

CHAPTER 11. DAM FAILURE

11.1 DAM FAILURE DEFINED

The following definitions apply in the discussion of dam failure hazards:

- **Dam**—Any artificial barrier or controlling mechanism that can impound 10 acre-feet or more of water.
- **Dam Failure**—An uncontrolled release of impounded water due to structural deficiencies in the water barrier.

11.2 GENERAL BACKGROUND

Dam failures can be catastrophic to human life and property downstream from the failure. Under the National Dam Safety Act (Public Law 92-367), the Corps of Engineers is responsible for inspecting federal and non-federal dams in the U.S. that meet the size and storage limitations of the act, in order to evaluate their safety. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding the design, construction, operation and maintenance of the dams; developed guidelines for the inspection and evaluation of dam safety; and formulated recommendations for a comprehensive national program (USACE, 1997).

The National Dam Safety Program requires a periodic, thorough engineering analysis of every major dam in the U.S. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public. The California Department of Water Resources Division of Safety of Dams monitors the program at the state level. When a new dam is proposed, Division engineers and geologists inspect the site and its subsurface to understand the local geologic conditions. Upon submittal of an application, the Division thoroughly reviews the plans and specifications prepared by the owner to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for the known geologic conditions. After approval of the application, the Division inspects all aspects of the construction to ensure that the work is being done in accordance with the approved plans and specifications. After construction, the Division inspects each dam on an annual basis to ensure that the dam is performing as intended and is not developing problems. Roughly a third of these inspections include in-depth instrumentation reviews. The Division periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California (California DSOD, 2007).

Dam failures typically occur as follows (see Figure 11-1):

- Overtopping of the primary dam structure, which accounts for 34 percent of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and by other means.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage account for 30 percent of all dam failures.
- Failure due to piping and seepage accounts for 20 percent of all failures. These are caused by internal erosion due to piping seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.

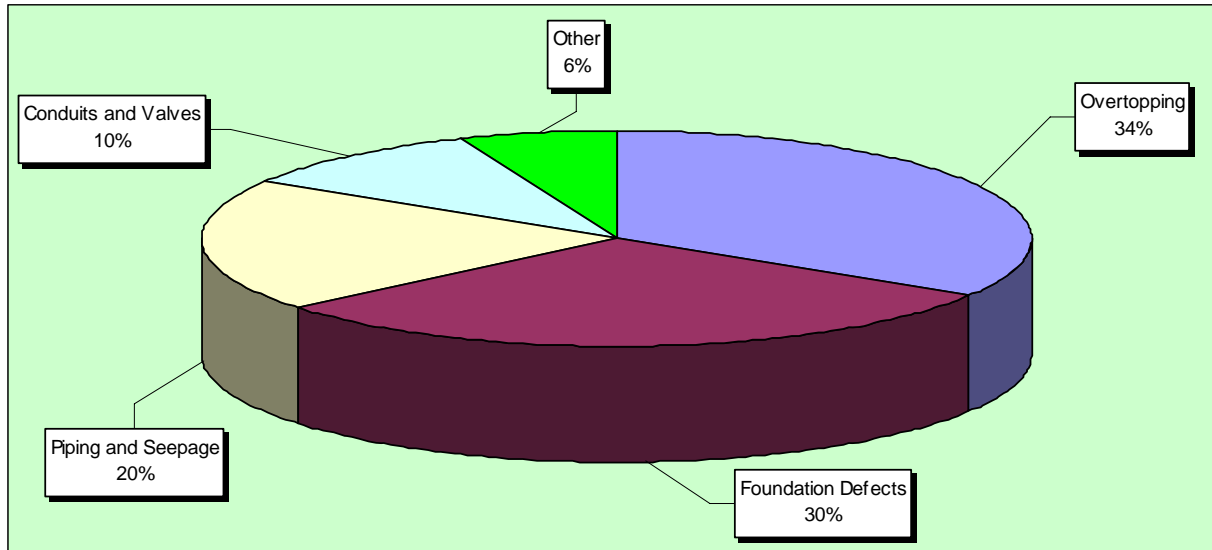


Figure 11-1: Historical Causes of Dam Failure

- Failure due to conduit and valve problems, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10 percent of all failures.
- The remaining 6 percent are due to other miscellaneous causes.

