HEALTH RISK TO LOCAL RESIDENTS FROM THE HUMBOLDT NUCLEAR PLANT

Joseph J. Mangano MPH MBA
Radiation and Public Health Project
February 6, 2026

EXECUTIVE SUMMARY

The Humboldt Bay 3 nuclear reactor in northern California operated from 1963 to 1976, when it closed permanently. During this time, the reactor experienced numerous mechanical difficulties, the worst of which was a loss of cooling water in the core in July 1970. In addition, Humboldt Bay 3 had the 2nd highest airborne radioactive emissions of 13 U.S. reactors. Science magazine called it "the dirtiest of the nation's power reactors."

Health trends in persons living near Humboldt Bay 3 are not routinely monitored. Humboldt Bay 3 was part of a study of cancer deaths by the National Cancer Institute (NCI) in the late 1980s. The NCI analysis compared cancer mortality rates before and after reactor startup. It found the Humboldt County rate was equal to the U.S. rate in 1950-1963, before the reactor began operating.

This report analyzes trends in Humboldt County of cancer incidence, plus trends in county versus California death rates. Major findings show that compared to the state, the county rate:

1. Is 10.8% higher for 2017-2021 cancer incidence, ranked 10th among 58 California counties; nine major types of cancer are among the 10 highest county rates in the state

2. Rose from 3.7% higher to 33.4% higher for cancer deaths (all ages) since the early 1970s

3. Rose from 0.1% higher to 41.7% higher for cancer deaths (age 0-74) since the early 1970s

4. Rose from 9.4% higher to 29.5% higher for all-cause deaths (all ages) since the early 1970s

5. Rose from 8.3% higher to 49.4% higher for all-cause deaths (age 0-74) since the early 1970s

6. Had the highest recent (2009-2020) excess mortality among middle age adults – including 99.1%, 77.5%, and 77.4% higher for age 25-34, 35-44, and 45-54

Aside from a somewhat higher rate of smoking, no obvious factor accounting for these trends is identified. It is important for health officials to further study possible reasons for these patterns, including latent effects of exposure to radioactive releases from the Humboldt Bay 3 reactor.\

Figure 1
Percent Humboldt County Rate vs. California Rate
Mortality from All Cancers Combined, All Ages
(Note: Before 1969, County Rate is Compared with U.S.)

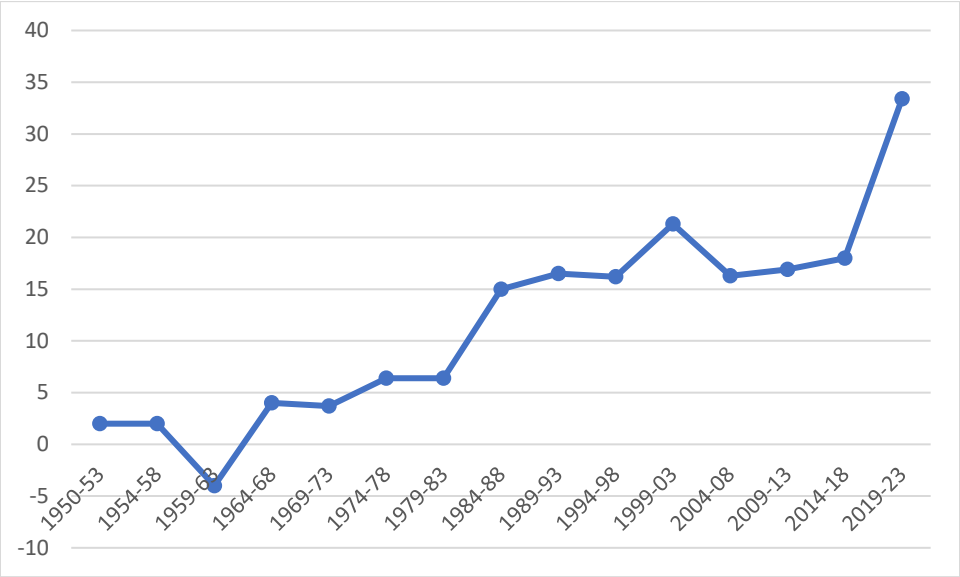

Figure 2
Percent Humboldt County Rate vs. California Rate
Mortality from All Causes Combined, Age 0-74 (blue) and 75+ (brown)

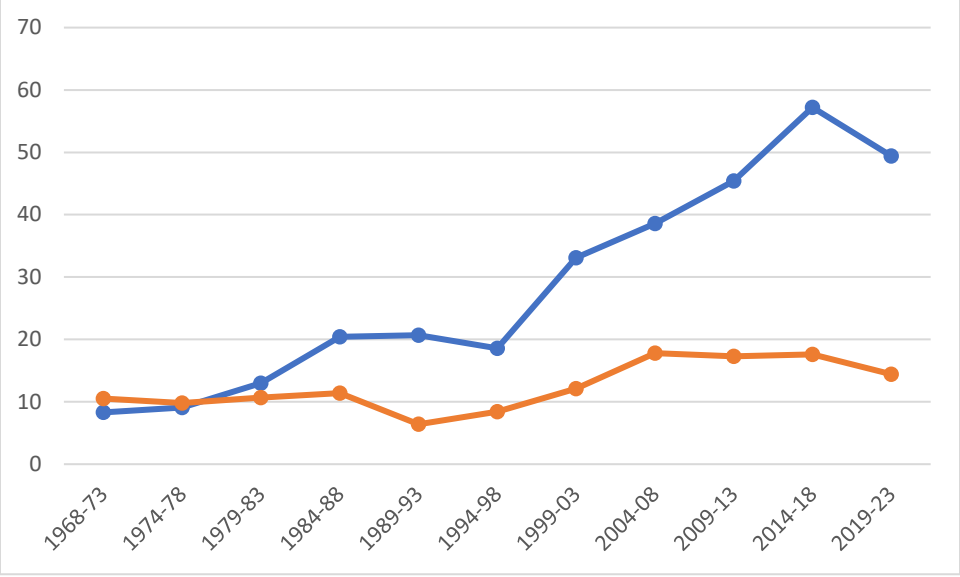

TABLE OF CONTENTS

Background– the Humboldt Bay 3 Nuclear Reactor.

