FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 2

KAUAI COUNTY, HAWAII

COMMUNITY NAME	COMMUNITY NUMBER
KAUAI COUNTY	**150002**

FEMA

REVISED: FEBRUARY 26, 2021

FLOOD INSURANCE STUDY NUMBER
150002V001D
Version Number 2.4.3.4

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Published Separately

Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT
KAUAI COUNTY, HAWAII

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the federal government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60, *Criteria for Land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the federal government.

Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as “Post-FIRM” buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) Report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum federal requirements. Contact your State NFIP Coordinator to ensure that any higher state standards are included in the community’s regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Kauai County, Hawaii.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the United States Geological Survey (USGS) 8-digit Hydrologic Unit Code (HUC-8) sub-basins affecting each, are shown in Table 1. The FIRM panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

The location of flood hazard data for participating communities in multiple jurisdictions is also indicated in the table.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Kauai County	150002	20070000	1500020010E[1], 1500020015E[1], 1500020020E[1], 1500020030E, 1500020035E, 1500020040E[1], 1500020045E, 1500020055E, 1500020060E, 1500020065E, 1500020070E[1],1500020079F, 1500020080F, 1500020087F, 1500020090F, 1500020095F, 1500020110F, 1500020120F, 1500020130F, 1500020135E[1], 1500020140F, 1500020145E, 1500020155E[1],1500020160E[1], 1500020165E[1],1500020170E[1], 1500020180E[1],1500020185E, 1500020190E[1],1500020191E[1], 1500020192E,1500020193E[1], 1500020194E,1500020201E, 1500020202E,1500020203E, 1500020204F,1500020210F, 1500020211E,1500020212F, 1500020213E,1500020214F, 1500020232F,1500020251F, 1500020252F,1500020253F, 1500020254F,1500020256G, 1500020257F,1500020258G, 1500020259G,1500020267F, 1500020280E[1],1500020285E[1], 1500020286G,1500020287G, 1500020288G,1500020289G, 1500020291E,1500020292F, 1500020293F,1500020294F, 1500020305E[1],1500020306E[1], 1500020307E,1500020308E[1], 1500020309E,1500020311E, 1500020312E,1500020313F, 1500020314F,1500020316E[1], 1500020317F,1500020318F, 1500020319F,1500020326F, 1500020327F,1500020328F, 1500020329F,1500020336F, 1500020352F,1500020356F, 1500020425F[1],1500020450F[1], 1500020475F[1],1500020500F[1],	

[1] Panel Not Printed

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages state and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1-percent-annual-chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report. Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 31, "Map Repositories," within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

  The initial Countywide FIS Report for Kauai County became effective on November 4, 1981. Refer to Table 28 for information about subsequent revisions to the FIRMs.

- Previous FIS Reports and FIRMs may have included levees that were accredited as reducing the risk associated with the 1-percent-annual-chance flood based on the information available and the mapping standards of the NFIP at that time. For FEMA to continue to accredit the identified levees, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

  Since the status of levees is subject to change at any time, the user should contact the appropriate agency for the latest information regarding levees presented in Table 9 of this FIS Report. For levees owned or operated by the U.S. Army Corps of Engineers (USACE), information may be obtained from the USACE National Levee

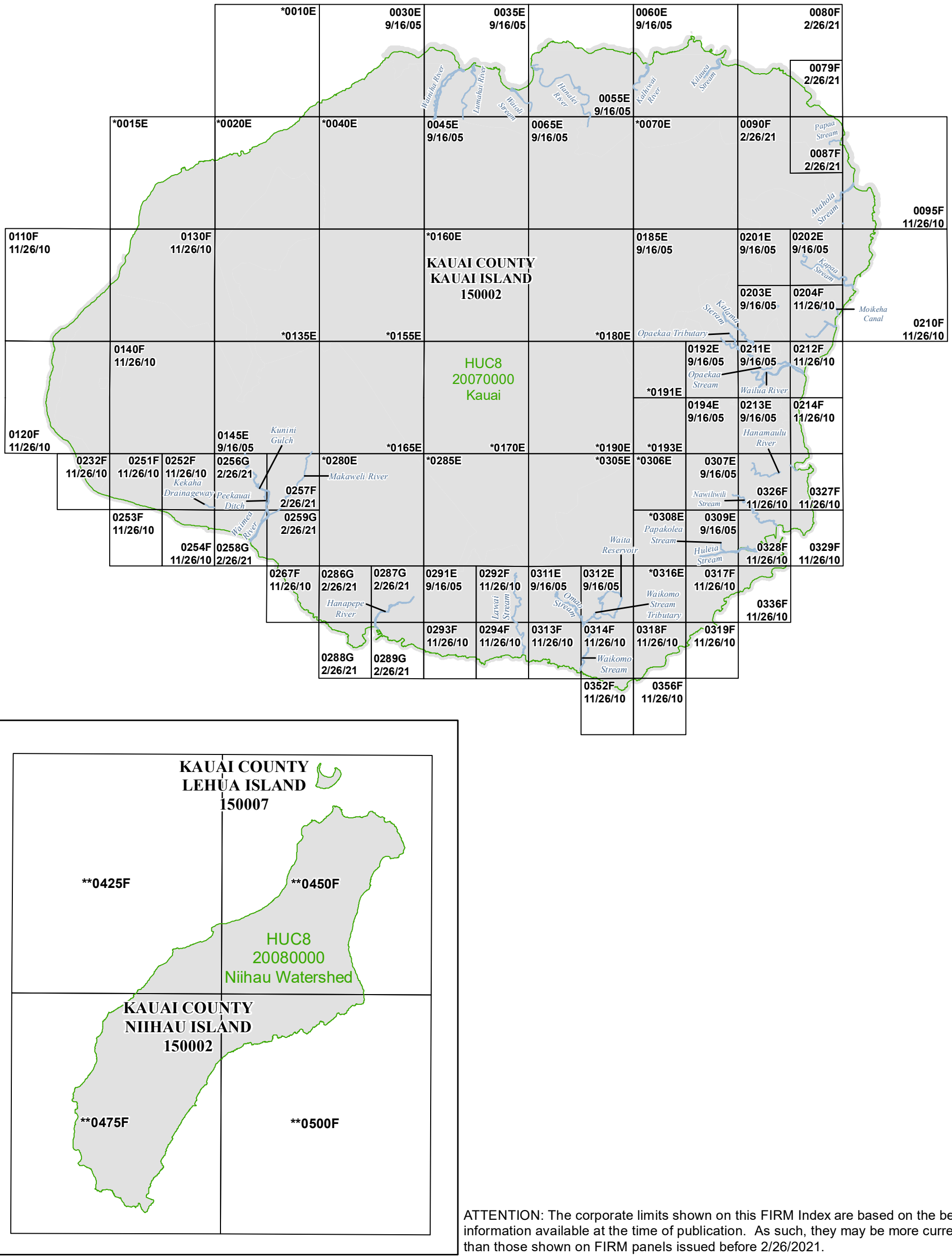
Database (nld.usace.army.mil). For all other levees, the user is encouraged to contact the appropriate local community.

Please also note that FEMA has identified one or more levees in this jurisdiction that have not been demonstrated by the community or levee owner to meet the requirements of 44 CFR 65.10, of the NFIP regulations as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. As such, temporary actions are being taken until such time as FEMA is able to initiate a new flood risk project to apply new levee analysis and mapping procedures to leveed areas. These temporary actions involve using the flood hazard data shown on the previous effective FIRM exactly as shown on that prior FIRM and identifying the area with bounding lines and special map notes. If a vertical datum conversion was executed for the county, then the Base Flood Elevations shown on the FIRM will now reflect elevations referenced to the Local Tidal Datum. These levees are on FIRM panel(s) 1500020256G, 1500020258G, and 1500020259G, on the Waimea River, 1500020204F, on the Moikeha Canal and the Waikaea Canal, and 1500020287G on the Hanapepe River, and are identified on FIRM panels as potential areas of flood hazard data changes based on further review. Please refer to Section 4.4 of this FIS Report for more information.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at www.fema.gov/online-tutorials.

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Kauai County, and also displays the panel number and effective date for each FIRM panel in the county. Other information shown on the FIRM Index includes community boundaries, flooding sources, watershed boundaries, and USGS HUC-8 codes.

Figure 1: FIRM Index



ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before 2/26/2021.

1 inch = 3.8 miles 1:240,000

Miles
0 1.75 3.5 7

Map Projection:
State Plane Hawaii 4, FIPS 5104; North American Datum 1983; Western Hemisphere; Vertical Datum: Local Tidal Datum

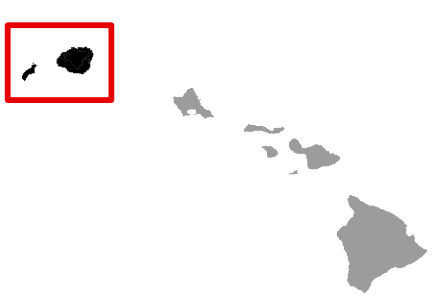
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SEE FIS REPORT FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
** PANEL NOT PRINTED - AREA IN ZONE D

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

KAUAI COUNTY, HAWAII

PANELS PRINTED:

0030, 0035, 0045, 0055, 0060, 0065, 0079, 0080, 0087, 0090, 0095, 0110, 0120, 0130, 0140, 0145, 0185, 0192, 0194, 0201, 0202, 0203, 0204, 0210, 0211, 0212, 0213, 0214, 0232, 0251, 0252, 0253, 0254, 0256, 0257, 0258, 0259, 0267, 0286, 0287, 0288, 0289, 0291, 0292, 0293, 0294, 0307, 0309, 0311, 0312, 0313, 0314, 0317, 0318, 0319, 0326, 0327, 0328, 0329, 0336, 0352, 0356

FEMA

MAP NUMBER
150002IND0D

MAP REVISED
FEBRUARY 26, 2021

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. Figure 2 contains the full list of these notes.

Figure 2: FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 28 in this FIS Report.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Non-Coastal Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

Coastal Base Flood Elevations shown on the map apply only landward of 0.0' Local Tidal Datum. Coastal flood elevations are also provided in the Coastal Transect Parameters table in the FIS Report for this jurisdiction. Elevations shown in the Coastal Transect Parameters table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

Figure 2. FIRM Notes to Users *(continued)*

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was HARN State Plane Hawaii 4 FIPS 5104 (US Feet). The horizontal datum was the North American Datum of 1983 (NAD83). Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the Local Tidal Datum**.** These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the Local Tidal Datum and the North American Vertical Datum of 1988**,** visit the National Geodetic Survey website at www.ngs.noaa.gov.

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 31 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by the U.S. Department of Agriculture at a scale of 1:6,000 and the Kauai County GIS Department at a scale of 1:5,000. The following panels used base map information provided by the U.S. Geological Survey at a scale of 1:12,000: 0130F, and 140F. For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Kauai County, Hawaii, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Kauai County, Hawaii, effective February 26, 2021.

Figure 2. FIRM Notes to Users *(continued)*

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Kauai County.

Figure 3: Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: *The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.

Figure 3: Map Legend for FIRM *(continued)*

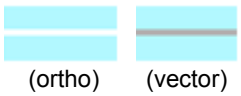
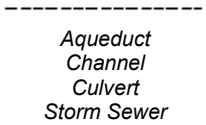
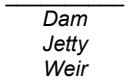
	Regulatory Floodway determined in Zone AE.
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced this Flood Risk from the 1% annual chance flood. See Notes to Users for important information.
	Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
	Channel, Culvert, Aqueduct, or Storm Sewer
	Dam, Jetty, Weir

Figure 3: Map Legend for FIRM *(continued)*

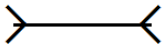
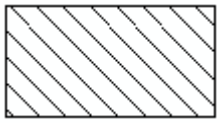
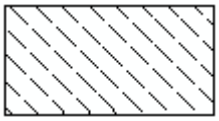
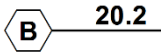
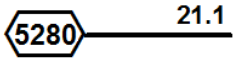
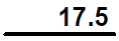
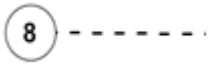
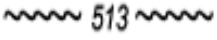
	Levee, Dike, or Floodwall
 *Bridge*	Bridge
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.*	
 **CBRS AREA 09/30/2009**	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
 **OTHERWISE PROTECTED AREA 09/30/2009**	Otherwise Protected Area
REFERENCE MARKERS	
	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
	Base Flood Elevation Line
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)

Figure 3: Map Legend for FIRM *(continued)*

ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}\mathbf{76}^{000m}\mathbf{E}$	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16' 52.5"	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and Kauai County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1-percent-annual-chance flood elevations; elevations corresponding to other floods (e.g. 10-, 4-, 2-, 0.2-percent-annual-chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1- and 0.2-percent-annual-chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1-percent-annual-chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM. Figure 3, “Map Legend for FIRM”, describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Kauai County, respectively.

Table 2, “Flooding Sources Included in this FIS Report,” lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1-percent-annual-chance floodplain corresponds to the SFHAs. The 0.2-percent-annual-chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

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. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

Within this jurisdiction, there are one or more levees that have not been demonstrated by the communities or levee owners to meet the requirements of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. As such, the floodplain boundaries in this area are subject to change. Please refer to Section 4.4 of this FIS Report for more information on how this may affect the floodplain boundaries shown on this FIRM.

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Anahola Stream	Kauai County, Hawaii	Approximately 0.1 miles upstream from Anahola Bay Inlet	Approximately 400 feet upstream from Kuhio Highway	20070000	1.1		Y	A, AE	1978
Hanalei River	Kauai County, Hawaii	Approximately 0.3 miles upstream from Hanalei Bay Inlet	Approximately 3.1 miles upstream from Kuhio Highway	20070000	5.1		Y	A, AE	2002
Hanamaulu Stream	Kauai County, Hawaii	Approximately 0.3 miles upstream from Hanamaulu Bay Inlet	Approximately 0.2 miles upstream of the confluence with Hanamaulu Stream Tributary	20070000	2.3		Y	A, AE	1995
Hanamaulu Stream Tributary	Kauai County, Hawaii	At confluence with Hanamaulu Stream	Approximately 472 feet upstream from Maalo Road	20070000	0.1		Y	AE	1995
Hanapepe River	Kauai County, Hawaii	Approximately 509 feet upstream of the Hanapepe Bay Inlet	Approximately 1.7 miles upstream from the Hanapepe Road	20070000	2.1		Y	AE	2017
Huleia Stream	Kauai County, Hawaii	At Nawiliwili Bay Inlet	Approximately 0.9 miles upstream from the confluence with Papakolea Stream	20070000	2.7		Y	AE	1987
Kalama Stream	Kauai County, Hawaii	At confluence with Opaekaa Stream	Approximately 1.3 miles upstream from Puuopae Road	20070000	3.1		Y	AE	1995
Kapaa Stream	Kauai County, Hawaii	Just downstream of State Route 56	Approximately 1.4 miles upstream from Hauaala Road	20070000	3.5		Y	A, AE	1978
Kekaha Drainageway	Kauai County, Hawaii	Approximately 0.3 miles upstream from Kekaha Road	Approximately 0.5 miles upstream from Hukipo Road	20070000	0.9		N	AE, AH	1987

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Lawai Stream	Kauai County, Hawaii	At the Lawai Bay Shoreline	Approximately 0.7 miles upstream from State Route 50	20070000	4.3		Y	A, AE	1987
Moikeha Canal	Kauai County, Hawaii	At Pacific Ocean Inlet	Just upstream of Apopo Road	20070000	1.3		Y	AE	1978
Moloa'a Stream	Kauai County, Hawaii	Approximately 0.4 miles upstream from the Pacific Ocean Inlet	Approximately 94 feet downstream from Koolau Road	20070000	0.9		N	AE	1994
Nawiliwili Stream	Kauai County, Hawaii	Approximately 224 feet downstream from Rice Street	Approximately 0.4 miles upstream from State Route 50	20070000	3.3		Y	AE	1978
Omao Stream	Kauai County, Hawaii	At confluence with Waikomo Stream	Approximately 2.5 miles upstream from Waikomo Stream confluence	20070000	2.5		Y	A, AE	1978
Opaekaa Stream	Kauai County, Hawaii	At confluence with Wailua River	Approximately 0.2 miles upstream from Puupilo Road	20070000	4.0		Y	A, AE	1987
Opaekaa Tributary	Kauai County, Hawaii	At confluence with Opaekaa Stream	Approximately 0.5 miles upstream from Poo Road	20070000	0.7		Y	AE	1987
Pacific Ocean	Kauai County, Hawaii	Open coast north of Moloa'a Bay	Open coast south of Moloa'a Bay	20070000	1.0		N	VE	2018
Pacific Ocean	Kauai County, Hawaii	Entire Coastline of Kauai County	Entire Coastline of Kauai County	20070000	90.0		N	AE, VE	2008
Papakolea Stream	Kauai County, Hawaii	At confluence with Huleia Stream	Approximately 0.4 miles upstream from Huleia Stream confluence	20070000	0.4		Y	AE	1987
Puali Stream	Kauai County, Hawaii	At Nawiliwili Bay Inlet	Approximately 0.5 miles upstream from Niumalu Road	20070000	0.7		Y	A, AE	1978

