

CHAPTER 17. SEVERE WEATHER

17.1 SEVERE WEATHER DEFINED

The following definitions apply in the discussion of severe weather hazards:

- **Freezing Rain**—The result of rain occurring when the temperature is below the freezing point. When this occurs the rain will freeze on impact and will result in a layer of glaze ice over everything it touches. Although the layer of glaze is generally thin, it can measure up to 1 inch in depth. In a severe ice storm an evergreen tree 20 meters high and 10 meters wide can be burdened with up to six tons of ice, creating a serious threat to power and telephone lines and transportation routes.
- **Severe Local Storms**—Includes “microscale” atmospheric systems: tornadoes, thunderstorms, windstorms, ice storms and snowstorms. Typically, major impacts from a severe storm are to transportation and loss of utilities. The major characteristic all of these events have in common is that their effects are usually limited in scope. Although one of these storms may cause a great deal of destruction and even death, its impact is generally confined to a small area.
- **Snowstorms**—Are caused by interaction between air of different temperatures and densities. The resultant low pressure system can cover thousands of square miles with snow. Heavy snow in Humboldt County is generally confined to the mountains, with heavy accumulation in the lowlands uncommon.
- **Thunderstorm**—Typically 25 kilometers in diameter and last 30 minutes from birth to growth through maturity to decay. Thunderstorms are underrated hazards. Lightning, which occurs with all thunderstorms, is a serious threat to human life nationwide. Heavy rains dumped in a small area over a very short time can lead to flash flooding. Strong winds, hail and tornadoes are also dangers associated with thunderstorms.
- **Tornado**—Tornadoes are funnel clouds of varying sizes that generate winds as fast as 500 miles per hour (mph). They can affect an area up to three-quarters of a mile wide, with the path varying in width and length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale ranging from F0 to F6. Humboldt County historical area-adjusted tornado activity is significantly below the California state average. It is 30.7 times below the national average. The last tornado on record in Humboldt County occurred March 29, 1958 and had a Fujita Scale rating of F2.
- **Windstorms**—These are storms consisting of violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

17.2 GENERAL BACKGROUND

The location of Humboldt County on the windward coast in mid-latitudes is such that climatic elements combine to produce a predominantly marine-type climate on the coast, while inland the climate possesses both continental and marine characteristics. The county’s climate is impacted by two significant factors:

- **Mountain ranges**—The coastal mountains affect rainfall. The first major release of rain occurs along the coast, and the second is along the west slopes of the Klamath Mountains.
- **Location and intensity of semi-permanent high- and low-pressure areas over the North Pacific Ocean**—During summer and fall, circulation of air around a high-pressure area over the North Pacific brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the Pacific Northwest. As the air moves inland, it becomes warmer and drier, resulting in a dry season. In the winter and spring, the high pressure resides further south while low pressure prevails in the Northeast Pacific. Circulation of air around both pressure centers brings a prevailing southwesterly and westerly flow of mild, moist air into the Pacific Northwest. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in late October or November, reaching a peak in winter, and gradually decreasing by late spring.

On the coast, summers are cool and relatively dry while winters are mild, wet and generally cloudy. Measurable rainfall occurs on 118 days each year at Humboldt Bay and on 190 days in the mountains. Thunderstorms occur up to 10 days each year over the lower elevations and up to 15 days in the mountainous regions. Damaging hailstorms rarely occur in Northern California. During July and August, the driest months, two to four weeks can pass with only a few showers; however, in December and January, the wettest months, precipitation is frequently recorded on 20 to 25 days or more each month. The range in annual precipitation is from about 38 inches along Humboldt Bay to 100 inches along the southern Humboldt Coast. The mountainous interior of Humboldt County averages close to 90 inches of rain per year (Figure 17-1). Snowfall is light in the lower elevations and heavier in the mountains.

During the wet season, rainfall is usually of light to moderate intensity and continuous over a long period rather than occurring in heavy downpours for brief periods; heavier intensities occur along the windward slopes of the mountains.

The strongest winds are generally from the south or southwest and occur during the winter and spring (Figure 17-2). In interior valleys, wind velocities reach 40 to 50 mph each winter, and 75 to 90 mph a few times every 50 years. The highest summer and lowest winter temperatures generally occur during periods of easterly winds. The climate of the interior county has characteristics of both continental and marine climates. Summers are warmer, winters are colder, and precipitation is greater than on the coast.

During most of the year, the prevailing wind is from the southwest or west. The frequency of northeasterly winds is greatest in the fall and winter. Wind velocities ranging from five to 10 knots can be expected 60 to 80 percent of the time; 10 to 15 knots, 30 to 45 percent of the time; and 20 knots or higher, two to 15 percent of the time (Figure 17-3). The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities on the coast can be expected to reach 50 mph at least once in two years; 60 to 70 mph once in 50 years; and 80 mph once in 100 years. The highest wind gust recorded in Eureka was 69 mph on Jan 31, 1981.