The Humboldt Bay nuclear plant was one of the first to produce nuclear power in the United States. The plant, which featured a single, small (63 megawatts electrical) reactor known as Humboldt Bay 3, is in the northwest portion of Humboldt County, California, about five miles from the city of Eureka. The plant operated from August 1, 1963 to July 2, 1976, when it shut permanently, after the discovery that it was built on a fault prone to earthquakes (Savage, 2021; World Nuclear Association, 2025). Decommissioning ended in 2021, and used fuel rods that hold radioactive waste are stored in steel and concrete casks on the site.

On July 17, 1970, an operator error at Humboldt Bay 3 caused cooling water to recede to just six inches above fuel in the reactor core, well below the normal level of nine feet. While the problem was noticed and pumps returned the water level to normal relatively quickly, radioactive steam filled the reactor core, and was vented into the building. While the extent of environmental releases is still unknown, a citizen group reported a large quantity of radioactivity was released into local air and water, citing a 1971 study by the Western Environmental Research Lab (Cairns, 2024).

In addition to the near-meltdown, Humboldt Bay 3 released radioactivity into local air and water on a routine basis during its operation, as do all nuclear power reactors. These releases enter bodies through breathing, food, and water. They, along with the 1970 accident, raise the issue of potential health hazards to persons living close to the reactor.

Two reports by federal regulators, published in 1970 and 1971, presented data on radioactive waste discharged into the environment for U.S. reactors that were operating during the 1960s. Among the types of radioactivity included was airborne noble and activation gases – primarily made up of krypton-83, -85, -87, -88 and -89; and xenon-133, -135, -137, and -138. Over 100 other isotopes are released routinely into the environment from reactors, but noble and activation gases can be used as a proxy for identifying the reactors with the highest total releases (U.S. Department of Health, Education, and Welfare, 1970; U.S. Environmental Protection Agency, 1971).

The high levels of releases from Humboldt were addressed in a June 1971 article in the journal *Science*. The article noted the federal Atomic Energy Commission's proposed rule that restricted reactor emissions to a dose no more than 1% of existing standards; all nuclear plants complied with this rule, except for Humboldt Bay and Dresden (Illinois). The article singled out Humboldt Bay releases "as much as 900,000 curies of radioactive noble gases (57 percent of the maximum allowed for that plant)," calling it "the dirtiest of the nation's power reactors" (Gillette, 1971).

The following table shows the total noble and activation gas emissions into the environment from the years 1959 to 1970, for each of the 13 U.S. reactors in operation, in curies. It also provides the percent of permissible limits that these releases represent. Appendix 1 includes detailed annual data for these releases.

Reactor	Year of 1st Reported Data	Releases of Noble and Activation Gases Total	% of Limit, 1967-70
Shippingport	1959	0.7	.002
Yankee Rowe	1961	21736	.087
Indian Point	1963	2468	.011
San Onofre	1967	1836	.074
Connecticut Yankee	1967	895	1.178
R.E. Ginna	1970	10070	2.790
Dresden	1961	4574400	2.820
Big Rock Point	1962	1811612	0.783
Humboldt Bay	1963	**3261891**	**44.050**
La Crosse	1965	1180	0.120
Nine Mile Point	1969	9555	0.016
Oyster Creek	1969	119000	0.627
Peach Bottom	1966	198	9.499

Humboldt Bay Releases and % of Limit, by Year

1963	716	.05
1964	5,975	.38
1965	197,000	12.5
1966	282,000	17.8
1967	896,000	**56.7**
1968	853,000	**54.0**
1969	492,000	**31.2**
1970	535,200	**34.3**

The data show that three reactors – Dresden, Big Rock Point, and Humboldt Bay – easily had the largest releases. These are the only three that are boiling water reactors, which are known to release larger amounts of radioactivity. All other reactors are pressurized water reactors, except for Peach Bottom, which is a high-temperature gas-cooled reactor.

Humboldt Bay had the largest total releases of any of the 13 reactors, except for Dresden, which began operations earlier. But by the period 1967-1970, when 10 of the 13 reactors were operating, Humboldt had the highest releases. More importantly, the percent of permissible limits released by Humboldt was 44.050% - far higher than the next highest (9.499%). All other reactors had permissible limits under 3%.

These large releases into the local environment near Humboldt Bay suggest humans were harmed, and support a study of local rates of disease and death in subsequent years.