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Waikaea Canal	Kauai County, Hawaii	At Pacific Ocean Inlet	Approximately 0.4 miles upstream from the confluence with Konohiki Stream	20070000	1.4		Y	AE	1978
Waikomo Stream	Kauai County, Hawaii	Approximately 678 feet downstream from Hoonani Road	Approximately 0.2 miles upstream from Wailaau Road	20070000	3.2		Y	AE	1995
Waikomo Stream Tributary	Kauai County, Hawaii	At confluence with Waikomo Stream	Approximately 34 feet downstream from Wailaau Road	20070000	0.2		Y	AE	1995
Wailua River	Kauai County, Hawaii	At Pacific Ocean Inlet	Approximately 3.1 miles upstream from State Route 56	20070000	3.1		Y	A, AE	1978
Waimea River	Kauai County, Hawaii	Approximately 0.2 miles upstream of the confluence with Makaweli River	Approximately 2.5 miles upstream of the confluence with Makaweli River	20070000	2.3		N	A	1987
Waimea River	Kauai County, Hawaii	At Pacific Ocean Inlet	Approximately 0.2 miles upstream of the confluence with Makaweli River	20070000	1.4		Y	AE	2017
Wainiha River	Kauai County, Hawaii	Approximately 0.2 miles upstream from State Route 560	Approximately 2.1 miles upstream from State Route 560	20070000	1.9		Y	A, AE	1987
Waioli Stream	Kauai County, Hawaii	Approximately 39 feet upstream of State Route 560	Approximately 1.2 miles upstream from the State Route 560	20070000	1.2		Y	A, AE	1978
Waipa Stream	Kauai County, Hawaii	Approximately 528 feet upstream of State Route 560	Approximately 0.5 miles upstream from State Route 560	20070000	0.4		Y	AE	1978

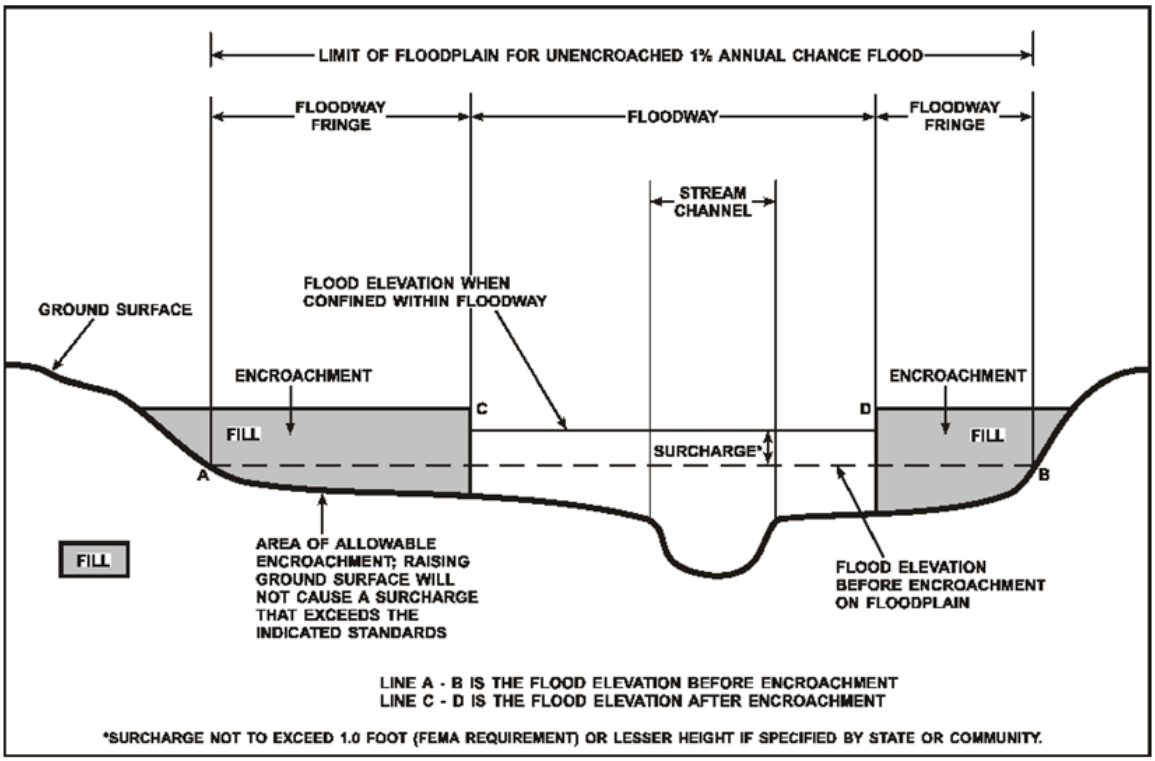
2.2 Floodways

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 balancing floodplain development against increasing flood hazard. With this approach, the area of the 1-percent-annual-chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1-percent-annual-chance flood. The floodway fringe is the area between the floodway and the 1-percent-annual-chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic



Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 24, "Floodway Data."

All floodways that were developed for this Flood Risk Project are shown on the FIRM using the symbology described in Figure 3. In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown on the FIRM. For information about the delineation of floodways on the FIRM, refer to Section 6.3.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (BFE) is the elevation of the 1-percent-annual-chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

BFEs are primarily intended for flood insurance rating purposes. Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. 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. For example, the user may use the FIRM to determine the stream station of a location of interest and then use the profile to determine the 1-percent-annual-chance elevation at that location. Because only selected cross sections may be shown on the FIRM for riverine areas, the profile should be used to obtain the flood elevation between mapped cross sections. Additionally, for riverine areas, whole-foot elevations shown on the FIRM may not exactly reflect the elevations derived from the hydraulic analyses; therefore, elevations obtained from the profile may more accurately reflect the results of the hydraulic analysis.

2.4 Non-Encroachment Zones

This section is not applicable to this Flood Risk Project

2.5 Coastal Flood Hazard Areas

For most areas along rivers, streams, and small lakes, BFEs and floodplain boundaries are based on the amount of water expected to enter the area during a 1-percent-annual-chance flood and the geometry of the floodplain. Floods in these areas are typically caused by storm events. However, for areas on or near ocean coasts, large rivers, or large bodies of water, BFE and floodplain boundaries may need to be based on additional components, including storm surges and waves.

Coastal flooding sources that are included in this Flood Risk Project are shown in Table 2.

2.5.1 Water Elevations and the Effects of Waves

Specific terminology is used in coastal analyses to indicate which components have been included in evaluating flood hazards.

The stillwater elevation (SWEL or still water level) is the surface of the water resulting from astronomical tides, storm surge, and freshwater inputs, but excluding wave setup contribution or the effects of waves.

- *Astronomical tides* are periodic rises and falls in large bodies of water caused by the rotation of the earth and by the gravitational forces exerted by the earth, moon and sun.
- *Storm surge* is the additional water depth that occurs during large storm events. These events can bring air pressure changes and strong winds that force water up against the shore.
- *Freshwater inputs* include rainfall that falls directly on the body of water, runoff from surfaces and overland flow, and inputs from rivers.

The 1-percent-annual-chance stillwater elevation is the stillwater elevation that has been calculated for a storm surge from a 1-percent-annual-chance storm. The 1-percent-annual-chance storm surge can be determined from analyses of tidal gage records, statistical study of regional historical storms, or other modeling approaches. Stillwater elevations for storms of other frequencies can be developed using similar approaches.

The total stillwater elevation (also referred to as the mean water level) is the stillwater elevation plus wave setup contribution but excluding the effects of waves.

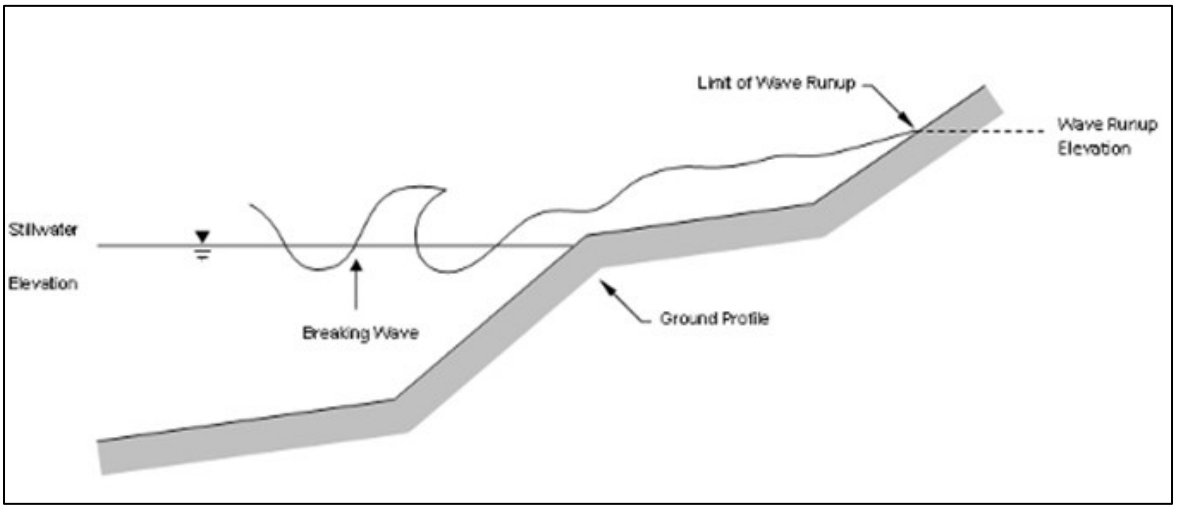
- *Wave setup* is the increase in stillwater elevation at the shoreline caused by the reduction of waves in shallow water. It occurs as breaking wave momentum is transferred to the water column.

Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1-percent-annual-chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since tidal gages are often sited in areas sheltered from wave action and do not capture this information.

Coastal analyses may examine the effects of overland waves by analyzing storm-induced erosion, overland wave propagation, wave runup, and/or wave overtopping.

- *Storm-induced erosion* is the modification of existing topography by erosion caused by a specific storm event, as opposed to general erosion that occurs at a more constant rate.
- *Overland wave propagation* describes the combined effects of variation in ground elevation, vegetation, and physical features on wave characteristics as waves move onshore.
- *Wave runup* is the uprush of water from wave action on a shore barrier. It is a function of the roughness and geometry of the shoreline at the point where the stillwater elevation intersects the land.
- *Wave overtopping* refers to wave runup that occurs when waves pass over the crest of a barrier.

Figure 5: Wave Runup Transect Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

For coastal communities along the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and the Caribbean Sea, flood hazards must take into account how storm surges, waves, and extreme tides interact with factors such as topography and vegetation. Storm surge and waves must also be considered in assessing flood risk for certain communities on rivers or large inland bodies of water.

Beyond areas that are affected by waves and tides, coastal communities can also have riverine floodplains with designated floodways, as described in previous sections.

Floodplain Boundaries

In many coastal areas, storm surge is the principle component of flooding. The extent of the 1-percent-annual-chance floodplain in these areas is derived from the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1-percent-annual-chance storm. The methods that were used for calculation of total stillwater elevations for coastal areas are described in Section 5.3 of this FIS Report. Location of

total stillwater elevations for coastal areas are shown in Figure 8, "1-Percent-Annual-Chance Total Stillwater Levels for Coastal Areas."

In some areas, the 1-percent-annual-chance floodplain is determined based on the limit of wave runup or wave overtopping for the 1-percent-annual-chance storm surge. The methods that were used for calculation of wave hazards are described in Section 5.3 of this FIS Report.

Table 26 presents the types of coastal analyses that were used in mapping the 1-percent-annual-chance floodplain in coastal areas.

Coastal BFEs
Coastal BFEs are calculated as the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1-percent-annual-chance storm plus the additional flood hazard from overland wave effects (storm-induced erosion, overland wave propagation, wave runup and wave overtopping).

Where they apply, coastal BFEs are calculated along transects extending from offshore to the limit of coastal flooding onshore. Results of these analyses are accurate until local topography, vegetation, or development type and density within the community undergoes major changes.

Parameters that were included in calculating coastal BFEs for each transect included in this FIS Report are presented in Table 17, "Coastal Transect Parameters." The locations of transects are shown in Figure 9, "Transect Location Map." More detailed information about the methods used in coastal analyses and the results of intermediate steps in the coastal analyses are presented in Section 5.3 of this FIS Report. Additional information on specific mapping methods is provided in Section 6.4 of this FIS Report.

2.5.3 Coastal High Hazard Areas

Certain areas along the open coast and other areas may have higher risk of experiencing structural damage caused by wave action and/or high-velocity water during the 1-percent-annual-chance flood. These areas will be identified on the FIRM as Coastal High Hazard Areas.

- *Coastal High Hazard Area (CHHA)* is a SFHA extending from offshore to the inland limit of the primary frontal dune (PFD) or any other area subject to damages caused by wave action and/or high-velocity water during the 1-percent-annual-chance flood.
- *Primary Frontal Dune (PFD)* is a continuous or nearly continuous mound or ridge of sand with relatively steep slopes immediately landward and adjacent to the beach. The PFD is subject to erosion and overtopping from high tides and waves during major coastal storms.

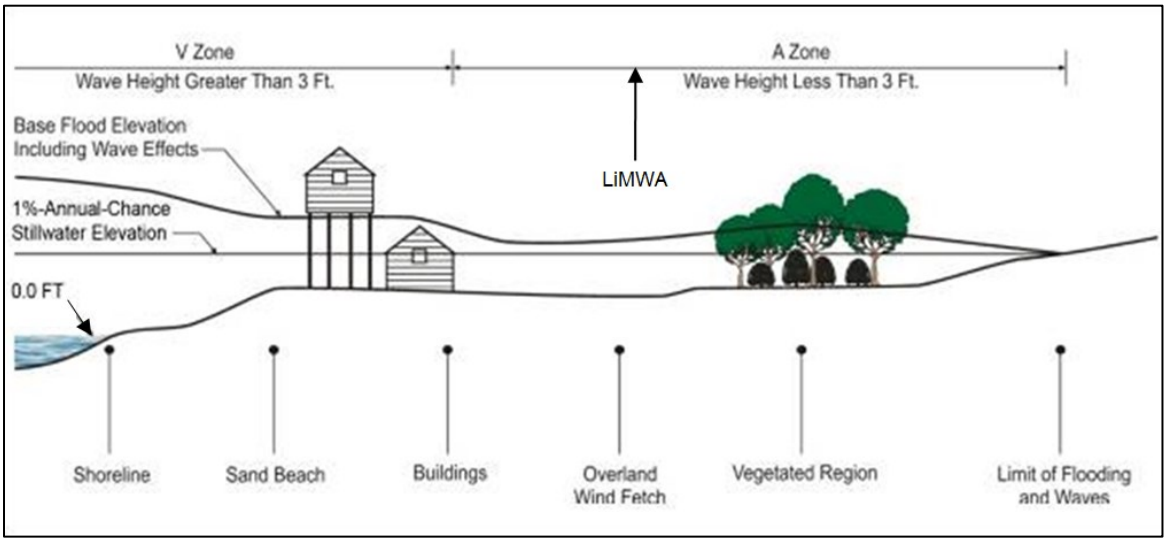
CHHAs are designated as "V" zones (for "velocity wave zones") and are subject to more stringent regulatory requirements and a different flood insurance rate structure. The areas of greatest risk are shown as VE on the FIRM. Zone VE is further subdivided into elevation zones and shown with BFEs on the FIRM.

The landward limit of the PFD occurs at a point where there is a distinct change from a relatively steep slope to a relatively mild slope; this point represents the landward extension of Zone VE. Areas of lower risk in the CHHA are designated with Zone V on the FIRM. More detailed information about the identification and designation of Zone VE is presented in Section 6.4 of this FIS Report.

Areas that are not within the CHHA but are SFHAs may still be impacted by coastal flooding and damaging waves; these areas are shown as "A" zones on the FIRM.

Figure 6, "Coastal Transect Schematic," illustrates the relationship between the base flood elevation, the 1-percent-annual-chance stillwater elevation, and the ground profile as well as the location of the Zone VE and Zone AE areas in an area without a PFD subject to overland wave propagation. This figure also illustrates energy dissipation and regeneration of a wave as it moves inland.

Figure 6: Coastal Transect Schematic



Methods used in coastal analyses in this Flood Risk Project are presented in Section 5.3 and mapping methods are provided in Section 6.4 of this FIS Report.