Many dam failures in the United States have been secondary results of other disasters, such as earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, or sabotage. The most likely disaster-related causes of dam failure in Humboldt County are earthquakes, overtopping caused by excessive rainfall, and landslides. Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

11.3 HAZARD PROFILE

11.3.1 Past Events

No known dam failures have occurred in Humboldt County or on any rivers that pass through Humboldt County. However, dam failures have occurred in California. In 1928, The Francisquito Canyon Dam near Los Angeles collapsed. The released water killed over 400 people. In 1963, the dam impounding the Baldwin Hills Reservoir, also near Los Angeles, failed and the subsequent wall of water and mud damaged or destroyed 123 homes and 670 apartment units (EDM, 2007).

11.3.2 Location

There are over 20 dams that are in Humboldt County or that impound rivers that flow through Humboldt County. Table 11-1 lists the dams that could impact portions of the County if they were to fail.

**TABLE 11-1.
DAMS IN HUMBOLDT COUNTY
OR IMPOUNDING RIVERS THAT FLOW THROUGH HUMBOLDT COUNTY**

Name of Dam	County	Water Course	Owner	Year Built	Crest Elevation (feet)	Dam Type	Crest Length (feet)	Height (feet)	Storage Capacity (acre-ft)	Use ^a
Trinity	Trinity	Trinity River	U.S. Bureau of Reclamation	1962	2,395.0	Earth	2,450	458	2,447,650	MULTI, IRR, REC, POW
Link River Diversion Dam	Klamath, Oregon	Klamath/ Link River	U.S. Bureau of Reclamation	1928	4,145.0		435	22	735,000	DIV
Copco No 1	Siskiyou	Klamath River	PacifiCorp	1922	2,613.0	Gravity	415	132	77,000	STO, DIV, POW
Scott	Lake	Eel River	Pac Gas And Electric	1921	1924.6	Gravity	815	138	73,000	STO, POW
Robert W Matthews	Trinity	Mad River	Humboldt Bay Municipal Water Dist	1962	2,686.0	Earth	630	150	61,000	STO, POW, MUN, REC
Iron Gate	Siskiyou	Klamath River	PacifiCorp	1962	2,343.0	Earth and Rock	745	188	58,000	STO, REG, POW
Lewiston	Trinity		U.S. Bureau of Reclamation	1963	1,910.0	Earth	745	73	14,660	
JC Boyle	Klamath, Oregon	Klamath River	PacifiCorp	1958	3,800.0	Earth	693	68	3,495	POW,
Benbow	Humboldt	S. Fork Eel River	CA Dept of Parks And Rec	1932	374.0	Slab and Buttress	283	16	1,060	STO, REC
Big Lagoon	Humboldt	Big Lagoon	Louisiana-Pacific Corp	1947	17.2	Earth	3,700	16	780	STO, IND
Van Arsdale	Mendocino	South Eel River	Pac Gas And Electric	1907	1,519.0	Gravity	515	96	700	STO, DIV, POW
Scotia Log Pond	Humboldt	Tributary Eel River	Pacific Lumber Co	1910	135.0	Earth	3,700	24	210	STO, IND
Jones Ranch	Trinity	Tributary Trinity River	Eleanor Jones	1980	1,905.5	Earth	350	36	58	STO, REC
Copco No 2	Siskiyou	Klamath River	PacifiCorp	1925	2,484.0	Gravity	148	37	55	DIV, POW
Arcata	Humboldt	Jolly Giant Creek	City Of Arcata	1937	455.0	Earth	160	50	46	STO, DOM, MUN

a. Use codes: DIV = Diversion; DOM = Domestic; IND = Industrial; IRR = Irrigation; MULTI = Multi-purpose; MUN = Municipal; POW = Power Generation; REC = Recreation; REG = Regulation; STO = Storage

