



# Hazard Identification & Vulnerability Assessment

**HIVA**

**October 1, 2019**



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# Introduction

*Risk*, for hazard mitigation planning, is the potential for damage, loss, or other impacts created by the interaction of natural hazards with community assets. The exposure of people, property, and other community assets to natural hazards can result in disasters depending on the consequential impacts of those hazards. Hazards may include droughts, earthquakes, floods, forest fires, landslides, severe storms, tsunamis, and volcanic ash fall. The type and severity of impacts are based on the extent of the hazard and the vulnerability of the asset, as well as the community's capabilities to prepare for, mitigate against, respond to, and recover from disasters.

The Hazard Identification and Vulnerability Assessment (HIVA) is a risk assessment that provides the foundation for the rest of the mitigation planning process, which is focused on identifying and prioritizing actions to reduce risks associated with hazards. In addition to informing the mitigation strategy, the risk assessment can be used to establish emergency preparedness and response priorities, and for land use and comprehensive planning. It can also be used for decision making by elected officials, City and County departments, businesses, and organizations in the community.



Figure 1: Risk Elements

This document enhances public and private agency understanding and awareness of vulnerability to hazards and influences the adoption of hazard mitigation programs. The findings revealed in the hazard vulnerability analysis serve as a basis for informed preparedness and mitigation activities, such as public education and the development of training and exercises for various agencies and first responders. The findings also serve as the basis for the County and Cities' Comprehensive Emergency Management Plans (CEMPs).

The four steps to conduct a risk assessment are:<sup>1</sup>



Figure 2: Steps to Conduct a Risk Assessment

<sup>1</sup> FEMA Local Mitigation Planning Handbook (2013)



Definitions <sup>2</sup>	
<b>Natural Hazard</b>	Source of harm or difficulty created by a meteorological, environmental, or geological event.
<b>Community Assets</b>	The people, structures, facilities, and systems that have value to the community.
<b>Vulnerability</b>	Characteristics of community assets that make them susceptible to damage from a given hazard.
<b>Impact</b>	The consequences or effects of a hazard on the community and its assets.
<b>Risk</b>	The potential for damage, loss, or other impacts created by the interaction of natural hazards with community assets.
<b>Risk Assessment</b>	Product or process that collects information and assigns values to risks for the purpose of informing priorities, developing, or comparing courses of action, and informing decision making.
<b>Threat or Human-Caused Incident</b>	Intentional actions of an adversary, such as a threatened or actual chemical or biological attack or cyber event.

Table 1: Definitions

## Mission Statement

The mission of the Kitsap County Department of Emergency Management (KCDEM) is to prepare for, mitigate against, respond to, and recover from any emergency or disaster that affects Kitsap County and its Cities.

## Authority

In accordance with **WAC 118-30-060**, a HIVA is required for the development of the Kitsap County CEMP as noted:

**WAC 118-30-060 Emergency Plan.** (1) *Each political subdivision shall maintain a current plan of operations which shall be based on hazard analysis...*

In 2019, under a new Director, KCDEM initiated a complete review, update, and reformatting of the Kitsap County Hazard Identification and Vulnerability Assessment (HIVA) to better capture the most recent hazard and mitigation information to best inform the County and to integrate the effects of Climate Change throughout the plan. The HIVA, which identifies and describes the hazards that may impact the County, informs the actions in the MHMP and was completed at the beginning of July 2019 and finalized on October 1, 2019.

## Purpose

In order to prepare for and mitigate against hazards that have the potential to strike the County, it is necessary to understand the history and projected future activity within Kitsap County, and how vulnerable the citizens may be to hazards within that context. This HIVA is not a detailed study of the hazards themselves; rather, it is a description of the hazards with the greatest

<sup>2</sup> FEMA Local Mitigation Planning Handbook (March 2013)

potential threat to Kitsap County and its citizens, environment, personal and public property, and economy. This analysis serves as a basis from which Kitsap County can develop plans, educate the public, provide training for first responders, and develop exercises to practice the skills and apply knowledge to better prepare for the hazards that may occur within the County.

This analysis covers hazards that are the most threatening to Kitsap County according to historical data, geologic projections, and social and technological trends. Without a basic understanding of the hazards and their potential impacts, it is impossible to appropriately meet the criteria of the KCDEM mission statement. This analysis serves as a basis from which Kitsap County can develop plans, educate the public, provide training for our first responders, and develop exercises to practice the skills and apply knowledge to better prepare for the hazards that may occur within the County.

At least every two years, communities in Washington State must update their CEMPs.<sup>3</sup> To support this update, The HIVA is reviewed concurrently with the CEMP to validate the natural, technological, and human-caused hazards to the County. This 2019 HIVA has been reviewed and updated by the KCDEM staff, and any changes will be incorporated into the CEMP.

This 2019 HIVA of Kitsap County focuses on natural hazard, but also discusses technological and human-made hazards. The document has the following sections:

- **County & City Profiles**
  - Kitsap County
  - Bainbridge Island
  - Bremerton
  - Port Orchard
  - Poulsbo
- **Natural Hazards**
  - Droughts
  - Earthquakes
  - Floods
  - Wildfires & Urban Fires
  - Landslides & Erosion
  - Severe Storms/Tornadoes
  - Tsunamis, High Waves, & Seiches
  - Volcanic Ash Fall
- **Technological Hazards & Human-Caused Threats**
  - Cyber Attacks
  - Dam Failure
  - Energy Emergency
  - Hazardous Sites/Materials
  - Radiological Emergencies
  - Search & Rescue Emergencies
  - Terrorism
  - Transportation Mass Casualty Incident
  - Epidemics

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<sup>3</sup> <https://apps.leg.wa.gov/wac/default.aspx?cite=118-30-060>

- **References & Authorities**

Each of the natural hazards is described through seven different lenses:

1. Location
2. Effects
3. Extent
4. History
5. Probability of Future Occurrence
6. Climate Change Impacts
7. Vulnerability Summary

Including technological and human-caused threats in this assessment is not mandatory according to Federal Emergency Management Agency (FEMA) Local Mitigation Plan guidance. However, Kitsap County identifies and discusses those hazards to better inform public officials, emergency managers, private partners, and community members about the potential risks and effects of technological and human-caused threats.

## Situation

Since the last update to the HIVA in 2015, there have been two major emergencies in Kitsap County. In 2016, a windstorm and severe winds affected the county, although it did not meet the State declaration threshold. The December 2018 Winter Storms included an EF-2 tornado that caused catastrophic damage to 250 homes and community buildings in incorporated and unincorporated Port Orchard. This was the strongest tornado to hit Washington State since 1986.<sup>4</sup> In 2016, a windstorm with severe rain affected Kitsap County, but did not meet State declaration threshold.<sup>5</sup> Historically, strong or severe winter storms have triggered the activation of the County Emergency Operations Center (EOC) to support a coordinated response to power outages, minor flooding, and minimal damage. These latter types of winter storms are the most common. Throughout the years, Kitsap County and its cities have made significant efforts to mitigate these events through successful stormwater systems, tree-trimming along roads, and community preparedness programs.

Enhancements in geographic information system (GIS) technologies have provided valuable information in assessing natural hazards in Kitsap County. These enhancements provide mapping of United States Geological Survey (USGS) and Washington State hazard data for ongoing assessments at all levels of government. For example, in 2010, FEMA began conducting mapping and analysis to provide better information regarding the effects of tides and tsunamis on Kitsap County's shorelines. FEMA also concluded a Risk Report for Kitsap County in 2015 discussing flood, earthquake, landslide, and tsunami hazards. The report includes a discussion of mitigation strategies for Bainbridge Island, Bremerton, Port Orchard, and Poulsbo. The installation of rain gauges throughout Kitsap County has also provided improved information on water tables, droughts, and rainfall data.

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<sup>4</sup> <https://www.king5.com/article/news/local/ef-2-tornado-in-port-orchard-strongest-to-hit-washington-in-32-years/281-c810fb2e-2beb-4906-bd88-cad3c411d43c>

<sup>5</sup> Kitsap County Department of Emergency Management

Although severe winter storms are Kitsap County’s most common events, the most significant risk to the County continues to be earthquakes. As such, KCDEM continues to prepare staff, first responders, and the public for the next significant earthquake. An earthquake of a “Nisqually” or greater incident will have a considerable impact on people, the economy, and the environment.<sup>6</sup> Within reason, preparing for the most significant all-hazard event will prepare Kitsap County for events of lesser magnitude.

The following table provides a summary of past risk assessment conclusions, as well as the conclusions documented in the Washington Enhanced State Hazard Mitigation Plan (2018).