Coastal floodplains are shown on the FIRM using the symbology described in Figure 3 "Map Legend for FIRM." In many cases, the BFE on the FIRM is higher than the stillwater elevations shown in Table 17 due to the presence of wave effects. The higher elevation should be used for construction and/or floodplain management purposes.

2.5.4 Limit of Moderate Wave Action

This section is not applicable to this Flood Risk Project

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, "Map Legend for FIRM." Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in Kauai County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Kauai County	A, AE, AH, AO, D, VE, X

3.2 Coastal Barrier Resources System

This section is not applicable to this Flood Risk Project

Table 4: Coastal Barrier Resources System Information

[Not applicable to this Flood Risk Project]

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 5 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Kauai	2007000	Pacific Ocean	Kauai County	555

4.2 Principal Flood Problems

Table 6 contains a description of the principal flood problems that have been noted for Kauai County by flooding source.

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
Pacific Ocean	The island of Kauai is subject to flooding from stream overflow, tsunamis, and hurricanes. In some areas along the coast, all three types of flooding may occur. Tsunamis, which are a series of waves generated by submarine earth movements, travel at high velocities and have had a devastating effect on the developed areas of Kauai County. Sources of these tsunamis are varied and are located in North and South America, the Aleutian Islands, Japan, Kamchatka, the islands lying between the Philippines and Samoa, and even Hawaii itself. Within the Hawaiian Islands, the City of Hilo on Hawaii has been most severely damaged from Tsunami impacts. Based on 1970 figures, Hilo had suffered losses of approximately $62 million over the past 50 years.
Hanalei Watershed	In Hanalei, the worst flood on record occurred on November 11 and 12, 1955, and inundated the entire Hanalei Valley lowlands. An approximately 0.5-mile section of Kuhio Highway was under 6 feet of water; the lowest highway segment was under 8 feet of water. The Hanalei River stream-gaging station, situated at the same location since 1915, was destroyed. Besides riverine flooding, Hanalei is also exposed to tsunami flooding.
Anahola Watershed	The largest flood recorded in the Anahola area occurred on January 25, 1956, when more than 13 inches of rain fell in the watershed within a 24-hour period. A U.S. Geological Survey (USGS) stream gage located approximately 3 miles above the mouth of Anahola Stream recorded a peak of 19,600 cfs, the highest in 57 years of stream gage records. The flood exceeded the expected 100-year and approached the 200year flood discharge of the stream gage record. On December 14, 1991, over 20 inches of rain fell during a 12-hour period, resulting in flash floods which recorded five deaths, severe flooding, erosions, and slides, as well as numerous property damages. Other major floods occurred in April 1948, August 1959, May 1965, November 1968, and January 1975.
Kanaa Watershed	The flood history in the Kapaa area is not well documented. Before construction of Moikeha and Waikaea Canals, flooding occurred periodically from sheet runoff, but since completion of the canals, there has been no extensive flood damage. Several factors aggravate flooding in the area. Debris buildup at the highway bridges over Kapaa Stream and siltation and plant growth within Moikeha and Waikaea Canalsarethe main problems.

Table 6: Principal Flood Problems *(continued)*

Flooding Source	Description of Flood Problems
Wailua Watershed	Flood problems from Opaekaa Stream have mostly occurred upstream of Kamalu Road, where, before 1976, a 6-foot-square box culvert restricted flood discharges. The box culvert has since been replaced by a bridge. The largest recorded flood in the watershed, measured at a gaging station with 15 years of records, located in the left branch of Opaekaa Stream, occurred on January 31, 1975. It had a peak discharge of 724 cfs, which is equivalent to approximately a 28-year recurrence interval. Flood problems caused by Opaekaa Tributary and the upstream study reach of Opaekaa Stream have not been documented.
Lihue Watershed	The lowlands of the Puali and Nawiliwili Streams are particularly vulnerable to inundation. Sand buildup at the mouth of Nawiliwili Stream causes backwater in the lower portions. To add to the problem, debris accumulation at the bridge openings has aggravated floods in the upstream areas, especially upstream of the Rice Street bridge. In the past, the lawns, parking lots, and roads near Puali Stream have been inundated by sheet runoff and stream overflow. Low spots in residential areas have been covered with standing water to depths of 1 to 2 feet.
Koloa Watershed	Properties in Koloa in the vicinity of Waikomo Stream and Waikomo Road are particularly flood prone. Debris and vegetation growth in the stream channel aggravate the flood problem in this area. Although Waikomo Stream has caused flooding in Koloa, the major flood problem area is the coastal region of Koloa Poipu, where shallow flooding caused by low-lying topography and inadequate drainage facilities frequently occurs. From six storms that caused flooding in the low-lying Koloa-Poipu area from 1954 to 1965, no flood damages were reported in areas adjacent to Waikomo Stream.
Hanapepe Watershed	The largest recorded flood in the Hanapepe area occurred on April 15, 1963. During the storm, the Hanapepe River gaging station recorded its highest discharge (39,000 cfs) in 47 years of record. The discharge approximated the magnitude of the 0.5% annual chance flood frequency. The flood destroyed several homes and severely damaged many more in the Hanapepe Valley area. A USACE flood-control levee project under construction at the time was also severely damaged. Since the completion of the levee project, the low-lying areas have been beset with interior drainage problems. In December 1968, several homes and lawns behind the levees were flooded to depths of 3 to 4 feet by floodwater discharged from nearby Hikiula Gulch.

Table 6: Principal Flood Problems *(continued)*

Flooding Source	Description of Flood Problems
Moloa'a Stream	From Ko'ola Road and continuing downstream for about 2,100 feet, stream discharges start to overflow the stream banks. Shallower channel slopes and the additional discharge from Tributary "B" contribute to this condition. From this point and continuing downstream until the coastline, the floodplain widens with the majority the flood flows spilling over the left overbank (looking downstream). Most of the residences within the area are situated on the right overbank. A sandbar at the stream mouth increases the flooding potential. This sandbar builds up over time from the surf and unless cleared regularly causes a severe obstruction to flow. No recorded data of any flooding events are available since no gaging station exists along Moloa'a Stream. However, historical records show major flooding events having occurred in the Anahola area, the nearest town to Moloa'a Stream, located in the adjoining drainage basin 3.8 miles to the south. Intense rainfall between the evening of the 13th and the morning of the 14th of December 1991 caused record heavy stream flows in the northeast portion of Kauai. Several USGS stream gaging stations lie within relatively close proximity of Moloa'a Stream. The two closest stream gages are: 0890 along Anahola Stream and 0975 along Halaulani Stream, located approximately 3.4 miles due south and 5.6 miles due west, respectively, of the Moloa'a Stream mouth. On December 14, 1991 gages 0890, with a drainage area of 4.27 square miles, and 0975, with a drainage area of 1.90 square miles, recorded peak discharges of 21,000 cfs and 4,500 cfs, respectively. Both floods exceeded the probable 100-year discharges of the stream gage record. The record rainfall intensities and volume during the early morning hours of December 14, 1991 caused flash floods which resulted in estimated total damage loss of about seven million dollars to public property, private residences and businesses. Further, three lives were lost due to flooding adjacent to Anahola Stream and on life lost along Moloa'a Stream. The largest flooding event prior December 14, 1991 was recorded at USGS stream gage number 0890. A Peak discharge of 19,600 cfs was recorded in January 25, 1956. This flood exceeded the probable 100-year flood discharge of the stream gage record. Other major floods in the Anahola area occurred in April 1948, August 1959, May 1965, November 1968, and January 1975.
West Kauai Watershed	The largest recorded storm in the Kekaha area occurred on December 1973. Intense rainfall (7 inches of rain within 2 hours) floodwater throughout Kekaha, inundating the Hawaiian Homes area and damaging Coxs Ditch. County and State roads about 50 homes sustained damage. Also flooded were sugarcane fields, which sustained damage from rock and debris deposition and topsoil erosion. According to several local residents, the flood was aggravated by nonnatural sand plugs in the drainageways near Kekaha. The flood was estimated by the SCS to have 15-year recurrence intervals.

Table 6: Principal Flood Problems *(continued)*

Flooding Source	Description of Flood Problems
Wainiha Watershed	Three severe floods have occurred on the Wainiha River. On February 17, 1956, more than 20 inches of rain fell in the valley during a 24-hour period. The Wainiha River stream gage, located 6.8 miles from the mouth with a drainage area of 10.2 square miles, was destroyed. From flood marks at the stream gage, a peak discharge of 40,000 cfs was calculated.
Waimea Watershed	On several occasions, Waimea River flooded the Waimea Town area. Severe floods dating back to 1916, 1921, 1927, and 1942 were recorded. On February 7, 1949, the most destructive flood occurred; two lives were lost and five houses were destroyed. The entire town was flooded; the business center was flooded to depths of 3 to 8 feet. Several commercial structures were shoved off their foundations. During the flood, the Waimea River gaging station (Station 380) recorded its highest stage height of 11.4 feet. (Peak discharges are not determined for this stream gage.) The stream gage has a 39-year record (1944 to 1983) and is located 150 feet upstream of the Kaeualii Highway bridge. Based on the river-stage data, the 1949 flood was equal to a 55-year flood.

Table 7: Historic Flooding Elevations

[Not applicable to this Flood Risk Project]

4.3 Non-Levee Flood Protection Measures

A tsunami warning system has been developed for the entire State of Hawaii. This warning system was designed to provide sufficient time for evacuation from tsunami danger zones.

Table 8: Non-Levee Flood Protection Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Hanapepe Bay	Hanapepe Jetty	Jetty	Eastern Hanapepe Bay shoreline	Jetty constructed of rip-rap and concrete approximately 1189 feet long, forming a man-made harbor.
Hanamaulu Bay	Hanamaulu Jetty	Jetty	At the southern bay outlet	Rock jetty approximately 328 feet long providing protection for the southern shoreline of Hanamaulu Bay
Nawiliwili Bay	Nawiliwili Seawall	Seawall	Along the eastern facing north bank of the Pacific Ocean Inlet from Nawiliwili Bay	Concrete coastal armoring structure approximately 2495 feet long, providing erosion control at the Nawiliwili Bay Outlet

4.4 Levees

Please note that FEMA has identified levees in this jurisdiction that have not been demonstrated by the community or levee owner to meet the requirements of 44 CFR 65.10 of the NFIP regulations as it relates to the levee's capacity to provide 1-percent-annual-chance flood protection. As such, new flood hazard analyses in the affected areas have been developed and reflected on the revised FIRM panels and the area has been clearly identified on the FIRM panel with notes and bounding lines. These levees occur on FIRM panel(s) 1500020204F, 1500020256G, 1500020258G, 1500020259G, and 1500020287G, on the Moikeha Canal, Waikaea Canal, Waimea River and the Hanapepe River, and are identified on the FIRM panel(s) as potential areas of flood hazard data changes based on further review. Levees and their accreditation status are listed in Table 9 of this FIS Report.

Table 9: Levees

Community	Flooding Source	Levee Location	Levee Owner	USACE Levee	Levee ID	Covered Under PL84-99 Program?	FIRM Panel(s)
Kauai County	Hanapepe River	Right Bank	County of Kauai, Department of Public Works	Yes	15007C_21	Yes	1500020287G
	Hanapepe River	Left Bank	County of Kauai, Department of Public Works	Yes	15007C_147	Yes	1500020287G
	Waimea River	Right Bank	County of Kauai, Department of Public Works	Yes	15007C_124	Yes	1500020256G 1500020258G 1500020259G
	Waikaea Canal	Left Bank	Kauai County	*	150002_191	*	1500020204F
	Moikeha Canal	Left Bank	Kauai County	*	150002_179	*	1500020204F

*Data not available

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded at least once on the average during any 10-, 25-, 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-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2-percent-annual-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 one year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 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.

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 13. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 10: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Anahola Stream	At mouth	10.3	15,000	*	24,000	29,000	*	42,000
Hanalei River	At mouth	23.8	37,000	*	51,000	58,000	*	73,000
Hanamalulu Stream	At mouth	8.9	*	*	*	27,300	*	*
Hanamalulu Stream Tributary	At mouth	*	*	*	*	11,193	*	*
Hanapepe River	At mouth	27.0	21,000	*	32,000	38,000	*	52,000
	At Gage No. 16049000	18.5	17,000	*	26,000	31,000	*	42,000
Huleia Stream	At mouth	26.07	21,270	*	34,020	40,160	*	56,190
	At a point approx. 13,800 feet inland	19.82	16,800	*	26,860	31,700	*	44,330
Kalama Stream	At confluence with Opaekaa Stream	2.4	3,800	*	6,600	8,200	*	12,200
Kapaa Stream	At mouth	13.6	21,000	*	32,000	37,000	*	51,000
Kekaha Drainageway	Kapilimao-Waimea Basin	5.79	*	*	*	10,650	*	*
	Waipao-Waika Basin	5.54	*	*	*	8,605	*	*
	Dainageway between basins	5.54	*	*	*	5,550	*	*

Table 10: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Lawai Stream	At Lauoho Road	3.62	3,090	*	5,470	6,650	*	10,170
	At upstream Access Road crossing	3.32	2,870	*	2,070	6,170	*	9,440
Moikeha Canal	At mouth	2.0	900	*	1,300	1,500	*	1,900
Moloa'a Stream	At mouth	3.3	3,630	*	5,780	6,800	*	9,480
	Upstream of Tributary "A"	3.1	3,410	*	5,430	6,390	*	8,900
	Downstream of Tributary "B"	2.6	2,950	*	4,690	5,520	*	7,690
	Upstream of Tributary "B"	2.2	2,530	*	4,020	4,730	*	6,590
Nawiliwili Stream	At mouth	4.7	2,400	*	6,350	10,400	*	19,000
	At Lihue Mill Access Road	4.0	2,250	*	5,800	9,450	*	17,400
Omao Stream	At confluence with Waikomo Stream	4.1	2,700	*	3,900	4,400	*	5,700
Opaekaa Tributary	At confluence with Wailua River	6.4	9,000	*	15,200	18,500	*	27,500
Opaekaa Tributary	Downstream of confluence of Kalama Stream	5.1	7,300	*	12,200	15,500	*	22,200

Table 10: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Opaekaa Tributary *(continued)*	Upstream of confluence of Kalama Stream	2.7	4,300	*	7,600	9,400	*	14,000
	At Access Road crossing	2.44	1,810	*	3,440	4,390	*	7,230
	Upstream of confluence of Opaekaa Tributary	2.05	1,560	*	2,960	3,775	*	6,200
	At confluence of Opaekaa Stream	1.80	370	*	710	900	*	1,480
	At Poo Road	0.39	350	*	660	840	*	1,380
Papakolea Stream	At confluence with Huleai Stream	3.48	3,760	*	6,000	7,060	*	9,830
Puali Stream	At mouth	2.0	3,000	*	5,400	6,600	*	9,700
Waikaea Canal	At mouth	6.7	3,300	*	4,700	5,400	*	6,900
Waikomo Stream	Downstream of confluence of Omao Stream	10.4	5,600	*	7,900	9,000	*	11,600
	At mouth	7.9	4,200	*	6,000	6,900	*	8,900
	Upstream of confluence of Omao Stream	*	*	*	*	2,500	*	*
Waikomo Stream Tributary	At confluence with Waikomo Stream	*	*	*	*	670	*	*
Wailua River	At mouth	53.1	40,000	*	64,000	76,000	*	105,000

Table 10: Summary of Discharges *(continued)*

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Waimea River	At mouth	86.5	35,500	*	54,500	64,000	*	89,000
	Upstream of confluence with Makaweli River	58.4	28,900	*	45,300	53,300	*	74,600
Wainiha River	At mouth	22.57	29,700	*	46,600	55,590	*	76,560
	At a point approx. 8,800 feet inland	20.68	27,550	*	43,220	51,540	*	70,980
Waipa Stream	At mouth	3.2	5,000	*	8,800	10,500	*	16,000
Waioli Stream	At mouth	5.1	7,400	*	12,500	16,000	*	23,000

*Not calculated for this Flood Risk Project

Figure 7: Frequency Discharge-Drainage Area Curves

[Not applicable to this Flood Risk Project]

Table 11: Summary of Non-Coastal Stillwater Elevations

[Not applicable to this Flood Risk Project]

Table 12: Stream Gage Information used to Determine Discharges

[Not applicable to this Flood Risk Project]

5.2 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. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. 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. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed in Table 24, “Floodway Data.”