17.3 HAZARD PROFILE

17.3.1 Past Events

Table 17-1 lists past severe weather events in Humboldt County, as provided by the National Oceanic and Atmospheric Administration. The NOAA data base covers all severe weather events declared by the National Weather Service from 1958 to 2005. The largest amount of property damage sustained from a weather event in Humboldt County occurred in late December 2005.

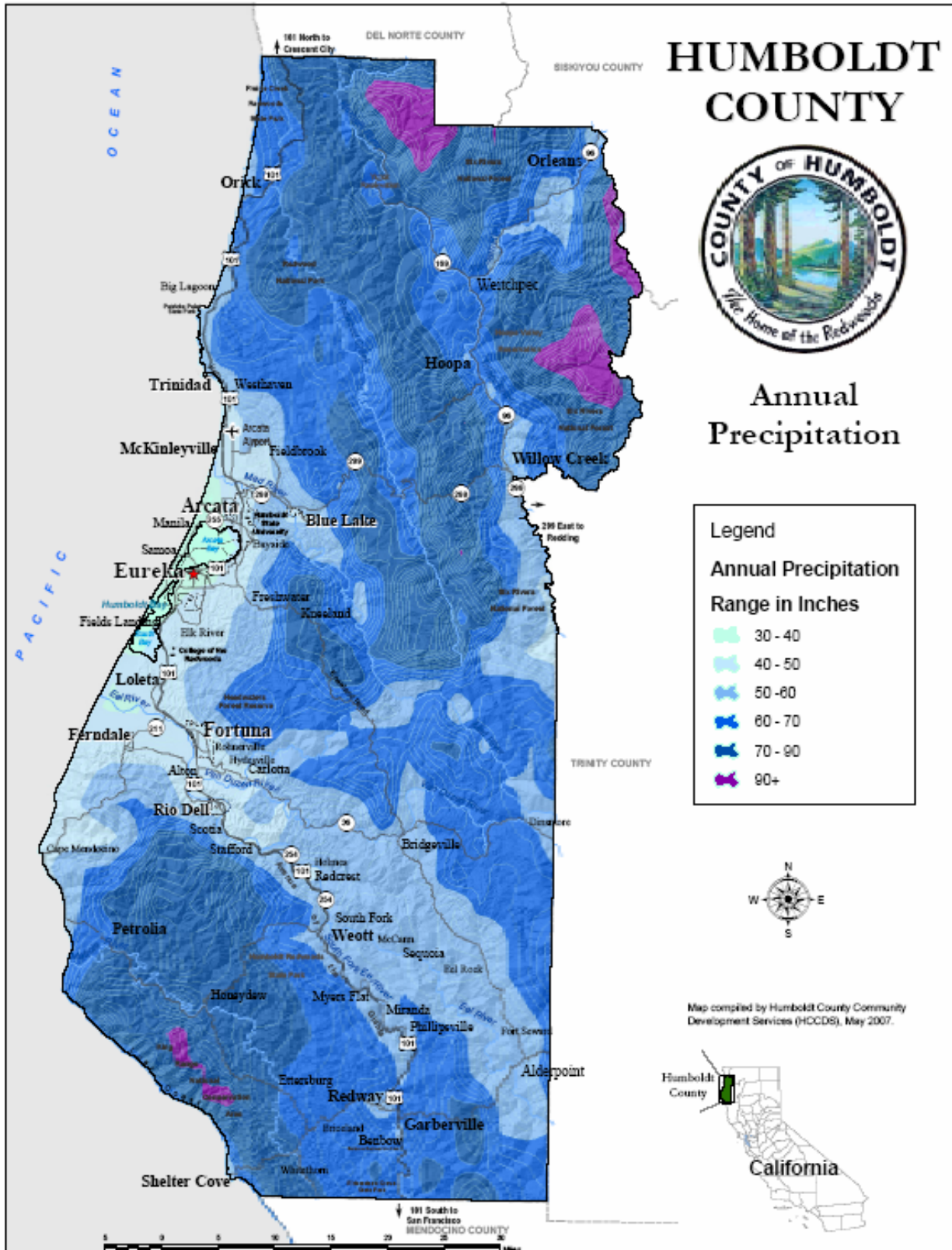


Figure 17-1: Annual precipitations for Humboldt County

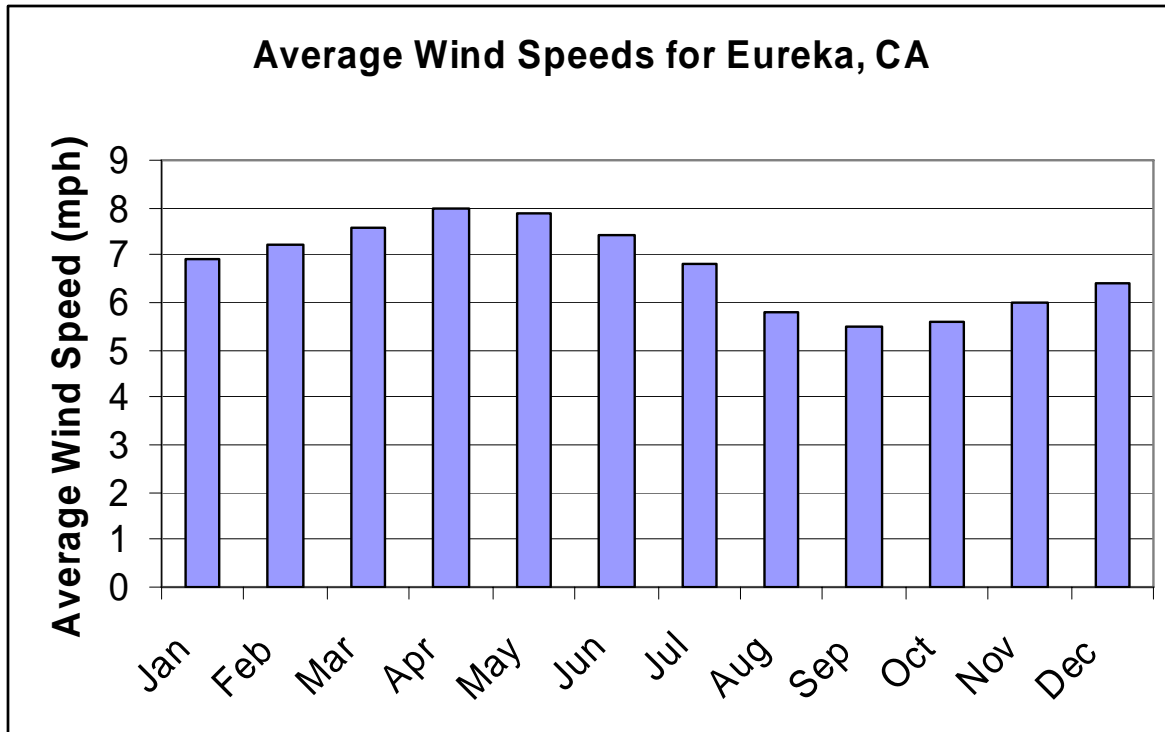


Figure 17-2: Average Wind Speed for Eureka California (NCDC, 2007)

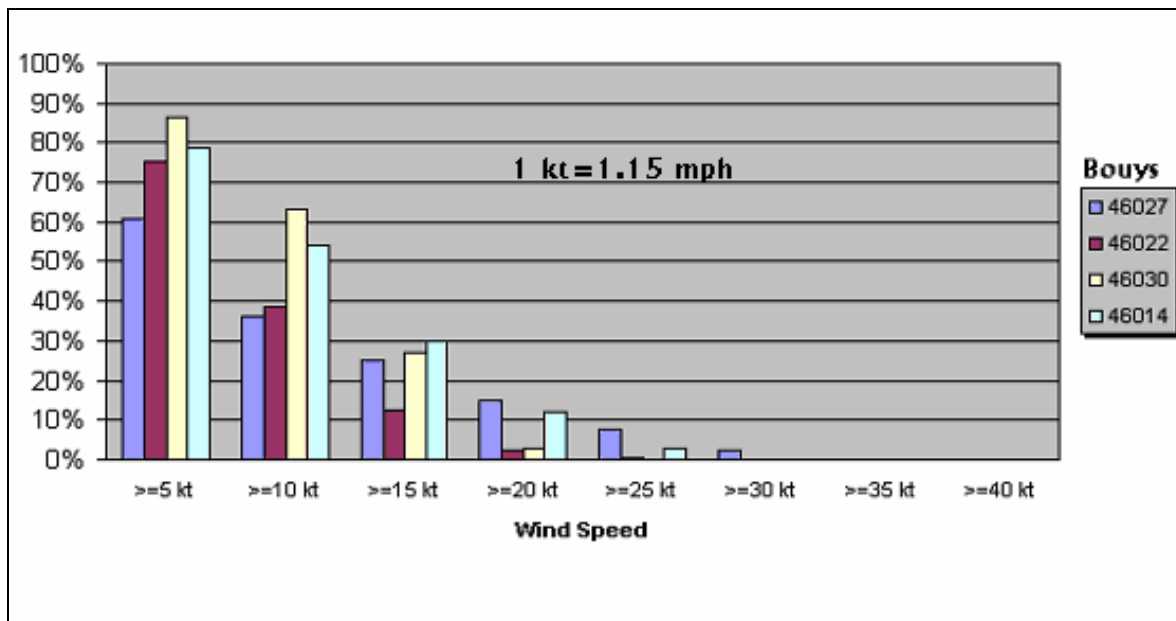


Figure 17-3: Wind Speed frequency recorded at four offshore buoys (Lorens 2003)