Introduction – Health Concerns from Humboldt Bay 3 Operations Remain Unaddressed.
When ingested, all radioactive isotopes damage DNA in cells or kills them outright, leading to an elevated risk of disease and death. Several major findings are clear after decades of study:

1. All humans are affected negatively by radiation exposure, even at the lowest doses (Committee on the Biological Effects of Ionizing Radiation, 1990)

2. The most severe effects of a radiation dose are to the fetus and infant, whose immune systems are immature; by the frail elderly, whose immune systems are failing; and by those who are immunocompromised

3. The lag time between exposure and onset of disease or death may take several years, or even decades

4. While some cancers are known to be especially sensitive to radioactivity, such as thyroid cancer or bone cancer, the risk of all cancers are increased after radiation exposure

Numerous articles have appeared in the medical literature, documenting the excess in cancers after relatively low-dose exposures. A recent article in the Journal of the National Cancer Institute found 21 of the 26 studies determined an excess of cancer from low-level radiation (Gonzalez, 2020). Another recent article of 310,000 nuclear plant workers tracked for an average of 35 years observed an excess rate of cancer deaths even at very low levels of exposure – levels well below those among survivors of the Hiroshima and Nagasaki bombs (Richardson, 2023).

The Radiation and Public Health Project (RPHP), a non-profit research and educational organization, has published 44 medical journal articles, mostly on health patterns and trends near nuclear plants. RPHP studies often document unexpectedly high rates of cancer closest to nuclear plants, especially near reactors built in the 1960s (Radiation and Public Health Project, 2025).

Government studies of health near nuclear facilities have been virtually non-existent. In the late 1980s, at the insistence of Senator Edward M. Kennedy, the National Cancer Institute conducted a study of cancer mortality near 62 U.S. nuclear plants. The study compared the ratio of county vs. U.S. cancer mortality rates before and after the plants began operating, using 1950-1984 data. The study concluded there was no consistent link between plant startup and cancer mortality, and remains the only federal analysis of health patterns near U.S. nuclear plants (Jablon, 1990).

One of the 62 plants in the study was Humboldt Bay 3. A comparison of Humboldt County and U.S. cancer death rates for five-year periods found a modest increase in this ratio after the plant operated; the Humboldt County rate was equal to the U.S. rate in 1950-1963, and 4% higher in 1964-1984. Some of the information from that study will be used in this report.

Methods – Ratio of Humboldt County vs. California Morbidity and Mortality Rates.
Humboldt County will be the focus of this report. It is the location of the Humboldt Bay 3 reactor, and was selected by the National Cancer Institute as the target area in its 1990 study. The most populated cities of Eureka, Arcata, and Fortuna are in the northwest portion of the county, which means roughly half of the county's 136,000 residents live within 10 miles of the reactor, in the downwind direction.

One measure of local health will be cancer incidence. The National Cancer Institute makes incidence (the rate and number of newly-diagnosed cancers) available for each U.S. county, along with each state and the U.S., in the five-year period 2017-2021 on its web site (National Cancer Institute, 2025). Earlier cancer incidence statistics are not readily available.

In addition, mortality from cancer and from all causes will be studied, using the Centers for Disease Control and Prevention's CDC Wonder data base as a source. Available online, CDC Wonder includes information on U.S. deaths, each year from 1968 to 2020; county-specific mortality rates are available for 2021-2024, but are still preliminary as county-specific populations have not been updated since the 2020 census (U.S. Centers for Disease Control and Prevention, 2025).

Both incidence and mortality rates are age-adjusted to the 2000 U.S. standard population. Age adjustment is a standard technique used in epidemiology, which averts areas with the largest elderly populations from having the highest rates, allowing rates of geographic areas to be compared on an "apples to apples" basis.

The mortality ratio used in this study will be the Humboldt County rate compared to the California rate. Ratios begin with 1968-1973 (six years) and ending 2019-2020 (two years), and each five-year period in between.

Results – Current Cancer Incidence.
The Humboldt County cancer incidence rate for the five years 2017-2021 was 10.8% above the California rate – the 10th highest rate of all 58 California counties. A total of 3,845 cancer cases were diagnosed in county residents this period. Humboldt was ranked 9th highest for males, females, and persons under 65, and 11th highest for persons over 65.

Humboldt County incidence rates are among the highest 10 California counties for nine types of cancer, including bladder, child (under age 15), liver, lung, melanoma, non-Hodgkin's Lymphoma, oral cavity/pharynx, ovary, and pancreas. See Appendix 2 for more detailed data.

Results – Cancer Mortality Trends Since 1950.
The 1990 National Cancer Institute study shows that in the period before Humboldt Bay 3 began operating, the county's cancer mortality rate was close to the U.S. rate. In 1950-1953, the county was 2% above the U.S., followed by 2% above and 4% below in the following five-year periods.

The 1990 report showed the ratio of Humboldt County and U.S. death rates for all cancers combined increased modestly after plant startup. It assigned a Standard Mortality Rate (SMR) for Humboldt County, for the periods before (1950-1963) and after (1964-1984) startup. The SMR for all cancers rose from 1.00 to 1.04 in these periods, based on 1,628 and 3,590 cancer deaths in the respective periods. An SMR of 1.00 indicates the county and national rates were equal, while 1.04 indicates Humboldt's rate was 4% greater.

In the periods beginning in the late 1960s, the Humboldt County/California cancer mortality ratio gradually increased, peaking at 33.4% in 2019-2023, the most recent period available:

1969-1973	3.2% higher
1974-1978	6.4% higher
2014-2018	18.0% higher
2019-2023	33.4% higher

Currently, over 300 residents of Humboldt County die of cancer each year. See Appendix 3 and Figure 1 for more detailed data.