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 13. Roughness coefficients are provided in Table 14. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 13: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Anahola Stream	Approximately 0.1 miles upstream from Anahola Bay Inlet	Approximately 400 feet upstream from Kuhio Highway	Multiple Linear Correlations	HEC-2	June 1978	A, AE	
Hanalei River	Approximately 0.3 miles upstream from Hanalei Bay Inlet	Approximately 3.1 miles upstream from Kuhio Highway	Multiple Linear Correlations	HEC-2	October 18, 2002	A, AE	
Hanamaulu Stream	Approximately 0.3 miles upstream from Hanamaulu Bay Inlet	Approximately 0.2 miles upstream of the confluence with Hanamaulu Stream Tributary	Multiple Linear Correlations	HEC-2	September 30, 1995	A, AE	
Hanamaulu Stream Tributary	At confluence with Hanamaulu Stream	Approximately 472 feet upstream from Maalo Road	Multiple Linear Correlations	HEC-2	September 30, 1995	AE	
Hanapepe River	Approximately 509 feet upstream of the Hanapepe Bay Inlet	Approximately 1.7 miles upstream from the Hanapepe Road	Multiple Linear Correlations	HEC-RAS 5.0 and up	October 24, 2017	AE	The Natural Valley method was used for both levees removed

Table 13: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Huleia Stream	At Nawiliwili Bay Inlet	Approximately 0.9 miles upstream from the confluence with Papakolea Stream	Multiple Linear Correlations	HEC-2	March 4, 1987	AE	
Kalama Stream	At confluence with Opaekaa Stream	Approximately 1.3 miles upstream from Puuopae Road	Multiple Linear Correlations	HEC-2	September 30, 1995	AE	
Kapaa Stream	Just downstream of State Route 56	Approximately 1.4 miles upstream from Hauaala Road	Multiple Linear Correlations	HEC-2	June 1978	A, AE	
Kekaha Drainageway	Approximately 0.3 miles upstream from Kekaha Road	Approximately 0.5 miles upstream from Hukipo Road	Multiple Linear Correlations	HEC-2	March 4, 1987	AE, AH	
Lawai Stream	At the Lawai Bay Shoreline	Approximately 0.7 miles upstream from State Route 50	Regional Equations	HEC-2	March 4, 1987	A, AE	
Moikeha Canal	At Pacific Ocean Inlet	Just upstream of Apopo Road	Multiple Linear Correlations	HEC-2	June 1978	AE	
Moloa'a Stream	Approximately 0.4 miles upstream from the Pacific Ocean Inlet	Approximately 94 feet downstream from Koolau Road	Regression Equations	HEC-2	June 1, 1994	AE	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Nawiliwili Stream	Approximately 224 feet downstream from Rice Street	Approximately 0.4 miles upstream from State Route 50	Multiple Linear Correlations	HEC-2	June 1978	AE	
Omao Stream	At confluence with Waikomo Stream	Approximately 2.5 miles upstream from Waikomo Stream confluence	Multiple Linear Correlations	HEC-2	June 1978	A, AE	
Opaekaa Stream	At confluence with Wailua River	Approximately 0.2 miles upstream from Puupilo Road	Regional Equations	HEC-2	March 4, 1987	A, AE	
Opaekaa Tributary	At confluence with Opaekaa Stream	Approximately 0.5 miles upstream from Poo Road	Regional Equations	HEC-2	March 4, 1987	AE	
Papakolea Stream	At confluence with Huleia Stream	Approximately 0.4 miles upstream from Huleia Stream confluence	Multiple Linear Correlations	HEC-2	March 4, 1987	AE	
Puali Stream	At Nawiliwili Bay Inlet	Approximately 0.5 miles upstream from Niumalu Road	Multiple Linear Correlations	HEC-2	June 1978	A, AE	

Table 13: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Waikaea Canal	At Pacific Ocean Inlet	Approximately 0.4 miles upstream from the confluence with Konohiki Stream	Multiple Linear Correlations	HEC-2	June 1978	AE	
Waikomo Stream	Approximately 678 feet downstream from Hoonani Road	Approximately 0.2 miles upstream from Wailaau Road	Multiple Linear Correlations	HEC-2	September 30, 1995	AE	
Waikomo Stream Tributary	At confluence with Waikomo Stream	Approximately 34 feet downstream from Wailaau Road	Multiple Linear Correlations	HEC-2	September 30, 1995	AE	
Wailua River	At Pacific Ocean Inlet	Approximately 3.1 miles upstream from State Route 56	Multiple Linear Correlations	HEC-2	June 1978	A, AE	
Waimea River	Approximately 0.2 miles upstream of the confluence with Makaweli River	Approximately 2.5 miles upstream of the confluence with Makaweli River	Regional Equations	HEC-2	March 4, 1987	A	
Waimea River	At Pacific Ocean Inlet	Approximately 0.2 miles upstream of the confluence with Makaweli River	Multiple Linear Correlations	HEC-RAS 5.0 and up	October 24, 2017	AE	Left levee analysis was conducted using the Natural Valley method

Table 13: Summary of Hydrologic and Hydraulic Analyses *(continued)*

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Wainiha River	Approximately 0.2 miles upstream from State Route 560	Approximately 2.1 miles upstream from State Route 560	Regional Equations	HEC-2	March 4, 1987	A, AE	
Waioli Stream	Approximately 39 feet upstream of State Route 560	Approximately 1.2 miles upstream from the State Route 560	Multiple Linear Correlations	HEC-2	June 1978	A, AE	
Waipa Stream	Approximately 528 feet upstream of State Route 560	Approximately 0.5 miles upstream from State Route 560	Multiple Linear Correlations	HEC-2	June 1978	AE	

Table 14: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Anahola Watershed		
Anahola Stream	0.025 – 0.035	0.040 – 0.070
Hanalei Watershed		
Waipa Stream	0.030 – 0.040	0.030 – 0.080
Waioli Stream	0.030	0.040 – 0.090
Hanalei Stream	0.030 – 0.150	0.030 – 0.150
Kapaa Watershed		
Kapaa Stream	0.028 – 0.038	0.032 – 0.070
Moikeha Canal	0.017 – 0.030	0.025 – 0.034
Waikaea Canal	0.023 – 0.036	0.025 – 0.050
Koloa Watershed		
Waikomo	0.030 – 0.040	0.040 – 0.100
Omao Stream	0.040 – 0.050	0.070 – 0.080
Lawai Stream	0.040 – 0.050	0.040 – 0.080
Hanapepe Watershed		
Hanapepe River	0.030-0.040	0.015-0.090
Lihue Watershed		
Nawiliwili Stream	0.030 – 0.040	0.035 – 0.300
Puali Stream	0.030	0.035 – 0.080
Huleia Stream	0.025 – 0.045	0.025 – 0.070
Papakolea Stream	0.040	0.040 – 0.060
Hanamaulu Stream	0.020	0.030 – 0.080
Hanamaulu Stream Tributary	0.020	0.040
Moloa'a Watershed		
Moloa'a Stream	0.020-0.050	0.035-0.100
Wailua Watershed		
Wailua River	0.030 – 0.045	0.050 – 0.100
Opaekaa Stream	0.020 – 0.050	0.040 – 0.100
Opaekaa Tributary	0.020 – 0.050	0.040 – 0.080
Kalama Stream	0.035 – 0.040	0.038 – 0.080
Waimea Watershed		
Waimea River	0.030 – 0.040	0.050 – 0.100
Wainiha Watershed		
Wainiha River	0.025 – 0.045	0.030 – 0.080
West Kauai Watershed		
Kekaha Drainageway	0.050 – 0.080	0.060 – 0.100

5.3 Coastal Analyses

For the areas of Kauai County that are impacted by coastal flooding processes, coastal flood hazard analyses were performed to provide estimates of coastal BFEs. Coastal BFEs reflect the increase in water levels during a flood event due to extreme tides and storm surge as well as overland wave effects.

The following subsections provide summaries of how each coastal process was considered for this FIS Report. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation. Table 15 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.

Table 15: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Pacific Ocean	Open coast north of Moloa'a Bay	Open coast south of Moloa'a Bay	Tsunami	Hybrid Finite Element model	10/30/2018
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Overland Wave Propagation	WHAFIS 4.0	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Erosion	CHAMP	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Statistical Analyses	EST	*
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Storm Surge	ADCIRC	*
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Generation	ACES	*
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Generation	SPM hurricane prediction techniques	12/31/2007

Table 15: Summary of Coastal Analyses *(continued)*

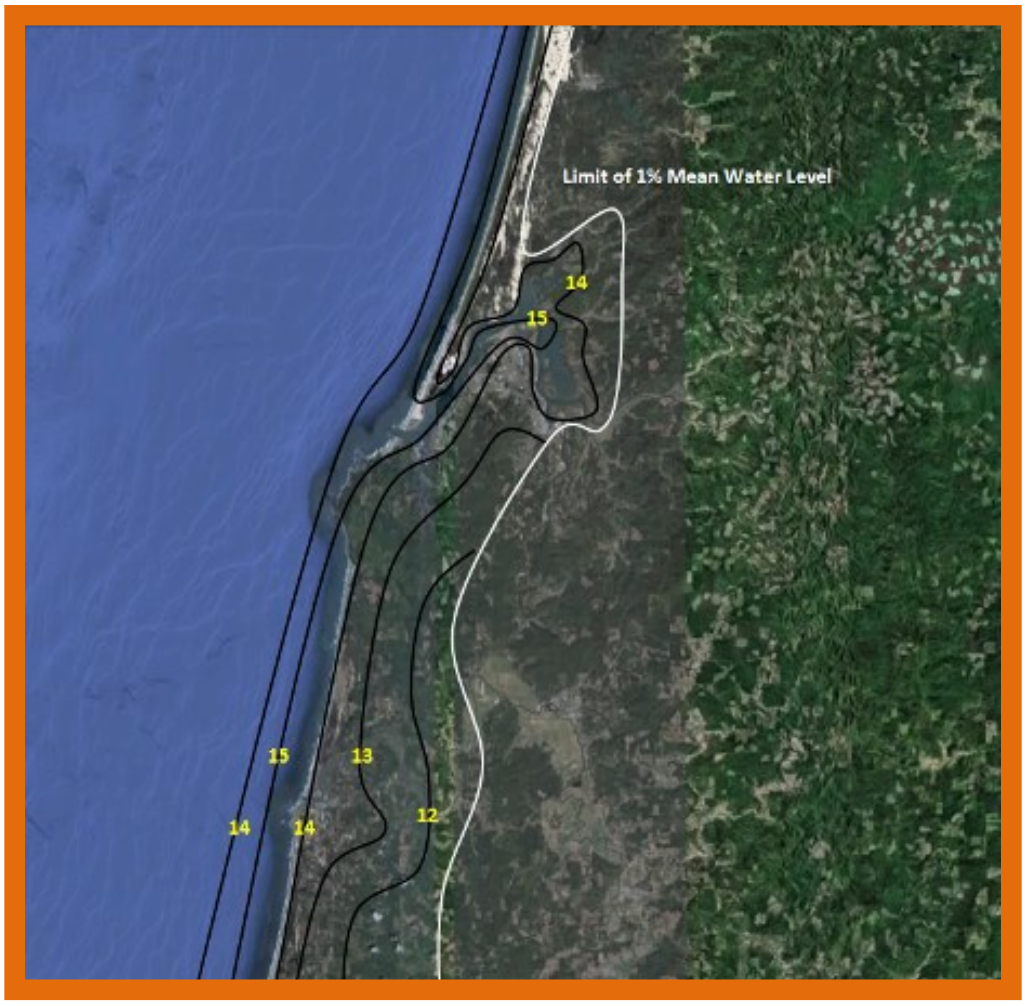
Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Runup	TAW	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Runup	SPM	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Runup	RUNUP 2.0	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Setup	Direct Integration Method (DIM)	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Wave Setup	Gourlay	02/28/2008
Pacific Ocean	Entire coastline of Kauai County	Entire coastline of Kauai County	Tsunami	Hybrid finite element model	*

*Unconfirmed

5.3.1 Total Stillwater Elevations

The total stillwater elevations (stillwater including storm surge plus wave setup) for the 1-percent-annual-chance flood were determined for areas subject to coastal flooding. The models and methods that were used to determine storm surge and wave setup are listed in Table 15. The stillwater elevation that was used for each transect in coastal analyses is shown in Table 17, “Coastal Transect Parameters.” Figure 8 shows the total stillwater elevations for the 1-percent-annual-chance flood that was determined for this coastal analysis.

Figure 8: 1-Percent-Annual-Chance Total Stillwater Elevations for Coastal Areas



Astronomical Tide
Astronomical tidal statistics were generated directly from local tidal constituents by sampling the predicted tide at random times throughout the tidal epoch.

Storm Surge Statistics
Storm surge is modeled based on characteristics of actual storms responsible for significant coastal flooding. The characteristics of these storms are typically determined by statistical study of the regional historical record of storms or by statistical study of tidal gages.

When historic records are used to calculate storm surge, characteristics such as the strength, size, track, etc., of storms are identified by site. Storm data was used in conjunction with numerical hydrodynamic models to determine the corresponding storm surge levels. An Empirical Simulation Technique was performed on the storm surge modeling results to determine the stillwater elevations for the 1-percent-annual-chance event.

Table 16: Tide Gage Analysis Specifics

[Not applicable to this Flood Risk Project]

Wave Setup Analysis
Wave setup was computed during the storm surge modeling through the methods and models listed in Table 15 and included in the frequency analysis for the determination of the total stillwater elevations.

5.3.2 Waves

This section is not applicable to this Flood Risk Project

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated to determine the modification to existing topography that is expected to be associated with flooding events. Erosion was evaluated using the methods listed in Table 15.

5.3.4 Wave Hazard Analyses

Overland wave hazards were evaluated to determine the combined effects of ground elevation, vegetation, and physical features on overland wave propagation and wave runup. These analyses were performed at representative transects along all shorelines for which waves were expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1-percent-annual-chance flood.

Transect locations were chosen with consideration given to the physical land characteristics as well as development type and density so that they would closely represent conditions in their locality. Additional consideration was given to changes in the total stillwater elevation. Transects were spaced close together in areas of complex topography and dense development or where total stillwater elevations varied. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects shown in Figure 9, “Transect Location Map,” are also depicted on the FIRM. Table 17 provides the location, stillwater elevations, and starting wave conditions for each transect evaluated for overland wave hazards. In this table, “starting” indicates the parameter value at the beginning of the transect.

Wave Height Analysis
Wave height analyses were performed to determine wave heights and corresponding wave crest elevations for the areas inundated by coastal flooding and subject to overland wave propagation hazards. Refer to Figure 6 for a schematic of a coastal transect evaluated for overland wave propagation hazards.

Wave heights and wave crest elevations were modeled using the methods and models listed in Table 15, “Summary of Coastal Analyses”.

Wave Runup Analysis

Wave runup analyses were performed to determine the height and extent of runup beyond the limit of stillwater inundation for the 1-percent-annual-chance flood. Wave runup elevations were modeled using the methods and models listed in Table 15.

Tsunami Analysis

Tsunami wave elevations for the coastal areas of Kauai were calculated using a report prepared by the USACE Waterways Experiment Station (Houston, et al., 1977) in conjunction with Japanese Tsunamis in Hawaii – A Preliminary Report, By D.C. Cox (D.C. Cox, 1980). A hybrid finite-element numerical model was developed to supplement historical data in determining the 10 largest tsunami elevations from 1837 to 1979. The finite-element model provides an accurate, representative response of the island to tsunami activity as a result of rapid bathymetric and/or wave height variations. The numerical model was adjusted and verified by comparing the calculated results of the model with tide gauge recordings of the 1960 and 1964 tsunamis. Use of the model yields starting tsunami elevations for various flood frequencies at a point 200 feet inland from the shoreline.

The procedure used for determining the tsunami runup profile was extracted from a study entitled “Tsunami Inundation Prediction” (Bretschneider and Wybro, 1976) in which a formula was developed for predicting tsunami runup profiles, and the calculated results were compared with the recorded inundation data of the 1946 and 1960 tsunami on the islands of Maui and Hawaii. Good to excellent correlations were obtained between the observed and calculated inundation profiles.

Tsunami elevations, as the wave travels inland, and the maximum inundation limits were determined utilizing a study entitled Tsunami Inundation Prediction (Bretschneider and Wybro, 1976). Runup elevations and inundation limits are dependent on starting tsunami elevations, inland ground elevations, roughness factors (Manning’s “n” values), and the expected type of wave behavior (non-bore or bore formation).

Overland roughness factors used in the hydraulic computations were chosen by engineering judgment and based on field observations of the coastal areas. Most of the coastal areas of Kauai have experienced only the non-bore type of tsunami wave action. The only recorded bore formation in Kauai occurred in 1946 in the Haena area.

Revised coastal tsunami analyses for Moloa’a Bay were completed as a part of this 2018 FIS revision. Detailed study of the Moloa’a Bay area re-mapped the 1-percent annual chance tsunami runup elevations and special flood hazard areas using topographic and bathymetric LiDAR data from the USACE (USACE, 2013). The same methodology for determination of the tsunami bore propagation and inland inundation limits previously used were also applied for this revision.