**TABLE 17-1.
SEVERE WEATHER EVENTS IN HUMBOLDT COUNTY SINCE 1958 (NOAA 2007)**

Location	Date	Type	Magnitude	Damage (see notes)				Description of Event
				D	Inj	PrD	CrD	
Humboldt	3/29/1958	Tornado	F2	0	0	3K	0	
Humboldt	6/24/1982	Hail	0.75 in.	0	0	0	0	
Humboldt	6/24/1982	Thunderstorm Wind	0 knots	0	0	0	0	
Humboldt	1/26/1983	Thunderstorm Wind	52 knots	0	0	0	0	
Humboldt	1/26/1983	Thunderstorm Wind	61 knots	0	0	0	0	
Humboldt	2/9/1983	Thunderstorm Wind	50 knots	0	0	0	0	
Humboldt	2/9/1983	Thunderstorm Wind	55 knots	0	0	0	0	
South of Honeydew	12/6/1993	Heavy Rain	N/A	0	0	50K	0	Heavy rains over a 30-hour period caused mudslides and debris flows which closed some roads in the southwest portion of Humboldt County. Rainfall totals for the period ranged up to 15.57 inches at a site 9 miles south of Honeydew, 20.37 inches 4 miles
Shelter Cove	3/20/1995	Hail	0.50 in.	0	0	0	0	
Orleans	5/24/1995	Thunderstorms Winds	N/A	0	0	2K	0	A microburst from a thunderstorm downed several trees at the northeast end of Orleans. Two of the trees fell on fences. A Forest Service ranger reported that the storm was rotating.
Humboldt	12/12/1995	Flooding	N/A	0	0	0	0	The Van Duzen River crested at 17.8 feet (flood stage 17 feet) between 1000 and 1100 PST. The Eel River at Fernbridge crested below flood stage on the morning of the 13th but the crest coincided with an 8+ foot high tide and heavy surf which impeded flow.
Arcata, Blue Lake, McKinley- ville	12/14/1995	Flash Flood	N/A	0	0	0	0	A stationary line of thunderstorms produced heavy rains causing creeks north and northeast of Humboldt Bay to flood. Spotters and radar indicated widespread 3 to 4 inches of rain in about 2 hours with local amounts of 5 to 7 inches.
Fortuna	12/15/1995	Funnel Cloud	N/A	0	0	0	0	

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Humboldt	12/29/1995	Flood	N/A	0	0	7.0M	0	Persistent heavy rain caused streams in central Humboldt County to overflow. Many mud and debris slides blocked roads. Flooding occurred on Salmon Creek, Jacoby Creek, Freshwater Creek, Yager Creek, and Power's Creek plus many smaller streams.
Arcata Airport	2/21/1996	Waterspout	N/A	0	0	0	0	Waterspout was reported by the Coast Guard off the coast from Arcata Airport.
Shelter Cove	3/4/1996	Hail	0.75 in.	0	0	0	0	Widespread convection producing hail, mostly pea-sized
Fieldbrook	10/25/1996	Wind Damage	N/A	0	0	0	0	Two trees were downed, several artichoke plants were ripped out of the ground and a willow tree was damaged by a convective wind gust. Unconfirmed report of a funnel cloud, possible cold air funnel.
Arcata And Blue Lake	12/4/1996	Urban/small Stream Flood	N/A	0	0	0	0	Urban and small stream flooding in Arcata and Blue Lake.
Widespread	12/29/1996	Urban/small Stream Flood	N/A	0	0	0	0	Deans Creek near Rio Dell, Janes Creek in Arcata, many creeks near Carlotta and other small streams were flooding.
Trinidad	3/30/1997	Funnel Cloud	N/A	0	0	0	0	Funnel cloud was seen by off-duty National Weather Service employee off the coast near Trinidad.
Fields Landing	4/23/1997	Waterspout	N/A	0	0	0	0	A waterspout was sighted by the public over the southern part of Humboldt Bay near the College of the Redwoods. It was reported to be picking up water and mud
Bridgeville	4/23/1997	Funnel Cloud	N/A	0	0	0	0	A spotter reported a funnel cloud from the same storm complex that generated a waterspout earlier over Humboldt Bay.
Honeydew	1/29/1998	Hail	0.75 in.	0	0	0	0	
Loleta	2/3/1998	Lightning	N/A	0	0	0	0	Three cows struck and killed by lightning.