Dams on the Klamath, Trinity, Mad, and Eel Rivers pose the major threats to people or property in Humboldt County because they hold the most water and would inundate the widest area. The Scotia Log Pond, which impounds up to 210 acre-feet of water on a tributary to the Eel River, poses the most

immediate threat to life. A total failure of this dam would inundate some or all of the 49 homes immediately downstream within 60 feet to 400 feet of the dam. At this proximity, inundation would occur without warning.

Figure 11-2 shows worst-case inundation areas from dam failure on the large rivers. The Klamath and Trinity Rivers are displayed together, though they are impounded by unconnected systems. The total impact area is 22,769 acres for the Klamath/Trinity Rivers, 8,074 acres for the Mad River, and 16,673 acres for the Eel River. Combined, this accounts for just over 2 percent of the total area of Humboldt County. However, stream-side and river-front properties are often more heavily populated and more highly valued than other areas. Therefore, the potential impact of dam failures to human life and land values in the County pose a considerable threat. In addition there could be a significant cultural impact due to the presence of Tribal lands downstream of dam failure inundation areas.

11.3.3 Frequency

Dam failure events are infrequent and usually coincide with the events that may cause them, including earthquakes, landslides and overtopping due to excessive rainfall and snowmelt. No recorded dam failures have occurred in Humboldt County.

11.3.4 Severity

Dam failure can be catastrophic to all life and property downstream. Past dam failure events in California have led to loss of life and have had significant economic and environmental impacts. Table 11-2 shows the US Army Corps of Engineers' classification for determining hazard potential of dam failures (USACE, 1995).

11.3.5 Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or anticipated massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, it is possible that there would be no warning time.

A dam's structural type also affects warning time. Earthen dams, which far outnumber all other types of dams, do not tend to completely fail, nor do they fail instantaneously. Once a developing breach has been initiated, the discharging water will erode the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections formed during the dam construction are forced apart by the escaping water. The time for breach formation is in the range of a few minutes to a few hours (USACE, 1997).

The time from dam failure until the resulting floodwaters reach developed portions of the County will be 5.5 hours on the Mad River, about 6 hours on the Eel River, and 7 hours on the Trinity River. The number of people to be alerted and evacuated can vary widely. There may be few people along the river in winter, when only permanent residents are apt to be present; but there may be many people in summer, when seasonal cabins are occupied and there are fishermen and campers along all the rivers. Another factor that must be considered is the initial flow in the river when the failure occurs. This initial flow is normally very low on all the rivers from May through October. During winter, the initial flow is much higher and, at times, may even be equal to or greater than flood stage. This wide variation in initial flow has a significant impact on the areas that must be evacuated.