Table 17: Coastal Transect Parameters†

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	1	*	*	0.7 0.7	* *	0.9 0.9	4.2[1] 1.2	2.3 2.3	VE AE	6 6[2]
Pacific Ocean	2	*	*	0.7	*	0.8	7.0[1]	2.0	VE AE	9-11 7-9
Pacific Ocean	3	*	*	0.7 0.7	*	0.8 0.8	5.6[1] 1.1	2.0 2.0	VE AE AE	8-9 8 7[2]
Pacific Ocean	4	*	*	0.7	*	0.8	1.1	2.0	VE AE	13[2] 13[2]
Pacific Ocean	5	*	*	0.7 0.7	*	0.9 0.9	5.5[1] 1.1	2.2 2.2	VE AE AE	8 7-8 6[2]
Pacific Ocean	6	*	*	0.7	*	0.9	5.6[1]	2.1	VE AE	8-9 6-8

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	7	*	*	0.7 0.7	*	0.9 0.9	7.4[1] 1.2	2.3 2.3	VE AE AE	10-11 10 9[2]
Pacific Ocean	8	*	*	0.7	*	0.8	7.4[1]	2.2	VE AE	9-11 7-9
Pacific Ocean	9	*	*	0.7 0.7	*	0.8 0.8	7.4[1] 1.1	2.2 2.2	VE AE	9-11 9[2]
Pacific Ocean	10	*	*	0.7	*	0.9	7.6[1]	2.4	VE AE	10-12 8-10
Pacific Ocean	11	*	*	0.7	*	0.9	7.5[1]	2.2	VE AE	10-12 8-10
Pacific Ocean	12	*	*	0.7 0.7	*	0.8 0.8	8.0[1] 1.1	2.0 2.0	VE VE AE	12 11[2] 11[2]
Pacific Ocean	13	*	*	0.7	*	0.9	5.7[1]	2.4	VE AE	8-9 6-8

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	14	*	*	0.7	*	0.9	1.1	2.0	VE AE	14[2] 14[2]
Pacific Ocean	15	*	*	0.7 0.7	*	0.8 0.8	5.4[1] 1.1	2.2 2.2	VE AE AE	8 7-8 6[2]
Pacific Ocean	16	*	*	0.7	*	0.9	5.4[1]	2.5	VE AE	7-8 5-7
Pacific Ocean	17	*	*	0.7	*	1.0	1.5	3.1	VE AE	7[2] 7[2]
Pacific Ocean	18	*	*	0.7	*	0.8	1.1	2.2	VE AE	16[2] 16[2]
Pacific Ocean	19	*	*	0.7 0.7	*	0.9 0.9	6.0[1] 1.1	2.3 2.3	VE AE AE	8-9 8 7[2]
Pacific Ocean	20	*	*	0.7	*	0.8	5.6[1]	2.2	VE AE	8-9 6-8

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	21	*	*	0.7	*	0.9	5.6[1]	2.2	VE AE	8-9 6-8
Pacific Ocean	22	*	*	0.7 0.7	*	0.9 0.9	5.5[1] 1.1	2.1 2.1	VE AE	8 8[2]
Pacific Ocean	23	*	*	0.7	*	0.8	1.0	1.8	VE AE	23[2] 23[2]
Pacific Ocean	24	*	*	0.7 0.7	*	0.8 0.8	5.1[1] 1.1	2.1 2.1	VE AE AE	7-8 7 6[2]
Pacific Ocean	25	*	*	0.7 0.7	*	0.8 0.8	4.9[1] 1.1	2.2 2.2	VE AE	8 7[2]
Pacific Ocean	26	*	*	0.7 0.7	*	0.8 0.8	6.2[1] 1.1	2.2 2.2	VE VE AE	10 9[2] 9[2]
Pacific Ocean	27	*	*	0.7	*	0.9	5.3[1]	2.4	VE AE	7-8 5-7

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	28	*	*	0.7	*	0.8	1.1	2.3	VE AE	13[2] 13[2]
Pacific Ocean	29	*	*	0.7 0.7	*	0.8 0.8	5.6[1] 5.2[1]	2.0 2.0	VE AE AE	8-9 6-8 5
Pacific Ocean	30	*	*	0.7	*	0.8	1.1	2.2	VE AE	47[2] 47[2]
Pacific Ocean	31	*	*	0.7	*	0.8	5.3[1]	2.2	VE AE	7-8 5-7
Pacific Ocean	32	*	*	0.7 0.7	*	0.8 0.8	5.6[1] 1.1	2.3 2.3	VE AE AE	8-9 8 7[2]
Pacific Ocean	33	*	*	0.7	*	0.8	5.0[1]	2.4	VE AE	7-8 5-7
Pacific Ocean	34	*	*	0.7 0.7	*	0.8 0.8	5.9[1] 1.0	1.9 1.9	VE AE AE	8-9 7-8 6[2]

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	35	*	*	0.7	*	0.8	1.1	2.1	VE AE	9[2] 9[2]
Pacific Ocean	36	*	*	0.7	*	0.8	5.1[1]	2.1	VE AE	7-8 5-7
Pacific Ocean	37	*	*	0.7	*	0.8	5.1[1]	2.1	VE AE	7-8 5-7
Pacific Ocean	38	*	*	0.7 0.7	*	0.8 0.8	5.2[1] 1.1	2.3 2.3	VE AE AE	7-8 6-7 5[2]
Pacific Ocean	39	*	*	0.7	*	0.8	5.2[1]	2.3	VE AE	7-8 5-7
Pacific Ocean	40	*	*	0.7	*	0.8	5.1[1]	2.1	VE AE	7-8 5-7
Pacific Ocean	41	*	*	0.7	*	0.8	5.2[1]	2.2	VE AE	7-8 5-7

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	42	*	*	0.7 0.7	*	0.8 0.8	5.6[1] 1.0	2.0 2.0	VE AE AE	8-9 8 7[2]
Pacific Ocean	43	*	*	0.7	*	0.8	5.4[1]	2.1	VE AE	7-8 5-7
Pacific Ocean	44	*	*	0.7	*	0.8	5.6[1]	2.0	VE AE	8-9 6-8
Pacific Ocean	45	*	*	0.7	*	0.8	5.6[1]	1.7	VE AE	8-9 6-8
Pacific Ocean	46	*	*	*	*	*	*	*	VE	25^
Pacific Ocean	47	*	*	*	*	*	*	*	VE	25^
Pacific Ocean	48	*	*	*	*	*	*	*	VE	25^

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	49	*	*	*	*	*	*	*	VE	25^
Pacific Ocean	50	*	*	*	*	*	*	*	VE	25^
Pacific Ocean	51	*	*	*	*	*	*	*	VE	8-25^
Pacific Ocean	52	*	*	*	*	*	*	*	VE	11-25^
Pacific Ocean	53	*	*	*	*	*	*	*	VE	23-26^
Pacific Ocean	54	*	*	*	*	*	*	*	VE	25^

Table 17: Coastal Transect Parameters† *(continued)*

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft LOCAL TIDE DATUM) Range of Stillwater Elevations (ft LOCAL TIDE DATUM)					Zone Designation	1% Annual Chance Base Flood Elevation (ft LOCAL TIDE DATUM)
		Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance		
Pacific Ocean	55	*	*	*	*	*	*	*	VE	25^

*Not calculated for this Flood Risk Project
†All elevations reflect the hurricane surge hazard only, unless otherwise noted.
^Base Flood Elevation reflects tsunami hazard
[1]Includes wave setup
[2]Wave runup elevation

Figure 9: Transect Location Map

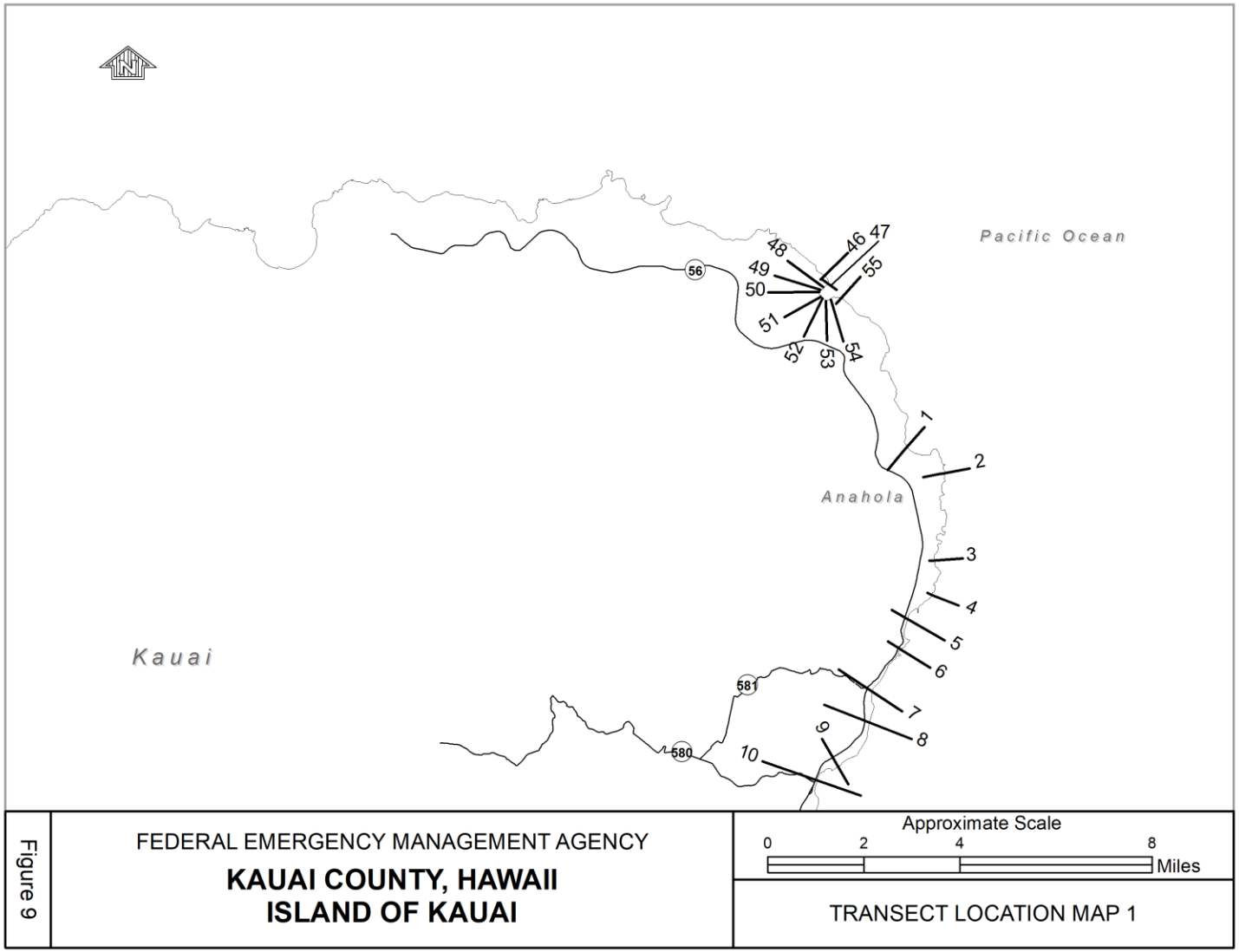


Figure 9: Transect Location Map *(continued)*

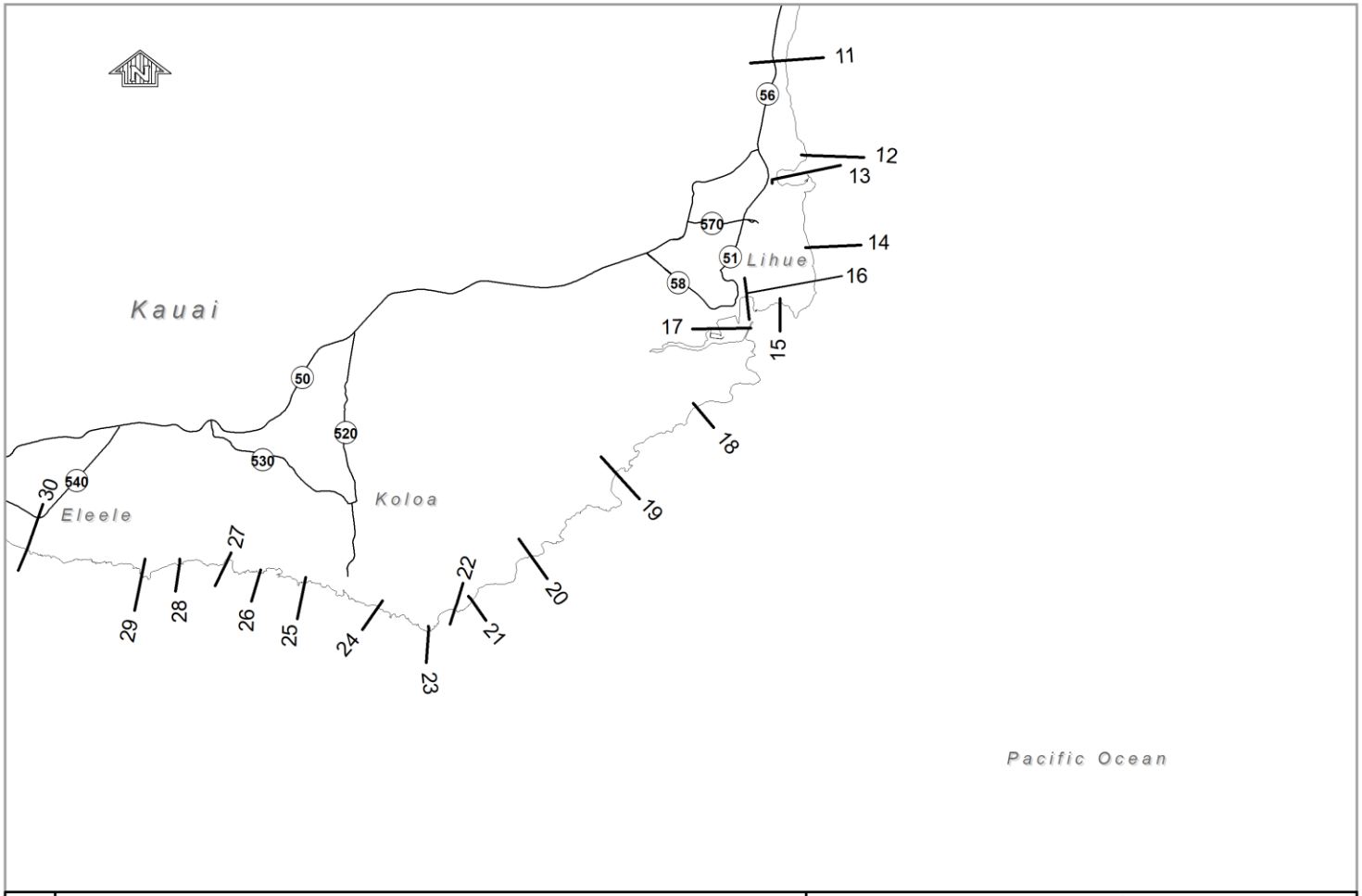


Figure 9	FEDERAL EMERGENCY MANAGEMENT AGENCY **KAUAI COUNTY, HAWAII** **ISLAND OF KAUAI**	Approximate Scale 0 2 4 8 Miles TRANSECT LOCATION MAP 2

