxford, one lane of Maryland State Route 333 was totally submerged near the causeway. Field flooding was reported in Saint Michaels and on Tilghman Island. Strong winds increased during the day on the 28th and became their strongest between 10 a.m. and 2 p.m. EST. Peak gusts reached between 45 and 55 mph. The strong winds and heavy rain were able to push over some weak trees and power lines across the Eastern Shore. There were downed trees and morning power outages in Talbot County (Reference 9).

On February 4, 1998, the strongest northeaster of the winter brought heavy rain, damaging winds and minor tidal flooding to the southern half of the Maryland Eastern Shore. In Talbot County, flooding was reported along low lying areas of Neavitt, Oxford, Saint Michaels and Unionville during the afternoon of the 4th. Roadway flooding was also reported in Trappe. A few roads were closed and minor outages were reported because of the downed trees. The heavy rain might have also damaged the 275,000 acres of winter wheat planted across the lower Eastern Shore, especially if precipitation continues above normal for the rest of the winter (Reference 9).

Hurricane Floyd battered the Maryland Eastern Shore on September 16, 1999 and brought with it torrential rains and damaging winds. The torrential downpours associated with Hurricane Floyd exceeded the 1-percent annual chance flood return period for most of the Eastern Shore. Hundreds of roads and bridges were closed. In Talbot County, flooding forced the closure of numerous roads in Easton, St. Michael's and Oxford. At 10:40 a.m. EDT, a man hanging from a branch was rescued in Easton. About 75 people went to shelters as citizens in low-lying areas were urged to evacuate. On the Talbot County side of Queen Anne, severe damage occurred to 10 homes, three businesses and 30 vehicles on Cannery Road. The water was up to 10 feet high on the 16th and there was still up to six feet of water in the streets the next day. Downed trees caused about 3,000 homes and businesses to lose power in Easton, Saint Michael's and Trappe. Storm totals included 9.16 inches in Royal Oak (Talbot County), 9.15 inches in Easton (Talbot County). Another effect of Floyd was a boom in the mosquito population throughout the Middle Atlantic States (Reference 9).

Tropical Storm Isabel caused a record breaking tide and storm surge up the Chesapeake Bay, heavy rain and strong power outage producing winds on September 18-19, 2003. Winds gusted up to 58 mph in the bay and caused numerous trees, tree limbs and power lines to be knocked down. This was one of the worst power outage events in history for Conectiv Energy. Storm totals included 2.97 inches in Saint Michaels, Talbot County (Reference 9).

On September 6, 2008, Tropical Storm Hanna brought heavy rain, strong winds and some tidal flooding to the Eastern Shore during the day and into the evening of the 6th. Rain moved into the region during the morning, fell heavy at times from the late morning into the afternoon and ended during the evening. Storm totals ranged from around 1 to around 4 inches. The strongest winds occurred during the morning and afternoon with peak gusts as high as 56 mph. Siding was ripped from a restaurant in Tilghman (Talbot County). Tidal flooding occurred during the early evening as the surge averaged two to three feet and affected mainly Talbot and Caroline Counties. In Talbot County, in Oxford, Pier Street was flooded. The water was over the docks and bulkheads at Knapps Narrow. In St. Michaels, the tide reached into the parking lot of a restaurant off of Mill Street. Patrons were ferried in and out of the restaurant by pick-up truck. Southeast of Saint Michael's, the tide covered the deck of a restaurant off of Mulberry Street and totally closed North Harbour Road. In Easton, the Easton Point Marina became an island off of Port Street. Peak wind gusts included 56 mph in Tilghman. Precipitation totals included 1.20 inches in Easton (Reference 9).

On August 28, 2011, Hurricane Irene produced heavy flooding rain, tropical storm force wind gusts and caused one wind related death across the Eastern Shore. Preliminary damage estimates were around three million dollars and approximately 85,000 homes and businesses lost power. Power was not fully restored until September 1st. The combination of heavy rain and wind closed numerous roadways across the Eastern Shore and downed thousands of trees. Event precipitation totals averaged 6 to 12 inches and caused widespread field and roadway flooding. Because the flash flooding and flooding blended into one, all flooding related county entries were combined into one under flood events. In Talbot County, debris closed Maryland State Route 662C. Flooding rains forced the closure of sections of Maryland State Routes 565A, 329, 328 and 33. The combination of flooding and tropical storm winds damaged 100 properties and 50 roadways and bridges. Roadway damage alone was estimated at $750,000. Event rainfall totals included 11.50 inches in Beechwood, 10.68 inches in North Easton, 9.75 inches in Easton, 9.48 inches in Papermill Pond, 9.40 in Bellevue and 9.12 inches in Trappe (Reference 9).

2.4 Flood Protection Measures

The State of Maryland Department of Natural Resources has established rules and regulations governing construction on nontidal waters and flood plains. It restricts development in, obstructions to, and encroachment on the 1-percent annual chance flood plain.

Talbot County has no flood protection measures and none are currently proposed.

Minimum construction setback requirements from shorelines are enforced; however, this regulation does not reference flood waters.

When Talbot County and the Towns of Easton, Oxford, and St. Michaels entered the Emergency Phase of the National Flood Insurance Program, the county adopted an elevation of 7.5 feet as the minimum first floor elevation for a new structure (Reference 10).

The Towns of Easton, Oxford, and St. Michaels have no flood protection measures. No flood protection measures are currently proposed, however, the State of Maryland Department of Natural Resources has established rules and regulations governing construction on nontidal waters and flood plains. It restricts development in, obstructions to, and encroachment on the 1-percent annual chance flood plain.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are 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-, 2-, 1-, and 0.2-percent annual chance floods, have a 10-, 2-, 1-, 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 which equals or exceeds the 1-percent annual chance flood in any 50-year period is approximately 40 percent (4 in 10), and, 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 Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the county.

Pre-countywide Analyses

The previous FIS for Talbot County, Maryland included hydrologic analyses for the areas studied in detail. The TR-20 computer program (Reference 11) was used to determine the 10-, 2-, 1- and 0.2-percent annual change peak discharges for Windmill Branch.