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Big Lagoon	2/17/1998	Beach Erosion	N/A	0	0	0	0	Beach erosion due to ongoing large surf began to crumble a bluff with several homes. The homes nearest the ocean were either condemned or moved away from the cliff. The erosion continued for several weeks.
Numerous	2/21/1998	Urban/small Stream Flood	N/A	0	0	0	0	Widespread small stream flooding in Del Norte, Humboldt and Mendocino Counties. Numerous road closures due to flooding. Del Norte County Sheriff's Dispatch described the county as "swampy." Highways 175 and 128 were closed in Mendocino County.
Eureka	3/22/1998	Urban/small Stream Flood	N/A	0	0	0	0	Small stream flooding on Coffee Creek at Trinity Center and around Hayfork in Trinity County. In Humboldt County, the Elk River flooded on the lower reaches.
Big Lagoon	10/30/1998	Rip Currents	N/A	1	0	0	0	A visitor on her first trip to the ocean was swept 100 yards offshore while collecting rocks and shells. The surf was 10 to 15 feet high. The victim was standing in knee-deep water with her back to the ocean.
Countywide	11/20/1998	Urban/small Stream Flood	N/A	0	0	0	0	Widespread urban and small stream flooding due to very heavy rain. Flooding was reported in the following locations: Fieldbrook, McKinleyville, Bayside (Jacoby Creek), Highway 197 near Crescent City, Arcata, Humboldt State University campus, Blue Lake
Countywide	12/2/1998	Urban/small Stream Flood	N/A	0	0	0	0	Heavy rain caused flooding along many small streams in Northern/Central Humboldt County and Central Del Norte County. Some streams involved include: Noisy Creek, Jacoby Creek and Elk River. Highway 101 near Sand Mine Road and Highway 197

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				D	Inj	PrD	CrD	
Arcata Airport	1/18/1999	Funnel Cloud	N/A	0	0	0	0	
Countywide	3/24/1999	Urban/small Stream Flood	N/A	0	0	0	0	Many roads were closed as streams and small rivers spilled their banks.
Hoopa	10/1/1999	Wild/forest Fire	N/A	0	0	0	0	Megram Fire started by lightning in August, fanned by high winds in September was knocked down by rain in October so that firefighters could bring it under control. Dense smoke forced the evacuation of thousands of residents of the Hoopa and Willow Creek
Eureka	11/30/1999	Thunderstorm Wind	57 knots	0	0	0	0	
Shelter Cove	3/25/2000	Rip Currents	N/A	3	0	0	0	A school group from Calgary, Alberta was visiting Black Sands Beach near Shelter Cove. A rogue wave swept the female victim out to sea. Four other members of the group attempted a rescue but were overcome by waves and currents.
Eureka	12/14/2002	Urban/small Stream Flood	N/A	0	0	0	0	Small stream flooding occurred in a wide swath across central Humboldt County. A powerful Pacific storm swept across Northwest California with strong winds and heavy rain.
Eureka	12/27/2002	Heavy Rain	N/A	0	0	0	0	Eureka set an all time daily rainfall record of 6.79 inches. Nearby Honeydew reported 11.24 inches.
Eureka	12/27/2002	Urban/small Stream Flood	N/A	0	0	0	0	Widespread urban and small stream flooding in Eureka and around Humboldt Bay
Arcata	12/30/2002	Thunderstorm Wind	61 knots	0	0	0	0	Thunderstorm embedded in a strong cold front.
Willow Creek	8/4/2003	Hail	1.00 in.	0	0	0	0	
Blue Lake	8/4/2003	Hail	0.75 in.	0	0	0	0	Redwood Valley

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Weott	9/3/2003	Wildfire	N/A	0	0	0	0	Honeydew/Canoe Complex Lightning sparked numerous fires across Humboldt, Trinity, and Mendocino Counties. The fires grew rapidly in the dry, windy conditions. Over 50 total fires were ignited. By September 30, approximately 26,000 acres were burned.
Orick	12/7/2003	Funnel Cloud	N/A	0	0	0	0	
Orick	2/25/2004	Thunderstorm Wind	75 knots	0	0	0	0	Patrick's Point State Park
Inland Humboldt County	1/2/2005	Heavy Snow		0	1	0	0	8-16 inches snow during event
King Salmon	1/9/2005	Astronomical High Tide		0	0	5K	0	Inundation of King Salmon area occurred
Countywide	11/28/2005	High Wind	44	0	0	10K		High winds downed trees and power poles
Countywide	12/28/2005	Landslide		0	0	55.9M		Costs refer to all of North Coast, including Del Norte, Humboldt, Trinity, and Mendocino County
Humboldt Coast	12/29/2005	Flood		0	0	60.8M		Costs refer to all of North Coast, including Del Norte, Humboldt, Trinity, and Mendocino County
Humboldt Coast	12/31/2005	High Wind	64	0	0	3.2M		Costs refer to all of North Coast, including Del Norte, Humboldt, and Trinity County
Humboldt County	12/31/2005	Storm Surge		0	0	1.7M		

