CHAPTER 15.
FLOOD

15.1 FLOOD DEFINED

The following definitions apply in the discussion of flood hazards:

- **Flood**—A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water.
- **Floodplain**—A floodplain is the land area along the sides of a river that becomes inundated with water during a flood. The ***100-year floodplain*** is the area flooded by the flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; in fact, a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.
- **Return Period**—The average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

15.2 GENERAL BACKGROUND

A floodplain is any normally dry land area that is susceptible to being inundated by water from any natural source. This area is usually low land adjacent to a river, creek, or lake. The extent of floodplain inundation depends partly on the flood magnitude, defined by the return period.

Floodplains may be extremely broad, as in the case of the Platte River flowing across the Great Plains, where the boundary between river and floodplain is not even clear, or quite narrow, as in the case of entrenched rivers such as the Snake River in the Snake River Canyon or Colorado River in the Grand Canyon. In unmodified drainage systems where the terrain is fairly flat and rainfall intermittent, a floodplain may take the place of a river entirely. Instead of a defined streambed, there is simply a broad flat area where water flows from time to time. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream or river. These are accumulations of sand, gravel, loam, silt, and/or clay, and are often important aquifers, the water being drawn from them being pre-filtered compared to the water in the river or stream. Geologically ancient floodplains are often represented in the landscape by terrace deposits. These are old floodplain deposits that remain relatively high above current deposits, and can indicate former courses of rivers and streams.

Floodplains can support particularly rich ecosystems, both in quantity and diversity. These are termed riparian zones or systems. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly; however the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. Markedly different species grow in floodplains than grow outside of floodplains. For instance, riparian trees (that grow in floodplains) tend to be very tolerant of root disturbance and tend to be very quick-growing, compared to non-riparian trees.

15.2.1 Effects of Human Activities

Human activities and settlements tend to concentrate in floodplains, frequently interfering with natural processes, with resulting inconvenience or catastrophe. Human activities encroaching upon floodplains affect the distribution and timing of drainage, thereby increasing flood problems. The developed environment creates local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: 1) it reduces the stream's capacity to contain flows; and 2) it increases flow rates or velocities downstream during the initial stages of a flood event. Historically, many towns, homes and other buildings have been built on floodplains where they are highly susceptible to flooding, for several reasons:

- This is where water is most available.
- Floodplain land is usually the most fertile for farming.
- Rivers represent cheap sources of transportation, and are often where railroads are located.
- The flatter land is easier to develop than hill land.

As development occurs in the floodplain, managers are put in the position of having to manage the flooding in such a way that people and property are not significantly impacted. Historically this has been through structural approaches such as dams, levees, channelization projects, floodwalls and berms. The existence of these facilities can be directly attributed to human activity within the floodplain. These facilities are critical infrastructure in terms of controlling the level of flood risk. While these facilities are effective, their level of effectiveness is based on their ability to maintain a level of flood protection through their design operations and maintenance protocol. If these facilities are not maintained to their design standards, or their level of protection is compromised due to increases in the flood risk exposure, the effectiveness of these facilities is lessened.

15.2.2 Federal Programs Related to Flooding

In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer-funded disaster relief for flood victims and the increasing amount of damage caused by floods. The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in communities participating in the program. For most communities participating in NFIP, FEMA has prepared a detailed ***Flood Insurance Study*** (FIS). The FIS presents water surface elevations for floods of various magnitudes, including the flood that has a 1-percent probability of being equaled or exceeded in any given year (also called the ***100-year flood*** or ***base flood***) and the flood that has a 0.2-percent probability of being equaled or exceeded in any given year (also called the ***500-year flood***). The water surface elevation of the 100-year flood event is called the base flood elevation (BFE). BFEs and the boundaries of the 100- and 500-year floodplains are shown on participating communities' ***Flood Insurance Rate Maps*** (FIRMs).

A ***repetitive loss property*** as defined by FEMA is an NFIP-insured property that, since 1978 and regardless of any changes in ownership during that period, has experienced any of the following:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

Repetitive loss properties make up only 1 to 2 percent of the flood insurance policies currently in force nationally, yet they account for 40 percent of the country's flood insurance claim payments. A report on repetitive loss structures recently completed by the National Wildlife Federation found that 20 percent of these structures are listed as outside the 100-year floodplain. In 1998, FEMA reported that the NFIP's

75,000 repetitive loss structures have already cost $2.8 billion in flood insurance payments and that numerous other flood-prone structures are in the floodplain and remain at high risk. To address this ongoing issue, the government has instituted several programs that encourage communities to identify and mitigate the causes of their repetitive losses such as the Community Rating system (CRS), the Flood Mitigation Assistance Grant Program (FMA), and the Pre-Disaster Mitigation Grant program (PDM) created under the Disaster Mitigation Act.

It should be noted that participation, and maintaining compliance and “good standing” with the program requirements of the National Flood Insurance Program is a prerequisite for most funding afforded under the Robert T. Stafford Act. At the time of the preparation of this plan, all participating NFIP communities within the Humboldt Operational Area were in good standing under the NFIP. All NFIP participating planning partners are committed to maintaining this standing in order to fully implement the recommendations of this plan.

15.3 HAZARD PROFILE

Humboldt County lies within the North Coast hydrologic region of California, which runs along the Pacific Coast from the California-Oregon border to the mouth of the Russian River. This region is sparsely populated, with the majority of settlement in the Humboldt Bay area. The area receives larger rain totals than any other region of the state and experiences some of the State’s most spectacular and devastating flood events. Tsunamis are a threat along the coastline, as evidenced by one caused by the 1964 Alaskan earthquake that killed 12 and caused $10 million in property damage in the Crescent City area. The typical type of flooding that occurs in this area is represented by the 1964 late winter storms that caused $213 million in property damage.

The Trinity Klamath Rivers are in the Klamath Mountains Province; the other river systems in the County lie within the Coast Range Province. The Coast Range Province contains classic sedimentary and igneous rocks mostly from the Franciscan formation. Northwest-trending folds and faults control the drainage patterns in the Coast Range Province, leading to a fairly uniform orientation of rivers. The rocks in the area of these rivers are both metasedimentary and granitic. Drainage in the Klamath Mountains Province is dendritic, differing from the trellis drainage patterns typical for the Coast Range Province.

15.3.1 Principal Drainage Basins

The Eel River Basin

This 3,260-square-mile basin drains a predominantly mountainous area in the southern portion of the county. The Eel River flows through a narrow canyon from its junction with the Middle Fork downstream to its confluence with the Van Duzen River. Downstream of the confluence with the Van Duzen River, the Eel River meanders through a wide coastal plain between the City of Fortuna and the Pacific Ocean. The second largest tributary in this basin is the South Fork Eel River. The South Fork joins the Eel River at Dryerville and flows through steep-walled canyons for most of its length. The Van Duzen River drains an area of approximately 430 square miles to its confluence with the Eel River. The Van Duzen floodplain is narrow for most of its length, widening only in its downstream portions near Cummings Creek Camp. The average annual precipitation in this basin ranges from 59 to 70 inches, depending on the location in the basin. The duration of floods in this basin is relatively short. Stages can rise from normal flow to extreme peaks in 16 to 44 hours. Flooding generally has a duration of 50 to 55 hours.