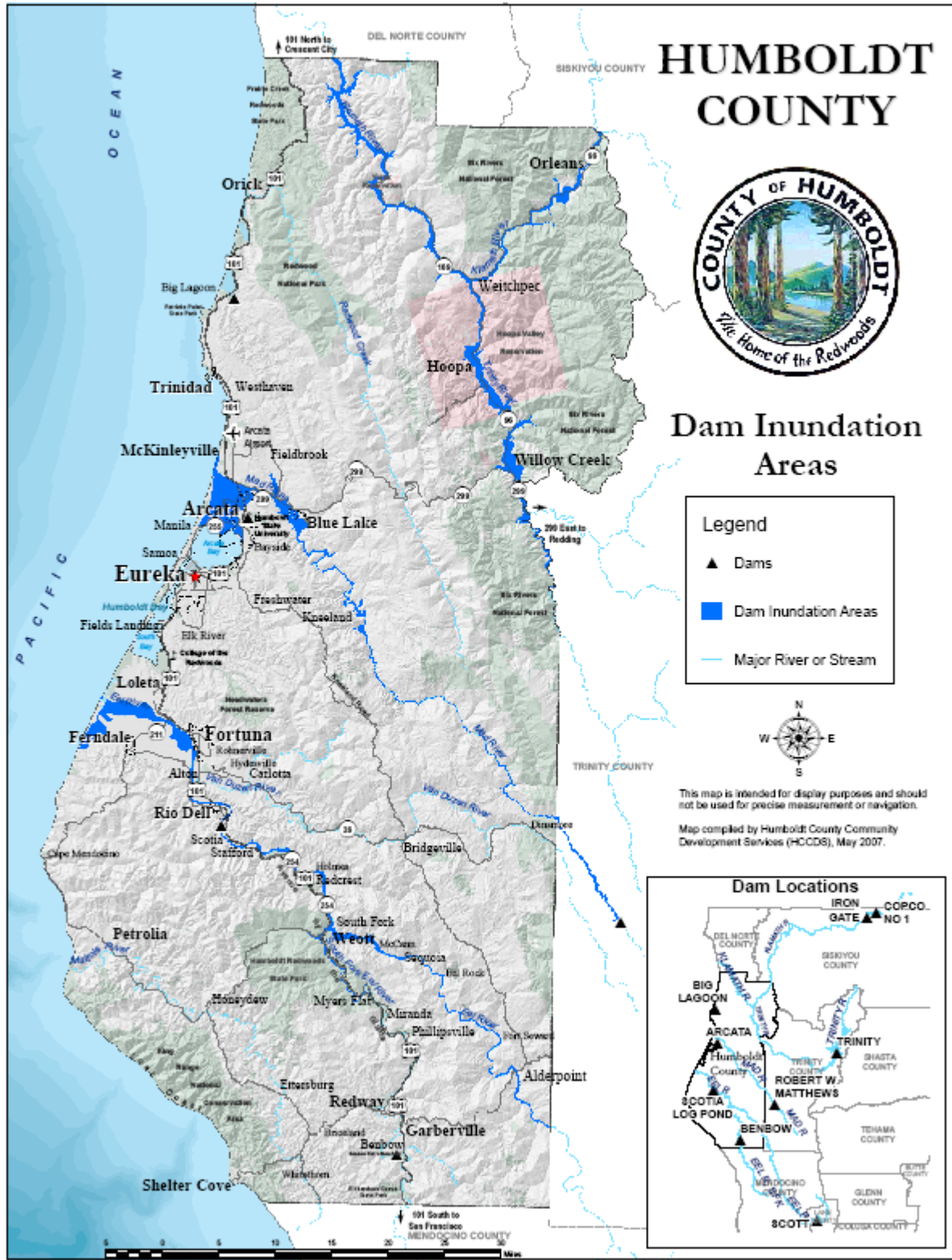


Figure 11-2: Dam Inundation Areas

**TABLE 11- 2.
HAZARD POTENTIAL CLASSIFICATION**

Category ¹	Direct Loss of Life ²	Lifeline Losses ³	Property Losses ⁴	Environmental Losses ⁵
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

1. Categories are based upon project performance and do not apply to individual structures within a project.
2. Loss of life potential based upon inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
3. Indirect threats to life caused by the interruption of lifeline services due to project failure, or operation, i.e. direct loss of (or access to) critical medical facilities.
4. Direct economic impact of property damages to project facilities and downstream property and indirect economic impact due to loss of project services, i.e. impact on navigation industry of the loss of a dam and navigation pool, or impact upon a community of the loss of water or power supply.
5. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond which would normally be expected for the magnitude flood event under which the failure occurs.

11.4 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding depending on the magnitude of the failure. Other potential secondary hazards of dam failure include landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

11.5 EXPOSURE

There are 20 dams of concern that are either in Humboldt County or impound rivers that flow through the County. A failure of any of these dams would threaten life and property to some degree. In particular, those dams on the Klamath, Trinity, Mad, and Eel Rivers are of the greatest concern. Figure 11-2 displays the areas of Humboldt County that are subject to inundation. This map was used to determine the degree of occupancy, the value of parcels, and the number of critical facilities within inundation areas.