Results – Mortality for All Cancers Age 0-74.
In 1968-1973, the Humboldt County cancer death rate for persons age 0-74 was just 0.1% above the California rate. Since then, there has been a steady increase in the gap; the peak occurred in the most recent five years (2019-2023), when the county rate exceeded the state by 41.7% (see below, and Appendix 6).

1968-1973	+ 0.1%
1974-1978	+ 5.0%
2014-2018	+24.2%
2019-2023	+41.7%

Results – Mortality for All Causes Combined.
In both 1968-1973 and 1974-1978, the Humboldt County rate of death from all causes exceeded the California rate by 9.4%. Fewer than 900 county residents died each year during this period.

The county/state mortality ratio increased steadily thereafter, reaching peaks in recent periods:

1968-1973 9.4% higher
1974-1978 9.4% higher

2014-2018 33.9% higher
2019-2023 29.5% higher

Currently, about 1500 Humboldt County residents die each year. Part of this increase over the past half-century is the increase in the portion of elderly persons; but because the rates are age-adjusted, the larger proportion of elderly cannot completely account for the increase. See Appendix 4 and Figure 2 for more detailed information.

Results – Mortality for All Causes Age 0-74.

The Centers for Disease Control and Prevention has historically defined premature deaths as deaths which occur before age 75 (Cheng and Kindig, 2012). Slightly over half of all deaths in the U.S. are premature. The Humboldt County/California ratio of premature deaths was slightly higher in the late 1960s and into the 1970s. However, the ratio has steadily risen since then (see Appendix 5 and Figure 2).

1968-1973 8.3% higher
1974-1978 9.1% higher

2014-2018 57.2% higher
2019-2023 49.4% higher

Conversely, the county/state ratio for persons age 75 and older has only risen slightly. The Humboldt County rate has fluctuated between 6-18% above the California rate in each five-year period. See Appendix 7 and Figure 2.

1968-1973 10.5% higher
1974-1978 9.8% higher

2014-2018 17.6% higher
2019-2023 14.4% higher

Results – Mortality by Race and Ethnic Group, 2009-2020.

Mortality rates have peaked after the turn of the century. One issue that merits more detailed analysis is how each major racial and ethnic group is affected. The table below provides data on

each race/ethnic group for recent years (2009-2020), for cancer and all causes, both for all ages and age 0-74 (also see Appendix 3, 4, 5, and 6).

	All Ages Cancer	All Ages All Causes	Age 0-74 Cancer	Age 0-74 All Causes
White Non-Hispanic	**+11.6%**	**+19.1%**	**+14.4%**	**+35.3%**
White Hispanic	- 1.7%	- 6.8%	+ 7.1%	+31.1%
Black Non-Hispanic	- 24.9%	- 9.4%	----	+ 1.1%
Asian Non-Hispanic	- 19.7%	+ 5.2%	- 4.7%	+45.1%
American Indian Non-Hispanic	**+42.4%**	**+44.4%**	**+42.7%**	**+61.9%**
TOTAL	+20.9%	+30.1%	+23.4%	+45.9%

The racial/ethnic group for which the Humboldt County rate most greatly exceeds the California rate is American Indian non-Hispanics, followed by white non-Hispanics. County rates are mostly higher than the state for other racial/ethnic groups.

Results – By Age, Change from 1968-1978 to 2009-2020.

Another issue raised by the data is which age groups are most affected by the rising mortality rates in Humboldt County versus California. Below is a table showing the county/state mortality ratio for each age group, for the earliest and latest periods, namely 1968-1978 and 2009-2020 (see Appendix 8 for more detailed statistical information).

Age	1968-78	2009-20
0-1	- 1.6	+31.8
1-4	- 14.1	+70.9
5-14	+38.1	+14.9
15-24	+ 1.8	+20.0
25-34	+ 7.3	**+99.1**
35-44	+11.2	**+77.5**
45-54	+ 7.2	**+77.4**
55-64	+ 6.5	+47.1
65-74	+12.2	+30.4
75-84	+15.5	+26.6
85+	+14.0	+ 7.4
Total	+ 9.6	+30.1

An increase in the county/state mortality ratio is observed for each age group, with two exceptions (age 5-14 and age 85+). The age groups with the largest increase are those for young and middle-age adults (25-34, 35-44, and 45-54). In the most recent 12 years, the county mortality rate exceeded the state by 99.1%, 77.5%, and 77.4%, respectively for these three age groups.

Results – By Cause of Death, Change from 1968-1978 to 2009-2020.

Another issue raised by the findings is which causes of death have had the largest increases in county/state mortality ratios. The table below shows data from 1968-1978 and 2009-2020 for nine major causes of death, which account for over 95% of all U.S. deaths. Premature deaths, or deaths from age 0-74, are used. More detailed statistics can be found in Appendix 9.

	1968-1978	2009-2020
Infectious and parasitic diseases	- 24.2	+ 37.2
Neoplasms (cancers)	+ 2.5	+ 23.4
Endocrine, nutritional, metabolic diseases	+ 1.7	+ 17.3
Mental and behavioral disorders	+68.1	+254.3
Diseases of the nervous system	+ 9.0	+ 57.8
Diseases of the circulatory system	+ 8.9	+ 31.2
Diseases of the respiratory system	+35.1	+ 73.5
Diseases of the digestive system	- 6.4	+ 73.4
Accidents, suicide, and homicide	+16.7	+120.5
TOTAL 0-74	+ 8.9	+ 49.4

Increases in the county/state ratio occurred for each of the nine major categories. The 2009-2020. excesses were especially high for mental/behavioral diseases (+254.3%, or more than triple) and accidents/suicide/homicide (+120.3%, or more than double). Excesses for other conditions such as respiratory diseases (+73.5%) and digestive diseases (+73.4%) are also much higher than half a century ago.