The stillwater surge elevations were determined for various frequency relationships by the Virginia Institute of Marine Science (VIMS). The relationships were computed by using a finite element, hydrodynamic computer model of the Chesapeake Bay and the Virginia offshore area of the Atlantic Ocean (Reference 12). The model utilized meteorologic, topographic, and bathymetric input to generate and modify storm surges. This general input included the astronomical tide, the inverted barometer effect, wind stress acting on water surface, coastal configurations, bottom topography, bottom friction, internal stress, and discharge and surface elevations of rivers. The compilation and analysis of this data were accomplished using a high speed digital computer which forecasted peak elevations.

Countywide Revision

All streams studied by detailed methods received updated hydrologic and hydraulic data as part as this revision except for the tidal portions of the Chesapeake Bay, Eastern Bay, Choptank River, Tred Avon River, Wye East River, Miles River, Harris Creek and Broad Creek. The new hydrologic analysis calculated revised 10-, 2-, 1- and 0.2-percent annual chance flows. For this FIS update, flows were also established for streams studied using approximate methods.

The Maryland Department of Environment contracted Dr. Glenn Moglen of the Department of Civil and Environmental Engineering at the University of Maryland to perform the updated hydrologic calculations for this FIS (Reference 13).

The current regional regression equations being used by the Maryland State Highway Administration were developed by Jonathan Dillow, a hydrologist for the USGS. Dillow defined regression equations for five hydrologic fixed regions: Appalachian Plateaus and Allegheny Ridges, Blue Ridge and Great Valley, Piedmont, Western Coastal Plain and Eastern Coastal Plain (Reference 14).

Dr. Moglen developed a new set of regression equations, called the fixed region regression equations, for the State of Maryland. The fixed region method used in his study is based on the predefined regions of Dillow since these regions are based on physiographic regions. Talbot County is located within the Eastern Coastal Plain.

The fixed region regression equations for the Eastern Coastal Plain Region are based on 15 stations in Maryland and 9 stations in Delaware with drainage area (DA) ranging from 2.27 to 112.20 square miles, basin relief (BR) ranging from 5.1 to 43.5 feet, and percent A soils (S_A) ranging from 0.0 to 49.4 percent.

Basin relief is not statistically significant for discharges less than the 20-percent annual chance event but is included in the equations for consistency. The standard errors range from 33.7 percent (0.142 log units) for $Q_{1.50}$ to 50.8 percent (0.208 log units) for Q_{500}. Equations applicable to this report, along with their standard error of estimate in percent, and equivalent years of record are listed in Table 4, "Eastern Coastal Plain Fixed Region Regression Equations" (Reference 15).

TABLE 4 – EASTERN COASTAL PLAIN
FIXED REGION REGRESSION EQUATIONS

Eastern Coastal Plain

Fixed Regression Equation	Standard Error (percent)	Equivalent Years of Record
$Q_{10} = 31.17\ DA^{0.777}\ BR^{0.439}\ (S_A + 1)^{-0.215}$	38.2	9.5
$Q_{50} = 50.00\ DA^{0.732}\ BR^{0.549}\ (S_A + 1)^{-0.261}$	41.7	16
$Q_{100} = 63.44\ DA^{0.711}\ BR^{0.576}\ (S_A + 1)^{-0.279}$	44.0	18
$Q_{500} = 108.7\ DA^{0.660}\ BR^{0.628}\ (S_A + 1)^{-0.316}$	50.8	21

The work on the fixed region regression equations was aided by the GISHydro2000 software. GISHydro is a computer program used to assemble and evaluate hydrologic models for watershed analysis. Originally developed in the mid-1980s, the program combines a database of terrain, land use, and soils data with specialized GIS tools for assembling data and extracting model parameters. The primary purpose of the GISHydro program is to assist engineers in performing watershed analyses in the State of Maryland. In the fall of 1997, a new collaborative project between the Department of Civil and Environmental Engineering at the University of Maryland and the Maryland State Highway Administration updated and enhanced GISHydro into GISHydro2000. GISHydro2000 runs on ArcView 3, software no longer supported by its developer ESRI. The move of GISHydro to the ArcGIS platform is ongoing and will result in the GISHydroNXT application.

It should also be emphasized that these regression equations, although not developed by the USGS, provide better standard error performance than the current USGS regression equations for Maryland. These equations were endorsed for use in Maryland by the Maryland Hydrology Panel as documented in their report which can be obtained from the Maryland State Highway Administration or from the following URL (Reference 15):

http://www.gishydro.umd.edu/HydroPanel/panel_report_103106.pdf

Peak discharge-drainage area relationships for the selected recurrence intervals are shown in Table 5.

TABLE 5 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Windmill Branch					
Approximately 50 feet downstream of Washington Street	3.28	235	477	626	1,130
Approximately 130 feet downstream of confluence from Tributary1 to Windmill Branch	3.06	226	460	606	1,100
Approximately 450 feet upstream of confluence from Tributary1 to Windmill Branch	2.84	218	449	593	1,080
Approximately 163 feet downstream of confluence from Tributary 2 to Windmill Branch	2.76	215	445	589	1,080
Approximately 280 feet downstream of confluence from Tributary 2 to Windmill Branch	2.56	205	427	566	1,040
Approximately 570 feet downstream of confluence from Tributary 3 to Windmill Branch	2.3	193	405	539	1,000
Approximately 121 feet upstream of confluence from Tributary 3 to Windmill Branch	1.61	148	316	424	802
Approximately 280 feet downstream of confluence from Tributary 4 to Windmill Branch	1.56	141	301	403	761

TABLE 5 - SUMMARY OF DISCHARGES – (CONTINUED)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cubic feet per second)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Windmill Branch (continued)					
Approximately 225 feet upstream of confluence from Tributary 4 to Windmill Branch	1.35	119	251	336	635
Approximately 600 feet upstream of confluence from Tributary 4 to Windmill Branch	1.31	96	194	256	474
Approximately 250 feet downstream of farm access road crossing	0.82	63	129	171	323
Tanyard Branch					
Approximately 185 feet upstream of Easton Parkway	0.98	93	200	270	518
Approximately 775 feet upstream of access road	0.79	74	157	212	408
Approximately 40 feet upstream from Aurora Street	0.57	60	132	180	354
Approximately 400 feet upstream of railroad trail	0.43	33	67	90	171
Tributary No. 3 to Windmill Branch					
Approximately 120 feet upstream of confluence with Windmill Branch	0.69	73	161	220	432

No new coastal flood analysis was conducted for this revision. The effective coastal stillwater analysis and wave heights from the Previous Flood Insurance Studies were brought forward from the previous FIS. The effective coastal flood elevations were converted from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88) as part of this revision.