11.5.1 Population

All populations within dam failure inundation zones would be exposed to the effects of a dam failure. Failure or mis-operation at any of the major dams is likely to cause loss of human life. The potential for loss of life is affected by the capacity and number of evacuation routes available to populations living in areas of potential inundation. The population within the inundation areas of the Klamath, Trinity, Mad, and Eel Rivers is 4,977, or 3.93 percent of the total County population. Approximately 2,404 houses, 4.37 percent of the County total, are within the inundation areas. Table 11-3 summarizes the at-risk population information.

TABLE 11-3. HUMBOLDT COUNTY POPULATION AT RISK TO DAM FAILURE				
River System	Affected Population	% of County	# of Houses	% of County
Klamath/Trinity	2,924	2.31%	1,422	2.58%
Mad	1,365	1.08%	664	1.21%
Eel	688	0.54%	318	0.58%
Total	4,977	3.93%	2,404	4.37%

11.5.2 Property and Land Use

GIS analysis was used to determine the land use types of parcels within the mapped inundation areas. Approximately 4,567 parcels face the possibility of inundation in the event of dam failure. These properties range from just downstream of the dams to properties on coastal riverfronts. Of these parcels, nearly 30 percent are occupied rural residential; 16 percent are unoccupied rural residential. Thus, nearly half of the exposed parcels are zoned residential. Figure 11-3 shows the distribution of general land use types in the dam inundation areas. Table 11-4 lists detailed information on the land use of the parcels exposed to potential inundation due to dam failure.

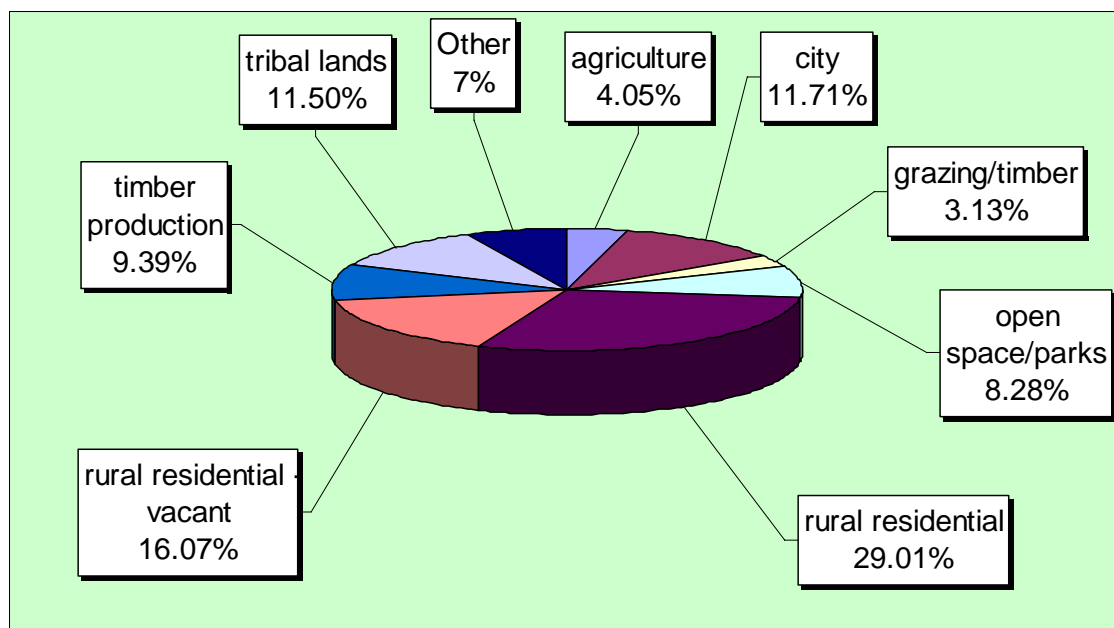


Figure 11-3: Land Use Types in Dam Inundation Areas

GIS analysis was used to determine the number of critical facilities within mapped dam inundation areas. Tables 11-5 and 11-6 identify the County’s critical facilities in areas of potential dam inundation. The majority of these are bridges. Table 11-7 shows the number of critical facilities within the inundation area by jurisdiction; this includes 33 critical facilities in the County under the jurisdiction of Native American tribes, which are not among the planning partners for this plan.