Results – Infant Mortality.

While radiation exposure poses potential health risks to all humans, a dose of radiation is most harmful to the very young, especially the fetus and infant. Below is an analysis of the ratio of rates of infant deaths (before age one) for Humboldt County versus California, for each of the past five decades. Appendix 10 includes more detailed statistical data on infant mortality.

1968-1978	- 1.6%
1979-1988	+ 2.7%
1989-1998	+24.1%
1999-2009	+ 5.6%
2010-2020	+41.2%

In the period 1968-1978, during the period when Humboldt Bay 3 operated, the county infant death rate was 1.6% below the state rate. But in each decade since then, the county rate has exceeded the state rate. In the most recent period (2010-2020), the excess reached 41.2% higher than the state.

Discussion.

The Humboldt Bay 3 nuclear reactor, which operated from 1963-1976, added harmful radioactivity to the local environment. These microscopic metal particles entered bodies of persons living near the reactor through breathing, food, and water, raising the issue of whether local rates of disease and death were affected. Environmental emissions were the largest of any U.S. reactor from the mid-1960s to the mid-1970s, along with the Dresden reactor in Illinois.

The only study by the federal government on health patterns near nuclear power reactors was conducted in the late 1980s by the National Cancer Institute. Humboldt Bay was included in the study, which found a modest increase in the ratio of Humboldt County versus U.S. cancer death rates after reactor startup. But no data after 1984 was included; since cancer can take decades to be diagnosed after radiation exposure, and longer until cancer causes death, the study is outdated.

This report provides a review of historical data on Humboldt County health patterns during the 56-year period 1968 to 2023. Using Centers for Disease Control and Prevention data, the report found the ratio of Humboldt County versus California cancer mortality rates has increased dramatically, from 3.7% higher in 1968-1973 to 33.4% higher in 2019-2023. Over 300 Humboldt County residents now die from cancer each year.

The report also includes data from the National Cancer Institute showing Humboldt County has the 10th highest cancer incidence – the rate of newly-diagnosed cases – among the 58 California counties, and that nearly 800 new cases in Humboldt County residents are diagnosed each year. The county incidence rate is among the 10 highest of California counties for nine major types of cancer. Unfortunately, historical cancer incidence data is not readily available, so no review of incidence trends could be made.

Other analyses in this report show the county/state ratio increased over time for all causes, especially for those premature deaths (under age 75). These increases were consistent for nearly all age groups and all major causes of death, and were especially large for non-Hispanic whites and American Indians/Native Americans.

Multiple factors can increase risk of dying from cancer and other diseases. Appendix 11 shows rates of 11 indicators of socioeconomic status and health-related behaviors for Humboldt County and California. For 10 of the 11, state and county rates are similar. The exception is the percent of adults who smoke, for which Humboldt County has a modestly higher rate (15% to 10%).

With no obvious factor accounting for the worsening health status of Humboldt County, radioactive releases from Humboldt Bay 3 should be considered as one potential factor – even almost half a century after the reactor closed permanently. Further studies are warranted, including analyses of health patterns and of radioactivity levels in the local environment. Results should be shared with the public, and with officials responsible for managing the Humboldt Bay plant, especially the large amount of high-level radioactive waste in storage.

Appendix 1
Airborne Releases of Noble and Activation Gases, in Curies
And Percent of Federal Permissible Limits
13 U.S. Reactors in Operation, 1959-1970

	Year of 1st	Releases of Noble and Activation Gases			% of Limit
Reactor	Reported Data	Total	Avg./Yr	Avg. 1967-70	1967-70
Shippingport	1959	0.7	.06	0	.002
Yankee Rowe	1961	21736	2174	6	.087
Indian Point	1963	2468	308	596	.011
San Onofre	1967	1836	459	459	.074
Connecticut Yankee	1967	895	224	224	1.178
R.E. Ginna	1970	10070	10070	10070	2.790
Dresden	1961	4574400	457440	579250	2.820
Big Rock Point	1962	1811612	201290	243250	0.783
Humboldt Bay	1963	3261891	407736	**694050**	**44.050**
La Crosse	1965	1180	590	590	0.120
Nine Mile Point	1969	9555	4778	4778	0.016
Oyster Creek	1969	119000	59500	59500	0.627
Peach Bottom	1966	198	40	49	9.499

Humboldt Bay, Annual Releases and Percent Permissible Limits

1963	716	.05
1964	5,975	.38
1965	197,000	12.5
1966	282,000	17.8
1967	896,000	**56.7**
1968	853,000	**54.0**
1969	492,000	**31.2**
1970	535,200	**34.3**

Sources:
U.S. Department of Health, Education, and Welfare, March 1970.
U.S. Environmental Protection Agency, October 1971.