Water-surface elevations were developed by VIMS using a unique storm surge model for the Chesapeake Bay (Reference 12). Specific input parameters developed by VIMS include bathymetric data recorded and coded for computer use, historical storm events analyzed for their probability of occurrence where known and unknown elevations were identifiable, astronomical tides (periodic rise and fall of the water surface resulting from gravitational interactions between the sun, moon, and earth) were mathematically described, and orthogonal segments were designed to describe coastal configurations. The model was verified and calibrated by known water-surface elevations and measured storm surges from field data and gage records.

The stillwater surge elevation is the elevation of the water due solely to the effects of the astronomical tides, storm surge, and wave set-up on the water surface but does not include wave heights. The inclusion of wave heights, which is the distance from the trough to the crest of the wave, increases the water-surface elevations. The height of a wave is dependent upon wind speed and its duration, depth of water, and length of fetch. The wave crest elevation is the sum of the stillwater elevation and the portion of the wave height above the stillwater elevation. Wave heights and corresponding wave crest elevations were determined using the National Academy of Sciences (NAS) methodology (Reference 16).

It was determined that the highest possible surge would occur when a hurricane travels north along the western shore of the Chesapeake Bay (Reference 12). This will produce high southwesterly winds changing to westerly as the storm passes north of the region. Shorelines exposed to the southwesterly winds are the most likely to experience wave velocity effects in conjunction with a high stillwater surge. For this reason, the wave height analysis was limited to southwesterly facing shorelines.

Tidal frequency data for the Chesapeake Bay, Eastern Bay, Choptank River, Tred Avon River, Wye East River, Miles River, Harris Creek, Broad Creek, Town Creek, and San Domingo Creek were based upon the relationships developed by VIMS (Reference 12). Tidal frequency data were based upon tidal gages, both permanent and temporary, established at designated points on various rivers throughout the area.

A summary of peak elevation-frequency relationships is shown in Table 6, Summary of Stillwater Elevations.

TABLE 6 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) NAVD88			
	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
CHESAPEAKE BAY				
At Tilghman Island	3.1	4.8	5.4	7.1
At Claiborne	3.1	5.0	5.8	7.8
EASTERN BAY	3.2	5.0	6.0	7.9

TABLE 6 - SUMMARY OF STILLWATER ELEVATIONS – (CONTINUED)

FLOODING SOURCE AND LOCATION	ELEVATION (feet) NAVD88			
	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
CHOPTANK RIVER				
At Cambridge	3.1	4.3	5.1	6.7
TRED AVON RIVER				
At Oxford	3.1	4.3	5.1	6.7
At Easton	3.1	4.3	5.1	6.7
WYE EAST RIVER				
At Bruffs Island	3.2	5.0	6.0	7.9
MILES RIVER				
At St. Michaels	3.2	5.0	5.7	7.8
HARRIS CREEK				
At Indian Point	3.1	4.9	5.6	7.3
BROAD CREEK				
At Mulberry Point	3.1	4.9	5.6	7.3
TOWN CREEK				
At Oxford	3.1	4.3	5.1	6.7
SAN DOMINGO CREEK				
At St. Michaels	3.2	5.0	5.7	7.8

3.2 Hydraulic Analyses

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 whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Pre-countywide Analyses

Analyses of the hydraulic characteristics of the streams in the county were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Water-surface elevations for Windmill Branch were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 17). Input data for the backwater analyses were developed from field surveys. Cross sections were located at various intervals throughout the stream length to present an accurate representation of cross-sectional geometry. Cross sections were surveyed directly above and below bridges, dams, and culverts to compute backwater effects from these structures. Additional information and supplemental cross sections were determined from detailed topographic maps at a scale of 1:7,200 with a contour interval of 2 feet for Windmill Branch (Reference 18).

The starting water-surface elevations for Windmill Branch and Tanyard Branch were developed from tidal elevations interpolated from VIMS data (Reference 12) at Peach Blossom Road and Easton Parkway, respectively.

Roughness coefficients (Manning's "n") were assigned from information collected in the field regarding vegetation, type of channel lining, surface soils, and channel and bank irregularities. The range of "n" values for Windmill Branch is shown in the following tabulation:

Stream	Channel "n"	Overbank "n"
Tanyard Branch	0.012-0.05	0.04-0.08
Tributary No.3 to Windmill Branch	0.012-0.04	0.08
Windmill Branch	0.012-0.04	0.08

Hydraulic analyses of the shoreline characteristics of the flooding sources studied in detail were carried out to provide estimates of wave heights and corresponding wave crest elevations of floods of the selected recurrence intervals along each of the shorelines.

For the hydraulic analyses of the shoreline, areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (Reference 19). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures. This criterion has been adopted by FEMA for the determination of V Zones.

The methodology for analyzing wave heights and corresponding wave crest elevations was developed by the NAS (Reference 16). The NAS methodology is based on 3 major concepts.

First, a storm surge on the open coast is accompanied by waves. The maximum height of these waves is related to the depth of water by the following equation:

$$H_b = 0.78d$$

where H_b is the crest to trough height of the maximum or breaking wave and d is the stillwater depth. The elevation of the crest of an unimpeded wave is determined using the equation:

$$Z_w = S_* + 0.7\,H_* = S_* + 0.55d$$

where Z_w is the wave crest elevation, S_* is the stillwater surge elevation at the site, and H_* is the wave height at the site. The 0.7 coefficient is the portion of the wave height which reaches above the stillwater surge elevation. H_b is the upper limit for H_*.