Notes: D=deaths, Inj=injuries, PrD=property damage, CrD=crop damage

17.3.2 Location

Although some areas of Humboldt County experience more frequent severe weather events than others, severe weather events have the potential to happen anywhere in the county. Communities in low-lying areas next to streams or lakes are more susceptible to flooding events. Mountainous regions experience heavier snowfall and a greater risk of road closures. Wind events are most damaging to areas that are heavily wooded and areas along the coast are more susceptible to strong ocean surges and landslides. The large amount of coastline in Humboldt County equates to a large population exposed to the dangers of landslides from severe storm events.

At Big Lagoon in Humboldt County, large pieces of the bluff started falling on February 13, 1998. Rita Lakin's house, built in the 1970s with a 56-foot setback, threatened to fall to Patrick Point State Beach, so she had it demolished and removed except for the foundation. Four neighboring houses were moved inland and owners are now trying to find new lots for them. Had their property landed on the beach, they

would have been required to pay for removing the wreckage, according to Donald C. Tuttle, environmental services manager in the Natural Resources Division of Humboldt County's Department of Public Works. Previous bluff failures were recorded here in 1850, 1851, 1906, 1940, 1983, 1984 and 1985. Lots experienced more than 60 feet of bluff erosion during the winter storms of 1997-98, and the long term bluff retreat rate is estimated at 1 foot per year.

17.3.3 Frequency

Severe thunderstorms and wind events have occurred at least twice a decade since 1958. Flash floods or urban stream flooding has occurred at least five times per decade since 1980. See Table 17-1 for a complete list of past severe weather events in Humboldt County since 1958.

17.3.4 Severity

The effects on Humboldt County of a strong thunderstorm, tornado, windstorm or ice storm are likely to be similar: fallen trees, downed power lines and interruption of transportation lifelines, damaged homes and public buildings. Fatalities are uncommon, but they can occur.

A tornado is the smallest and potentially most dangerous of local storms, though extremely uncommon in Humboldt County. A tornado is formed by the turbulent mixing of layers of air with contrasting temperature, moisture, density and wind flow. The mixing layers of air account for most of the tornadoes occurring in April, May and June, when cold, dry air meets warm, moister air moving up from the south. If a major tornado were to strike a populated area, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. In the case of extremely high winds some buildings may be damaged or destroyed. Due to the often short warning period, livestock are commonly the victims of a tornado or windstorm.

The effects of an ice storm or snowstorm are downed power lines and trees and a large increase in traffic accidents. These storms can cause death by exposure, heart failure due to shoveling or other strenuous activity, traffic accidents (over 85 percent of ice storm deaths are caused by traffic accidents), and carbon monoxide poisoning. These storms also have the potential to cause large losses among livestock. Livestock losses are caused primarily by dehydration rather than cold or suffocation.

Windstorms are a frequent problem in Humboldt County and have been known to cause substantial damage. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may be 25 to 30 percent higher. Under most conditions the County's highest winds come from the southwest.

The most common problems associated with severe storms are immobility and loss of utilities. Roads may become impassable due to flooding, downed trees, ice, snow, or from a secondary hazard such as a landslide. Power lines may be downed due to high winds and other services, such as water or phone, may not be able to operate without power. Lightning can cause severe damage and can be deadly. Two major concerns for snowfall are dangerous roadway conditions and collapse of structures due to heavy snow load on roofs. In addition, ice can create dangerous situations on roadways as well as freeze pipes.

The following is a description of the 2005/2006 winter storm event, one of the most severe weather events to occur in Humboldt County. A series of strong Pacific storm systems with a subtropical moisture tap began on December 18, 2005 and continued through the end of the month. The first 10 days of this wet period conditioned the watersheds, with flooding of concern beginning on December 28. Total precipitation amounts for the series of systems ranged from 12 to 20 inches. While flooding was widespread throughout Humboldt, Del Norte, and Mendocino Counties, the major flood damage occurred