The Mad River Basin

The Mad River drains an area of approximately 500 square miles at its confluence with the Pacific Ocean. The river flows through narrow canyons for the majority of its 100-mile length. The river enters a wide coastal floodplain just north of Arcata, which continues to its confluence with the Pacific Ocean. The average annual precipitation for this basin is 64 inches upstream of the gauge located at the mouth of the Mad River.

The Freshwater Creek Basin

Freshwater Creek drains a small coastal basin of 34 square miles before it enters Ryan Slough. Ryan Slough flows into Eureka Slough, a brackish-water stream, which in turn empties into Arcata Bay just north of Eureka. The characteristics of the floodplain in this basin are a moderately wide floodplain situated between a narrow stream course in the mountains widening as it enters the coastal plain. The average annual precipitation for this basin in 54 inches upstream of the gauge located at the confluence with Jacoby Creek.

The Jacoby Creek Basin

Jacoby Creek is a coastal stream just north of Freshwater Creek. Its headwaters are in the Coast range and it flows west from there into Arcata Bay. The creek drains an area of 16 square miles at its mouth. The majority of this stream meanders through the Arcata Bay coastal plain. The average annual precipitation for this basin is 54 inches upstream of the gauge located at the confluence with Freshwater Creek.

The Trinity River Basin

As the largest tributary to the Klamath River, the Trinity River drains a total area of 2,969 square miles, the majority of which is in Trinity County. The river flows through a mountainous, heavily forested area in the eastern portion of Trinity County. Detailed flood insurance studies have been generated in the mountain valley downstream of the confluence with the South Fork Trinity River in the northeastern portion of Humboldt County. The average annual precipitation for this basin is 55 inches upstream of the gauge located at the mouth of the Trinity River.

The Klamath River Basin

The largest river in the region is the Klamath River, which originates in Oregon and drains 12,120 square miles. A 50-mile stretch runs through the mountainous forested northern part of Humboldt County, with its mouth draining to the Pacific Ocean in neighboring Del Norte County to the north. Detailed flood insurance studies have not been undertaken for the Humboldt portion of the Klamath.

Humboldt Bay

The configuration of Humboldt Bay protects the coastal communities of Humboldt County from direct exposure to coastal storm flooding. The Samoa Peninsula and South Spit block the effects of normal storm waves and sea swells. A single channel, defined by jetties and seawalls, provides passage for water into and out of Humboldt Bay. The unincorporated community of King Salmon is located on an artificially constructed peninsula along the eastern margin of Humboldt Bay. Old channel dredgings were stockpiled on the site until 1948, when residential development in the area began. The elevation of the King Salmon vicinity is a few inches higher than the normal maximum high tide. Flooding can occur in this area during unusually high tides accompanied by storm surges.

Portions of Humboldt County are subject to flooding from storm tides. The estimated highest tidal surge height in Humboldt Bay occurred on February 4, 1958, and was measured at 6.5 feet. The nearest long-term tide gauge is located at Crescent City, north of Humboldt County. The highest tide measured at Crescent City since 1933 occurred on February 4, 1958, with a height of 10.1 feet above mean lower low water (approximately 6.4 feet elevation).

15.3.2 Past Events

Seventy percent of precipitation in Humboldt County occurs from November to March; major floods have resulted from successions of intense storms during these months. Table 15-1 summarizes the 11 federally declared disasters in Humboldt County related to flooding between 1955 and 2006. The two worst flood events in Humboldt County occurred in December 1955 and December 1964. These events caused tens of millions of dollars in damage and also caused numerous fatalities. The following sections summarize available state and federal information on the most significant Humboldt County flood events

TABLE 15-1.
HUMBOLDT COUNTY FEDERAL DISASTERS DUE TO FLOODING

Date	Declaration #	Type of event	Type of Assistance	Estimated Damage
February 3, 2006	1628	Flooding, severe winters storms, landslides	PA	$20.3 million[a]
February 9, 1998	1203	Severe winter storms, flooding	PA	$7.75 million
January 4, 1997	1155	Severe winter storms, flooding	IA, PA	$35 million
March 12, 1995	1046	Severe Winter Storms, flooding		$1.3 million[a]
January 9, 1995	1044	Winter storms, flooding, landslides, mud flows	IA, PA	$15 million
February 25, 1992	935	Flooding	N/A	N/A
February 21, 1986	758	Flooding	N/A	$5.0 million[a]
January 25, 1983	677	Coastal Storms, Floods, Slides, Tornados	N/A	$3.84 million[a]
February 8, 1973	364	Severe storms, High Tides, flooding	N/A	N/A
December, 1964	N/A	Severe winter storms, flooding	N/A	$100 million
December 1955	N/A	Severe winter storms, flooding	N/A	$22 million

a. Data obtained from Spatial Hazard Events and Losses Database for the United States (SHELDUS)
N/A = Information is not available

December 1955 Flood Event

The December 1955 flood occurred following weeks of above-normal precipitation in the county, with rainfall measurements reaching as high as 24 inches over three days in Cummings. Damage in the Eel River Basin exceeded $22 million, with one reported fatality and 43,000 acres flooded. Heavy debris carried by high velocity river flows caused the majority of the damage.

December 1964 Flood Event

Heavy rains accompanied by runoff from an unusually large snowpack led to flooding of the Mad and Eel Rivers in December 1964. Total damage reached $100 million, with entire communities (including Pepperwood, the site of the 1955 fatality) being destroyed and 19 fatalities reported. Millions of board feet of lumber, thousands of acres of prime farmland, and 4,000 head of livestock were also lost, causing a tremendous economic impact on the county.

January 1995 Flood Event

Flooding caused one death and over $15 million in damage. Flood damage was reported throughout much of the county, but the most severely impacted area was the Eel River Valley. The county received both a Governor’s Proclamation and a Presidential Disaster Declaration.

March 1995 Flood Event

Continued winter storms and flooding in the months following the January 1995 event caused an additional $2 million in damage throughout the county. The county received a second Presidential Declaration in March 1995.

January 1997 Flood Event

According to the Environmental Protection Agency (EPA), the January 1997 flood event was the fifth largest flood on record in Humboldt County. The U.S. Forest Service reported that on the Klamath National Forest, the storms of December and January produced precipitation that was two to three times the monthly average. The four-day storm at the end of December produced rain above 7,000 feet. The flood of 1997 involved the movement of soil, rock, and organic debris from hill slopes to stream channels at a scale not experienced since about 1974 on the Klamath National Forest. The majority of the reported damage associated with this event was from landslides and road failures. The estimated damage to road facilities exceeded $35 million within the Klamath National Forest.