The second major concept is that the breaking wave height may be diminished by dissipation of energy by natural or man-made obstructions. The wave height transmitted past a given obstruction is determined by the following equation:

$$H_t = B\,H_i$$

where H_t is the transmitted wave height, H_i is the incident wave height, and B is a transmission coefficient ranging from 0.0 to 1.0. The coefficient is a function of the physical characteristics of the obstruction. Equations have been developed by the NAS to determine B for vegetation, buildings, natural barriers such as dunes, and manmade barriers such as breakwaters and seawalls (Reference 16).

The third concept deals with unimpeded reaches between obstructions. New wave generation can result from wind action. This added energy is related to distance and mean depth over the unimpeded reach.

These concepts and equations were used to compute wave heights and wave crest elevations associated with the 1-percent annual chance storm surge. Accurate topographic, land-use, and land cover data are required for the wave height analysis. Maps of the study area at a scale of 1:7,200 with a contour interval of 2 feet were used for the topographic data (Reference 18). The land use data were obtained through field surveys and aerial photographic interpretations (Reference 18).

Wave heights were computed along transects which were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Figure 1 illustrates the location of coastal transects for the county and Table 7 provides a physical description of the area along the shorelines represented by each transect.

Figure 2 illustrates the location of the transects for the community of the Town of Oxford. The physical description of the area along the shorelines represented by each transect is provided in Table 8.

TABLE 7 TRANSECT DESCRIPTIONS – TALBOT COUNTY

TRANSECT	LOCATION	1-PERCENT ANNUAL CHANCE FLOOD ELEVATION (FEET, NAVD 88) STILLWATER	MAXIMUM WAVE CREST
No. 1	Black Walnut Point to Bar Neck Road (extended)	5.3	8.2
No. 2	Bar Neck Road (extended) to Bay Shore Road	5.3	8.2
No. 3	Bay Shore Road to Sinclair Avenue	5.4	8.2
No. 4	Sinclair Avenue to Front Creek	5.4	9.2
No. 5	Front Creek to Green Marsh Point	5.5	9.2
No. 6	Green Marsh Point to Punch Point	5.6	9.2
No. 7	Punch Point to Lowes Point	5.6	8.2
No. 8	Lowes Point to Pot Pie Road (extended west)	5.7	9.2
No. 9	Pot Pie Road (extended west) to McDaniel	5.8	9.2
No. 10	McDaniel to Claiborne Landing	5.8	9.2
No. 11	Claiborne Landing to Tilghman Point	5.8	9.2
No. 12	Indian Point to Balls Creek Road (extended) (northwest)	5.6	8.2
No. 13	Turkey Neck Point to Balls Creek Road (extended) (northwest)	5.5	8.2
No. 14	Change Point to Turkey Neck Point	5.4	7.2
No. 15	Intersection of Elston Shore Road and Long Point Road to Change Point	5.4	8.2
No. 16	Nelson Point to intersection of Elston Shore Road and Long Point Road	5.4	8.2
No. 17	Church Neck Point Shoreline	5.6	8.2
No. 18	Church Neck Point to Mouth of San Domingo Creek	5.6	8.2
No. 19	Deep Neck Point to Bridge Creek	5.4	8.2
No. 20	Bridge Creek to "Jenaloo"	5.3	8.2
No. 21	"Jenaloo" to Lucy Point	5.3	8.2
No. 22	Lucy Point to Benoni Point	5.1	8.2
No. 23	Oxford to Boone Creek	5.1	8.2
No. 24	Boone Creek to Island Creek	5.1	8.2
No. 25	Island Creek to Chlora Point	5.1	8.2
No. 26	Chlora Point to Howell Point	5.1	7.2
No. 27	Howell Point to Porpoise Creek	5.1	7.2
No. 28	Bruffs Island to Presquille Road (extended)	6.0	8.2
No. 29	Bruffs Island to Woodland Creek	5.9	8.2
No. 30	Woodland Creek to Fairview Point	5.7	8.2
No. 31	Fairview Point to Long Point	5.7	8.2