Figure 9: Transect Location Map *(continued)*

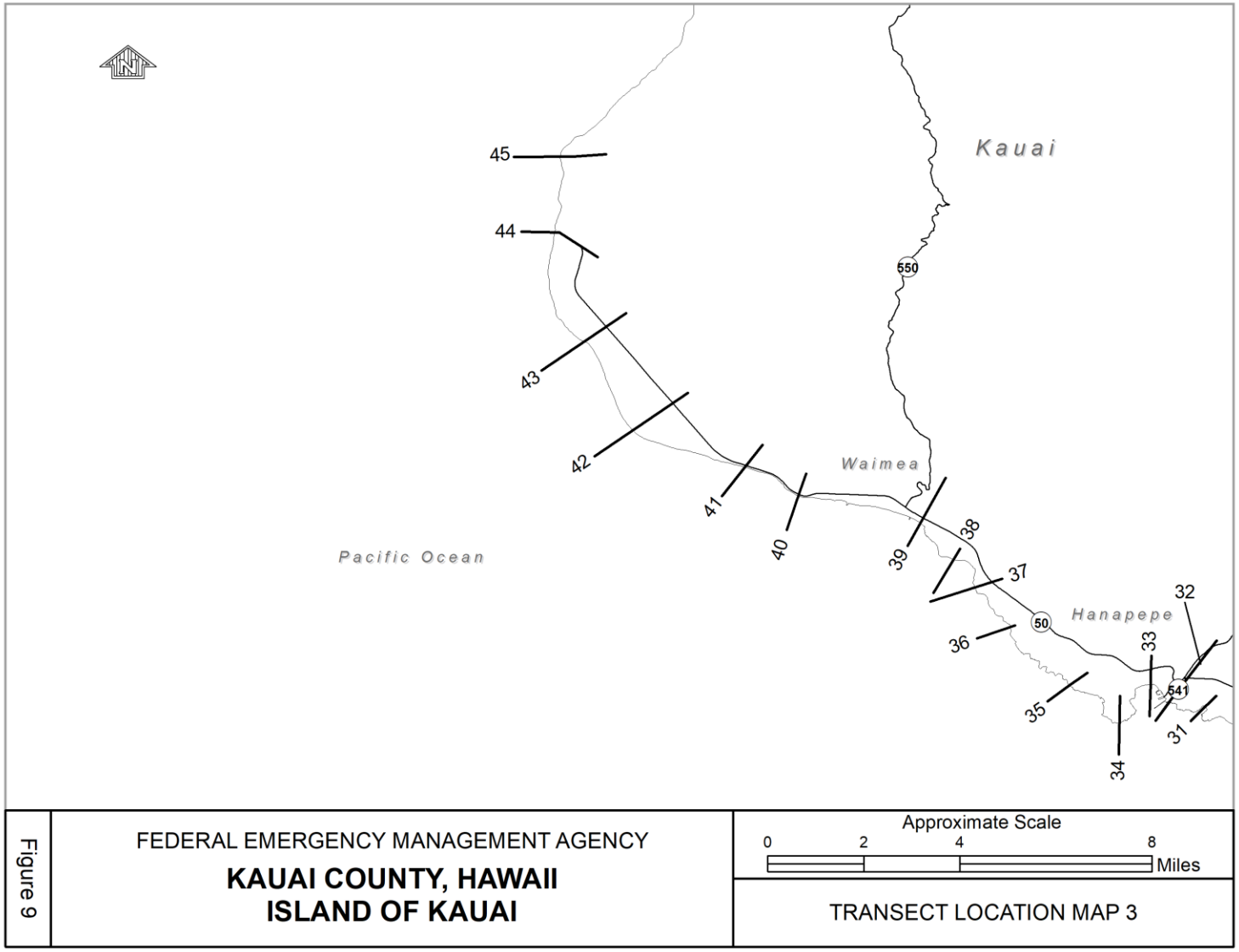


Figure 9	FEDERAL EMERGENCY MANAGEMENT AGENCY **KAUAI COUNTY, HAWAII** **ISLAND OF KAUAI**	Approximate Scale 0 2 4 8 Miles TRANSECT LOCATION MAP 3

5.4 Alluvial Fan Analyses

This section is not applicable to this Flood Risk Project

Table 18: Summary of Alluvial Fan Analyses

[Not applicable to this Flood Risk Project]

Table 19: Results of Alluvial Fan Analyses

[Not applicable to this Flood Risk Project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

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 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS Reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS Report and on the FIRMs are referenced to Local Tidal Datum. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between Local Tidal Datum and NAVD88 or other datum conversion, visit the National Geodetic Survey website at www.ngs.noaa.gov.

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 archived project documentation associated with the FIS Report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks in the area, please visit the NGS website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for Kauai County are provided in Table 20.

Table 20: Countywide Vertical Datum Conversion

[Not applicable to this Flood Risk Project]

Table 21: Stream-Based Vertical Datum Conversion

[Not applicable to this Flood Risk Project]

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA's FIRM Database specifications and geographic information standards. This information is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community. The FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA's *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping.

Base map information shown on the FIRM was derived from the sources described in Table 22.

Table 22: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
2017 Tiger Lines Roads Kauai, HI	United States Census Bureau	2018	1:6,000	Transportation base data
HUC-8 Watershed: Kauai, HI	United States Geological Survey	2018	1:6,000	HUC-8 watershed data
Kauai County, HI Orthography	United States Department of Agriculture	2016	1:6,000	Orthography for panels and basemap index

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23. For each coastal flooding source studied as part of this FIS Report, the mapped floodplain boundaries on the FIRM have been delineated using the flood and wave elevations determined at each transect; between transects, boundaries were delineated using land use and land cover data, the topographic elevation data described in Table 23, and knowledge of coastal flood processes. In ponding areas, flood elevations

were determined at each junction of the model; between junctions, boundaries were interpolated using the topographic elevation data described in Table 23.

In cases where the 1- 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.

The floodway widths presented in this FIS Report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 24, “Floodway Data.”

Certain flooding sources may have been studied that do not have published BFEs on the FIRMs, or for which there is a need to report the 1-percent-annual-chance flood elevations at selected cross sections because a published Flood Profile does not exist in this FIS Report. These streams may have also been studied using methods to determine non-encroachment zones rather than floodways. For these flooding sources, the 1-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23. All topographic data used for modeling or mapping has been converted as necessary to Local Tide Datum. The 1-percent-annual-chance elevations for selected cross sections along these flooding sources, along with their non-encroachment widths, if calculated, are shown in Table 25, “Flood Hazard and Non-Encroachment Data for Selected Streams.”

Table 23: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data			
		Description	Vertical Accuracy	Horizontal Accuracy	Citation
Kauai County	Hanapepe River, Waimea River	2006 FEMA LiDAR: Hawaiian Islands	The vertical accuracy of the LiDAR was 0.137 meters, RMSEz	The horizontal accuracy was 0.30 meters	NOAA 2006
	Moloa’a Bay, Moloa’a Stream	2013 USACE NCMP Topobathy LiDAR: Kauai-LMSL (IS)	19.6 centimeters at 95% confidence level (10 centimeters RMSE)	Compiled to meet 1 meter at 95% confidence level	USACE 2013

BFEs shown at cross sections on the FIRM represent the 1-percent-annual-chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations.

Table 24: Floodway Data

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Anahola Stream								
A	1,060[1]	555	3,879	7.5	8.6	8.6	8.7	0.1
B	1,630[1]	768	4,793	6.1	9.7	9.7	9.8	0.1
C	1,900[1]	980	7,531	3.4	10.9	10.9	11.0	0.1
D	2,165[1]	1,050	9,703	3.0	11.3	11.3	11.4	0.1
E	2,680[1]	1,160	9,402	3.4	11.4	11.4	11.6	0.2
F	3,300[1]	789	4,059	7.1	11.5	11.5	12.0	0.5
Hanalei River								
A	5,160[2]	3,434	30,081	1.9	12.0	12.0	12.9	0.9
B	8,000[2]	4,432	33,674	1.7	13.1	13.1	13.9	0.8
C	9,700[2]	2,330	16,246	3.6	14.3	14.3	14.9	0.6
D	10,400[2]	2,180	20,943	2.8	15.9	15.9	16.1	0.2
E	12,000[2]	1,930	14,214	4.1	16.1	16.1	16.4	0.3
F	14,500[2]	1,656	16,146	3.6	19.7	19.7	20.4	0.7
G	17,600[2]	1,236	17,761	3.3	24.3	24.3	24.8	0.5
H	19,400[2]	1,335	12,254	4.7	26.6	26.6	27.2	0.6
I	20,600[2]	1,517	13,110	4.4	28.7	28.7	29.3	0.6
J	23,400[2]	811	5,685	10.2	36.1	36.1	36.6	0.5

[1]Stream distance in feet above confluence with Anahola Bay
[2]Stream distance in feet above confluence with Hanalei Bay

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA ANAHOLA STREAM – HAHALEI RIVER

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hanamaulu Stream								
A	1,110[1]	226	1,828	14.9	11.1[2]	10.4	10.7	0.3
B	1,930[1]	574	6,560	4.2	17.5	17.5	18.3	0.8
C	3,140[1]	888	10,362	2.6	18.0	18.0	18.7	0.7
D	4,380[1]	540	5,430	5.0	18.2	18.2	18.9	0.7
E	5,750[1]	331	2,795	9.8	21.8	21.8	22.3	0.5
F	7,275[1]	293	4,736	5.8	34.3	34.3	34.9	0.6
G	8,795[1]	107	1,659	16.5	49.6	49.6	49.6	0.0
H	10,435[1]	202	2,185	12.5	74.3	74.3	74.3	0.0
I	11,945[1]	250	2,615	10.4	88.5	88.5	89.2	0.7
J	12,317[1]	130	2,731	5.9	110.6	110.6	110.6	0.0
K	13,277[1]	58	796	20.2	116.1	116.1	116.4	0.3
Hanamaulu Stream Tributary								
A	125[3]	162	2,814	4.0	104.4	104.4	104.4	0.0
B	825[3]	136	2,607	4.3	105.5	105.5	106.0	0.5

[1]Stream distance in feet above confluence with Hanamaulu Bay

[2]Elevation influenced by Hanamaulu Bay

[3]Stream distance in feet above confluence with Hanamaulu Stream

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet LOCAL TIDAL DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hanapepe River								
A	492	1,450	10,136	3.8	9.2	9.2	9.5	0.3
B	1,248	1,010	6,066	6.3	9.4	9.4	9.8	0.4
C	1,712	830	6,502	5.8	10.7[2]/ 10.0[4]	10.7	10.9	0.2
D	2,276	377	3,713	10.2	11.2[2]/ 10.2[4]	11.2	12.2	1.0
E	2,405	328	4,416	9.4	15.0[2]/ 14.9[3]/ 10.8[4]	15.0	15.8	0.8
F	2,876	232	3,641	10.4	15.4[2]/ 16.1[3]/ 10.8[4]	15.4	16.0	0.6
G	3,248	227	3,720	10.2	15.8[2]/ 16.6[3]/ 11.2[4]	15.8	16.3	0.5

[1]Stream distance in feet above confluence with the Pacific Ocean
[2]Elevation riverward of levee
[3]Elevation landward of right bank levee
[4]Elevation landward of left bank levee

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HI

FLOODWAY DATA

HANAPEPE RIVER

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet LOCAL TIDAL DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hanapepe River								
H	3,644	266	4,351	8.7	16.8[2]/ 17.1[3]/ 11.5[4]	16.8	17.2	0.4
I	4,368	206	3,822	9.9	17.4[2]/ 17.3[3]	17.4	17.6	0.2
J	4,792	332	5,189	7.3	18.3[2]/ 17.7[3]	18.3	18.6	0.3
K	5,208	682	10,639	3.6	19.2[2]/ 17.7[3]	19.2	19.5	0.3
L	6,059	1,120	15,076	2.5	19.4	19.4	19.7	0.3
M	6,349	1,250	16,314	2.3	19.5	19.5	19.8	0.3
N	7,881	769	8,554	4.4	20.3	20.3	20.6	0.3
O	8,245	712	6,994	5.4	20.6	20.6	20.9	0.3
P	9,059	605	4,432	8.6	21.5	21.5	21.7	0.2
Q	9,491	832	4,575	8.3	22.7	22.7	22.7	0.0
R	9,799	983	6,925	5.6	25.1	25.1	25.1	0.0
S	10,155	943	4,869	7.8	25.9	25.9	26.0	0.1
T	10,624	897	4,507	8.4	29.2	29.2	29.2	0.0
U	11,010	724	4,311	8.8	33.4	33.4	33.5	0.1
V	11,485	525	3,583	10.6	36.4	36.4	36.5	0.1

[1]Stream distance in feet above confluence with the Pacific Ocean
[2]Elevation riverward of levee
[3]Elevation landward of right bank levee
[4]Elevation landward of left bank levee

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HAWAII

FLOODWAY DATA

HANAPEPE RIVER

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Huleia Stream								
A	260[2]	650	6,225	6.5	6.7	6.7	6.7	0.0
B	660[2]	530	5,058	7.9	6.7	6.7	6.7	0.0
C	1,460[2]	400	4,221	9.5	7.5	7.5	7.5	0.0
D	2,260[2]	380	4,699	8.5	8.3	8.3	8.6	0.3
E	3,060[2]	460	6,075	6.6	9.5	9.5	9.8	0.3
F	3,860[2]	1,090	12,595	3.2	10.3	10.3	10.7	0.4
G	4,660[2]	1,080	12,472	3.2	10.4	10.4	10.8	0.4
H	5,060[2]	465	5,953	6.7	10.4	10.4	10.8	0.4
I	5,860[2]	317	4,414	8.1	12.8	12.8	12.8	0.0
J	6,460[2]	235	3,696	9.7	12.8	12.8	12.8	0.0
K	7,060[2]	411	4,511	8.0	13.7	13.7	13.7	0.0
L	7,860[2]	466	5,320	6.8	14.4	14.4	14.4	0.0
M	8,260[2]	454	5,053	7.1	14.6	14.6	14.6	0.0
N	9,460[2]	535	7,301	4.9	14.9	14.9	15.5	0.6
O	10,260[2]	583	7,853	4.6	15.0	15.0	15.8	0.8
P	11,060[2]	540	6,422	5.6	15.1	15.1	15.9	0.8
Q	11,860[2]	357	3,867	9.3	15.1	15.1	16.1	1.0
R	12,660[2]	281	2,437	13.0	19.0	19.0	19.0	0.0
S	13,060[2]	282	3,205	9.9	22.9	22.9	23.8	0.9

[1]Stream distance in feet above confluence with Nawiliwili Bay

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA HULEIA STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kalama Stream								
A	315	86	978	8.4	284.4	284.4	285.4	1.0
B	920	159	1,764	4.7	286.1	286.1	286.8	0.7
C	1,660	170	830	9.0	286.2	286.2	287.1	0.9
D	2,730	255	2,120	3.5	296.5	296.5	297.3	0.8
E	3,890	296	1,383	4.4	298.1	298.1	298.8	0.7
F	4,870	55	472	12.9	298.1	298.1	298.8	0.7
G	6,350	80	711	8.6	303.0	303.0	303.6	0.6
H	6,870	140	718	8.5	304.8	304.8	305.3	0.5
I	8,520	114	698	8.7	312.0	312.0	312.1	0.1
J	9,210	264	1,469	4.2	313.4	313.4	314.0	0.6
K	9,780	211	1,070	5.7	313.9	313.9	314.5	0.6
L	10,450	198	1,076	5.2	320.4	320.4	320.6	0.2
M	11,800	200	814	6.9	326.2	326.2	326.8	0.6
N	12,350	163	911	6.6	327.8	327.8	328.8	1.0
O	13,050	63	426	14.1	331.5	331.5	331.6	0.1
P	13,600	72	579	10.4	336.8	336.8	337.0	0.2
Q	14,650	379	1,659	2.8	350.4	350.4	350.9	0.5
R	15,720	46	318	14.4	362.9	362.9	363.2	0.3
S	16,320	62	593	7.7	379.5	379.5	380.5	1.0
T	17,170	108	612	7.5	400.2	400.2	400.7	0.5

[1]Stream distance in feet above confluence with Opaekaa Stream

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA KALAMA STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kapaa Stream								
A	1,875	1,572	22,943	1.6	21.3	21.3	21.5	0.2
B	2,775	1,947	28,998	1.2	21.3	21.3	21.6	0.3
C	3,600	1,855	25,649	1.4	21.4	21.4	21.6	0.2
D	4,700	1,061	14,702	2.4	21.4	21.4	21.6	0.2
E	6,000	679	8,909	3.9	21.5	21.5	21.8	0.3
F	6,430	359	5,832	5.9	21.6	21.6	21.8	0.2
G	7,400	484	6,485	5.3	22.0	22.0	22.4	0.4
H	7,935	497	5,380	6.4	22.2	22.2	22.6	0.4
I	8,600	337	5,475	6.3	23.2	23.2	23.8	0.6
J	9,350	430	7,393	4.6	24.3	24.3	24.8	0.5
K	10,000	765	7,700	4.4	24.6	24.6	25.2	0.6
L	10,300	768	6,592	5.1	24.7	24.7	25.2	0.5
M	11,100	197	3,001	11.3	24.8	24.8	25.2	0.4
N	12,700	216	2,531	13.4	27.6	27.6	28.3	0.7

[1]Stream distance in feet above confluence with Kauai Channel

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HI

FLOODWAY DATA

KAPAA STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lawai Stream								
A	100	77	500	13.3	383.5	383.5	383.5	0.0
B	500	80	487	13.7	387.2	387.2	387.6	0.4
C	900	95	571	11.7	393.8	393.8	393.8	0.0
D	1,200	94	525	12.7	397.6	397.6	398.5	0.9
E	1,600	72	504	13.2	410.6	410.6	410.6	0.0
F	1,900	104	614	10.8	414.2	414.2	415.1	0.9
G	3,100	58	460	13.9	444.2	444.2	444.3	0.1
H	3,500	106	544	11.8	452.2	452.2	452.4	0.2
I	3,800	102	564	11.4	459.0	459.0	459.2	0.2
J	4,200	146	500	12.3	467.1	467.1	467.3	0.2
K	4,500	86	570	10.8	475.1	475.1	475.1	0.0
L	4,900	100	422	14.6	482.6	482.6	482.6	0.0
M	5,200	79	484	12.8	489.1	489.1	489.4	0.3
N	6,100	71	786	7.8	512.7	512.7	512.8	0.1
O	6,600	118	841	7.3	517.7	517.7	518.7	1.0
P	6,900	83	503	12.3	525.9	525.9	526.3	0.4
Q	7,200	60	462	13.4	530.8	530.8	531.4	0.6
R	7,700	91	494	12.5	542.8	542.8	542.8	0.0
S	8,100	78	467	13.2	548.2	548.2	548.4	0.2