Appendix 2
Age-Adjusted Cancer Incidence
Humboldt County CA vs. California
All Cancers Combined, 2017-2021

Category	Cases/100,000 County	Cases/100,000 State	County Cases	% County Rate vs. State (rank)
All	440.5	397.4	3845	+10.8% (10th highest of 58 Cal. counties)
Males	472.6	421.2	1980	+12.2% (9)
Females	423.7	385.6	1865	+ 9.9% (9)
65 and over	1998.9	1798.9	2385	+11.1% (11)
Under 65	215.0	194.7	1465	+10.4% (9)
White	437.9	441.4	3320	- 0.8% (27)
Black	543.3	411.2	50	+32.1% (1)
Asian	306.7	297.7	55	+ 3.0% (22)
Am. Indian	444.6	402.0	165	+10.6% (25)
Hispanic	321.2	330.2	145	- 2.7% (37)
Selected cancers with largest county/state difference:				
Bladder	22.1	15.4	195	+43.5% (3)
Child (<15)	20.3	16.3	20	+24.5% (5)
Colorectal	36.4	33.5	310	+ 8.7% (13)
Esophagus	4.4	3.5	40	+25.7% (17)
Liver	11.8	9.6	110	+22.9% (9)
Lung	49.4	36.7	455	+34.6% (9)
Melanoma	33.6	22.7	256	+48.0% (10)
Non-Hodg. Lymph	20.9	17.7	175	+18.1% (4)
Oral Cavity/Pharynx	16.1	10.1	140	+59.4% (2)
Ovary	13.6	10.5	55	+29.5% (3)
Pancreas	13.8	12.4	125	+22.3% (9)

Source: National Cancer Institute. www.statecancerprofiles.state.gov

Appendix 3
Age-Adjusted Mortality, All Cancers Combined
Humboldt County CA vs. California, by Five-Year Periods, 1950-2023

Yr of Death	Humboldt County Rate (Deaths)	California Death Rate	% Humboldt vs. California	% Humboldt vs. U.S.
1950-1953	(410)			+ 2.0%
1954-1958	(587)			+ 2.0%
1959-1963	(631)			- 4.0%
1964-1968	(728)			+ 4.0%
1969-1973	204.9 (779)	198.5	+ 3.2%	
1974-1978	217.0 (890)	204.0	+ 6.4%	
1979-1983	221.4 (1004)	208.1	+ 6.4%	
1984-1988	242.8 (1211)	210.4	+15.0%	
1989-1993	238.1 (1331)	204.4	+16.5%	
1994-1998	224.8 (1370)	193.4	+16.2%	
1999-2003	222.7 (1447)	183.6	+21.3%	
2004-2008	196.4 (1389)	168.9	+16.3%	
2009-2013	183.0 (1400)	156.6	+16.9%	
2014-2018	168.6 (1428)	142.9	+18.0%	
2019-2023	178.1 (1616)	133.4	+33.4%	

2009-2020			
White N-Hisp	180.8 (3177)	161.9	+11.6%
White Hisp	122.0 (81)	124.1	- 1.7%
Black N-Hisp	143.9 (20)	191.7	- 24.9%
Asian N-Hisp	86.9 (31)	108.2	- 19.7%
Am Ind N-Hisp	204.9 (161)	143.9	+42.4%
TOTAL	177.0 (3483)	146.5	+20.9%

Sources: National Cancer Institute, Cancer in Populations Living Near Nuclear Facilities (1950-1968); U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov/ (1968-2023).

Appendix 4
Age-Adjusted Mortality, All Causes
Humboldt County CA vs. California by Five-Year Periods, 1968-2023

Yr of Death	Humboldt County Rate (Deaths)	California Death Rate	% Humboldt vs. California
1968-1973	1261.4 (5376)	1152.7	+ 9.4%
1974-1978	1112.6 (4337)	1016.6	+ 9.4%
1979-1983	1073.6 (4637)	960.5	+11.8%
1984-1988	1089.3 (5252)	943.2	+15.5%
1989-1993	1005.9 (5493)	891.2	+12.9%
1994-1998	946.5 (5714)	838.7	+12.9%
1999-2003	944.9 (6132)	782.0	+20.8%
2004-2008	897.9 (6314)	710.0	+26.5%
2009-2013	824.6 (6224)	640.5	+28.7%
2014-2018	822.4 (6645)	614.4	+33.9%
2019-2023	879.4 (7458)	679.3	+29.5%
2009-2020			
White N-Hisp	892.9 (13974)	692.5	+19.1%
White Hisp	531.6 (458)	570.3	- 6.8%
Black N-Hisp	799.7 (134)	882.8	- 9.4%
Asian N-Hisp	433.3 (150)	412.9	+ 5.2%
Am Ind N-Hisp	1089.9 (877)	754.6	+44.4%
TOTAL	821.9 (15663)	631.5	+30.1%

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2023).

Appendix 5
Age-Adjusted Mortality, All Causes, Age 0-74
Humboldt County CA vs. California by Five-Year Periods, 1968-2023

Yr of Death	Humboldt County Rate (Deaths)	California Death Rate	% Humboldt vs. California
1968-1973	637.2 (3302)	588.2	+ 8.3%
1974-1978	564.5 (2595)	517.4	+ 9.1%
1979-1983	536.4 (2681)	474.9	+13.0%
1984-1988	549.3 (2878)	456.2	+20.4%
1989-1993	519.3 (2903)	430.2	+20.7%
1994-1998	464.0 (2721)	391.2	+18.6%
1999-2003	460.4 (2795)	345.8	+33.1%
2004-2008	432.7 (2904)	312.1	+38.6%
2009-2013	402.4 (3008)	276.7	+45.4%
2014-2018	422.6 (3413)	268.8	+57.2%
2019-2023	466.9 (3875)	312.4	+49.4%
2009-2020			
White N-Hisp	407.8 (6679)	301.3	+35.3%
White Hisp	343.2 (315)	261.8	+31.1%
Black N-Hisp	495.5 (101)	489.9	+ 1.1%
Asian N-Hisp	234.7 (93)	161.8	+45.1%
Am Ind N-Hisp	704.4 (626)	435.2	+61.9%
TOTAL	414.0 (7868)	277.1	+45.9%

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2023).