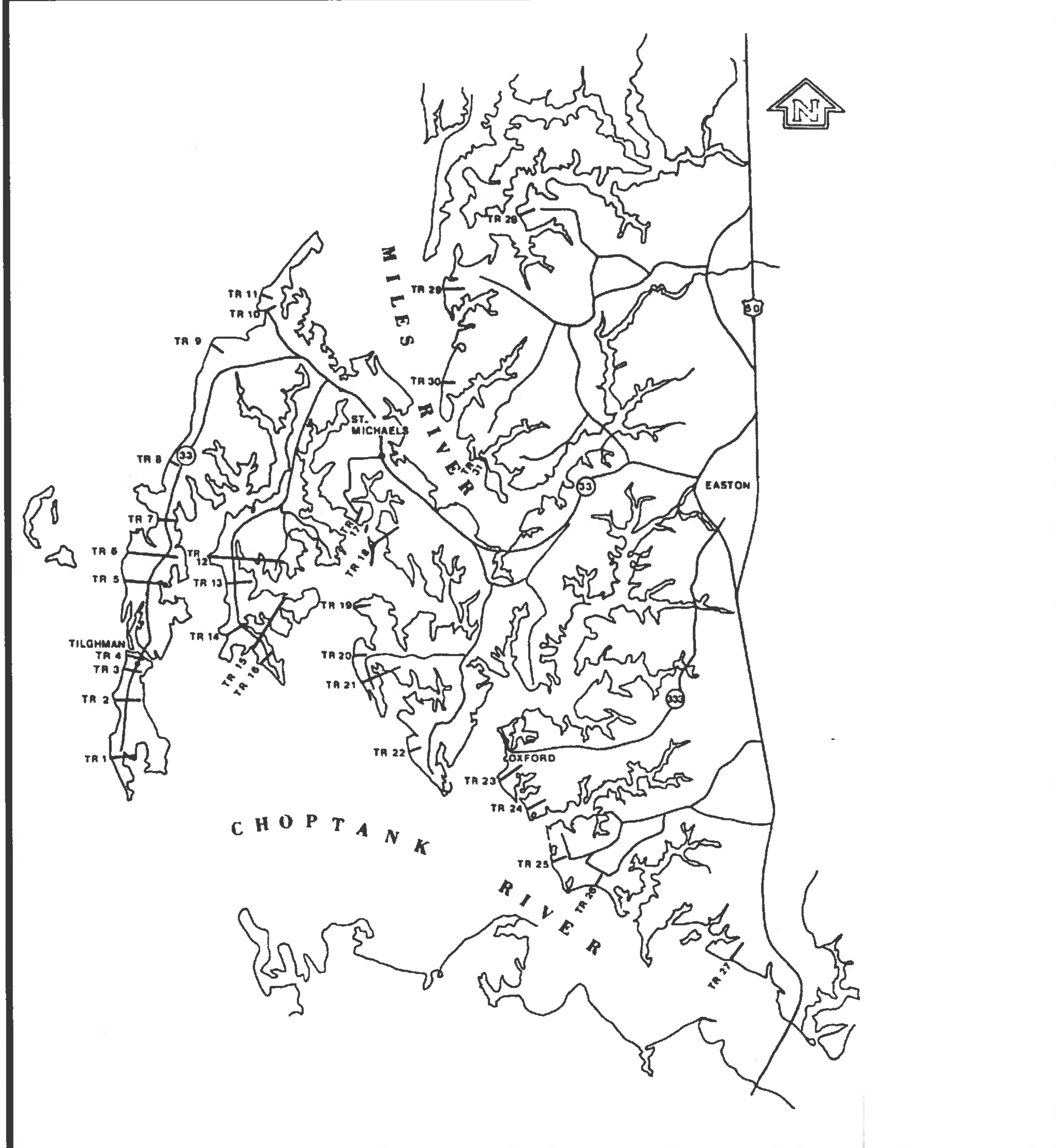


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD

AND INCORPORATED AREAS

APPROXIMATE SCALE

3 0 3 6 MILES

TRANSECT LOCATION MAP

TALBOT COUNTY

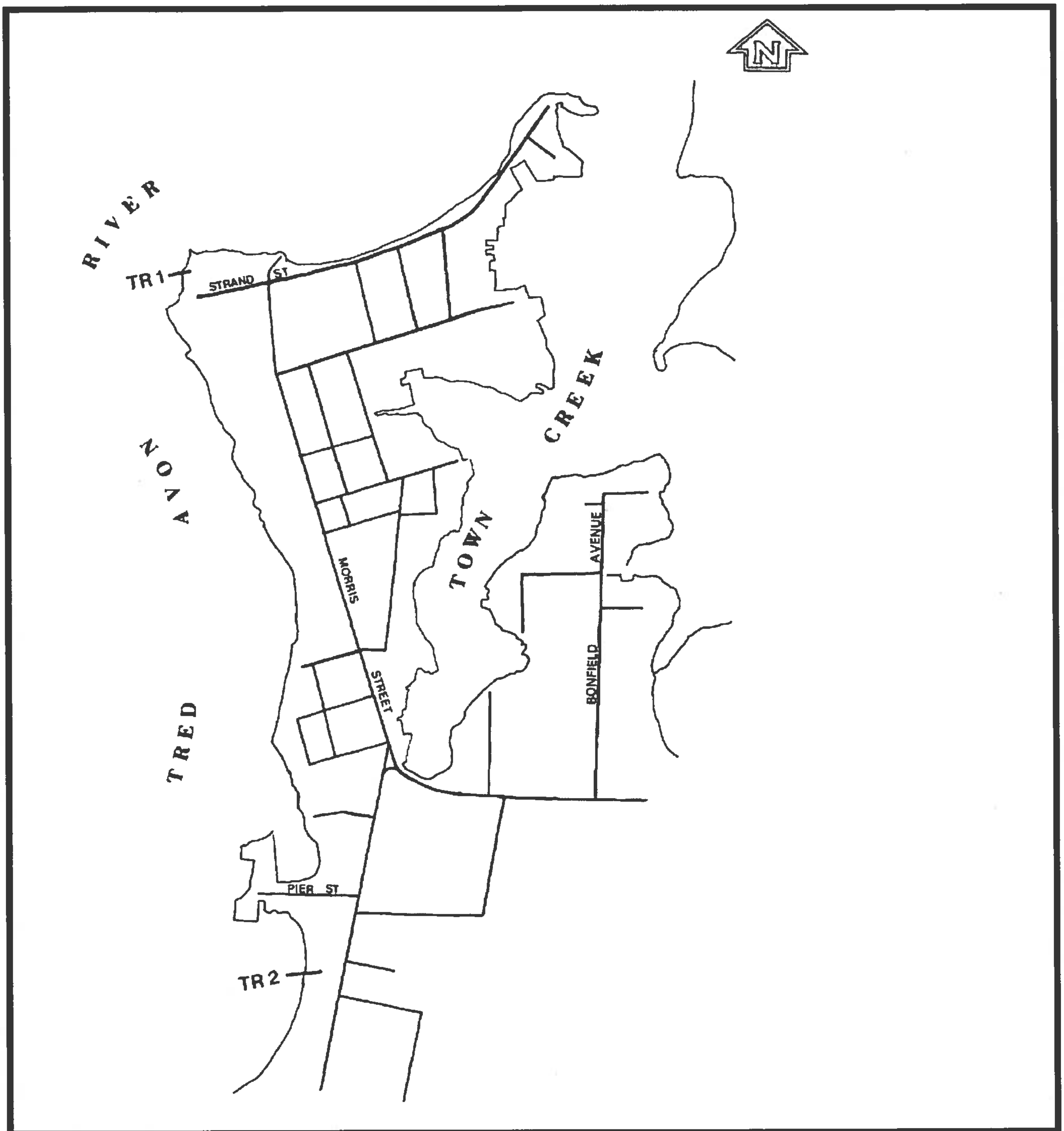


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD

AND INCORPORATED AREAS

TRANSECT LOCATION MAP

TOWN OF OXFORD

TABLE 8 TRANSECT DESCRIPTIONS – TOWN OF OXFORD

TRANSECT	LOCATION	1-PERCENT ANNUAL CHANCE FLOOD ELEVATION (FEET, NAVD 88) STILLWATER	MAXIMUM WAVE CREST
No. 1	Oxford Ferry dock to West Division Street	5.1	8.2
No. 2	West Division Street to Boone Creek	5.1	8.2

A computer program that determines wave height elevations for Flood Insurance Studies (WHAFIS) was used (Reference 19). Along each transect, wave heights and wave crest elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Wave heights were calculated to the nearest 0.1 foot, and wave crest elevations were determined at whole-foot increments along the transects. The calculations were carried inland along the transect until the wave crest elevations were permanently less than 0.5 foot above the stillwater surge elevation or the coastal flooding met another flooding source (i.e. riverine) with an equal water-surface elevation. The results of the calculations are accurate until local topography, vegetation, or cultural development of the community undergo any major changes.