<b>HIVA Risk Ratings 2019</b>					
<b>Hazard/Threat</b>	<b>Overall Risk</b>	<b>People</b>	<b>Damages</b>	<b>Economy</b>	<b>Environment</b>
<b>Natural Hazards</b>					
<b>Droughts</b>	Low	Low	Low	Low	Moderate
<b>Earthquake</b>	High	High	High	High	High
<b>Flooding</b>	Moderate	Low	Moderate	Low	Low
<b>Forest &amp; Urban Fires</b>	Moderate	High	Moderate	Low	Moderate
<b>Landslides</b>	Moderate	Low	Moderate	Low	Low
<b>Severe Storms/Tornadoes</b>	Moderate	Low	Moderate	Moderate	Moderate
<b>Tsunamis</b>	Moderate	Low	High	Moderate	Moderate
<b>Volcanic Ash Fall</b>	Low	Low	Low	Low	Moderate
<b>Technological &amp; Human-Caused Hazards</b>					
<b>Cyber Attack</b>	Moderate	High	Moderate	Moderate	Moderate
<b>Dam Failures</b>	Low	Low	Low	Low	Low
<b>Energy Emergencies</b>	Moderate	Moderate	Moderate	Moderate	Moderate
<b>Hazardous Materials</b>	Moderate	Moderate	Moderate	Moderate	Moderate
<b>Radiological</b>	Moderate	Low	Moderate	High	High
<b>Search &amp; Rescue</b>	Low	Moderate	Low	Low	Low
<b>Terrorism</b>	Moderate	Moderate	Moderate	Moderate	Moderate
<b>Transportation-MCI</b>	Moderate	Moderate	Moderate	Moderate	Moderate
<b>Epidemics</b>	Moderate	Moderate	Moderate	Moderate	Moderate

Table 2: HIVA 2019 Ratings

The overall ratings for hazards from the 2013 MHMP remain similar. Two major updates include raising the overall rating for Tsunamis from “Low” to “Moderate” due to studying simulated data

<sup>6</sup> The Nisqually earthquake, with a moment magnitude of 6.8 and Mercalli intensity rating of VIII-Severe, affected the region on February 28, 2001. [https://en.wikipedia.org/wiki/2001\\_Nisqually\\_earthquake](https://en.wikipedia.org/wiki/2001_Nisqually_earthquake)

and information as well as the addition of ratings for Cyber Attacks, which did not have any ratings previously.

In reviewing the HIVA, the reader should consider the following:

- Except for rare, isolated incidents, there is no hazard identified that would require an entire evacuation of Kitsap County and its four cities.
- Kitsap County plans for all-hazards response utilizing the National Incident Management System (NIMS) and by training all response personnel to use the Incident Command System (ICS).
- The HIVA helps to assign weight and focus to vulnerabilities and to ensure the County and four cities prepare themselves for the likelihood of an event.
- The Department of Homeland Security (DHS) Threat and Hazard Identification and Risk Assessment (THIRA) process provides a means to evaluate Kitsap County's state of readiness for manmade threats. Kitsap County relies on the Washington State THIRA for this information rather than a local assessment.

Kitsap County made several key updates to enhance this 2019 HIVA. The document:

- Was restructured to better align with FEMA Local Mitigation Plan requirement guidance.
- Contains updated statistical data and maps.
- Incorporates information from the Washington State Enhanced Hazard Mitigation Plan (2018) and Washington State THIRA (2018).
- Better integrates climate change information by moving the subject from its own section to within the hazard descriptions.
- Provides increased attention to cybersecurity information by giving topic into its own section under Technological & Human-Caused Hazards.

## **Hazard Assessment Process**

Before moving forward with the assessment, it is important to understand the process used to achieve the weight or measure of vulnerability for each hazard. This measure allows KCDEM, as well as government agencies, districts, and citizens, to define hazard priorities and evaluate training and preparedness programs, funding, and coordination efforts. In alignment with FEMA Local Mitigation Plan guidance, the risk assessment section for multi-jurisdictional plans, including this jurisdiction-inclusive County plan, only assesses each jurisdiction's risks where they vary from the risks facing the entire planning area.

### ***Methodology***

Overall, risk assessment is difficult to quantify, so the utilization of both qualitative and quantitative methods promotes a more comprehensive approach and process. The conditional and variable nature of hazards precludes risk analysis from being entirely objective or quantitative, and some subjectivity and variance are to be expected.

In order to identify, plan for, and respond to any hazard in a community, a risk assessment can provide information on the types of hazards, the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that

may result from any hazardous event. Specifically, the three levels of a risk assessment are as follows:

1. **Profiling Hazard Events:** describes the causes and characteristics of each hazard, how it has affected Kitsap County in the past (disaster history), and how the community's population, infrastructure, and environment has been impacted by the hazard.
2. **Vulnerability Assessment:** explains those factors that make the hazard a threat to the community or increase the threat and define those areas most susceptible to the threat.
3. **Probability of Occurrence:** An adjective description (High, Moderate, or Low) of the probability of a hazard's impacts Kitsap County within the next 25 years.

The 2019 Kitsap County HIVA drew significantly from the FEMA's 2015 Risk Report for Kitsap County including the Cities of Bremerton, Bainbridge, Port Orchard, Poulsbo, the Port Gamble S'Klallam Indian Reservation, the Suquamish Tribe, and Unincorporated Kitsap County. This report aimed to help community members act to reduce their risk regarding coastal flood, earthquake, landslide, and tsunami incidents. The scope included the 246.86 miles of coastline in Kitsap County, of which 136.05 miles were studied using detailed methods and 110.81 miles using approximate methods.

FEMA developed the report using its risk assessment tool, Hazus, which estimates losses that may result from flooding or earthquakes. The Hazus model incorporated a complete list of every building in Kitsap County. Other hazards, including landslides and tsunamis, were assessed through a vulnerability assessment. FEMA collected data on local at-risk assets and resources, the physical features and human activities that contribute to that risk, and the location and severity of the hazard to determine potential community losses. The loss data from Hazus and the exposure analysis highlight areas that would be affected, which provides an opportunity to prioritize mitigation action in these areas.

During the update of the HIVA and Multi-Hazard Mitigation Plan, a Google Forms survey was disseminated to individuals in the Stakeholder Steering Committee to capture risk rating information on the various hazards and threats that may affect Kitsap County. Stakeholders were asked to rate hazards and their impacts on Area Impacted, Population, Vulnerable Population, Built Environment, Critical Infrastructure, County Facilities, First Responder Facilities, Economic Consequences, and Environmental Impacts to mirror the 2018 Washington State Hazard Mitigation Plan. Stakeholders rated impacts on a 1-10 scale, with 1-3 meaning "Low," 4-7 meaning "Moderate," and 8-10 meaning "High." The survey had a total of 154 questions, and nine stakeholders provided input. A public Community Survey (as discussed in the Public Outreach & Engagement section) in electronic and printed form was also created to capture the community's perceptions of hazards and their effect on the County and their homes. The results of the stakeholder and public surveys are found in Appendix C: Stakeholder and Public Engagement Records.

The results from the Stakeholder Risk Rating and printed/electronic Public Community Surveys were studied and compared with the historical and quantitative hazard information reviewed during the 2019 Kitsap County Hazard Identification & Vulnerability Assessment (HIVA) update. Risk assessment is inherently problematic and hard to validate, so utilizing and reviewing both qualitative and quantitative data helped provide an appropriate risk rating to each hazard.

### Risk Assessment Overview

Risk assessment in the HIVA provides information regarding the types of hazards, the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from any hazardous event. Specifically, three levels of risk assessment included in this HIVA are “Low,” “Moderate,” and “High.”

An adjective description (High, Moderate, or Low) summarized the overall threat posed by a hazard over the next 25 years. It is a subjective estimate of the combination of the probability of occurrence and vulnerability.

Adjective	Description
<b>High</b> Major focus of Kitsap disaster preparedness program	There is strong potential for a disaster of major proportions during the next 25 years; or, history suggests the occurrence of multiple disasters of moderate proportions during the next 25 years.
<b>Moderate</b> Modest priority of disaster preparedness	There is moderate potential for a disaster of less than major proportions during the next 25 years.
<b>Low</b> Low priority program	There is little potential for a disaster during the next 25 years.

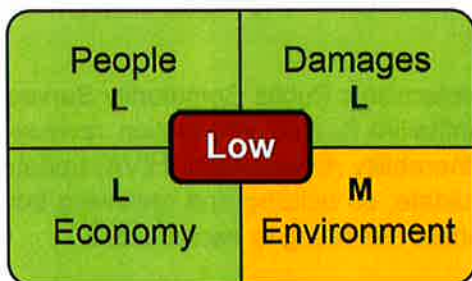
Table 3: Risk Rating Adjective Descriptions

### Limitations

Overall risk assessment is difficult to quantify, so utilizing both qualitative and quantitative methods promotes a more comprehensive approach and process. The conditional and variable nature of hazards precludes risk analysis from being entirely objective or quantitative, and some subjectivity and variance are to be expected.