15.3.3 Flooding Extent and Location

The major floods in Humboldt County have resulted form successions of intense winter rainstorms between November and March. Flooding in the county has been extensively documented by gage records, high water marks, damage surveys and personal accounts. This documentation was the basis for the Flood Insurance Rate Maps (FIRM) generated by FEMA for Humboldt County under the National Flood Insurance Program for. The FIRMs are the principle tool used to identify the extent and location of the flood hazard to assess risk for flooding. It is acknowledged by FEMA and the floodplain management community that FIRMs are not a total depiction of the flood risk within a given area; but they provide the most detailed and consistent data source available.

While the Flood Insurance Rate Maps (FIRMs) provide a creditable source to document extent and location of the flood hazard, there are limitations to the accuracy of the data reflected on these maps. These limitations need to be noted so that the flood hazard risk assessment can be viewed in relative terms. The first point is that FIRMs are based upon the existing hydrology conditions at the time of the maps preparation. FIRMs are not set up to account for the possible changes in hydrology that can occur over time. The age of the FIRMs utilized for this assessment range from 10 years to 25 years (see table 15-7). Therefore, these maps do not reflect the conditions of the watershed as they exist today, and may understate the hydrologic component of the floodplain.

Furthermore, FEMA maps do not depict the flood protection benefits of levees unless the levees are certified as providing 100-year flood protection (according to criteria specified in Section 65.10 of CFR44). If a levee is not certified as a 100-year levee, it is not incorporated in FIRM mapping. The national levee policy is in a state of flux in light of the impacts of Hurricane Katrina in 2005. There are levees in Humboldt County that are recognized as 100-year levees on the FIRM, and there are levees that are not. The age of the maps draws into question the level of protection of the levees in the County as they exist today. Whether the levees are certifiable in their current condition cannot be determined without costly, detailed risk-based analyses that currently do not exist. Therefore, the FIRMs represent the best data source available, but the level of risk they present may be understated or overstated compared to the current state of levees in the County.

For the purposes of this risk assessment, the planning team attempted to augment the data provided by the FIRMs with compatible data provided by the California Department of Water Resources, Awareness Mapping program. The Awareness Mapping program includes all of the floodplains that have been identified and mapped by FEMA on the FIRMs for Humboldt County. This data has been supplemented with approximate mapping of floodplain areas based on known conditions of flooding that are not reflected on the FIRMs. The primary purpose of the Awareness Mapping program is to identify mapping needs. It is not detailed information in that it reflects only the horizontal extent of a floodplain, without any flood depth or velocity information. The only assessment of risk that can be performed with this approximate information is to identify buildings and populations at risk. The severity and magnitude of that risk cannot be estimated without the key components of flood hazard identification, depth and velocity. Figures 15-1 and 15-2 show the extent and location of the flood hazard in Humboldt County.

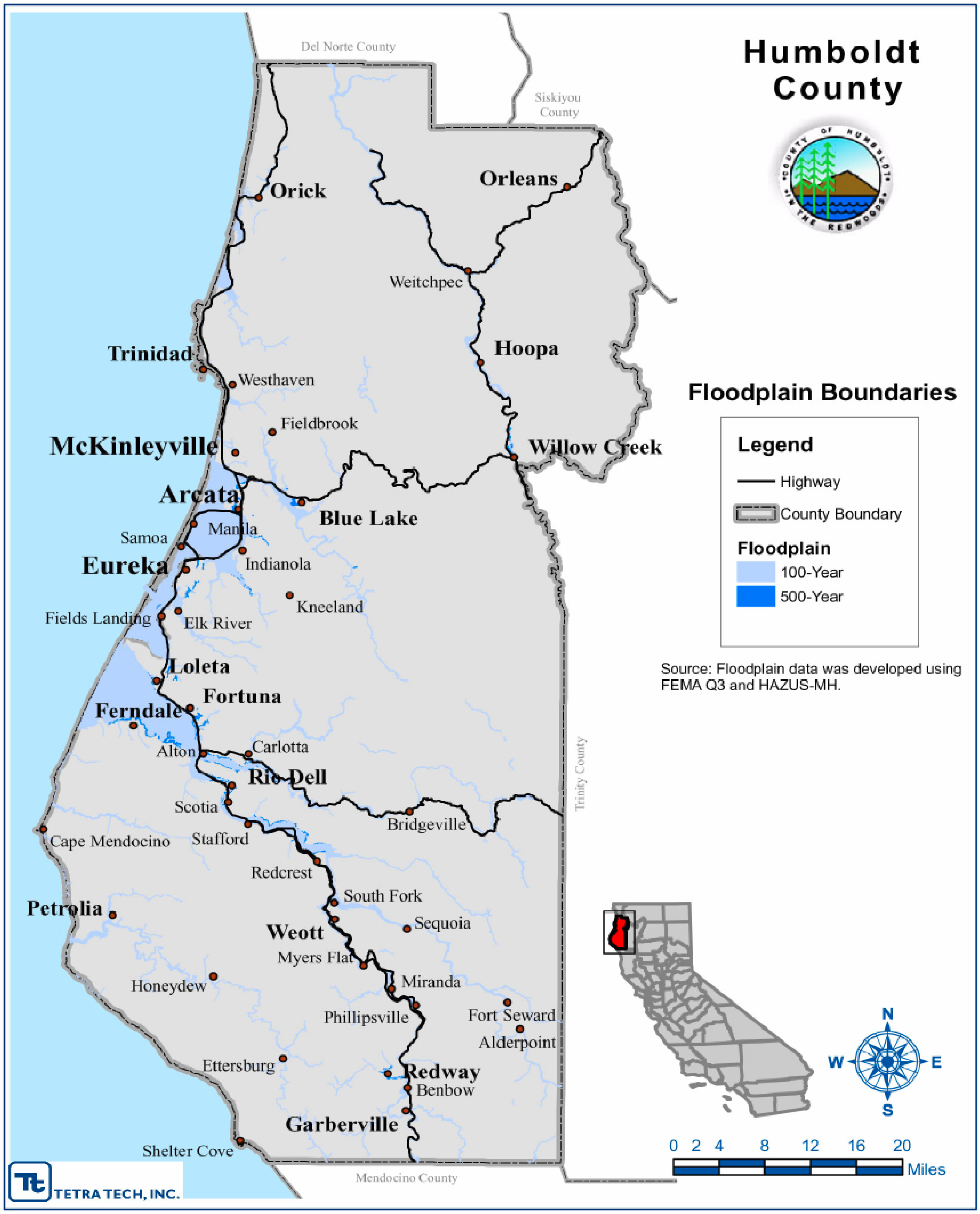

Figure 15-1: Extent and location of the Humboldt County Flood Hazard Area.