Figure 3 represents a typical transect which illustrates the relationship between the stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the A/V zone boundary.

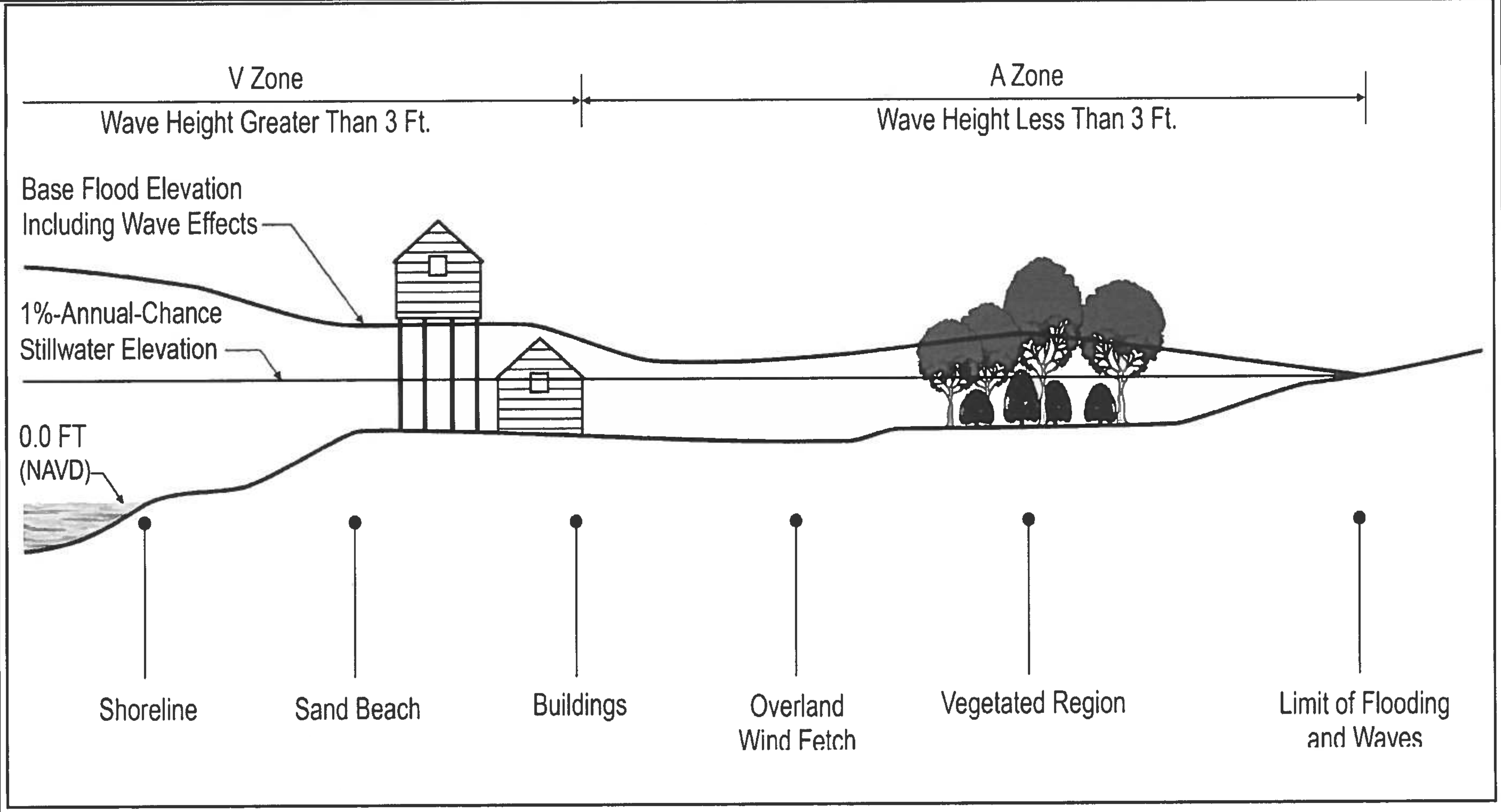


FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD AND INCORPORATED AREAS

TYPICAL TRANSECT SCHEMATIC

Countywide Revision

This FIS is a restudy of all flood hazards identified on the effective FIRM. Streams studied by detailed methods on the effective FIRM were to be restudied in detail while approximate effective streams were to be improved through enhanced approximate studies. The restudied detailed streams for Talbot County do not include new detailed field surveyed cross section data. Channel cross section information was extracted from the effective detailed models and incorporated into the new hydraulic models, where appropriate. The revised detailed models do include field measured stream crossing information, data that was collected and provided by the Maryland Department of the Environment (MDE). The enhanced approximate floodplain models also incorporate new hydraulic structure information.

Detailed hydraulic models include water-surface profile development for the 10-percent (10-year), 2-percent (50-year), 1-percent (100-year) and 0.2-percent (500-year) annual chance floods and floodway. Enhanced approximate models include only the 1-percent annual chance flood and do not include flood profile or floodway development.

Topographic data (2008), provided by Talbot County, was used to generate TINs that served as the terrain basis for detailed and approximate study model data extractions. HEC-RAS (version 4.0) models were created using AMEC-developed automated tools. For each stream a geodatabase containing the stream centerline, bank stations, flow path locations and cross sections is created and the data is imported into a HEC–RAS model. There is a single model for each defined reach.

The stream centerlines provided by the county were ortho-rectified and aligned with the contours where orthophotos were inconclusive. Cross-sections were placed within ArcGIS at hydraulically significant locations. Stream stationing for each designated reach begins at its outlet.