in the Klamath River basin and the Russian River Basin. On the Klamath River, two boat ramps were damaged, 15 structures were flooded, and the Klamath River Bridge over Highway 101 sustained \$15 million worth of damage. On the Russian River, hundreds of homes were flooded, major crop damage occurred, and widespread infrastructure damage occurred. In Mendocino County, landslide damage is not separated from flood damage. A major impact of this series of systems was heavy rain-induced landslides. Cal Trans reported \$25 million worth of damage in Humboldt County alone as a result of road washouts and mud slides, with additional damage of \$17.3 million and \$3.6 million reported by Cal Trans for Mendocino and Trinity Counties for similar causes. The Hoopa Indians reported \$8.5 million worth of similar damage for roads on their lands, and Humboldt and Del Norte County reported \$21.5 million worth of landslide damage to county-owned roads. Also associated with this series of systems were a storm surge coastal flooding event and a short-lived but destructive wind event. A wind gust of 64 mph was recorded at the Eureka Weather Forecast Office, and a gust of 97 mph was reported from a research vessel at dock. Combined damage from these two events was \$4.9 million. Damage from the wind event included downed power lines and trees falling on structures. Damage from the coastal flooding event occurred to shore side facilities in Del Norte, Mendocino, and Humboldt Counties.

17.3.5 Warning Time

A meteorologist can often predict the likelihood of an onset of a severe storm. This can give several days of warning time; however, meteorologists cannot predict the exact time of onset or the severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

17.4 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides and hazards from downed power lines. Rapidly melting snow combined with heavy rain can overwhelm natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

17.5 EXPOSURE

No detailed analysis could be performed of exposure and vulnerability to the severe weather hazard due to a lack of data to severe weather damage from flooding and landslide damage, which are covered under separate chapters. What follows are assumptions based on anecdotal information.

17.5.1 Population

Assumptions can be made that the entire County is exposed to some extent to severe weather events. Certain areas are more exposed due to geographic location and localized weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations living in low-lying areas are at risk for possible flooding.

17.5.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations (such as near the coast) may risk the most damage. The frequency and degree with which they occur will depend on specific locations. To estimate the value of exposed (and vulnerable) property for each jurisdiction, data from the 2005/2006 winter storms was obtained for the County, and, where available, for each jurisdiction (See Table 17-2). It was generally not possible to separate out the flooding and landslide damage from the wind and other “severe weather” damage, so the costs presented are total damage claims.

**TABLE 17-2.
HUMBOLDT COUNTY DAMAGE CAUSED BY THE 2005-2006 WINTER STORMS**

Jurisdiction	City Damage Value	Residential Damage Value	Notes
Eureka	Not Available	Not Available	
Arcata	\$3,500,000	\$832,000	Arcata damage due primarily to high winds.
Blue Lake	\$0	Not Available	No reported damages.
Ferndale	\$50,293	Not Available	Ferndale damage due primarily to flooding.
Fortuna	Not Available	Not Available	
Rio Dell	\$413,000	Not Available	Rio Dell damage due primarily to flooding and failed culverts.
Trinidad	\$16,733	Not Available	
Humboldt County (Unincorporated)	\$20,208,206 ^a	Not Available	Mainly associated with Road Damage

a. FEMA approved \$5,878,406 in reimbursements. \$13,600,000 was requested from the Federal Highway Administration. Emergency Relief for Federally Owned Roads provided \$716,688 in funds.

17.5.3 Critical Facilities and Infrastructure

All critical facilities listed as being exposed to flooding (Chapter 15) are also likely exposed to severe weather. Additional facilities located on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Consequently phone, water and sewer systems may not function. Roads may become impassable due to ice or snow or from secondary hazards such as landslides.

17.5.4 Environment

The environment is highly exposed to severe weather events in Humboldt County. Severe storm events can drastically affect the physical environment, changing natural landscapes and affecting property and people. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather can produce channel migration affecting property. Storm surges can erode beachfront bluffs and redistribute sediment loads. Severe local storms can have significant effects on the environment. Heavy rains will cause the ground to become saturated, and rivers and streams to rise. This will result in the potential for flooding and landslides. Additionally, snowmelt after snowstorms can cause riverine flooding, which has the potential to damage riparian habitat.

17.6 VULNERABILITY

For the State Hazard Mitigation Plan, factors used to determine which counties are most vulnerable to future non-flood severe storms are how often severe storm events occur, expressed as a percentage recurrence per year. The percentage used to differentiate jurisdictions most vulnerable differs by storm type and is explained below. Data for frequency of severe storm events from 1958 to 2005 was obtained from the National Oceanic and Atmospheric Administration (Table 17-1).

Areas most vulnerable to high winds are those areas affected most by possible downed trees and loss of power. The severe wind event of December 2005 resulted in the loss of power to hundreds of homes as well as many state and county buildings. Counties considered most vulnerable to high winds are 1) those most affected by conditions that lead to high winds, and 2) those with a high wind recurrence rate of 100 percent, meaning the county experiences at least one damaging high wind event every year.