### Reference Icon

Each hazard has a quick reference icon identifying the County’s vulnerability to that hazard. The icon rates the four significant priorities and losses associated with any disaster and offers an overall risk rating. For example, droughts have an overall score of “Low,” with “Low” to “Moderate” scores in each of the defined areas.



## Contact

Questions and comments about this HIVA can be directed to the:

**Director of Kitsap County Department of Emergency Management**

911 Carver St, Bremerton, WA 98312

360-307-5871

[dem@co.kitsap.wa.us](mailto:dem@co.kitsap.wa.us)



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# County & City Profiles

In this section, each jurisdiction is described, including its community assets at risk to hazards. Assets are defined broadly to include anything that is important to the *character and function* of a community and can be described very generally in the following four categories:

- People
- Economy
- Built environment
- Natural environment

Although all assets may be affected by hazards, some assets are more vulnerable because of their physical characteristics or socioeconomic uses.

The profiles are presented in the following order:

- Kitsap County
- Bainbridge Island
- Bremerton
- Poulsbo
- Port Orchard



Figure 3: Map of Kitsap County, Kitsap Economic Development Alliance

# Kitsap County

With a total area of 566 square miles, of which 395 square miles (70%) are land, and 171 square miles (30%) are water, Kitsap County is the fourth-smallest county in Washington by land area and third-smallest by total area.<sup>7</sup> The County is located between the metropolitan areas of Seattle and Tacoma and the wilderness of the Olympic Mountains and has four incorporated cities: Bainbridge Island, Bremerton, Port Orchard, and Poulsbo.

- Winslow became the City of Bainbridge Island in 1992 after citizens voted to annex the entire island in 1990. Bainbridge Islanders enjoy a beautiful, rural setting just minutes from the cultural and recreational attractions of Seattle. It is also home to the state's most heavily traveled ferry runs.
- Bremerton is Kitsap's most populated city, home to the area's largest employer, the Puget Sound Naval Shipyard.
- Port Orchard lies across Sinclair Inlet from Bremerton and is known for its downtown shops and antiques.
- Poulsbo, on the northern shore of Liberty Bay, is known as "Little Norway" due to its many residents of Norwegian descent.

In Washington, special purpose districts are limited purpose local governments separate from a city, town, or county government. Generally, they perform a single function, though some perform a limited number of functions. They provide an array of services and facilities including electricity, fire protection, flood control, health, housing, irrigation, parks and recreation, library, water-sewer service and more recently stadiums, convention centers, and entertainment facilities that are not otherwise available from city or county governments. Kitsap County currently has 42 special purpose districts which can be found in Appendix C: Special Districts.<sup>8</sup>

These districts are political subdivisions of the state and come into existence, acquire legal rights and duties, and are dissolved in accordance with statutory procedures. Enabling legislation sets forth the purpose of the district, procedures for formation, powers, functions and duties, the composition of the governing body, methods of finance, and other provisions. The districts are usually quasi-municipal corporations though some are statutorily defined as municipal corporations.<sup>9</sup>

Although the general provisions for some special district statutes have been consolidated, such as for diking and drainage districts, there is no set of uniform provisions covering all special districts in Washington as there is with cities and counties.<sup>10</sup>

Other Kitsap County cities have also conducted a number of annexations for urban growth areas.<sup>11</sup>

The County operates with three commissioners and the following elected officials: Sheriff, Prosecutor, Coroner, County Clerk, Auditor, and Treasurer. Cities of Bremerton, Poulsbo, and

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<sup>7</sup> United States Census Bureau (2012)

<sup>8</sup> Municipal Research and Services Center (MRSC) <http://mrsc.org/Home/About-MRSC.aspx>

<sup>9</sup> Municipal Research and Services Center (MRSC) <http://mrsc.org/Home/About-MRSC.aspx>

<sup>10</sup> Municipal Research and Services Center (MRSC) <http://mrsc.org/Home/About-MRSC.aspx>

<sup>11</sup> Kitsap County Department of Community Development (2019)

Port Orchard operate with an elected Mayor and City Council members. The City of Bainbridge Island operates with a Mayor *pro tempore*, which rotates among elected City Council members annually. Each city has a City Manager for day-to-day operations. The Port Gamble S'Klallam and Suquamish Tribes have a Tribal Council who oversees their tribal nations, and each has a Tribal Executive Director.

Due to location and topography, Kitsap County can be subject to various hazards such as earthquakes, floods, landslides, severe weather, and tsunamis. The County has seen 14 Federally declared disasters since 1953, including six flood events, four severe storms, two earthquakes, one coastal storm, and one volcano incident. KCDEM and its local, State, and Federal partners work together to prepare for, mitigate against, recover from, and respond to various events and disasters using a whole-community approach.

## People

### Population Overview

As of 2019, an estimated 273,927 people call Kitsap County their home.<sup>12</sup> Thirty-three percent of those citizens reside in the cities of Bainbridge Island, Bremerton, Port Orchard, and Poulsbo. Additional residents live on the four military installations and in the tribes of Suquamish at the Port Madison Reservation and Port Gamble S'Klallam along the Hood Canal. Each City Profile section provides specific population/demographic information.

Out of the other counties in Washington, Kitsap ranks seventh in total population, third in population density, fourth in median household income, and fourth in per capita income according to 2019 Esri Demographics.

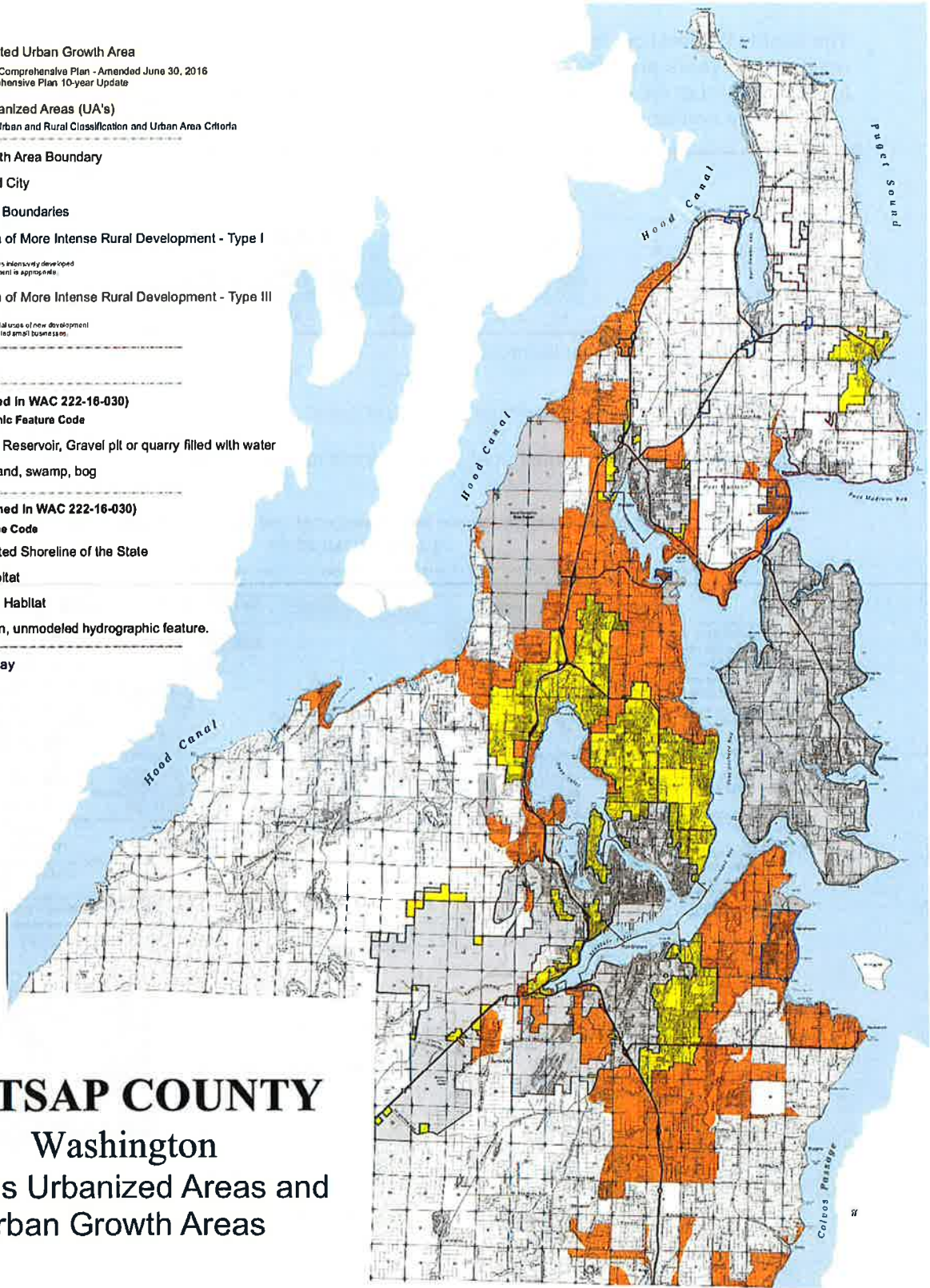
Kitsap County Most Recent Population Estimates <sup>13</sup>					
Location	Population	Population Density	Number of Households	Median Household Income	Under 65 with a Disability
<b>Kitsap County</b>	273,927 (2019)	694 per sq. mi (2019)	105,825 (2019)	\$75,977 (2019)	11.3% (2017)
<b>City of Bainbridge Island</b>	24,870 (2019)	901 per sq. mi (2019)	10,246 (2019)	\$118,382 (2019)	4.8% (2017)
<b>City of Bremerton</b>	43,268 (2019)	1,520 per sq. mi (2019)	16,813 (2019)	\$54,232 (2019)	15.6% (2017)
<b>City of Port Orchard</b>	15,163 (2019)	1,571 per sq. mi (2010)	5,775 (2019)	\$68,278 (2019)	12.9% (2017)
<b>City of Poulsbo</b>	11,121 (2019)	2,346 sq. mi (2019)	4,688 (2019)	\$69,072 (2019)	6.9% (2017)