The TINs were used to import the cross section data into HEC-RAS model. For streams studied in detail the channel data was extracted from effective HEC-2 hydraulic models and incorporated into the updated hydraulic models, where appropriate. All hydraulic structures were computed using MDE survey information, aerials and topography to obtain elevation data and structural geometry. For this study, the computed water-surface elevations were converted from the National Geodetic Vertical Datum of 1929 (NGDV 29) to the North American Vertical Datum of 1988 (NAVD 88).

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USACE's HEC-RAS (Version 4.0) step-backwater computer program (Reference 20).

Starting conditions for both Windmill Branch and Tanyard Branch are unchanged from the previously effective models. According to the FIS for the Town of Easton, dated March 27, 1984, the starting water-surface elevations for Windmill Branch and Tanyard Branch were developed from tidal elevation data interpolated from Virginia Institute of Marine Sciences data at Peach Blossom Road and Easton Parkway, respectively. The only adjustment made was to account for the change in vertical datum. Normal depth was specified as the boundary condition for Tributary No. 3 to Windmill Branch.

Stream crossings surveyed by MDE were incorporated in HEC-RAS models. Since the provided bridge data were not vertically referenced, structures were coded relative to road surface extracted from the TINs. Inaccessible structures were modeled using data from effective HEC-2 models; otherwise, assumptions were made for structure geometry based on the available data and engineering judgment. The internal manning's 'n' values for stream crossings were adjusted based on the MDE survey data photos.

Manning's 'n' values were assigned to each cross section using HEC-RAS Reference Manual Table 3-1 (Reference 20). The aerial photographs and pictures taken by MDE during structure survey were used to estimate the roughness coefficients.

Floodways were developed for streams studied by detailed methods. Initially, Encroachment Method 4 was used to obtain equal conveyance reduction on each overbank, if possible. The results were imported into Method 1 and adjusted accordingly to maintain allowable surcharges throughout the study reach.

The hydraulic analyses for the riverine portions of this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of the selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2)

All qualifying benchmarks within a given jurisdiction that are catalogued by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Benchmarks catalogued by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation (e.g., concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS benchmarks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for benchmarks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

3.3 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 the National Geodetic Vertical Datum of 1929 (NGVD 29). With the completion of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are now referenced to NAVD 88. In order to perform this conversion, effective NGVD 29 elevation values were adjusted downward by 0.77 foot. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities. The vertical datum conversion factor from NGVD 29 to NAVD 88 for Talbot County is -0.77 feet.

NGVD 29 - 0.77 = NAVD 88

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
http://www.ngs.noaa.gov/

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-, 2-, 1-, 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 many components of the FIS report, including Flood Profiles, and Floodway Data 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 county. For the streams studied in detail, the 1-percent annual chance and 0.2-percent annual chance boundaries have been determined at each cross section. The delineations are based on the best available topographic information.

Pre-countywide Analysis

For the streams studied in detail, the 1-percent and 0.2-percent annual chance floodplains have been delineated using the flood elevations determined at each cross section.

Talbot County (Unincorporated Areas)

The boundaries between cross sections were interpolated using topographic maps at a scale of 1:7,200 with a contour interval of 2 feet (Reference 18). For wave height analysis, the 1-percent annual chance and 0.2-percent annual chance boundaries were delineated using the same scale topographic maps of the study area.

For the areas studied by approximate methods, the boundary of the 1-percent annual chance flood was delineated using SCS soil survey maps and the existing Flood Hazard Boundary Map for the Unincorporated Areas of Talbot County (References 21 and 22).

The Zones A and V were divided into whole-foot elevation zones based on the average wave crest elevation in that zone. Where the map scale did not permit delineating zones at 1-foot intervals, larger increments were used.

Town of Easton

The boundaries between cross sections the boundaries were interpolated using topographic maps at a scale of 1:7,200 with a contour interval of 2 feet (Reference 18).

For streams studied by approximate methods, the boundary of the 1-percent annual chance flood was developed from normal depth calculations and the topographic maps referenced above.

Town of Oxford

For each flooding source studied in detail, the boundaries of the 1-percent and 0.2-percent annual chance floods have been delineated using topographic maps at a scale of 1:7,200 with a contour interval of 2 feet (Reference 18). For the wave height analysis, the 1-percent and 0.2-percent annual chance boundaries were delineated using the same scale topographic maps of the study area.

Zones A and V were divided into whole-foot elevation zones based on the average wave crest elevation in that zone. Where the map scale did not permit delineating zones at one foot intervals, larger increments were used.

Town of St. Michaels

For each flooding source studied in detail, the boundaries of the 1-percent and 0.2-percent annual chance floods have been delineated using topographic maps at a scale of 1:7,200 with a contour interval of 2 feet (Reference 18).

Countywide Revision

Floodplains were spatially adjusted to fit the best available stream centerline data. Also, floodplain boundaries from the jurisdictions outlined in section 1.1 have been combined in this countywide revision.

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 areas of special flood hazards (Zones A, AE 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 the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Exhibit 2).

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 hazard. 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 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS 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.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 9).

As shown on the FIRM (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the flood-way and the 1-percent annual chance flood are either close together or collinear, only the floodway boundary has been shown.