Appendix 6
Age-Adjusted Mortality, All Cancers, Age 0-74
Humboldt County CA vs. California by Five-Year Periods, 1968-2023

Yr of Death	Humboldt County Rate (Deaths)	California Death Rate	% Humboldt vs. California
1968-1973	132.3 (561)	132.1	+ 0.1%
1974-1978	140.7 (631)	134.0	+ 5.0%
1979-1983	143.1 (699)	134.1	+ 6.7%
1984-1988	160.0 (823)	134.0	+19.4%
1989-1993	151.1 (838)	126.5	+19.5%
1994-1998	131.4 (767)	129.2	+ 9.3%
1999-2003	126.3 (771)	105.5	+19.7%
2004-2008	93.0 (764)	111.0	+19.4%
2009-2013	96.2 (768)	84.0	+14.5%
2014-2018	93.9 (850)	75.6	+24.2%
2019-2023	98.1 (924)	69.2	+41.7%
2009-2020			
White N-Hisp	98.1 (1793)	85.7	+14.4%
White Hisp	72.6 (57)	67.8	+ 7.1%
Black N-Hisp	---- (12)	114.6	-----
Asian N-Hisp	55.8 (22)	58.6	- 4.7%
Am Ind N-Hisp	**117.2 (106)**	**82.1**	**+42.7%**
TOTAL	96.1 (1995)	77.9	+23.4%

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2023).

Appendix 7
Age-Adjusted Mortality, All Causes, Age 75+
Humboldt County CA vs. California by Five-Year Periods, 1968-2020

Yr of Death	Humboldt County Rate (Deaths)	California Death Rate	% Humboldt vs. California
1968-1973	10981.5 (2073)	9942.2	+10.5%
1974-1978	9646.5 (1740)	8789.4	+ 9.8%
1979-1983	9437.1 (1953)	8521.9	+10.7%
1984-1988	9496.8 (2369)	8525.0	+11.4%
1989-1993	8581.9 (2548)	8068.2	+ 6.4%
1994-1998	8457.9 (2989)	7805.2	+ 8.4%
1999-2003	8489.1 (3337)	7573.8	+12.1%
2004-2008	8142.1 (3410)	6909.9	+17.8%
2009-2013	7398.5 (3214)	6305.2	+17.3%
2014-2018	7048.2 (3232)	5995.0	+17.6%
2019-2023	7310.1 (3583)	6391.3	+14.4%

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2023).

Appendix 8
All-Cause Mortality, By Age Group
Humboldt County CA vs. California, 1968-1978 and 2009-2020

	Humboldt Rate (No.)		Calif. Death Rate		% Humboldt vs. California	
Age	1968-78	2009-20	1968-78	2009-20	1968-78	2009-20
0-1	1474.3 (260)	577.87 (102)	1479.8	438.44	- 1.6	+31.8
1-4	66.03 (44)	32.61 (23)	76.84	19.08	- 14.1	+70.9
5-14	47.19 (95)	12.02 (21)	34.17	10.46	+38.1	+14.9
15-24	128.40 (300)	68.16 (179)	126.18	56.79	+ 1.8	+20.0
25-34	156.02 (265)	171.38 (384)	145.41	86.08	+ 7.3	**+99.1**
35-44	289.37 (348)	248.99 (491)	260.27	140.29	+11.2	**+77.5**
45-54	667.42 (807)	578.34 (1117)	622.78	326.05	+ 7.2	**+77.4**
55-64	1521.0 (1573)	1082.0 (2454)	1427.9	735.52	+ 6.5	+47.1
65-74	3444.7 (2205)	1997.8 (3097)	3071.1	1532.2	+12.2	+30.4
75-84	8052.5 (2425)	5030.8 (3488)	6973.5	3973.1	+15.5	+26.6
85+	16902.1 (1388)	13363.3 (4305)	16252.3	12448.1	+14.0	+ 7.4
TOTAL	1190.28 (9713)	821.85 (15663)	1085.54	631.54	+ 9.6	+30.1

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2023). Total rates are adjusted for age, using the 2000 U.S. standard population.

Appendix 9
Age-Adjusted Mortality, By Major Cause, Age 0-74
Humboldt County CA vs. California, 1968-1978 and 2009-2020

	Humboldt Rate (No.)		Calif. Death Rate		% Humboldt vs. California	
Cause	1968-1978	2009-2020	1968-1978	2009-2020	1968-1978	2009-2020
Infectious/parasitic	3.69 (36)	10.52 (189)	4.87	7.67	- 24.2	+ 37.2
Neoplasms (cancers)	136.5 (1302)	96.13 (1995)	133.1	77.93	+ 2.5	+ 23.4
Endocrine+	10.70 (104)	17.06 (346)	10.52	14.55	+ 1.7	+ 17.3
Mental/behavioral	6.17 (58)	14.28 (266)	3.67	4.03	+68.1	+254.3
Nervous system	7.11 (70)	13.63 (272)	6.52	8.64	+ 9.0	+ 57.8
Circulatory system	241.4 (2285)	87.33 (1766)	221.8	66.58	+ 8.9	+ 31.2
Respiratory system	41.62 (412)	31.49 (663)	30.50	18.15	+35.1	+ 73.5
Digestive system	33.38 (310)	29.06 (543)	35.67	16.76	- 6.4	+ 73.4
External++	90.30 (967)	95.48 (1513)	77.39	43.31	+16.7	+120.5
TOTAL	603.50 (5897)	414.01 (7868)	554.25	277.05	+ 8.9	+ 49.4

+ Endocrine, nutritional, metabolic diseases; ++ Accidents, suicide, and homicide

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2020).