Table 4: Kitsap County Most Recent Population Estimates

<sup>12</sup> Esri Demographics (July 2019) <https://washington.hometownlocator.com/wa/kitsap/>

<sup>13</sup> United States Census Bureau (2010-2017) and Esri Demographics (July 2019) <https://washington.hometownlocator.com/wa/kitsap/>

- Unincorporated Urban Growth Area**  
Defined by Kitsap County Comprehensive Plan - Amended June 30, 2016  
Ord No. 354-2016 Comprehensive Plan 10-year Update
- Census Urbanized Areas (UA's)**  
Defined by 2010 Census Urban and Rural Classification and Urban Area Criteria
- Urban Growth Area Boundary**
- Incorporated City**
- Reservation Boundaries**
- Limited Area of More Intense Rural Development - Type I**  
RCW 36.70A.021(5)(d)  
Absent use areas or small communities intensely developed by 1980, where limited land development is appropriate.
- Limited Area of More Intense Rural Development - Type III**  
RCW 36.70A.021(5)(d)  
Lots containing isolated non-residential uses of new development of isolated cottage industries and isolated small businesses.
- Tax Parcels**
- Waterbodies (defined in WAC 222-16-030)**  
**WaterBody Cartographic Feature Code**
- Lake, Pond, Reservoir, Gravel pit or quarry filled with water**
- Marsh, wetland, swamp, bog**
- Watercourses (defined in WAC 222-16-030)**  
**Fish Habitat Water Type Code**
- (S) Designated Shoreline of the State**
- (F) Fish Habitat**
- (N) Non-fish Habitat**
- (U) Unknown, unmodeled hydrographic feature.**
- State Highway**
- Arterial**
- Collector**
- Salt Water**



**KITSAP COUNTY**  
Washington  
Census Urbanized Areas and  
Urban Growth Areas

Figure 4: Map of Census Urbanized Areas & Urban Growth

The figures below show the distribution of age and vulnerable population in Kitsap County. Those residents 65 years and older made up 17.3 percent of the county's population in 2017 compared to 15.1 percent of the state's population. There are also proportionately fewer residents under 18 years of age and less than five years of age in Kitsap County compared to the state.

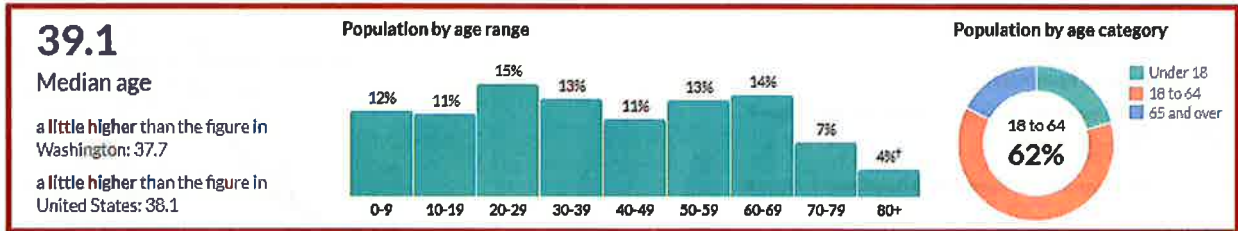


Figure 5: Kitsap County Population Distribution

### Functional Needs and Vulnerable Populations

Kitsap County's access and functional needs populations are outlined in the following figure.

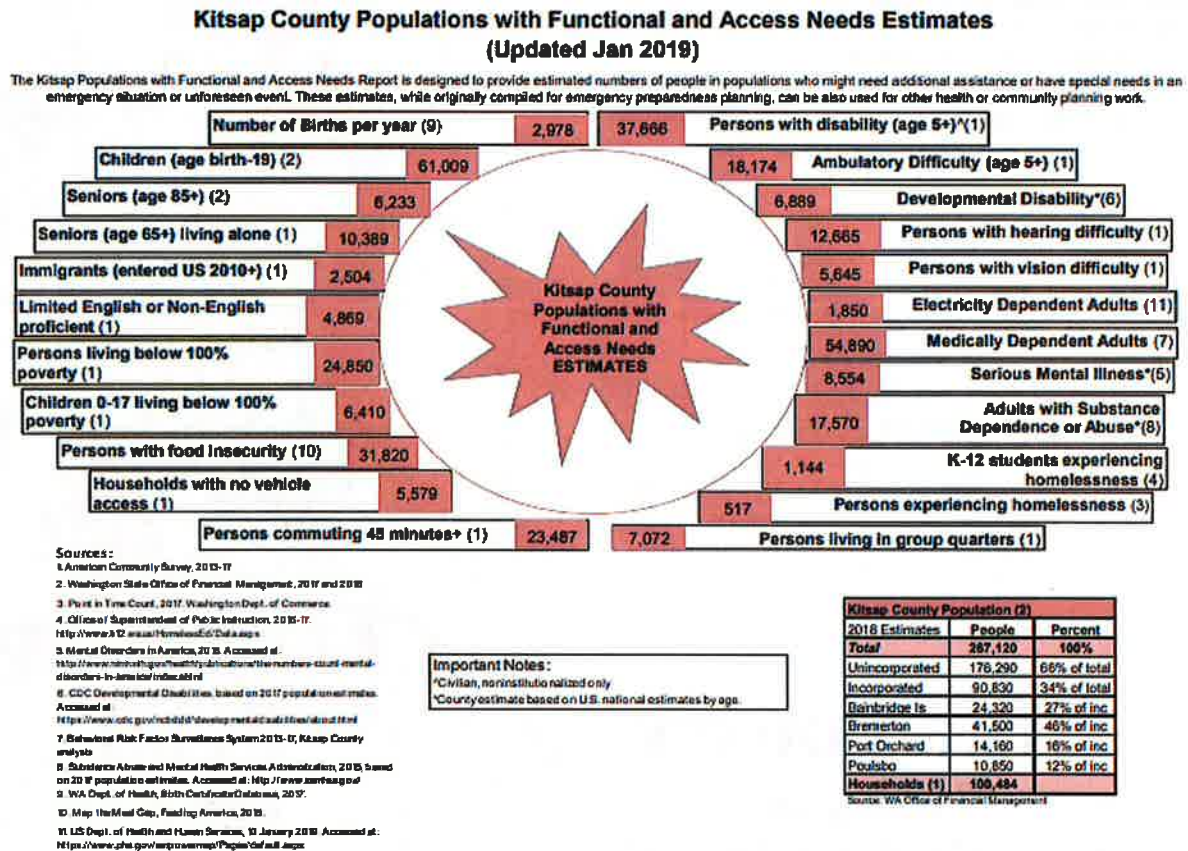


Figure 6: Kitsap County Populations with Functional and Access Needs Estimates (2019)

## Economy

In 2018, the civilian labor force in Kitsap County averaged 122,885, higher than the 2017 level of 120,148. On an annual average basis, there have been yearly increases in the labor force since 2014, another indicator of a healthy job market. In 2018, the county unemployment rate was 4.6 percent compared to 4.9 percent in 2017. The over-the-year decrease in the rate can be attributed to job gains and lower unemployment.<sup>14</sup>