[1]Stream distance in feet above Limit of Detailed Study**

**Limit of Detailed Study is approximately 2,540 feet downstream of Lauoho Road

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HI

FLOODWAY DATA

LAWAI STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Moikeha Canal**								
A	1,255	*	509	3.0	5.1	5.1	5.8	0.7
B	1,800	*	314	4.8	5.1	5.1	5.8	0.7
C	1,914	*	340	4.4	5.8	5.8	6.4	0.6
D	2,915	*	593	2.4	6.1	6.1	6.9	0.8
E	3,500	*	432	2.9	6.2	6.2	7.0	0.8
F	4,120	*	462	2.3	6.5	6.5	7.2	0.7
G	4,300	*	235	3.9	6.5	6.5	7.2	0.7
H	5,310	151	162	4.6	14.7	14.7	14.8	0.1

[1]Stream distance in feet above confluence with Kauai Channel

*Floodway coincident with channel banks

**Limit of Detailed Study is approximately 2,540 feet downstream of Lauoho Road

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA MOIKEHA CANAL

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Moloa'a Stream								
A	2,120	*	*	*	11.2	11.2	*	*
B	2,750	*	*	*	13.3	13.3	*	*
C	5,080	*	*	*	29.6	29.6	*	*
D	6,180	*	*	*	36.9	36.9	*	*
E	6,660	*	*	*	44.0	44.0	*	*

[1]Stream distance in feet above confluence with the Pacific Ocean

*Floodway not computed

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Nawiliwili Stream								
A	625[1]	397	3,777	2.8	16.8	16.8	17.7	0.9
B	880[1]	256	2,893	3.6	16.9	16.9	17.8	0.9
C	1,720[1]	615	6,347	1.6	17.2	17.2	18.2	1.0
D	2,720[1]	354	2,617	4.0	17.3	17.3	18.2	0.9
E	3,170[1]	203	1,134	9.2	17.5	17.5	18.2	0.7
F	7,700[1]	101	1,096	9.2	94.1	94.1	94.7	0.6
G	8,340[1]	87	753	13.0	97.5	97.5	97.5	0.0
H	9,020[1]	111	1,180	8.3	102.9	102.9	103.7	0.8
I	10,200[1]	68	666	14.6	112.7	112.7	113.4	0.7
J	11,520[1]	118	1,221	8.0	121.5	121.5	122.2	0.7
K	12,600[1]	174	959	10.2	133.2	133.2	133.3	0.1
L	13,390[1]	158	1,774	5.5	136.9	136.9	137.9	1.0
M	14,470[1]	112	834	11.7	147.6	147.6	147.6	0.0
N	16,200[1]	162	1,713	5.5	158.6	158.6	159.4	0.8
O	17,600[1]	80	670	14.1	162.5	162.5	162.5	0.1
Omao Stream								
A	270[2]	237	1,301	3.4	213.9	213.9	214.7	0.8
B	1,300[2]	160	738	6.0	214.3	214.3	215.3	1.0
C	2,400[2]	311	1,105	4.0	221.7	221.7	222.7	1.0
D	3,600[2]	170	859	5.1	224.4	224.4	225.3	0.9
E	4,400[2]	341	1,589	2.8	226.6	226.6	227.4	0.8
F	5,030[2]	85	682	6.5	227.2	227.2	228.0	0.8

[1]Stream distance in feet above confluence with Nawiliwili Bay
[2]Stream distance in feet above confluence with Waikomo Stream

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA NAWILIWILI STREAM – OMAO STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Opaekaa Stream								
A	-2,970	90	1,232	12.6	275.7	275.7	276.7	1.0
B	-2,090	104	1,568	9.9	281.4	281.4	281.7	0.3
C	-1,030	102	1,384	11.2	283.5	283.5	284.2	0.7
D	-370	169	2,148	4.4	287.3	287.3	288.3	1.0
E	190	82	1,199	7.8	289.5	289.5	289.5	0.0
F	970	157	1,173	8.0	289.5	289.5	289.9	0.4
G	1,810	130	1,509	6.2	294.0	294.0	294.3	0.3
H	2,550	133	1,396	6.7	296.0	296.0	296.1	0.1
I	3,370	148	1,687	5.6	297.9	297.9	298.3	0.4
J	3,680	145	1,670	2.6	298.0	298.0	299.0	1.0
K	4,080	251	2,425	1.6	298.2	298.2	299.2	1.0
L	4,480	110	1,262	3.0	298.2	298.2	299.2	1.0
M	4,880	173	1,799	2.1	298.7	298.7	299.7	1.0
N	5,280	75	698	5.4	298.9	298.9	299.9	1.0
O	5,980	210	1,559	2.3	300.8	300.8	301.5	0.7
P	6,480	70	506	7.1	302.3	302.3	302.6	0.3
Q	7,080	117	807	4.4	305.0	305.0	305.7	0.7
R	7,480	80	533	6.7	307.6	307.6	307.6	0.0
S	7,780	120	1,042	3.2	308.8	308.8	309.8	1.0
T	8,280	90	627	5.4	309.0	309.0	310.0	1.0
U	8,680	65	536	6.3	310.4	310.4	310.9	0.5

[1]Stream distance in feet from Kamalu Road

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY	FLOODWAY DATA
	KAUAI COUNTY, HI	OPAEKAA STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (**FEET**)	SECTION AREA (**SQ. FEET**)	MEAN VELOCITY (**FEET/SEC**)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Opaekaa Tributary								
A	**400[1]**	**85**	**265**	**3.4**	**289.1**	**289.1**	**289.2**	**0.1**
B	**740[1]**	**195**	**1,661**	**0.5**	**300.2**	**300.2**	**301.2**	**1.0**
C	**1,000[1]**	**53**	**325**	**2.8**	**300.2**	**300.2**	**301.2**	**1.0**
D	**1,300[1]**	**70**	**120**	**7.5**	**303.5**	**303.5**	**303.5**	**0.0**
E	**1,640[1]**	**76**	**629**	**1.3**	**311.5**	**311.5**	**312.4**	**0.9**
F	**1,940[1]**	**30**	**109**	**7.7**	**311.6**	**311.6**	**312.5**	**0.9**
Papakolea Stream								
A	**800[2]**	**648**	**1,814**	**3.9**	**14.62**	**8.1**	**8.8**	**0.7**
B	**1,400[2]**	**331**	**1,554**	**4.5**	**14.62**	**10.9**	**11.9**	**1.0**
C	**1,700[2]**	**191**	**672**	**10.5**	**14.62**	**11.9**	**12.6**	**0.7**
D	**2,000[2]**	**101**	**619**	**11.4**	**15.1**	**15.1**	**15.9**	**0.8**
E	**2,300[2]**	**74**	**491**	**14.4**	**17.7**	**17.7**	**18.0**	**0.3**

[1]Stream distance in feet above confluence with Opaekaa Stream
[2]Stream distance in feet above confluence with Huleia Stream

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HI

FLOODWAY DATA

OPAEKAA TRIBUTARY – PAPAKOLEA STREAM

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Puali Stream								
A	615[1]	332	1,666	4.0	8.3	8.3	9.2	0.9
B	730[1]	566	2,742	2.4	9.2	9.2	10.2	1.0
C	1,040[1]	314	1,805	3.7	9.4	9.4	10.3	0.9
D	1,930[1]	162	845	7.8	11.8	11.8	12.0	0.2
Waikaea Canal								
A	950[2]	154	881	6.1	7.7	7.7	7.8	0.1
B	1,235[2]	87	658	8.2	7.7	7.7	7.8	0.1
C	1,380[2]	236	1,167	4.6	8.9	8.9	9.0	0.1
D	1,800[2]	514	3,288	1.6	9.2	9.2	9.4	0.2
E	2,300[2]	853	4,194	1.3	9.2	9.2	9.5	0.3
F	2,765[2]	730	4,342	1.2	9.3	9.3	9.5	0.2
G	4,080[2]	988	4,881	1.0	9.3	9.3	9.6	0.3
H	5,225[2]	190	837	5.7	9.3	9.3	9.6	0.3

[1]Stream distance in feet above confluence with Nawiliwili Bay
[2]Stream distance in feet above confluence with Pacific Ocean

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA PUALI STREAM – WAIKAEA CANAL

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Waikomo Stream								
A	1,160[1]	167	1,268	7.1	38.8	38.8	39.7	0.9
B	3,200[1]	110	789	10.7	73.6	73.6	74.6	1.0
C	5,570[1]	116	621	12.8	114.5	114.5	114.6	0.1
D	6,980[1]	239	703	11.3	146.4	146.4	147.4	1.0
E	7,330[1]	100	528	15.0	151.6	151.6	151.7	0.1
F	8,400[1]	162	582	12.8	174.5	174.5	175.1	0.6
G	10,760[1]	308	1,778	4.2	204.4	204.4	205.4	1.0
H	12,600[1]	351	2,043	3.4	213.6	213.6	214.1	0.5
I	13,890[1]	399	2,682	0.9	216.7	216.7	217.4	0.7
J	15,875[1]	121	527	4.7	217.2	217.2	218.0	0.8
K	16,835[1]	168	839	2.2	220.7	220.7	220.8	0.1
L	17,675[1]	443	2,388	0.8	222.5	222.5	223.5	1.0
Waikomo Stream Tributary								
A	165[2]	164	968	0.7	220.6	220.6	220.6	0.0
B	1,135[2]	40	323	2.1	220.6	220.6	220.6	0.0

[1]Stream distance in feet above confluence with Pacific Ocean
[2]Stream distance in feet above confluence with Waikomo Stream

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HI

FLOODWAY DATA

WAIKOMO STREAM – WAIKOMO STREAM TRIBUTARY

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Wailua River								
A	1,000	1,125	14,711	5.2	15.0	15.0	15.0	0.0
B	1,650	1,700	19,417	3.9	15.2	15.2	15.3	0.1
C	2,800	1,276	14,315	5.1	15.2	15.2	15.5	0.3
D	4,600	994	14,588	4.8	16.4	16.4	16.8	0.4
E	5,565	881	14,500	4.8	17.1	17.1	17.6	0.5
F	6,460	845	13,017	5.2	17.5	17.5	18.0	0.5
G	7,990	463	8,770	7.4	18.5	18.5	19.0	0.5
H	8,700	684	8,992	7.1	19.2	19.2	19.7	0.5
I	9,300	735	11,595	5.4	20.5	20.5	21.0	0.5
J	10,160	314	7,167	8.5	21.0	21.0	21.5	0.5
K	10,800	383	7,257	6.5	22.0	22.0	22.5	0.5
L	11,400	315	7,608	6.2	23.1	23.1	23.6	0.5
M	12,400	356	6,854	6.4	23.6	23.6	24.1	0.5

[1]Stream distance in feet above confluence with Wailua Bay

TABLE 24	FEDERAL EMERGENCY MANAGEMENT AGENCY KAUAI COUNTY, HI	FLOODWAY DATA WAILUA RIVER

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet LOCAL TIDAL DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Waimea River								
A	525	332	4,584	14.0	11.1	11.1	11.1	0.0
B	874	350	5,280	12.1	12.7[2]/ 13.6[3]	12.7	12.8	0.1
C	978	346	5,158	12.4	13.9[2]/ 13.9[3]	13.9	14.8	0.9
D	1,267	399	6,053	10.6	15.0[2]/ 14.1[3]	15.0	15.1	0.1
E	2,028	725	9,860	6.5	16.1[2]/ 14.8[3]	16.1	16.2	0.1
F	2,639	877	10,957	5.8	16.8[2]/ 15.1[3]	16.8	16.9	0.1
G	3,423	870	10,728	6.0	17.5[2]/ 15.5[3]	17.5	17.6	0.1
H	3,995	986	13,514	4.7	19.1[2]/ 16.2[3]	19.1	19.1	0.0
I	4,607	918	11,963	5.4	19.5[2]/ 16.7[3]	19.5	19.5	0.0
J	4,966	745	9,328	6.9	19.7[2]/ 17.0[3]	19.7	19.7	0.0

[1]Stream distance in feet above confluence with the Pacific Ocean
[2]Elevation riverward of levee
[3]Elevation landward of right bank levee

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HAWAII

FLOODWAY DATA

WAIMEA RIVER

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet LOCAL TIDAL DATUM)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Waimea River								
K	5,262	530	5,821	11.0	20.1[2]/ 17.4[3]	20.1	20.1	0.0
L	5,596	287	5,318	12.0	22.0[2]/ 18.9[3]	22.0	22.1	0.1
M	6,279	366	5,344	12.0	22.4[2]/ 19.3[3]	22.4	22.6	0.2
N	6,551	490	8,152	7.9	24.8[2]/ 21.7[3]	24.8	25.0	0.2
O	6,729	595	9,998	6.4	25.7[2]/ 22.3[3]	25.7	25.9	0.2
P	7,046	799	11,122	5.8	26.5[2]/ 22.5[3]	26.5	26.6	0.1
Q	7,474	676	9,811	5.4	26.8[2]/ 22.5[3]	26.8	26.9	0.1

[1]Stream distance in feet above confluence with the Pacific Ocean
[2]Elevation riverward of levee
[3]Elevation landward of right bank levee

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HAWAII

FLOODWAY DATA

WAIMEA RIVER

Table 24: Floodway Data *(continued)*

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET LOCAL TIDE DATUM)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Wainiha River								
A	2,400[1]	841	8,975	6.2	17.5	17.5	18.5	1.0
B	2,800[1]	780	7,924	7.0	18.6	18.6	19.5	0.9
C	3,300[1]	744	4,982	11.2	20.4	20.4	21.4	1.0
D	3,800[1]	649	4,253	13.1	26.4	26.4	26.9	0.5
E	4,200[1]	640	4,666	11.9	30.2	30.2	31.0	0.8
F	4,700[1]	810	5,909	9.1	33.8	33.8	34.7	0.9
G	5,300[1]	773	4,771	11.2	37.5	37.5	38.5	1.0
Waioli Stream								
A	2,600[2]	775	5,551	2.9	12.7	12.7	13.6	0.9
B	4,400[2]	876	7,039	2.3	13.1	13.1	14.1	1.0
C	5,800[2]	908	3,923	4.1	13.5	13.5	14.5	1.0

[1]Stream distance in feet above confluence with Wainiha Bay
[2]Stream distance in feet above confluence with Hanalei Bay

TABLE 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

KAUAI COUNTY, HI

FLOODWAY DATA

WAINIHA RIVER – WAIOLI STREAM

Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams

[Not applicable to this Flood Risk Project]

6.4 Coastal Flood Hazard Mapping

Flood insurance zones and BFEs including the wave effects were identified on each transect based on the results from the onshore wave hazard analyses. Between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and knowledge of coastal flood processes to determine the aerial extent of flooding. Sources for topographic data are shown in Table 23.

Zone VE is subdivided into elevation zones and BFEs are provided on the FIRM.

The limit of Zone VE shown on the FIRM is defined as the farthest inland extent of any of these criteria (determined for the 1-percent-annual-chance flood condition):

- The *primary frontal dune zone* is defined in 44 CFR Section 59.1 of the NFIP regulations. The primary frontal dune represents a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes that occur immediately landward and adjacent to the beach. The primary frontal dune zone is subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune zone occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

- The *wave runup zone* occurs where the (eroded) ground profile is 3.0 feet or more below the 2-percent wave runup elevation.

- The *wave overtopping splash zone* is the area landward of the crest of an overtopped barrier, in cases where the potential 2-percent wave runup exceeds the barrier crest elevation by 3.0 feet or more.

- The *breaking wave height zone* occurs where 3-foot or greater wave heights could occur (this is the area where the wave crest profile is 2.1 feet or more above the total stillwater elevation).

- The *high-velocity flow zone* is landward of the overtopping splash zone (or area on a sloping beach or other shore type), where the product of depth of flow times the flow velocity squared (hv^2) is greater than or equal to 200 ft^3/sec^2. This zone may only be used on the Pacific Coast.

The SFHA boundary indicates the limit of SFHAs shown on the FIRM as either “V” zones or “A” zones.