Appendix 10
Infant Mortality, All Causes, Age <1
Humboldt County CA vs. California by Ten-Year Periods, 1968-2020

Yr of Death	Humboldt County Rate (Deaths)	California Death Rate	% Humboldt vs. California
1968-1978	1474.34 (260)	1497.83	- 1.6%
1979-1988	994.67 (179)	968.38	+ 2.7%
1989-1998	857.60 (139)	691.32	+24.1%
1999-2009	582.88 (96)	551.78	+ 5.6%
2010-2020	608.02 (98)	430.76	+41.2%

Source: U.S. Centers for Disease Control and Prevention, https://wonder.cdc.gov (1968-2020).

Appendix 11
Selected Adult Health Risk Factors, Humboldt County vs. California, 2022

Indicator	California Rate	Humboldt Rate
% in Poor/Fair Health	18%	19%
% Who Smoke	10%	15%
% Who are Obese	26%	28%
% Physically Inactive	22%	22%
% Who Drink Excessively	19%	21%
% Uninsured	9%	10%
% Who Completed High School	84%	91%
% With Some College	67%	67%
% Unemployed	10.1%	8.4%
% Children in Poverty	15%	19%
% With Severe Housing Problems	26%	24%

Source: University of Wisconsin Population Health Institute. County Health Rankings and Roadmaps. https://www.countyhealthrankings.org/health-data/compare-counties?compareCounties=06000%2C06023&year=2022. Published 2022. Accessed July 31, 2025.

REFERENCES:

Cairns T. Humboldt County History. Facebook, January 10, 2024. https://www.facebook.com/groups/136640606405094/posts/7071429486259470/.

Cheng ER, Kindig DA. Disparities in premature mortality between high- and low-income US counties. Prevention of Chronic Diseases 2012;9:110120. Centers for Disease Control and Prevention, https://www.cdc.gov/pcd/issues/2012/11_0120.htm.

Committee on the Biological Effects of Ionizing Radiations (BEIR), National Research Council. Health Effects of Exposures to Low Levels of Ionizing Radiation: BEIR V. Washington DC: National Academy Press, 1990.

Gillette R. Reactor emissions: AEC guidelines move toward critics' position. Science. 1971; pp. 1215-1216.

Gonzalez AB, Daniels RD, Cardis E, et al. Epidemiological studies of low-dose ionizing radiation and cancer: Rationale and framework for the monograph and overview of eligible studies. JNCI Monographs. 2020;56:97-113. https://doi.org/10.1093/jncimonographs/Igaa009.

Jablon S, Hrubec Z, Boice JD Jr., Stone BJ. Cancer in Populations Living Near Nuclear Facilities. NIH Pub. No. 90-874. National Cancer Institute, July 1990.

National Cancer Institute. State Cancer Profiles - Incidence. Accessed August 1, 2025. https://www.statecancerprofiles.cancer.gov/incidencerates/index.php.

Radiation and Public Health Project. Cancer Death Rate Changes Near Oldest U.S. Nuclear Plants. February 17, 2025. https://radiation.org/wp-content/uploads/2025/02/Cancer-mort-nr-oldest-17-plants-3-time-periods-1.pdf.

Richardson DB, Leuraud K, Laurier D, et al. Cancer mortality after low dose exposure to ionising radiation in workers in France, the United Kingdom, and the United States (INWORKS): cohort study. BMJ. 2023 Aug 16:382:e074520.

U.S. Centers for Disease Control and Prevention. CDC Wonder; underlying cause of death or compressed mortality. https://wonder.cdc.gov/. Published 2025. Accessed August 1, 2025.

U.S. Department of Health, Education, and Welfare. U.S. Public Health Service, Environmental Health Service. Joe E. Logdon and Robert I. Chussler, Division of Environmental Radiation. Radioactive Waste Discharges to the Environment from Nuclear Power Facilities. Document BRH/DER 70-2, March 1970, p. 15, 17. https://nepis.epa.gov/Exe/ZyNET.exe/940025VR.txt?ZyActionD=ZyDocument&Client=EPA&Index=Prior%20to%201976&Docs=&Query=%28Humboldt%20Bay%29%20OR%20FNAME%3D%22940025VR.txt%22%20AND%20FNAME%3D%22940025VR.txt%22&Time=&EndTim

e=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C70THRU75%5CTXT%5C00000030%5C940025VR.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=85.

U.S. Environmental Protection Agency, Office of Radiation Programs. Radioactive Waste Discharges to the Environment from Nuclear Power Facilities. Joe E. Logsdon and Thomas L. Robinson, Surveillance and Inspection Division. Addendum 1 to Document BRH/DER 70-2, October 1971, p. 11, 13. https://nepis.epa.gov/Exe/ZyNET.exe/20017YLZ.txt?ZyActionD=ZyDocument&Client=EPA&Index=Prior%20to%201976&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C70THRU75%5CTXT%5C00000005%5C20017YLZ.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r105g16/r105g16/x150y150g16/i600&Display=hpfr&DefSeekPage=&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=23

World Nuclear Association. Humboldt Bay: Permanent Shutdown. https://world-nuclear.org/nuclear-reactor-database/details/Humboldt-Bay. Accessed August 4, 2025.