The largest component of Kitsap County nonfarm employment is the government. This sector typically accounts for a third of the nonfarm total with a 2018 total of 32,900 jobs. Of that total, 19,400 was federal government employment. The second-largest group was local government, with 11,400 jobs. Five military installations are located in Kitsap County and are a critical factor in the County's economic balance. The remaining work in the fields of fishing, construction, manufacturing, transportation, public utilities, wholesale, retail, financial, insurance, real estate, and services. Kitsap County is also home to many citizens who consider themselves retired and enjoying the culture and incredible atmosphere of Kitsap County and its four "port" cities.<sup>15</sup>

Civilian Labor Force, 2017	
<b>Kitsap County</b>	<b>56.2%</b>
<b>City of Bainbridge Island</b>	<b>60.3%</b>
<b>City of Bremerton</b>	<b>53%</b>
<b>City of Port Orchard</b>	<b>50.1%</b>
<b>City of Poulsbo</b>	<b>55.8%</b>

Table 5: Civilian Labor Force, 2017  
Estimates (US Census)

School District Attendance	
<b>Bainbridge Island</b>	<b>4,023</b>
<b>Bremerton</b>	<b>5,500</b>
<b>Central Kitsap</b>	<b>12,174</b>
<b>North Kitsap</b>	<b>5,700 (2019)</b>
<b>Olympic College</b>	<b>12,000</b>
<b>South Kitsap</b>	<b>10,500</b>
<b>Total Students</b>	<b>49,897</b>

Table 7: School District Attendance, 2010  
Estimates (US Census)

Indian Nations, 2019	
<b>Port Gamble S'Klallam</b>	<b>1,085</b>
<b>Suquamish</b>	<b>4,490</b>

Table 8: Indian Nations, 2019 Esri  
Demographics

NonFarm Industry Employment <sup>16</sup>	
<b>Total Nonfarm</b>	<b>95,900</b>
<b>Total Private</b>	<b>62,200</b>
<b>Goods Producing</b>	<b>8,200</b>
<b>Mining, Logging, &amp; Construction</b>	<b>5,00</b>
<b>Manufacturing</b>	<b>2,900</b>
<b>Service Providing</b>	<b>87,700</b>
<b>Private Service Providing</b>	<b>54,000</b>
<b>Trade, Transportation, &amp; Utilities</b>	<b>14,200</b>
<b>Retail Trade</b>	<b>11,600</b>
<b>Professional and Business Services</b>	<b>8,700</b>
<b>Leisure &amp; Hospitality</b>	<b>10,400</b>
<b>Government</b>	<b>33,700</b>
<b>Federal Government</b>	<b>20,200</b>
<b>Local Government</b>	<b>11,700</b>
<b>State Government</b>	<b>1,800</b>

Table 6: Nonfarm Industry Employment

<sup>14</sup> Washington Employment Security Department 2019

<sup>15</sup> Washington Employment Security Department 2019

<sup>16</sup> Washington Employment Security Department 2019

## Built Environment

As of 2017, Kitsap County has 112,667 housing units and 1,094 building permits issued. Figure 7 (following the text of this section) offers a view of comprehensive land use in the County.

The Hazus risk assessment in the 2015 FEMA Risk Report identifies the buildings most at risk from multiple hazards, as well as specific areas of mitigation interest. The table below highlights some of the buildings in the unincorporated Kitsap County affected by flooding, tsunami, earthquake, and landslide risks. Unincorporated Kitsap County has 30% of its structures built before modern building code and has 766 buildings within the landslide zone, representing \$137 million in value.<sup>17</sup>

Kitsap County Areas of Mitigation Interest <sup>18</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
Multiple Single-Family Homes	NE Twin Spits Rd	\$2.0 million (15 Homes)	\$790,000	40%	Flood
Sunnyslope Elementary School	4183 Sunnyslope Rd. SW, Port Orchard	\$2.6 million	\$1.3 million	50%	Earthquake
Apartment Complex	1623 W. Admiralty Heights Ln.	\$8.1 million (9 Units)	N/A	N/A	Landslide
Tracyton Community Library	351 NW Tracy Ave.	\$85,000	\$53,000	64%	Earthquake
South Kitsap Fire and Rescue	1974 Fircrest Dr. SE	\$994,000	\$651,000	65%	Earthquake

Table 9: Kitsap County Areas of Mitigation Interest

### Existing Structures

#### City/County Public Buildings

The combined City/County public buildings are approximately 2500 units. In the past decade, the Cities and County enjoyed a building boom, which included the construction of a new County Administration Building and four new city halls. Most other critical facilities are relatively new except for older structures used by the fire districts or non-governmental organizations (NGOs) serving Kitsap County. The Kitsap County Housing Authority did not participate in this planning process; most of their buildings are of wood stock with minor exceptions and were not damaged during the Nisqually earthquake.

#### Residential Structures

Most residential structures in the County are constructed of wood stock. KCDEM offers programs to instruct building contractors and residence on how to “brace and bolt” older structures to improve some of the over 100,000 residential structures that have not been retrofitted to

<sup>17</sup> FEMA Risk Report for Kitsap County (2015)

<sup>18</sup> FEMA Risk Report for Kitsap County (2015)



earthquake mitigation standards. The table below contains the number of housing units in Kitsap as of 2017:

<b>Residential Structures Information</b>		
<b>Type</b>	<b>Estimate</b>	<b>Percent</b>
<b>House Occupancy</b>		
Total housing units	110,944	100%
Occupied housing units	100,484	90.6%
Vacant housing units	10,460	9.4%
Homeowner vacancy rate	1.9	(X)
Rental vacancy rate	6.0	(X)
<b>Units in Structure</b>		
Total housing units	110,944	100%
1-unit, detached	76,427	68.9%
1-unit, attached	5,309	4.8%
2 units	2,534	2.3%
3 or 4 units	3,157	2.8%
5 to 9 units	4,152	3.7%
10 to 19 units	4,095	3.7%
20 or more units	6,025	5.4%
Mobile home	8,953	8.1%
Boat, RV, van, etc.	292	0.3%
<b>Year Structure Built</b>		
Total housing units	110,944	100%
Built 2014 or later	994	0.9%
Built 2010 to 2013	2,797	2.5%
Built 2000 to 2009	15,382	13.9%
Built 1990 to 1999	24,674	22.2%
Built 1980 to 1989	18,125	16.3%
Built 1970 to 1979	20,019	18.0%
Built 1960 to 1969	7,643	6.9%
Built 1950 to 1959	5,267	4.7%
Built 1940 to 1949	6,805	6.1%
Built 1939 or earlier	9,238	8.3%

Table 10: Kitsap County Housing Characteristics 2013-2017 American Community Survey 5-Year Estimates (US Census

- Rural Residential
  - Rural Protection
  - Rural Wooded
  - Forest Resource Lands
  - Mineral Resource
- 
- Rural Commercial
  - Rural Industrial
- 
- Urban Industrial
  - Urban High-Intensity Commercial/Mixed Use
  - Urban Low-Intensity Commercial/Mixed Use
  - Urban Low-Density Residential
  - Urban Medium/High-Density Residential
- 
- Limited Area of More Intense Rural Development - Type I  
RCW 36.70A.070(5)(d)(i)  
*Mixed use areas or small communities intensively developed by 1990, where limited infill development is appropriate.*
  - Limited Area of More Intense Rural Development - Type III  
RCW 36.70A.070(5)(d)(i)  
*Lots containing isolated nonresidential uses or new development of isolated cottage industries and isolated small businesses.*
- 
- Poulsbo Urban Transition Area
  - Public Facility
  - Incorporated City
  - Military
  - Tribal Land
  - Lake
  - Salt Water
- 
- Urban Growth Area Boundary
  - Incorporated City Boundary
  - Limited Areas of More Intense Rural Development - Type I
  - Limited Areas of More Intense Rural Development - Type III
  - Reservation Boundary
  - Railroad Line
  - Tax Parcels

**KITSAP COUNTY**  
 Washington  
**Comprehensive Plan**  
 Land Use Map  
*Effective February 15, 1999*  
*Amended December 10, 2018*