The GIS analysis was also used to determine the value of property within inundation areas. Table 11-8 displays these values.

**TABLE 11-4.
HUMBOLDT COUNTY LAND USE AND DAM INUNDATION RISK**

Land Use	Parcels Within Inundation Area						All Parcels in County	
	Klamath/Trinity		Mad River		Eel River		Parcels	% of Total
	Parcels	% of Total	Parcels	% of Total	Parcels	% of Total		
No Description	14	0.54%	23	2.12%	5	0.57%	426	0.57%
Agriculture	0	<0.01%	24	2.21%	161	18.30%	1,647	2.20%
Camp	0	<0.01%	0	<0.01%	1	0.11%	4	<0.01%
Cemetery	0	<0.01%	0	<0.01%	0	<0.01%	7	<0.01%
Church	17	0.65%	2	0.18%	0	<0.01%	101	0.14%
City	0	<0.01%	453	41.75%	82	9.32%	22,368	29.90%
Commercial	52	2.00%	2	0.18%	2	0.23%	783	1.05%
Commercial - vacant	2	0.08%	0	<0.01%	0	<0.01%	332	0.44%
Golf course	0	<0.01%	0	<0.01%	0	<0.01%	13	0.02%
Gravel mining	4	0.15%	11	1.01%	2	0.23%	28	0.04%
Grazing/timber	0	<0.01%	49	4.52%	94	10.68%	2,251	3.01%
Heavy industrial	0	<0.01%	3	0.28%	1	0.11%	78	0.10%
Heavy industrial - vacant	0	<0.01%	8	0.74%	1	0.11%	90	0.12%
Landfill	0	<0.01%	0	<0.01%	0	<0.01%	2	<0.01%
Light industrial	0	<0.01%	0	<0.01%	0	<0.01%	15	0.02%
Light industrial - vacant	0	<0.01%	0	<0.01%	0	<0.01%	60	0.08%
Multi family residential	10	0.38%	2	0.18%	0	<0.01%	715	0.96%
Multi fam residential - vacant	0	<0.01%	0	<0.01%	0	<0.01%	113	0.15%
Open space/parks	184	7.07%	20	1.84%	174	19.77%	3,401	4.55%
Public	34	1.31%	46	4.24%	33	3.75%	830	1.11%
Rural residential	1,081	41.54%	156	14.38%	88	10.00%	11,248	15.04%
Rural residential - vacant	537	20.64%	88	8.11%	109	12.39%	5,612	7.50%
School	0	<0.01%	0	<0.01%	0	<0.01%	30	0.04%
Single family residential	0	<0.01%	9	0.83%	3	0.34%	11,570	15.47%
Single family residential - vacant	0	<0.01%	0	<0.01%	7	0.80%	5,044	6.74%
Timber production	147	5.65%	173	15.94%	109	12.39%	7,010	9.37%
Tribal lands	520	19.98%	5	0.46%	0	<0.01%	958	1.28%
Vacant	0	<0.01%	11	1.01%	8	0.91%	64	0.09%
Total Parcels	2,602	100.00%	1,085	100.00%	880	100.00%	74,800	100.00%
Total Vacant Parcels	539	20.71%	107	9.86%	125	14.20%	11,315	14.20%
Non-dwelling Parcels	974	37.43%	830	76.50%	673	76.48%	40,498	76.48%
Dwelling parcels (occupied)	1,091	41.93%	167	15.39%	91	10.34%	23,533	10.34%
Dwelling parcels (vacant)	537	20.64%	88	8.11%	116	13.18%	10,769	13.18%