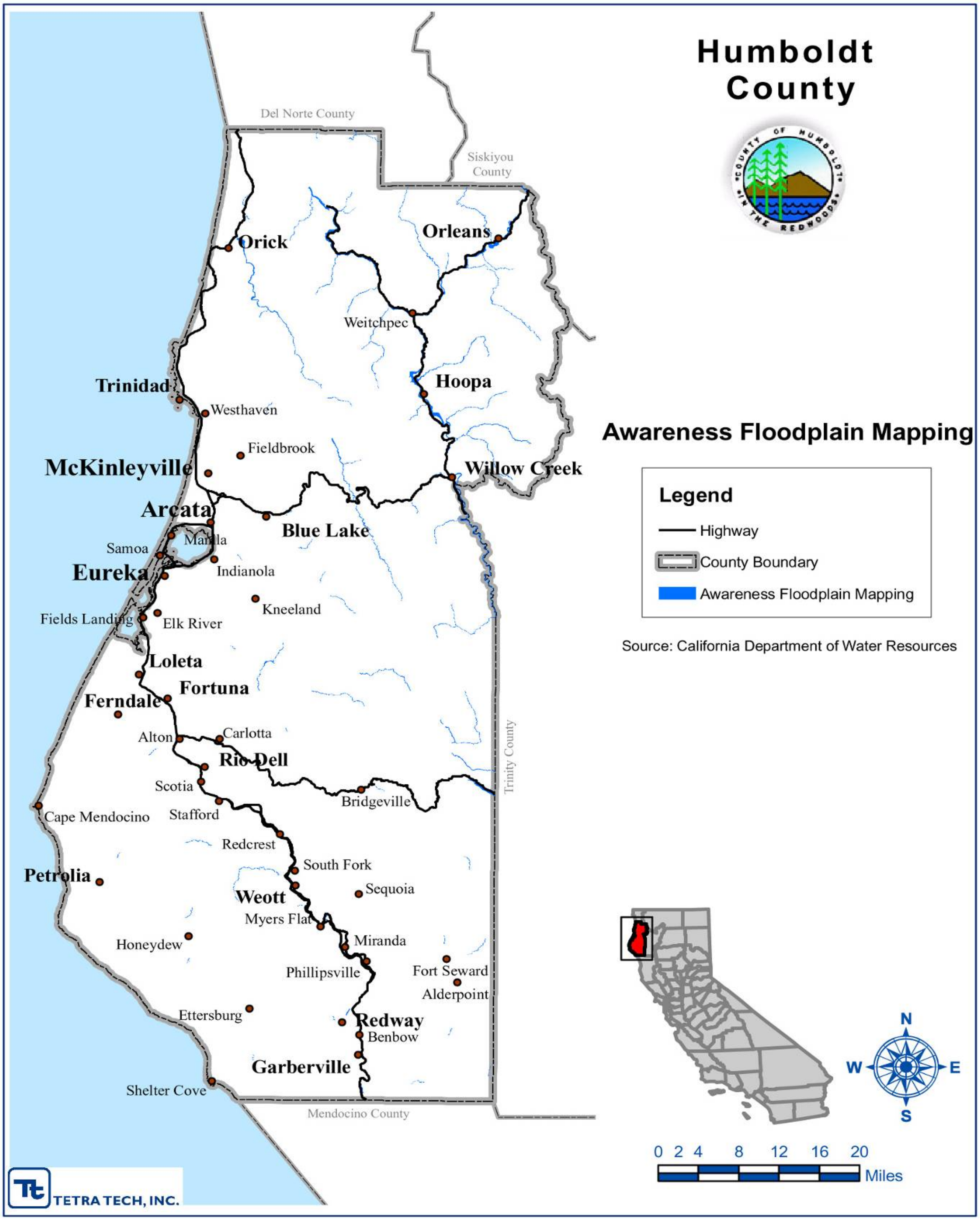

Figure 15-2: The extent and location of the Awareness Flood zones mapped by California Department of Water Resources.

15.3.4 Frequency

Floods are commonly described as having a 10-, 50-, 100-, or 500-year recurrence interval, meaning that floods of these magnitudes have (respectively) a 10, 2, 1, or 0.2 percent chance of occurring in any given year. These measurements reflect averages of likelihood of occurrence; it is possible for two or more floods with a 100-year or higher recurrence interval to occur within a short time period. Assigning recurrence intervals to floods is valuable as a rough comparison among the magnitudes of floods on a given waterway, and as a way of showing the intensity of a storm over a large area. For example, the 1964 flood event was determined to have a 290-year recurrence interval on the Eel River, while the recurrence interval for the Mad River was determined to be a 50-year event. This illustrated how watersheds react differently to storm events.

Recent history has shown that Humboldt County can expect an average of one episode of minor river flooding each winter. Winter floods inundate most of the County's 100-year floodplain at intervals of 3 to 10 years. Large, damaging floods typically occur every 10 years. The frequency of flooding in smaller streams and basins can be expected to increase somewhat as a result of increased development in Humboldt County, increasing the amount of impervious surfaces.

15.3.5 Severity

The severity of flooding is typically measured by the amount of damage it could cause. This can be evaluated by reviewing past flood damage estimates or by examining flow rates of the rivers using peak discharges utilized by FEMA in mapping floodplains. Table 15-2 summarizes the peak discharges for rivers and streams in Humboldt County.

TABLE 15-2.
SUMMARY OF PEAK DISCHARGES WITHIN HUMBOLDT COUNTY

		Peak Discharge (cfs)			
Source/Location	Drainage Area (Square Miles)	10-Year	50-Year	100-Year	500-Year
Eel River, at the Mouth	3,620	390,000	601,000	695,000	924,000
Eel River, at Scotia	3,113	331,000	521,000	680,000	820,000
Van Duzen River, at the Mouth	426	60,000	84,000	94,000	117,000
Van Duzen River, at confluence with Yaeger Creek	280	39,000	54,000	60,000	75,000
South Fork Eel River, at Redway	507	104,000	159,000	166,000	213,000
Mad River, near Arcata	485	58,360	81,720	90,960	113,480
Mad River, downstream of confluence with North Fork	443	53,790	74,910	83,840	104,600
Jacoby Creek, at Myrtle Avenue	16.6	4,050	6,400	7,400	10,700
Williams Creek, at Grizzly Bluff Road	5.57	—	—	1,985	—
Janes Creek, at "Q" Street	3.51	—	—	1,030	—
Freshwater Creek, at Myrtle Ave.	32.4	5,400	8,600	10,000	14,200
Freshwater Creek, upstream of confluence with Little Freshwater Creek	28.5	5,100	8,000	9,500	13,200
Trinity River, downstream of confluence with Kirkham Creek	2,016	3,110	4,560	5,070	6,290
Eastside Channel, upstream of Van Ness Avenue	N/A (breakout from Francis Creek)	—	—	140	—

15.3.6 Warning Time

Due to the sequential pattern of storms needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

15.3.7 Secondary Hazards

The most problematic secondary hazard for flooding in Humboldt County is bank erosion. In many cases the effects of bank erosion are worse than actual flooding. This is especially true on the upper courses of the rivers in the County where there are steep gradients so that the floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous material spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or drainage sewers.