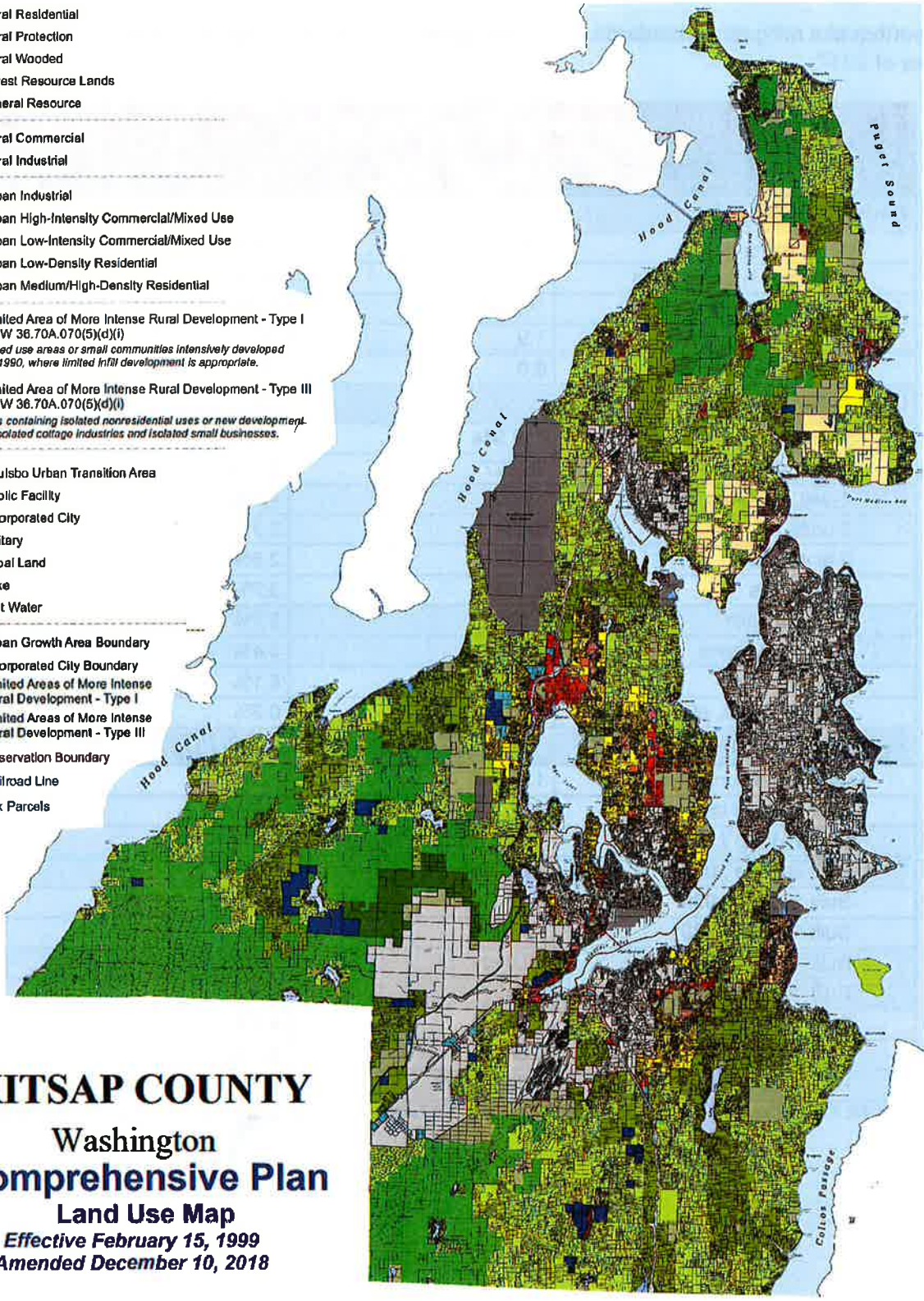


Figure 7: Comprehensive Land Use Map (2018)

## Transportation, Communications, and Utilities

Transportation, communications, and utilities are vulnerable to hazardous events. Transportation corridors are vital to the movement of citizens and the economy, as well as electrical and natural gas grids providing energy in the County. Transportation is provided through state and county roads but limited by the geographic characteristics of Kitsap County shorelines and is subject to ferry systems and bridges. There is no major rail service in the County with some track provided to Naval installations.

The Hood Canal Floating Bridge is critical to Clallam and Jefferson Counties as their main supply route which may be impacted by various hazards.

### Transportation Concerns

- The Tacoma Narrows is the major route for commercial traffic into the county and may be affected by various hazards.
- The Gorst area is a choke point that most traffic heading north of this point has to pass through. The bridges in the area are particularly vulnerable to natural disasters such as earthquakes due to liquefaction.
  - Gorst continues to be a transportation chokepoint that becomes impassable with nearly any hazard, including high winds, floods, and car accidents. This issue has the potential to result in delays in emergency response operations and critical transportation.
- All other bridges on SR16 including those in Pierce County.
  - This is the main route for getting things into Kitsap County.
- The three Ferry Terminals (Bremerton, Bainbridge, and Southworth).
- The Agate Pass Bridge, as it is the only land connection to Bainbridge Island.

Kitsap County enjoys all of the communications available to major Puget Sound cities. These networks—including high-speed internet and cable TV services—are available to its citizens. Kitsap County built a 911 Center in 2004 as a hazard mitigation strategy. Seismic isolation systems were installed to provide better protection of the County and 911 communication networks.

Puget Sound Energy (PSE) provides essential electrical power to most residential and commercial facilities in Kitsap County. This combination of pole and underground service has received hazard mitigation-related upgrades over the years to reduce winter storm outages and improve structural integrity. However, gas lines, public utility, and sewer systems are underground and vulnerable to earthquakes and other causes of moving earth (e.g., landslides).

Transportation Links in Kitsap County		
Type	Link	Comments
<b>Air</b>	Bremerton Airport	Limited commercial service
<b>Highways</b>	Major routes SR 3, 16, 104	No interstate highways in Kitsap
<b>Bridges</b>	Agate Pass Bridge Tacoma Narrows Bridge Hood Canal Bridge Manette Bridge East Bremerton Bridge	Vital links to adjoining counties

Transportation Links in Kitsap County		
Type	Link	Comments
Transit	Kitsap Transit Access and regular service	Vital service to military installations and ferry docks
Rail	Puget Sound Pacific Railroad	Service from Mason County to military installations
Ferries	Kitsap Transit Inter-harbor service Ferry Terminals	Service to Bremerton/Port Orchard and Bremerton/Annapolis
WA State Ferries	Service from Bremerton, Bainbridge Island, Kingston, and Southworth	Service to Edmonds, Seattle, and King County

Table 11: Transportation Links in Kitsap County

### Critical Facilities & Cultural Resources

Following is a table of an overview of the more critical facility and cultural elements of the County. More in-depth information regarding critical facilities, cultural resources, and locations can be found in each City Profile following this section.

Kitsap County Critical Facilities & Cultural Resources		
City/Jurisdiction	Type/Name	Notes
Kitsap County/ Bremerton	Department of Emergency Management	Main location of Emergency Operations Center (EOC).
Kitsap County/ Port Orchard	Community Development	
Kitsap County/ Silverdale	Emergency Medical Services	
Kitsap County/ Port Orchard	Sheriff	
Kitsap County	Public Works	<p>Critical KCPW Infrastructure:</p> <ul style="list-style-type: none"> <li>• Central Kitsap Treatment Plant: Provides sewer service to Poulsbo, Navy (Bangor, Keyport), Silverdale and Central Kitsap</li> <li>• Kingston Treatment Plant: Provides Sewer Service to Kingston UGA</li> <li>• Suquamish Treatment Plant: Provides Sewer Service to Port Madison Reservation/Suquamish Tribe and Suquamish LAMIRD</li> <li>• Manchester Treatment Plant: Provides Sewer Service to EPA/USN Fueling Station and Manchester LAMIRD</li> <li>• Main PW Building in Port Orchard: Houses Finance, Engineering, Construction Management functions</li> <li>• Randy W Casteel PW Annex in Olympic View Industrial Park (OVIP): Houses Stormwater, Sewer and Solid Waste staff functions</li> </ul>