Table 26 indicates the coastal analyses used for floodplain mapping and the criteria used to determine the inland limit of the open-coast Zone VE and the SFHA boundary at each transect.

Table 26: Summary of Coastal Transect Mapping Considerations

[Not applicable to this Flood Risk Project]

Tsunami and Hurricane Inundation Boundaries
Inundation limits from the 1-percent-annual-chance tsunami were computed for most of the shoreline of the Island of Kauai. The methodology employed in this computation is described in Section 5.3.4. The 1-percent-annual-chance tsunami inundation boundaries were delineated using methods outlined in Tsunami Inundation Prediction (Bretschneider and Wybro 1976), and the best topographic information available at the time of the analysis.

Previous and revised mapping of the tsunami hazard was merged with the detailed hurricane coastal hazard study. This was accomplished by comparing the zone type, base flood elevation, and inland flooding extent of coincident tsunami and hurricane storm surge hazards. The higher of the two elevations was retained and presented on the Flood Insurance Rate Map. If in a tsunami hazard-dominated area, the inland limit of the hurricane storm surge flooding extends further landward than the tsunami hazard, the tsunami base flood elevation is shown, and the flooding extent is extended to where the hurricane hazard is mapped. This is to reflect the increased hazard generated by the use of updated topographic data. In some cases, the dominant hazard transitioned from hurricane storm surge to tsunami (or vice-versa) moving inland, for which only a single transition was allowed. The VE Zone was extended and mapped to the inland limit of the Primary Frontal Dune for both tsunami and hurricane hazards. In cases where elevations were similar, engineering judgment was applied to facilitate the most appropriate representation of the higher hazard.

The inundation limits for the 1-percent-annual-chance tsunami are based on existing conditions. Any modification or alteration to existing conditions may have a significant effect on the tsunami inundation limits. For example, any regrading or reduction of surface roughness in onshore areas, such as that caused by the removal of native vegetation could increase the extent of inundation. Similarly, dredge and fill operations offshore could increase the extent of inundation because of the effects of coastal bathymetry on tsunami wave setup. However, existing or planned coastal features such as natural reefs, seawalls, groins, jetties, or beach stabilization projects may have a mitigating effect on tsunami inundation.

Revisions to coastal tsunami floodplain boundaries were completed as a part of this 2018 FIS revision for Moloa'a Bay. Detailed study of the Moloa'a Bay area re-mapped the 1-percent annual chance tsunami runup elevations and special flood hazard areas using topographic and bathymetric LiDAR data from the USACE (USACE, 2013).

All AE and VE Zones are identified on the FIRM, except where the zones are too narrow to show because of map scale limitations. In cases where the AE and VE Zones are too small to be shown separately, only Zone VE was shown.

The Coastal High Hazard Zone consists of all areas that are identified by Zone VE. Special performance standards for construction in Coastal High Hazard Zones have been set by FEMA. The Coastal High Hazard Zones and areas of known bore formations are delineated on the FIRM.

6.5 FIRM Revisions

This FIS Report and the FIRM are based on the most up-to-date information available to FEMA at the time of its publication; however, flood hazard conditions change over time. Communities or private parties may request flood map revisions at any time. Certain types of requests require submission of supporting data. FEMA may also initiate a revision. Revisions may take several forms, including Letters of Map Amendment (LOMAs), Letters of Map Revision Based on Fill (LOMR-Fs), Letters of Map Revision (LOMRs) (referred to collectively as Letters of Map Change (LOMCs)), Physical Map Revisions (PMRs), and FEMA-contracted restudies. These types of revisions are further described below. Some of these types of revisions do not result in the republishing of the FIS Report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data (shown in Table 31, "Map Repositories").

6.5.1 Letters of Map Amendment

A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative process that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in a SFHA. A LOMA cannot be issued for properties located on the PFD (primary frontal dune).

To obtain an application for a LOMA, visit www.fema.gov/floodplain-management/letter-map-amendment-loma and download the form "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill". Visit the "Flood Map-Related Fees" section to determine the cost, if any, of applying for a LOMA.

FEMA offers a tutorial on how to apply for a LOMA. The LOMA Tutorial Series can be accessed at www.fema.gov/online-tutorials.

For more information about how to apply for a LOMA, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627).

6.5.2 Letters of Map Revision Based on Fill

A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the base flood elevation and is, therefore, excluded from the SFHA.

Information about obtaining an application for a LOMR-F can be obtained in the same manner as that for a LOMA, by visiting www.fema.gov/floodplain-management/letter-map-amendment-loma for the "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill" or by calling

the FEMA Map Information eXchange, toll free, at 1-877-FEMA MAP (1-877-336-2627). Fees for applying for a LOMR-F, if any, are listed in the "Flood Map-Related Fees" section.

A tutorial for LOMR-F is available at www.fema.gov/online-tutorials.

6.5.3 Letters of Map Revision

A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations and planimetric features. All requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

To obtain an application for a LOMR, visit www.fema.gov/media-library/assets/documents/1343 and download the form "MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision". Visit the "Flood Map-Related Fees" section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

Previously issued mappable LOMCs (including LOMRs) that have been incorporated into the Kauai County FIRM are listed in Table 27.

Table 27: Incorporated Letters of Map Change

Case Number	Effective Date	Flooding Source	FIRM Panel(s)
199210608MBJ	08-07-1986	Pacific Ocean	*
1995105419FIA	04-06-1987	Pacific Ocean	*
199210607MBJ	06-09-1988	Pacific Ocean	*
03-09-0017P	10-21-2002	Pacific Ocean	1500020035E
07-09-0537P	01-26-2007	Pacific Ocean	1500020055E 1500020313F

*Unable to determine

6.5.4 Physical Map Revisions

A Physical Map Revisions (PMR) is an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if

warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit www.fema.gov and visit the "Flood Map Revision Processes" section.

6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of Kauai County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 28, "Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.

- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first FHBM. This date may be the same date as the Initial NFIP Map Date.

- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.

- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community.

- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as PMRs of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Kauai County FIRMs was November 4, 1981.

Table 28: Community Map History

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Kauai County	12/20/1974	12/20/1974	12/20/1977	11/04/1981	02/26/2021 11/26/2010 09/16/2005 10/18/2002 09/30/1995 03/04/1987

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 29 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 29: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Anahola Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Hanalei River	9/16/2005	USACE	EMW-96-1A0288	October 2002	Kauai County
Hanamaulu Stream	9/30/1995	Sam O. Hirota, Inc. (SHI)	EMW-89-C-2842	September 1995	Kauai County

Table 29: Summary of Contracted Studies Included in this FIS Report *(continued)*

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Hanamaulu Stream Tributary	9/30/1995	Sam O. Hirota, Inc. (SHI)	EMW-89-C-2842	September 1995	Kauai County
Hanapepe River	12/17/2020	STARR II (Strategic Alliance for Risk Reduction)	HSFE60-15-D-0005	September 2017	Kauai County
Huleia Stream	9/30/1995	USACE	EMW-84-E-1506	June 1985	Kauai County
Kalama Stream	9/30/1995	Sam O. Hirota, Inc. (SHI)	EMW-89-C-2842	September 1995	Kauai County
Kapaa Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Kekaha Drainageway	9/30/1995	USACE	EMW-84-E-1506	June 1985	Kauai County
Lawai Stream, Lawai Stream Side Channel	9/30/1995	USACE	EMW-84-E-1506	June 1985	Kauai County
Moikeha Canal	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Moloa'a Bay/Pacific Ocean	12/17/2020	STARR II (Strategic Alliance for Risk Reduction)	HSFE60-15-D-0005	October 2018	Kauai County
Moloa'a Stream	12/17/2020	USACE	DACA83-93-D-0016	June 1994	Kauai County
Nawiliwili Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Omao Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Opaekaa Stream, Opaekaa Tributary	9/30/1995	USACE	EMW-84-E-1506	June 1985	Kauai County
Pacific Ocean	11/26/2010	RMTC/URS	EMW-2003-CQ-0046	March 2008	Kauai County
Papakolea Stream	9/30/1995	USACE	EMW-84-E-1506	June 1985	Kauai County

Table 29: Summary of Contracted Studies Included in this FIS Report *(continued)*

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Puali Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Waikaea Canal	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Waikomo Stream, Waikomo Stream Tributary	9/30/1995	Sam O. Hirota, Inc. (SHI)	EMW-89-C-2842	September 1995	Kauai County
Wailua River	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Waimea River	12/17/2020	STARR II (Strategic Alliance for Risk Reduction)	HSFE60-15-D-0005	September 2017	Kauai County
Wainiha River	9/30/1995	USACE	EMW-84-E-1506	June 1985	Kauai County
Waioli Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County
Waipa Stream	9/30/1995	USACE	IAA-H-7-76, IAA-H-10-77	June 1978	Kauai County

7.2 Community Meetings

The dates of the community meetings held for this Flood Risk Project and previous Flood Risk Projects are shown in Table 30. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 30: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Kauai County	11/04/1981	03/1976	Initial CCO Meeting	COE, FEMA and Kauai County
		02/23/1977	Intermediate CCO Meeting (Tsunami Conference)	University of Hawaii, Joint Tsunami Research Effort of NOAA, COE, Oahu Civil Defense Agency and FEMA
		02/28/1978 03/01/1978	Intermediate CCO Meetings	FEMA, Kauai County and Local Community
		05/14/1980 05/15/1980	Final CCO Meetings	COE, FEMA, Kauai County and Local Community
	03/04/1987	08/1983	Initial CCO Meeting	COE, FEMA and Kauai County
	09/30/1995	10/10/1985	Intermediate and Final CCO Meetings	COE, FEMA and Kauai County
	10/18/2002	11/08/2001	Final CCO Meeting	*
	09/16/2005	12/2004	Final CCO Meeting	*
	11/26/2010	08/25/2009	Final CCO Meeting	*
	12/17/2020	07/11/2020	Final CCO Meeting	FEMA, Kauai County, and STARR II

*Data Not Available

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see www.fema.gov.

The additional data that was used for this project includes the FIS Report and FIRM that were previously prepared for Kauai County, (FEMA 2010). In addition, the USACE prepared a Tsunami Prediction Study for Kauai County in 1967 in response to the destruction caused by the March 1964 tsunami (USACE 1967).

Table 31 is a list of the locations where FIRMs for Kauai County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 31: Map Repositories

Community	Address	City	State	Zip Code
Kauai County	Department of Public Works 4444 Rice Street	Lihue	HI	96766

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM Databases and LOMCs. Together they create a GIS data layer for a state or territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 32.

Table 32 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the State NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of state or territorial government to coordinate that state's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of state and local GIS data in their state.

Table 32: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/engineering-library
NFIP website	www.fema.gov/national-flood-insurance-program
NFHL Dataset	msc.fema.gov
FEMA Region IX	Federal Regional Center 1111 Broadway, Suite 1200 Oakland, CA 94607 (510) 627-7181
Other Federal Agencies	
USGS website	www.usgs.gov
Hydraulic Engineering Center website	www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Carol Tyau-Beam, CFM Hawaii Dept. of Land & Natural Resources Post Office Box 373 Honolulu, Hawaii 96809 (808) 587-0267 carol.l.tyau@hawaii.gov
State GIS Coordinator	Arthur Buto GIS Program Director Post Office Box 2359 Honolulu, Hawaii 96813 Phone: (808) 587-2894 arthur.j.buto@dbedt.hawaii.gov

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 33 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 33: Bibliography and References

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
Bretschneider and Wybro 1976	American Society of Civil Engineers	*Tsunami Inundation Prediction*	Bretschneider and Wybro	Honolulu, Hawaii	July 1976	https://ascelibrary.org/doi/10.1061/9780872620834.060
D.C. Cox 1980	Environmental Center, University of Hawaii	*Japanese Tsunamis in Hawaii*	Cox, D.C	Honolulu, Hawaii	January 1980	
Elsevier 1996	Elsevier	*Coastal Engineering: Wave Set-Up on Coral Reefs. 2, Set-Up on Reefs with Various Profiles*	Gourlay, M. R.	Brisbane, Australia	September 1996	https://www.sciencedirect.com/journal/coastal-engineering/vol/28/issue/1
FEMA 2010	Federal Emergency Management Agency	*FEMA Flood Insurance Study, Kauai County, Hawaii*	Federal Emergency Management Agency	Washington D.C.	November 2010	www.msc.fema.gov
Houston, et al. 1977	U S. Department of the Army, Corps of Engineers	*Tsunami-Wave Elevation Frequency of Occurrence for the Hawaiian Islands*	J.R. Houston, R.D Carver, and D C. Markle	Vicksburg, Mississippi	August 1977	
Kauai DPW 1976	Kauai County Department of Public Works	*The Moikeha Canal Improvement Plans*	Kauai County Department of Public Works	Lihue, Kauai, Hawaii	October 1976	
McGraw-Hill 1959	McGraw-Hill	*Open-Channel Hydraulics*	Chow, Ven Te	New York	1959	
NOAA 2006	NOAA	*2006 FEMA LiDAR: Hawaiian Islands*	NOAA's Ocean Service, Office for Coastal Management	Charleston, South Carolina	October 2012	
STARR II 2017	STARR II	*Hanapepe and Waimea Rivers Detailed Analysis*	STARR II	San Diego, California	October 2017	

Table 33: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
STARR II 2018	STARR II	*Tsunami runup study of Moloa'a Bay*	STARR II	Tampa, Florida	October 2018	
STARR II 2018a	STARR II	*Project Narrative Floodplain Mapping, Moloa'a Bay*	STARR II	Calveron, Maryland	December 2018	
Tiger 2017	U.S. Census Bureau	*2017 Tiger Lines Roads, Kauai County, HI*	U.S. Census Bureau	Washington D.C.	February 2018	
Univeristy of Hawaii 1976	Hawaii Institute of Geophysics, University of Hawaii	*Tsunami Wave Runup Heights in Hawaii*	Loomis, N.G.	Honolulu, Hawaii	May 1976	
USACE 1962	U S. Department of the Army, Corps of Engineers, Sacramento District	*Statistical Methods in Hydrology*	Leo R. Beard	Sacramento, California	January 1962	
USACE 1967	U.S. Army Corps of Engineers	*Tsunami Prediction Study for Kauai County*	Army Corps of Engineers		1967	
USACE 1973	U S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center	*HEC-2 Water Surface Profiles. Generalized Computer Program*	U S. Army Corps of Engineers	Davis, California	October 1973	
USACE 1985	U S. Department of the Army, Corps of Engineers, Pacific Ocean Division	*Hurricane Vulnerability Study for Honolulu. Determination of Coastal Inundation Limits*	Charles L. Bretschneider, and Edward K. Noda and Associates	Honolulu, Hawaii	March 1985	

Table 33: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USACE 1992a	U S. Army Engineer Waterways Experiment Station	*Unified Program for the Specification of Hurricane Boundary Layer Winds over Surfaces of Specific Roughness, Contract Report CERC-92-1*	Cardone, V.J., Greenwood, C.V., and Greenwood, J.A.	Vicksburg, Mississippi	1992	www.dtic.mil/dtic/tr/fulltext/u2/a257462.pdf
USACE 1992b	U S. Army Engineer Waterways Experiment Station	*ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves. Coasts, and Estuaries. Report 1: Theory and Methodology of ADC1RC-2DD1 and ADC1RC-3DL*	Luettich, R A., Westerink, J. J., and Scheffner	Vicksburg, Mississippi	1992	
USACE 1994	U.S. Army Corps of Engineers	*Detailed study of Moloa'a Stream*	Army Corps of Engineers	Honolulu, Hawaii	June 1994	
USACE 1994a	U S. Department of the Army, Corps of Engineers	*Hurricane Iniki Coastal Inundation*	U.S. Army Corps of Engineers		April 1994	
USACE 2013	U.S. Army Corps of Engineers	*2013 USACE NCMP Topobathy LiDAR: Kauai-LMSL (IS)*	Army Corps of Engineers	Tampa, Florida	October 2018	
USACE-CHL 1999	U S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory	*Use and Application of the Empirical Simulation Technique: User's Guide. Technical Report CHL-99-21*	Scheffner	Vicksburg, Mississippi	1999	
USDA-NRCS 2016	U.S. Department of Agriculture	*Kauai County, HI Orthography*	USDA-NRCS	Fort Worth, Texas	October 2016	

Table 33: Bibliography and References *(continued)*

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USDOC 1962	U.S. Department of Commerce, Weather Bureau	*Rainfall-Frequency Atlas of the Hawaiian Islands*	U.S. Department of Commerce	Washington D.C.	1962	
USGS 2018	U.S. Geological Survey	*HUC-8 Watershed: Kauai, HI*	U.S. Geological Survey	Washington D.C.	February 2018	
USWRC 1976	U.S. Water Resources Council	*Guidelines for Determining Flood Flow Frequency*	U.S. Water Resources Council		March 1976	