15.4 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to flooding in the planning area. HAZUS-MH uses census data at the block level and FEMA floodplain data. Although the data generated by HAZUS-MH is considered to be an estimate, its level of accuracy is acceptable for planning purposes. Where possible based on data compatibility, the HAZUS-MH data for this risk assessment was enhanced utilizing GIS data provided by county, state and federal sources.

15.4.1 Population

Population counts of those living in the floodplain within the planning area was generated analyzing the census blocks that intersect with the 100-year and 500-year floodplain as mapped and identified on effective FIRMs. Census tract and blocks groups do not follow the same boundaries as the floodplain. Rather, they use rivers and streams as boundaries, which mean that populations living in the floodplain were split into different areas.

The methodology used to generate these estimates evaluates census tract groups whose centers are in the 100-year floodplain. Other tract groups were chosen in which the majority of the population most likely lives in or near the 100-year floodplain. This analysis indicated that there are 26 census tract groups near or partially in the 100-year floodplain. HAZUS-MH estimated the number of buildings within each block that are within the floodplain, and then estimated the total population by multiplying the average Humboldt County household size of 2.39 persons per household by the number of structures within the floodplain. Using this approach, it is estimated that the exposed population is 10,590 (7.8 percent of the County total) within the 100-year floodplain and 12,460 (9.1 percent of the County total) within the 500-year floodplain.

15.4.2 Property

The value of exposed buildings in the 100-year and 500-year floodplains within the planning area was generated using HAZUS-MH at the census block level and is summarized in Table 15-3. The estimates include the value of both the building and the contents. This methodology estimates that that there is approximately $1.19 billion worth of building/contents exposure to the 100-year flood within the planning area. This represents approximately 12.3 percent of the total assessed value of the planning area, based on Humboldt County Assessor values as of March 1, 2007. It is estimated that there is $1.41 billion of building/contents exposure to the 500-year flood within the planning area, or 14.6 percent of the total assessed value for the area.

**TABLE 15-3.
VALUE OF EXPOSED BUILDINGS WITHIN 100/500-YEAR FLOODPLAINS IN HUMBOLDT COUNTY**

	Floodplain Area (acres)		Building/Contents Exposure Value ($)				% of total Assessed Value	
			100-year		500-year			
Jurisdiction	100-Year	500-Year	Building	Contents	Building	Contents	100-year	500-year
Arcata			$69,002,400	$51,015,400	$133,875,100	$107,482,100	9.2	18.5
Blue Lake	134	243	$9,410,700	$11,902,900	$21,583,400	$19,532,700	33.4	64.4
Eureka	5,722	5,795	$48,609,600	$37,737,500	$62,704,900	$45,593,300	3.9	4.9
Ferndale	36	45	$4,100,700	$3,182,700	$4,421,000	$3,343,400	6.1	6.6
Fortuna	366	491	$68,580,600	$53,130,800	$99,244,800	$72,800,600	15.4	21.7
Rio Dell	221	242	$19,878,500	$10,383,000	$22,292,800	$11,632,600	18.8	21.0
Trinidad	7	7	$462,300	$232,900	$462,300	$232,900	1.9	1.9
Tribes	4,082	4,084	$14,207,700	$8,631,100	$14,566,700	$8,810,800	12.2	17.3
Unincorporated County	113,912	115,478	$488,665,682	$288,602,206	$494,882,437	$289,609,712	15.7	15.9
Total	**126,889**	**128,979**	**$722,918,182**	**$464,818,506**	**$854,033,437**	**$559,038,112**	**12.3**	**14.6**

Land Use in the 100-Year Floodplain

Some land uses are more vulnerable to flooding, such as single-family homes, while others are less vulnerable, such as agricultural land or parks. Table 15-4 shows the existing land use of all parcels in the 100-year floodplain, including vacant parcels and those in public/open space uses, broken down for the planning area. For parcels in cities, residential, commercial and public/open space are the dominant land use. In unincorporated areas, residential and timber/forest are the dominant land uses. This assessment also found that 24 percent of the parcels within the 100-year floodplain are vacant or undeveloped. Combining the vacant lands with open space or low density land uses, 57 percent of the parcels within the 100-year floodplain have existing uses considered to be lower-risk uses for the floodplain.

Structures in the 100-Year Floodplain

The number and type of structures exposed to the 100-year and 500-year floods was estimated from the Level 2 HAZUS-MH analysis and is illustrated in Table 15-5. For planning purposes, these estimates represent a fair gauge of vulnerability.

15.4.3 Critical Facilities and Infrastructure

Using the definition of critical facilities established by the Steering Committee, an inventory of critical facilities located in the 100-year floodplain was created using the HAZUS-MH program. The detailed inventory of these facilities has not been included in this plan for security purposes. Table 15-6 summarizes the findings of this analysis.

TABLE 15-4.
GENERAL LAND USE OF PARCELS IN 100-YEAR FLOODPLAIN

	Parcels in 100-Year Floodplain								
Land Use	Arcata	Blue Lake	Eureka	Ferndale	Fortuna	Rio Dell	Trinidad	Unincorporated County	**Total**
Residential	277	1	44	74	162	70	4	2969	**3,601**
Commercial	17	3	24	11	57	3	0	81	**196**
Light Industrial	14	1	22	0	5	0	0	28	**70**
Heavy Industrial	1	0	4	0	2	0	0	24	**31**
Agricultural	1	0	0	0	0	0	0	94	**95**
Timber/Forest	0	0	0	0	0	0	0	1474	**1,474**
Public Lands	59	10	146	9	23	12	0	1229	**1,488**
Vacant lands	62	2	64	17	50	17	3	1929	**2,144**
Total	**431**	**17**	**304**	**111**	**299**	**102**	**7**	**7828**	**9,099**

TABLE 15-5.
STRUCTURES WITHIN 100-YEAR/500-YEAR FLOODPLAIN HUMBOLDT COUNTY

	100-Year			500-Year		
Jurisdiction	Residential	Other	**Total**	Residential	Other	**Total**
Arcata	242	13	**255**	464	23	**487**
Blue Lake	17	4	**21**	100	4	**104**
Eureka	106	9	**115**	172	9	**181**
Ferndale	13	1	**14**	16	1	**17**
Fortuna	237	20	**257**	376	20	**396**
Rio Dell	170	2	**172**	192	2	**194**
Trinidad	4	0	**4**	4	0	**4**
Tribes	117	0	**117**	121	0	**121**
Unincorporated County	3005	54	**3,059**	3,056	53	**3,109**
Total	**3,911**	**103**	**4,014**	**4,501**	**112**	**4,613**

TABLE 15-6.
CRITICAL FACILITIES IN THE 100-YEAR FLOODPLAIN

Jurisdiction	Medical and Health Services	Government Function	Hazardous Materials	Schools	Other	**Total**
Arcata	1	0	1	1	0	**3**
Blue Lake	0	0	0	0	0	**0**
Eureka	0	0	4	0	6	**10**
Ferndale	0	0	0	0	0	**0**
Fortuna	0	0	4	0	2	**6**
Rio Dell	0	0	0	0	0	**0**
Trinidad	0	0	0	0	0	**0**
Tribes	0	0	0	0	0	**0**
Unincorporated County	0	4	1	0	9	**14**
Total	**1**	**4**	**10**	**1**	**17**	**33**

Tier II Facilities

Tier II facilities are those that can harm the surrounding environment if damaged by a flood. Ten businesses in the 100-year floodplain report containing Tier II hazardous materials. During a flood event, containers holding these materials could rupture and leak into the surrounding area, having a disastrous effect on the environment as well as residents.