## Kitsap County Critical Facilities & Cultural Resources

City/Jurisdiction	Type/Name	Notes
		<ul style="list-style-type: none"> <li>Household Hazardous Waste Facility in OVIP: Handles low-level hazardous waste for community</li> <li>Olympic View Transfer Station in OVIP: Serves as the centralized collection point for all solid waste generated within Kitsap County including tribal land and USN/Federal. Garbage and Recycling Facilities in Silverdale (Dickey Road), Olalla, Hansville provide household garbage and recycling drop off spots for the community</li> <li>Road Maintenance Facilities (South Road Shop, Central, and North): House the road maintenance functions for Kitsap County</li> <li>Numerous Sewer Pump Stations (over 50) bring sewage from community to the 4 KCPW operated Treatment plants</li> </ul>
<b>Kitsap County/ Port Orchard</b>	Human Resources	
<b>Kitsap County/ Port Orchard</b>	Information Services	
<b>Bainbridge Island</b>	Police Station	
<b>Bainbridge Island</b>	Fire Stations	Fire Stations 21, 22, and 23.
<b>Bainbridge Island</b>	City Hall	
<b>Bainbridge Island</b>	Public Works facilities	
<b>Bainbridge Island</b>	Main Wastewater Treatment Facility	
<b>Bainbridge Island</b>	Reservoir Facilities	Located at High School Road, Old Creosote Road, and Knechtel and Grand.
<b>Bainbridge Island</b>	Well Fields	Located at the Head of the Bay, Fletcher Bay, and Rockaway Beach.
<b>Bainbridge Island</b>	Pump Stations	17 sewage pump stations total.
<b>Bainbridge Island</b>	Agate Pass bridge and Winslow Ferry Terminal	
<b>Bainbridge Island</b>	Elementary schools	5 total
<b>Bainbridge Island</b>	Middle/Intermediate Schools	3 total
<b>Bainbridge Island</b>	High Schools	2 total
<b>Bainbridge Island</b>	Alternate Schools	3 total
<b>Bainbridge Island</b>	Medical Clinics	4 total
<b>Bainbridge Island</b>	Senior Assistance Center	
<b>Bainbridge Island</b>	Parks & Nature Reserve	Bainbridge Island has several parks, learning centers, religious centers, and a nature preserve.
<b>Bainbridge Island</b>	Historic Properties	The City of Bainbridge Island has seven historic properties registered with the federal register and 35 historic properties.

## Kitsap County Critical Facilities & Cultural Resources

City/Jurisdiction	Type/Name	Notes
		registered with the local historic register. There are 19 heritage trees on the island. <sup>19</sup>
<b>Bainbridge Island</b>	Museums	The island has two museums: Kids Discovery Museum (KiDiMu) and the Bainbridge Island Historical Museum. <sup>20</sup>
<b>Bainbridge Island</b>	Japanese American Exclusion Memorial	This museum is an outdoor exhibit commemorating the internment of Japanese Americans from Bainbridge Island in the state of Washington.
<b>Bremerton</b>	Police Station	
<b>Bremerton</b>	Fire Stations	Both fire stations in Bremerton are brick, are not retrofitted, and show significant damage in earthquake Hazus models.
<b>Bremerton</b>	Courthouse	
<b>Bremerton</b>	The Norm Dicks Building	Houses City Government and Kitsap Public Health.
<b>Bremerton</b>	Public Works Campus	
<b>Bremerton</b>	Olympic College	
<b>Bremerton</b>	Bremerton School District	As of 2019, the Old East High/Junior High School was demolished, and 10,000 square feet was added to the STEM West Hills Elementary School.
<b>Bremerton</b>	Casad Dam	
<b>Bremerton</b>	American Red Cross	
<b>Port Orchard</b>	Police Station	
<b>Port Orchard</b>	Fire Stations	Fire District #7 – Fire Station #31.
<b>Port Orchard</b>	City Hall	
<b>Port Orchard</b>	Public Works Shop	
<b>Port Orchard</b>	Port Orchard School District	South Kitsap School District: South Kitsap High School, Cedar Heights Jr. High
<b>Port Orchard</b>	Givens Community Center	
<b>Port Orchard</b>	Kitsap County Courthouse Complex and county jail	
<b>Port Orchard</b>	Health Facilities	Group Health Coop of Puget Sound, Harrison Memorial.
<b>Port Orchard</b>	Joint Wastewater Treatment Facility Wells:	5 wells and one transmission main from the City of Bremerton.
<b>Port Orchard</b>	Emergency Operations Center (EOC)	Port Orchard's Emergency Operations Center (EOC) has been relocated to South Kitsap Fire and Rescue, Station 31, which resolves the critical vulnerabilities that were inherent with the previous EOC location.

<sup>19</sup> City of Bainbridge Island - Planning Department (2019)

<sup>20</sup> City of Bainbridge Island - Planning Department (2019)

Kitsap County Critical Facilities & Cultural Resources		
City/Jurisdiction	Type/Name	Notes
Port Orchard	The Masonic Hall on the National Register of Historic Places	
Port Orchard	The Sidney Museum and Arts Association	Includes cultural assets such as a gallery, art museum, and log cabin museum
Port Orchard	The Western Washington Center for the Arts	Acts as a community theater.
Port Orchard	The Veteran's Living History Museum	
Port Orchard	The Fathoms 'O' Fun Festival	Considered a valued community tradition.
Poulsbo	Police Station	
Poulsbo	Fire Stations	Fire District #18 Headquarters/Fire Station #71
Poulsbo	City Hall	
Poulsbo	Public Works Office & Shop	
Poulsbo	North Kitsap School District	<ul style="list-style-type: none"> <li>• Administration Building</li> <li>• North Kitsap Senior High School</li> <li>• Poulsbo Junior High School</li> <li>• Poulsbo and Vinland Elementary Schools</li> <li>• The building formerly known as Spectrum Alternative School has been repurposed after being closed in 2010. As of 2019, it is a new alternative learning program.</li> </ul>
Poulsbo	Olympic College Poulsbo Branch Campus	
Poulsbo	Health Facilities	<ul style="list-style-type: none"> <li>• Poulsbo Village Medical Center with Regional Hospitals as backup</li> <li>• North Kitsap Medical Center</li> </ul>
Poulsbo	Wastewater Treatment Plan	Brownsville via pressurized pipe under Liberty Bay
Poulsbo	Wells	6 total operational and one not online at this time
Poulsbo	Water Tanks	9 water tanks wastewater lift stations

Table 12: Kitsap County Critical Facilities & Cultural Resources

### Culturally Sensitive Areas

Kitsap Peninsula is rich with arts and culture, from museums showcasing the region's diverse people, creations, and history to dozens of venues featuring live theater, dance, and music. Various groups, societies, and associations enrich Kitsap County's cultural environment and these entities bring benefits to residents and visitors in many ways.

- Kitsap Historical Society & Museum
- Kitsap Maritime Heritage
- Kitsap Regional Library
- Military Historic Sites & Memorials
- Puget Sound Navy Museum

- South Kitsap Arts Association
- West Sound Arts Council

Some of the best artists in the region call Kitsap County home and a number of programs throughout the county support established and emerging artists and provide the public with ample opportunities to view the work of old favorites and talented newcomers. Bainbridge Island, Bremerton, and Silverdale all host regular art walks, where area businesses stay open late and serve as temporary art galleries for local painters, sculptors, photographers, and other artisans. Kitsap is known for its superior art galleries such as the Amy Burnett Fine Art Gallery in Bremerton, the Bainbridge Arts and Crafts Gallery on Bainbridge Island, and The Front Street Gallery in Poulsbo and The Lisa Stirrett Glass Art Gallery in Silverdale.

The beautifully restored Admiral Theater in Bremerton brings a variety of performances to the area, and the Bremerton Symphony delivers classical music offerings throughout the year. In addition, a number of local and regional theater groups exist in the county and perform everything from Shakespeare to show tunes. Kitsap is home to two beautiful new museums, The Bainbridge Island Museum of Art and the Suquamish Museum and Cultural Center. Other popular museums offering unique experiences include The Naval Undersea Museum, the Kids Discovery Museum, and touring the historic Navy Destroyer the U.S.S. Turner Joy.

Kitsap is home to several world-class gardens including the internationally renowned Bloedel Reserve, the legendary Heronswood Gardens, and Elandan Garden's Bonsai Collection.

The strong cultural influences of the Suquamish and Port Gamble S'Klallam tribes are integral to the Kitsap Peninsula. Suquamish is the ancestral home of the great Chief Seattle and hosts the annual Chief Seattle Days festival in his honor. Another cultural highlight is the annual Tribal Canoe Journey, a gathering of 90 Northwest Native tribes with scheduled landings in Suquamish and Port Gamble. The Suquamish Clearwater Casino and Resort and The Point Casino offer a wide variety of entertainment options and are major economic drivers in the County.

### **Tribal Lands**

Founded in its deep cultural values, the Suquamish People consider all lands and waters on our Reservation and U&A to be sacred and sensitive. Therefore, it's important to note that in accordance with Federal government criteria, the Tribe has identified 20 specifically culturally sensitive areas within the Port Madison Indian Reservation. Sixteen resources are on or directly adjacent to the contemporary marine shoreline and may be affected by wave action during severe storms, by oil spills and other toxic substances that enter marine waters, or by tidal waves caused by earthquakes on the Seattle Fault Zone. Again, based on the Tribe's cultural values, these specific areas only represent a portion of those lands and waters considered culturally sensitive.

The following map illustrates where each of the culturally sensitive sites is located. They are labeled on the map by numbers that correspond with their assigned identification names.