The National Weather Service (NWS) defines a winter storm as having significant snowfall, ice, and/or freezing rain; the quantity of precipitation varies by elevation. Heavy snowfall is 4 inches or more in a 12-hour period, or 6 or more inches in a 24-hour period in non-mountainous areas; and 12 inches or more in a 12-hour period or 18 inches or more in a 24-hour period in mountainous areas. In Humboldt County, severe winter storms generally consist of rain and wind events, not snow and ice.

The NWS defines a tornado as a violently rotating column of air that is in contact with the ground; tornados usually develop from severe thunderstorms. Humboldt County has not had a tornado event since 1958 and therefore cannot be considered vulnerable to a tornado event.

The NWS defines coastal flooding as flooding of shoreline areas on the Pacific Coast and inland waters caused by storm surge, high tides, or a combination of the two. Humboldt County's vulnerability to flooding is covered in Chapter 15.

17.6.1 Population

Vulnerable populations are the elderly, low income, linguistically isolated, people with life-threatening illnesses and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard. The elderly population is distributed relatively evenly throughout the county.

17.6.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Those in higher elevations and on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

There are currently no generally accepted damage function values established to estimate damage from severe storm events. There are too many intangible components to consider in establishing regional damage functions. For the purposes of this risk assessment, a damage function was established by looking at reported damages from the 2005-2006 winter storms and comparing those numbers to assessed building values in the communities that reported damages. Using this approach, it was determined that the average damage from this event was approximately 0.25 percent of the assessed value for buildings in the affected areas. To estimate vulnerability for planning purposes, this ratio has been applied to the building stock for each of the planning partners. These values are presented in Table 17-3. These estimates are based on a past occurrence, and may be understated or overstated compared to future events. However, they represent the best available information at this time and can be used by the planning partners to rank risk and establish mitigation priorities. As new science and technology become available specific to severe weather events, this vulnerability assessment should be updated.

**TABLE 17-3.
ESTIMATED LOSS FOR SEVERE WEATHER EVENTS IN HUMBOLDT COUNTY**

Jurisdiction	Assessed Building Value	Estimated Damage
Arcata	\$1,303,758,000	\$3,259,395
Blue Lake	\$63,827,000	\$159,568
Eureka	\$2,232,915,000	\$5,582,288
Ferndale	\$118,678,000	\$296,695
Fortuna	\$791,684,000	\$1,979,210
Rio Dell	\$161,199,000	\$402,998
Trinidad	\$36,825,000	\$92,063
Tribes	\$119,810,099	\$299,525
Unincorporated County	\$4,947,654,000	\$12,369,135
Total	\$9,776,350,099.00	\$24,440,877.00

17.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures, most of which are associated with secondary hazards. Mass wasting events such as landslides that block roads are caused by heavy prolonged rains. High winds can cause significant damage to trees and power lines, blocking roads and incapacitating transportation and isolating population, disrupting ingress and egress on roads with obstructing debris. Additionally, snowstorms in the higher elevations can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly.

Prolonged obstruction of major routes due to landslides, snow, debris or floodwaters can disrupt the shipment of goods and other commerce. Large and prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication for households. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

17.6.4 Environment

Severe storm events can drastically affect the physical environment, changing natural landscapes and affecting property and people. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather can produce channel migration affecting property. Storm surges can erode beachfront bluffs and redistribute sediment loads. Severe local storms can have significant effects on the environment. Heavy rains will cause the ground to become saturated and rivers and streams to rise. This will result in the potential for flooding and landslides. Snowmelt after snowstorms can cause riverine flooding, which has the potential to damage riparian habitat.

17.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms.

17.8 SCENARIO

A worst-case event would involve prolonged high winds during an extremely wet rain/snowstorm accompanied by freezing temperatures, followed by warmer weather and continued rain. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to flooding, downed tree obstructions, and downed power lines. Power outages would be common throughout the county. Some subdivisions in more rural unincorporated areas could experience limited ingress and egress. Later, as the weather warms and rains continue while snow melts, the sudden run-off could produce flooding, overtopped culverts with ponded water on roads, and landslides on steep slopes. Flooding and landslides could further obstruct roads and bridges, further isolating residents.

17.9 ISSUES

- Severe local storms will have significant impacts as Humboldt County continues to experience residential growth. In general, every household and resident in the County is likely to be exposed to severe weather, but some are more likely than others to experience isolation as a result. Those residing in higher elevations with limited transportation routes may have the greatest vulnerability to isolation from storms. Another group at risk is the 10 percent of the County population that is over the age of 65.
- Climate change may cause more severe weather patterns that could impact vulnerable populations within the planning area. Increased frequency and intensity of storms may result in greater damage.
- Detailed spatial analysis to locate the most vulnerable populations followed by focused public education and outreach mitigation activities with these populations is needed.
- The risk associated the severe weather hazard overlaps the risk associated with other hazards such as earthquake, landslide and flood. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.