Utilities/Infrastructure

Roads or railroads that are blocked or damaged can prevent access throughout the County and can isolate residents and emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris from floods also can cause isolation. Water and sewer systems can be flooded or backed up, causing further health problems. Underground utilities can also be damaged during flood events. Levees are key components of the infrastructure that can both provide protection and be impacted by a flood event. Thus it is critical to identify which infrastructure is exposed to flooding to determine what is vulnerable and who may be at risk if that infrastructure is damaged.

Roads

Several roads in Humboldt County have been affected by past flood events, both inside and outside the 100-year floodplain. The following major roads in Humboldt County pass through the 100-year floodplain and thus are exposed to flooding.

- Highway 101
- Highway 254
- Highway 36
- Highway 211
- Highway 96
- Highway 299
- Highway 255
- Highway 1
- King Salmon Ave.

Many of these roads are built above the flood level, and many others function as levees to prevent flooding. Nonetheless, in certain events these roads may be blocked or damaged by flooding, preventing access to many areas.

Bridges

Flooding events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. An analysis showed that there are 73 bridges that are in or cross over the floodplain.

Water/Sewer/Infrastructure

Water and sewer systems can be affected by flooding events. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can also be backed up, causing wastes to spill into homes, neighborhoods, rivers and streams.

Levees

The County maintains levees on the Mad River near the City of Blue Lake, the Eel River near the City of Fortuna and on Redwood Creek near Orrick. The Mad River levee was built by the Corps of Engineers in 1955 and the Eel River levee was built by the Corps of Engineers in 1958-1959. Congress authorized construction of the Redwood Creek flood control project with the Flood Control Act of 1962, and construction was completed in 1968. The Redwood Creek levee system is critical infrastructure for the protection of life and property in the community of Orick. For the last 20 years, Humboldt County's ability to maintain the levees has been significantly constrained by the applicable environmental laws and regulations including the federal Endangered Species Act. In February 2007, the flood control project was included in the Corps of Engineers' nationwide list of 122 levee units with known deficiencies that present an increased risk to the public. The County submitted a correction plan in June 2007, which must be implemented by March 29, 2008, in order to remain within the federal PL 84-99 rehabilitation assistance program.

15.4.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

15.5 VULNERABILITY

Many of the areas identified as exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure and environment.

15.5.1 Population

A geographic analysis of demographics was performed utilizing the HAZUS-MH model. The inventoried data included total population; age, gender, and race distribution and other data obtained from the U.S. Census Bureau and Dun & Bradstreet. The demographic for this analysis was aggregated at the Census block level. For this assessment, the analysis was broken down as follows:

- **Economically Disadvantaged Populations**—Recent catastrophic events on a national scale have shown that economically disadvantaged populations tend to make decisions on their risk exposure based on the net economic impact to their family. It costs money for people to evacuate their homes. If the level of risk is not perceived as high, people will tend to think they will be able to "ride out" the impacts of flood events. For the purposes of this risk assessment, the planning team and the steering committee defined "economically disadvantaged" as households with a net annual income of $20,000 or less based on county demographic data and national standards established for this type of analysis. Based on these parameters, it has been estimated that 12.47 percent of the people within the 100-year floodplain would be considered to be economically disadvantaged.

- **Population over 65 Years Old**—It is estimated that 12 percent of the population in the census blocks that intersect the floodplain and floodway within the planning area are over 65 years old. This group makes up about 1.02 percent of the total population for the planning area. This population group is vulnerable because they are more likely to need special medical attention. During flood events, this may not be available due to isolation caused by flooding. Furthermore, elderly residents have more difficulty leaving their homes during flood events and could be stranded in dangerous situations. Approximately 5 percent of the over-65 population also have incomes considered to be economically disadvantaged and would be considered to be extremely vulnerable.
- **Population under 16 Years Old**—It is estimated that 21 percent of the population within census blocks located in or near the 100-year floodplain are under 16 years of age. This represents approximately 1.76 of the total population for the planning area. This population is vulnerable because of their young age and dependence on others for basic necessities such as food, water and clothing. Very young children are also vulnerable to injury or sickness; this vulnerability can be worsened during a flood because they may not understand the measures that need to be taken to protect themselves from hazards.

The HAZUS-MH based spatial analysis and future, more detailed, spatial analysis identifying the distribution of the most vulnerable populations by variables including age and income will aid the county in mitigation efforts through public education and outreach.

15.5.2 Property, Infrastructure and the Environment

Unless discussed specifically in this section, vulnerable property, infrastructure and environment are assumed to be the same as discussed in the section on exposure.

National Flood Insurance Program

Flood insurance statistics help identify vulnerability by isolating where there is claim activity, where there is a high rate of flood insurance in force, and where flooding may be occurring in areas not identified as flood prone. Table 15-7 lists insurance statistics that can be used to help identify vulnerability in the Humboldt County planning area.

Seven communities in the planning area are participating in the NFIP, with 1,062 flood insurance policies in force that provide $170.2 million in insurance coverage. According to FEMA statistics, 179 flood insurance claims were paid for a total of $2.3 million between November 1978 and June 30, 2006. The location of the policies in force and the claims paid is illustrated in Figure 15-3.

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before the FIRM are more vulnerable to flooding and related damages because they do not meet code or are located in hazardous areas. The first FIRMs for Humboldt County were available in 1982.