TABLE 11-5. HUMBOLDT COUNTY CRITICAL FACILITIES IN AREAS OF DAM INUNDATION								
Jurisdiction	Medical and Health Services	Government Function	Protective Function	Schools	Societal Function	Hazmat	Other Critical Function	Total
Arcata	3	1	3	6	0	7	5	25
Blue Lake	1	1	0	1	0	1	1	5
Fortuna	1	0	0	0	1	5	3	10
Rio Dell	0	0	0	1	0	1	2	4
Unincorporated County	1	2	6	5	6	15	11	46
Total	6	4	9	13	7	29	22	90

TABLE 11-6. CRITICAL INFRASTRUCTURE WITHIN HUMBOLDT COUNTY								
Jurisdiction	Water Supply	Water Storage	Waste Water	Power	Fuel storage	Communications	Bridges	Total
Arcata	1	0	0	0	0	0	14	15
Blue Lake	0	0	1	1	0	0	1	3
Fortuna	0	0	2	0	0	0	5	7
Rio Dell	0	0	1	1	0	0	5	7
Unincorporated County	5	0	3	0	0	2	26	36
Total	6	0	7	2	0	2	51	68

TABLE 11-7. LOCATION OF CRITICAL FACILITIES IN DAM INUNDATION AREAS BY JURISDICTION	
Jurisdiction	Number of Critical Facilities
City of Blue Lake	7
City of Rio Dell	1
Tribes	33
Humboldt County	49
Total	90

**TABLE 11-8.
VALUE OF PROPERTY WITHIN HUMBOLDT COUNTY DAM INUNDATION AREAS**

Type	Property Value Exposed			% of Total Assessed Value		
	Klamath/ Trinity	Mad	Eel	Klamath/ Trinity	Mad	Eel
AGRICULTURE						
Agriculture	\$469,327	\$163,406	\$47,437	<0.01%	<0.01%	<0.01%
COMMERCIAL						
Retail Trade	\$3,078,278	\$793,867	\$620,520	0.03%	<0.01%	<0.01%
Wholesale Trade	\$1,160,945	\$3,950	\$504,720	0.01%	<0.01%	<0.01%
Personal and Repair Services	\$1,318,224	\$13,400	\$156,919	0.01%	<0.01%	<0.01%
Professional/Technical Services	\$1,590,703	\$248,954	\$138,514	0.02%	<0.01%	<0.01%
Banks	\$344,579	\$67,177	\$0	0.18%	<0.01%	<0.01%
Hospital	\$3,746,996	\$0	\$0	0.04%	<0.01%	<0.01%
Medical Office/Clinic	\$373,127	\$0	\$19	<0.01%	<0.01%	<0.01%
Entertainment & Recreation	\$2,575,057	\$14,697	\$475,415	0.03%	<0.01%	<0.01%
Theaters	\$0	\$0	\$0	<0.01%	<0.01%	<0.01%
Parking	\$0	\$0	\$0	<0.01%	<0.01%	<0.01%
EDUCATION						
Grade Schools	\$4,033,159	\$13,257	\$54,074	0.04%	<0.01%	<0.01%
Colleges/Universities	\$254,000	\$0	\$0	<0.01%	<0.01%	<0.01%
GOVERNMENT						
General Services	\$4,024,996	\$422,783	\$0	0.04%	<0.01%	<0.01%
Emergency Response	\$896,498	\$0	\$0	<0.01%	<0.01%	<0.01%
INDUSTRIAL						
Heavy	\$8,206	\$6,871	\$71,908	<0.01%	<0.01%	<0.01%
Light	\$90,000	\$7,306	\$93,403	<0.01%	<0.01%	<0.01%
Food/Drugs/Chemicals	\$0	\$129,076	\$0	<0.01%	<0.01%	<0.01%
Metals/Minerals Processing	\$0	\$0	\$0	<0.01%	<0.01%	<0.01%
High Technology	\$0	\$0	\$0	<0.01%	<0.01%	<0.01%
Construction	\$587,892	\$496,955	\$58,490	<0.01%	<0.01%	<0.01%
RELIGION						
Churches /Other Non-profit Org.	\$1,686,127	\$10,499	\$19	0.02%	<0.01%	<0.01%
SINGLE FAMILY						
Single Family Dwelling	\$110,876,637	\$59,680,717	\$29,001,177	1.15%	0.62%	0.30%