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

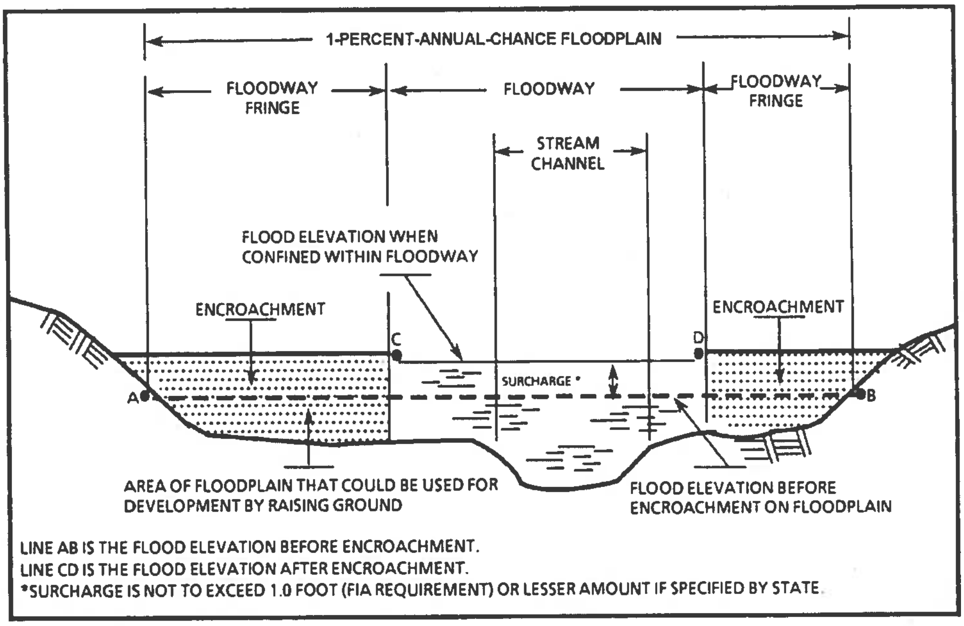


FIGURE 4: FLOODWAY SCHEMATIC

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tanyard Branch								
A	296.6	72	420.3	0.6	5.2	5.2	5.2	0.0
B	907.8	65	229.1	1.2	5.5	5.5	5.5	0.0
C	1,441.4	140	544.9	0.5	5.7	5.7	6.1	0.4
D	1,626.8	140	470.4	0.6	5.7	5.7	6.1	0.4
E	2,111.8	92	426.5	0.6	6.9	6.9	7.1	0.2
F	2,362.4	72	247.4	1.1	6.9	6.9	7.1	0.2
G	2,799.4	33	102.3	2.6	7.2	7.2	7.6	0.4
H	3,043.7	38	94.0	2.3	7.3	7.3	8.0	0.7
I	3,234.9	10	28.1	6.4	7.8	7.8	8.3	0.5
J	4,877.2	23	63.2	2.9	19.8	19.8	19.8	0.0
K	5,499.8	31	44.5	4.0	21.6	21.6	21.6	0.0
L	5,681.2	32	63.4	2.8	22.6	22.6	22.7	0.1
M	6,259.7	17	38.1	2.4	26.9	26.9	27.8	0.9

[1] Feet above confluence with North Branch Tred Avon River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD
AND INCORPORATED AREAS

FLOODWAY DATA

TANYARD BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary 3 to Windmill Branch								
A	589.9	30	67.1	3.3	21.1	20.8[2]	20.9	0.1
B	1,100.5	13	44.7	4.9	22.8	22.8	23.0	0.2
C	1,618	11	32.6	6.8	24.2	24.2	24.3	0.1

[1] Stream distance in feet above confluence with Windmill Branch
[2] Elevation computed without consideration of backwater effects from Windmill Branch

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD AND INCORPORATED AREAS

FLOODWAY DATA

TRIBUTARY 3 TO WINDMILL BRANCH

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Windmill Branch								
A	181.0	71	1,567.7	1.5	6.5	6.5	7.1	0.6
B	528.6	260	679.6	1.6	6.6	6.6	7.2	0.6
C	741.4	250	2,407.5	0.3	8.2	8.2	8.9	0.7
D	1,440.3	140	869.9	0.7	8.3	8.3	9.0	0.7
E	2,518.2	125	515.8	1.2	8.5	8.5	9.1	0.6
F	3,307.3	145	700.6	0.9	9.0	9.0	9.6	0.6
G	4,204.5	52	101.5	5.8	9.7	9.7	10.1	0.4
H	4,485.0	204	1,227.5	0.5	14.8	14.8	14.8	0.0
I	5,434.1	111	346.5	1.6	14.8	14.8	14.9	0.1
J	6,400.7	52	111.3	5.1	16.2	16.2	16.3	0.1
K	6,643.9	198	1,224.4	0.5	21.0	21.0	21.7	0.7
L	7,595.8	100	744.6	0.7	21.1	21.1	21.7	0.6
M	7,987.9	90	693.1	0.6	21.1	21.1	21.8	0.7
N	9,209.6	105	202.0	1.7	21.8	21.8	22.3	0.5
O	9,791.8	110	253.3	1.0	23.3	23.3	23.5	0.2
P	10,012.4	55	170.8	1.0	24.0	24.0	24.6	0.6
Q	10,190.8	30	177.1	1.0	24.4	24.4	25.0	0.6

[1] Stream distance in feet above Easton Parkway

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD
AND INCORPORATED AREAS

FLOODWAY DATA

WINDMILL BRANCH

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The 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 by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations 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 by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals 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 base flood elevations 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, and to 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 1-percent annual chance flood by levees. No base flood elevations 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. In the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations 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 are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Talbot County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each incorporated community with identified flood hazard areas and the unincorporated areas of the county. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 10, "Community Map History."

7.0 OTHER STUDIES

Flood Insurance Studies for neighboring Caroline and Dorchester Counties have been completed. The results of those analyses will be in exact agreement with the analysis of the November 15, 1984 study (References 23 and 24).

Flood Insurance Studies for the Towns of Easton, Oxford, St. Michaels, and Queen Anne were prepared in 1984 (References 25, 26, 27, and 28). The results of these studies will be in exact agreement with the results of the November 15, 1984 Talbot County study.

A Flood Hazard Boundary Map has been published for Talbot County (Reference 22). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

A Flood Hazard Boundary Map has been published for the community of the Town of Easton (Reference 29). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

Countywide Flood Insurance Studies for Caroline and Queen Anne's Counties are underway and Dorchester County has been completed (References 30, 31, and 32).

This study is authoritative for purposes of the Flood Insurance Program and the data presented here either supersede or are compatible with previous determinations.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, Federal Emergency Management Agency, One Independence Mall, Sixth Floor, 615 Chestnut Street, Philadelphia, Pennsylvania 19106-4404.

COMMUNITY NAME	INITIAL NFIP MAP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Easton, Town of	August 9, 1974	January 16, 1976	September 28, 1984	
Oxford, Town of	August 9, 1974	None	September 28, 1984	
St. Michaels, Town of	August 30, 1974	June 25, 1976	November 1, 1984	
Talbot County, Unincorporated Areas	April 25, 1975	None	May 15, 1985	June 16, 1992

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

TALBOT COUNTY, MD
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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