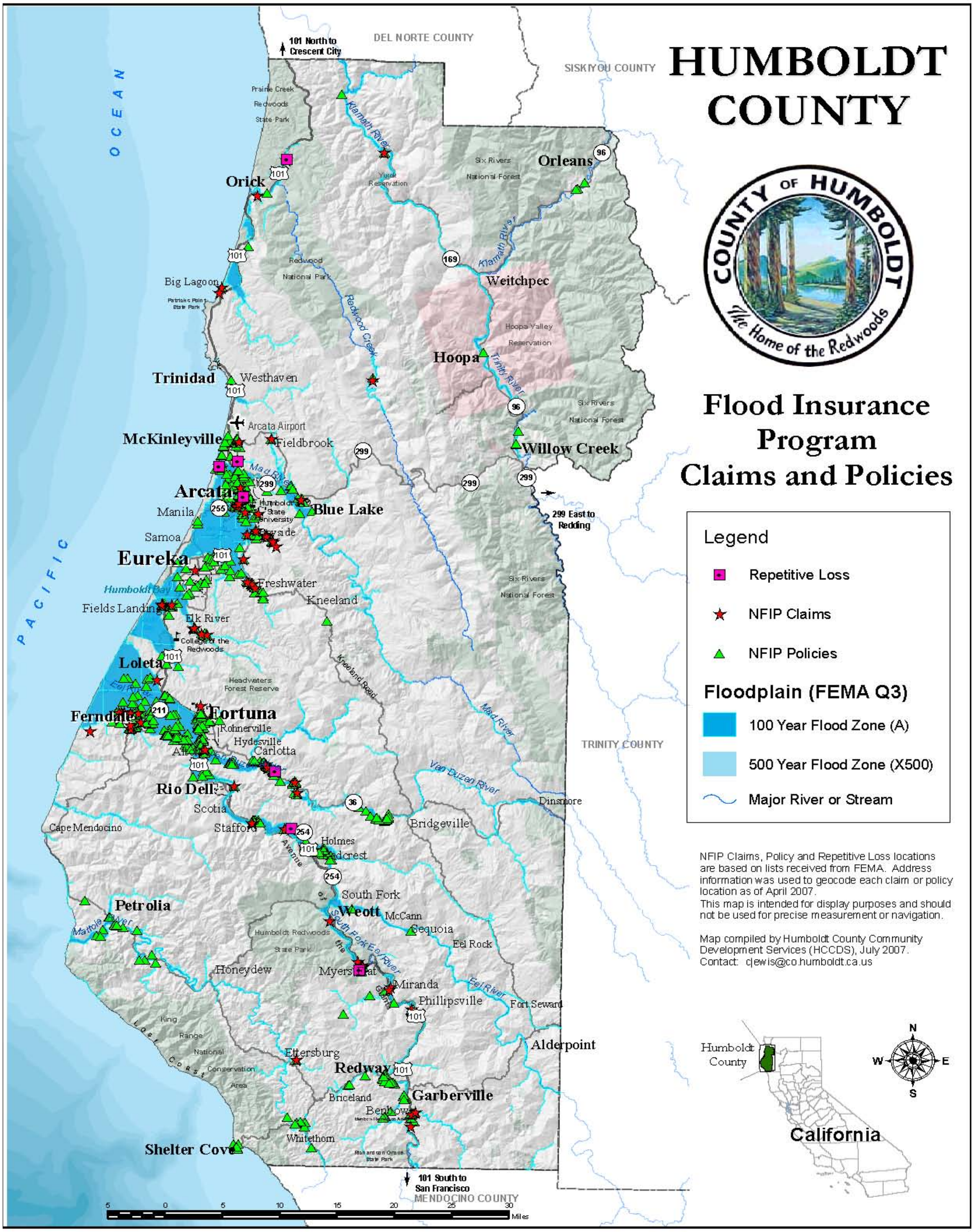

Figure 15-3: Flood Insurance Policies, Claims and Repetitive Losses for Humboldt County

TABLE 15-7.
FLOOD INSURANCE STATISTICS FOR HUMBOLDT COUNTY

Jurisdiction	Date of Entry Initial FIRM Effective Date	Current FIRM Effective Date	# of Flood Insurance Policies as of 06/30/2006	Total Insurance Coverage in Force	Claims, 11/1978 to 6/30/2006	Value of Claims paid, 11/1978 to 6/30/2006
Arcata	05/02/1983	11/05/1997	140	$23,099,700	16	$186,652.55
Blue Lake	09/30/1982	05/05/1997	11	$1,936,100	2	$7,851.86
Eureka	06/01/1982	06/17/1986	26	$5,363,900	4	$30,889.91
Ferndale	12/01/1993	01/07/1998	18	$3,732,400	2	$18,364.05
Fortuna	05/03/1982	05/03/1982	43	$7,123,900	4	$5,968.84
Rio Dell	05/03/1982	05/03/1982	6	$166,400	5	$30,939.89
Unincorporated County	07/19/1982	02/08/1999	818	$128,789,500	146	$2,036,261.51
Total			**1062**	**$170,211,900**	**179**	**$2,316,928.61**

Information relevant to reducing the risk to the flood hazard provided by flood insurance statistics is summarized as follows:

- Approximately 19.4 percent of the at-risk buildings in the planning area are covered by a flood insurance policy. Based on the approximate number of primary, insurable structures in the floodplain and the insurance coverage in force within the floodplain, insurance coverage as a form of mitigation appears to be well below the national average. According to a study being conducted for the NFIP by the Rand Corporation, nationwide about 49 percent of single-family homes in special flood hazard areas (SFHAs) are covered by flood insurance.
- Approximately 35 percent of the current policies in force within the planning area are for properties located outside of the 100-year floodplain.
- The total value of insurance coverage in force represents 23.5 percent of the total building exposure value.
- The total claims paid by flood insurance polices since 1978 represents approximately 17.7 percent of the total requests for individual assistance (IA) within the same period.
- Of total claims paid, 27.7 percent were for properties located outside of an identified 100-year floodplain.

Repetitive Loss

The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by those policies. FEMA-sponsored programs, such as the Community Rating System, require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of the floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss.

FEMA's list of repetitive loss properties identifies 10 such properties in the Humboldt County planning area, as of May 1, 2006, as summarized in Table 15-8. None of these properties are outside mapped or identified floodplain. They likely were flooded by flood events typical for the floodplain reflected in the current mapping. The dates of loss coincide with major flood events that have impacted the planning area. Therefore it can be concluded that the overall cause of repetitive flooding is the same as has been identified for the river basins in which each repetitive loss area is found. It can also be concluded that the entire mapped floodplain within Humboldt County can be and is subject to repetitive flooding. Therefore the Planning Team has defined the Repetitive Loss Area to be contiguous with the currently mapped and regulated 100-year floodplain. The location of the identified repetitive loss areas is illustrated in Figure 15-3.

TABLE 15-8.
BREAKDOWN OF REPETITIVE LOSS PROPERTIES WITHIN HUMBOLDT COUNTY (BASED ON FEMA REPORT OF REPETITIVE LOSSES, MAY 1, 2006)

Jurisdiction	Repetitive Loss Properties	Properties That Have Been Mitigated	Number of Corrections	Corrected Number of Repetitive Loss Properties
Arcata	1	0	0	1
Unincorporated County	9	2	2[a]	5
Totals	**10**	**2**	**2**	**6**

a. Information provided not sufficient to locate property

Flood Loss Potential of Structures

The HAZUS-MH program calculates losses to structures from flooding by looking at two primary components: depth of flooding and type of structure. Using historical trend information provided by flood insurance claim data, HAZUS-MH analyzes these components to estimate a percentage of damage to the structure and its contents. This information is intersected with the Humboldt County Assessor parcel based data to generate an estimate that can be used for a multitude of purposes. The analysis for Humboldt County is summarized in Table 15-9. It is estimated that there would be up to $183.4 million of flood loss potential from a 100-year flood event within the planning area. This represents 15.44 percent of the total exposure to the 100-year flood. It is also estimated that there would be approximately $211.5 million of flood loss potential from a 500-year flood event within the planning area. This represents 14.96 percent of the total exposure to a 500-year flood event.