**TABLE 11-8 (continued).
VALUE OF PROPERTY WITHIN HUMBOLDT COUNTY DAM INUNDATION AREAS**

Type	Property Value Exposed			% of Total Assessed Value		
	Klamath/ Trinity	Mad	Eel	Klamath/ Trinity	Mad	Eel
RESIDENTIAL						
Manufactured Housing	\$14,769,026	\$4,747,357	\$2,068,776	0.15%	0.05%	0.02%
Duplex	\$1,214,838	\$2,698,596	\$656,221	0.01%	0.03%	<0.01%
Triplex / Quads	\$388,902	\$1,913,544	\$1,118,181	<0.01%	0.02%	0.01%
Multi-dwellings (5 to 9 units)	\$111,197	\$3,312,171	\$105,713	<0.01%	0.03%	<0.01%
Multi-dwellings (10 to 19 units)	\$456,734	\$131,551	\$98,447	<0.01%	<0.01%	<0.01%
Multi-dwellings (20 to 49 units)	\$222,429	\$9,593	\$158,249	<0.01%	<0.01%	<0.01%
Multi-dwellings (50+ units)	\$0	\$18,030	\$0	<0.01%	<0.01%	<0.01%
Temporary Lodging	\$3,513,355	\$5,860,986	\$887,148	0.04%	0.06%	<0.01%
Institutional Dormitory	\$526,999	\$0	\$694,023	<0.01%	<0.01%	<0.01%
Nursing Home	\$0	\$0	\$0	<0.01%	<0.01%	<0.01%
TOTAL VALUE EXPOSED	\$158,318,233	\$80,764,742	\$37,009,372	1.64%	0.84%	0.38%

11.5.3 Environment

The environment would be exposed to a number of risks in the event of dam failure. The inundation could introduce many foreign elements and debris into local waterways. This could result in destruction of downstream habitat and could have detrimental effects on many species of animals, especially endangered species such as salmon.

11.6 VULNERABILITY

All above mentioned dams are subject to failure, and all dams are vulnerable to a variety of possible causes of failure.

11.6.1 Population

Vulnerable populations include all populations downstream from a dam failure that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system.

11.6.2 Property

Vulnerable properties are those located closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since this is where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

11.6.3 Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation of excess water has the potential to introduce foreign elements and debris into local waterways. This could result in destruction of downstream habitat and could have detrimental effects on many species of animals, especially endangered species such as coho salmon. The extent of the vulnerability of the environment is the same as the exposure of the environment.

11.7 FUTURE TRENDS IN DEVELOPMENT

Of the 4,567 parcels in Humboldt County that fall within dam inundation areas, 771 or 17 percent are vacant residential parcels. Therefore, future trends in development are very likely along areas subject to dam inundation.

11.8 SCENARIO

In a worst-case scenario, a shallow fault-generated earthquake with a magnitude of 7.5 could be enough to cause dam failure in many of the Humboldt County dams that are of concern. An earthquake such as this could lead to liquefaction of the ground soils where the dams are located. This could occur without warning in the middle of the night when residents in river-front homes and campers are asleep and unprepared to evacuate.

11.9 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zones. Flooding as a result of a failure would significantly impact these areas. Additionally, there is often little or no warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides and severe weather, which limits their predictability and compounds the hazard. Additional inundation area studies may be necessary for the Scotia Log Pond Dam.

Spatially explicit (GIS based) studies identifying populations living in the inundation zones with an emphasis on the most vulnerable community members are needed.