Critical Facilities

HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities, HAZUS-MH correlates these estimates into an estimate of functional down-time. Functional down-time is the estimated time it will take to restore a facility to 100 percent of its functionality. This helps to gauge how long the planning area could have limited usage of facilities deemed critical to the response and recovery of a flood disaster. HAZUS estimated that on the average, critical facilities would receive approximately 11.69 percent damage to the structure and 33.88 percent damage to the contents during a 100-year flood event. The estimated time to restore these facilities to 100 percent of their functionality is 510 days. A 500-year flood event would damage the structures an average of 11.71 percent and the contents an average 40.63 percent. The estimated time to restore these facilities to 100 percent of their functionality after a 500-year event is 529 days.

**TABLE 15-9.
ESTIMATED FLOOD LOSS FOR THE 100-YEAR/500-YEAR FLOOD EVENTS IN HUMBOLDT COUNTY**

	Estimated Flood Loss ($)						% of Total Exposure in the floodplain	
	100-Year Flood			500-Year Flood				
	Building	Contents	**Total**	Building	Contents	**Total**	100-year	500-year
Arcata	$2,002,400	$1,897,100	**$3,915,500**	$2,316,900	$2,144,300	**$4,461,200**	3.24	1.84
Blue Lake	$412,100	$291,000	**$703,100**	$758,000	$512,900	**$1,270,900**	3.30	3.10
Eureka	$1,502,600	$891,900	**$1,944,500**	$1,694,700	$1,281,600	**$2,976,300**	2.26	2.75
Ferndale	$1,923,300	$1,730,600	**$3,653,900**	$1,923,700	$1,730,800	**$3,654,500**	50.0	46.8
Fortuna	$2,504,800	$2,245,000	**4,749,800**	$3,934,800	$3,461,600	**$7,396,400**	3.96	4.33
Rio Dell	$7,820,000	$4,330,700	**$12,150,700**	$10,007,900	$5,517,300	**$15,525,200**	39.68	45.22
Trinidad	$9,100	$4,800	**$13,900**	$9,100	$4,800	**$13,900**	1.97	1.97
Tribes	$2,780,800	$1,800,900	**$4,581,700**	$2,780,800	$1,800,900	**$4,581,700**	20.06	19.6
Unincorporated County	$91,517,683	$60,207,993	**$151,725,676**	$102,707,733	$68,870,509	**$171,578,242**	19.52	21.87
Total	**$110,472,783**	**$73,399,993**	**$183,438,776**	**$126,133,633**	**$85,324,709**	**$211,458,342**	**15.44**	**14.96**

15.6 FUTURE TRENDS

The Humboldt County planning area has recently seen an annual growth rate of less than 1 percent. Considering these historical trends and future population projections produced by the state, anticipated development trends for the planning area are considered low, consisting primarily of residential development with the exception of the Eureka and Fortuna areas (see Volume 2 for jurisdiction-specific growth trends). Higher rates of growth tend to increase demand for new development. With this fact in mind, it would be assumed that development/redevelopment trends within Humboldt County are not such that there is major concern about development within identified flood hazard areas.

Humboldt County is subject to state general planning law and the California Coastal Act. The County and its cities have adopted critical areas and resources lands regulations pursuant to these laws. Maintaining the agricultural heritage of Humboldt County is a high priority for its land use programs and managers. It has been Humboldt County's policy in the past to not allow for an increase in exposure within its floodplains. Flood loss history and the current land use trends support these policies. The information in this plan provides Humboldt County and its Planning Partners a tool to ensure that there is no increase in exposure within the floodplains of the planning area.

15.7 SCENARIO

The major river systems in Humboldt County flood at irregular intervals, but generally in response to a succession of intense winter rainstorms. Storm patterns of warm, moist air usually occur between early November and late March. A series of such storms can cause severe flooding in Humboldt County. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time. This would overwhelm city and County response and floodplain management departments. Major roads would be blocked, preventing critical access for many residents and critical functions. High river flows could cause rivers to scour, possibly washing out roads and creating more isolation problems. In the case of multibasin flooding, the County would not be able to make repairs quickly enough to restore critical facilities and infrastructure.

15.8 ISSUES

In evaluating the information contained in this risk assessment of the flood hazard, the planning team has identified the following issues that are consistent within the planning area:

- The true degree of vulnerability is not certain due to the age of flood hazard mapping for the planning area, and the lack of detailed mapping.
- Data prepared by the California Department of Water Resources through the "Awareness Mapping Program" suggest that the extent and location of flood-prone areas within the planning area is not well identified with the existing mapping.
- The level of detail of the coastal flood hazard risk is less than adequate.
- The extent of flood-protection provided by current flood control facilities (dams, dikes and levees) is unknown due to the lack of a national policy on flood protection standards.
- In general, the structural flood-protection measures currently in place within the planning area provide little if any attenuation effect of the flood hazard. This is due primarily to the fact that the majority of these facilities were not designed with flood control as a primary function.
- The risk associated with the flood hazard overlaps the risk associated with other hazards such as earthquake, landslide and fishing losses. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- The degree of vulnerability to the flood hazard is fairly consistent for all planning partner cities except Trinidad, which has little if any identified flood risk. Most of the municipal planning partners have a percentage of the total exposure in the 0 to 25-percent range.
- There is no degree of consistency of land-use practices and regulatory floodplain management scope within the planning area.
- The Redwood Creek levee system was not designed to account for the major sediment loading coming from the upper watershed, associated with historical logging and road-building. The capacity of the system is reduced every year by the deposition of thousands of cubic yards of sediment. The County annually excavates accumulated sediment to the extent feasible, but environmental laws prevent the level of removal needed to restore the design capacity. The County has been working with the National Park Service, the Redwood Creek Watershed Group, and others to request Congressional funding for a reconnaissance study by the Corps of Engineers. The reconnaissance study would provide a vehicle for local, state, and federal stakeholders to identify opportunities for long-term flood control for the community and enhancement of the lower Redwood Creek and estuary, which were severely impacted by construction of the levees. The reconnaissance study would be a Section 905(b) analysis authorized under Section 216 of the River and Harbors Flood Control Act of 1970 (33 USC 426 et. seq.) as amended. Setback levees in some form could help ensure continued flood protection, provide environmental restoration, and allow continued agricultural use of adjacent lands.
- Climate change may cause more extensive flood problems due to possible sea level rise and more severe weather patterns. Consequently, the 500-year floodplain inundation area may become a higher probability risk. Coastal flood hazard ratings may also need to be reviewed.