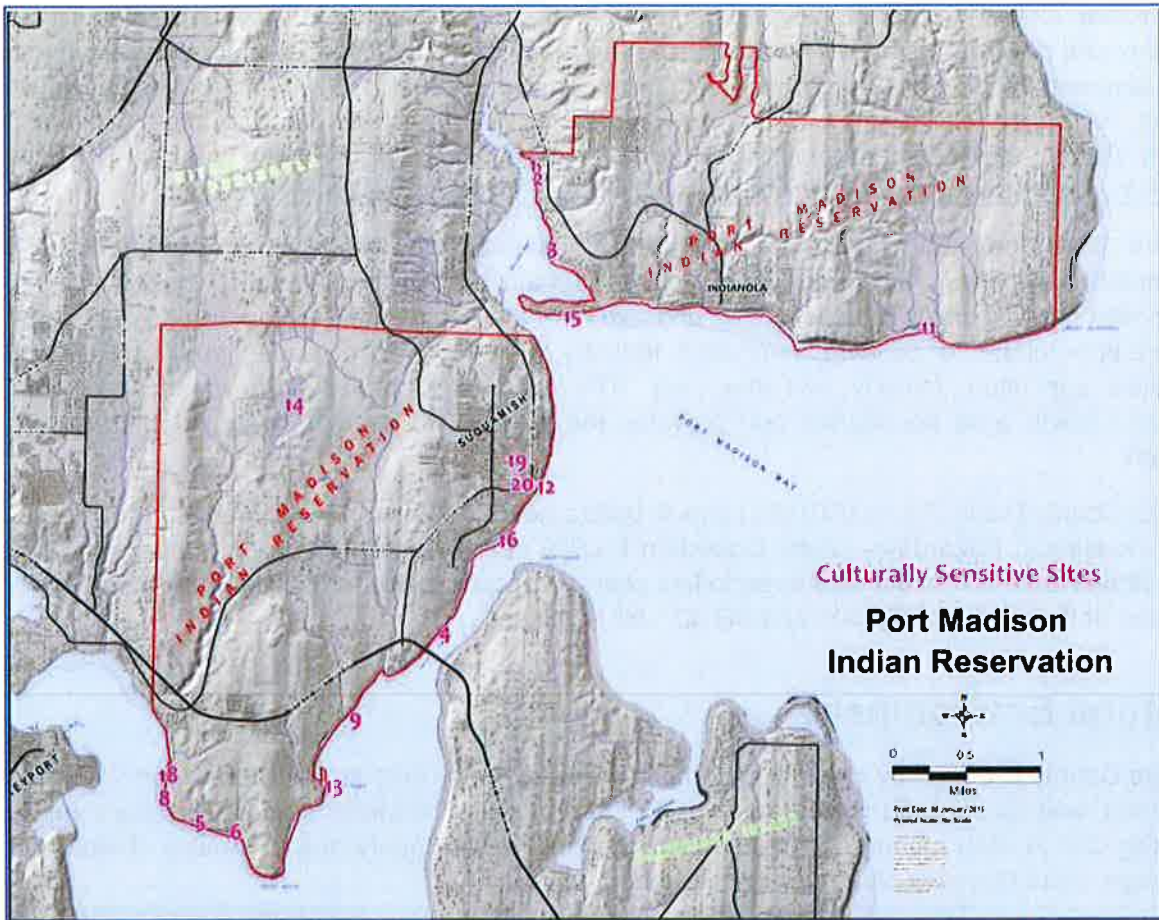


Table 2.1: Culturally Sensitive Sites	
Site ID Number	Resource Description
1	Archaeological Site 45KP32 - Shell Midden
2	Archaeological Site 45KP33 - Shell Midden
3	Archaeological Site 45KP34 - Shell Midden
4	Archaeological Site 45KP40 - Shell Midden
5	Archaeological Site 45KP41 - Shell Midden
6	Archaeological Site 45KP42 - Shell Midden
7	Archaeological Site 45KP43 - Shell Midden
8	Archaeological Site 45KP44 - Shell Midden and Adams Marsh Complex
9	Archaeological Site 45KP45 - Petroglyph
10	Archaeological Site 45KP48 - Petroglyph
Table 2.1: Culturally Sensitive Sites, continued	
Site ID Number	Resource Description
11	Doe-Kag-Wats Marsh Complex
12	House of Awakened Culture Complex
13	Kiana Lodge Complex
14	Marsh Complex Inland
15	Miller Bay Spit Complex
16	Old Man House Archaeological Site (45KP2) and Historic Village
17	Sacred Place
18	Sacred Place
19	St. Peter Mission
20	Suquamish Cemetery

Figure 9: Map of Culturally Sensitive Sites Port Madison Indian Reservation

The Kitsap County Comprehensive Plan describes the 20-year vision for unincorporated Kitsap County and how that vision will be achieved. The plan covers land use, economic development, environment, housing and human services, transportation, capital facilities and utilities as well as parks, recreation, and open space. The Comprehensive Plan is mandated by the Washington State Growth Management Act (RCW 36.70A). A full copy of the plan can be found at [https://www.kitsapgov.com/dcd/Pages/Kitsap\\_County\\_Comprehensive\\_Plan.aspx](https://www.kitsapgov.com/dcd/Pages/Kitsap_County_Comprehensive_Plan.aspx).

Figure 9 is a Comprehensive Land Use Map that shows the land uses that are permitted by the Comprehensive Plan. The Land Use Map is adopted as part of the Plan. It designates the proposed general distribution, locations and extent of the uses of land for urban and rural uses, where appropriate, for housing, commerce, industry, recreation, open spaces, public utilities and facilities, agriculture, forestry, and other uses. The Land Use Map guides growth consistent with Urban Growth area boundaries and provides the capacity to accommodate adopted growth targets.

Kitsap County Public Works (KCPW) plans to build a new North Kitsap Road Maintenance Facility and Household Hazardous Waste Collection Facility near the intersection of Gunderson Road and State Route 307 in the next three to five years. The current North Road Maintenance Facility located at the corner of SR 305 and SR 307 will be closed.

## Natural Environment

Kitsap County is bound by Hood Canal to the west, Admiralty Inlet to the north, Puget Sound to the east, and Mason and Pierce counties to the south. Its landmass totals 393 square miles, ranking 36<sup>th</sup> in area among counties in Washington. Kitsap County has 228 miles of saltwater frontage, more than any other county in Washington.

Most of the land area consists of remnants of a glacial drift plain. The surface is composed generally of flat-topped rolling hills separated by valleys and bays. The land rises from sea level to maximum elevations of 400 to 600 feet, except for Green Mountain and Gold Mountain west of Bremerton. These hills, formed from ancient volcanic rocks, cover about 20 square miles and rise to an elevation of 1,761 feet. The County occupies lowlands in the shadow of the Olympic Mountains.

Kitsap has a moderate climate with mild, wet winters and cool, dry summers. Mean annual precipitation ranges from 26 inches in the north to nearly 80 inches in the vicinity of Green and Gold Mountains, with a yearly average of 41.2 inches of rain and 3.5 inches of snow countywide. Kitsap County has an average of 161 precipitation days per year. The average low temperature in January is 33.8 degrees F, and the average high temperature in July is 75.1 degrees F.<sup>21</sup>

### **Topography**

The Kitsap Peninsula area is geologically the remnant of a glacial drift plain. The peninsula is extensively carved by inlets, giving the County roughly 33 miles of freshwater waterfront and 228 miles of saltwater coastline. Landslide and marine bluff failures are relatively common in the low

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<sup>21</sup> <http://kitsapeda.org/life-work/enviable-quality-of-life/location-and-climate/>

hills on the perimeter of Puget Sound, particularly in unsheltered bluff areas subjected to wave cutting.

Four main geologic units exist in the subsurface: (1) fill; (2) younger alluvium, including beach deposits; (3) alluvium associated with the Vashon Glacier; and (4) basaltic bedrock. Low areas have filled with peat and very loose soils over time, and some may have been artificially filled during periods of development.

### **Creeks and Freshwater Ways**

Although Kitsap County has the propensity to flood, it does not have any rivers. Rather, it has 39 known creeks that can swell from significant rainfall and flood downstream structures. Kitsap County and its Cities have been proactive in managing runoff and reducing the impacts of low area flooding during significant rainfall events. Mitigation efforts have reduced common flooding areas in cities through innovative means to manage rainfall such as improved stormwater systems.

### **Saltwater Landmarks**

Saltwater landmarks include Admiralty Bay, Dyes Inlet, Sinclair Inlet, Port Washington Narrows, Liberty Bay, Miller Bay, and Hood Canal. FEMA's flood map and the National Flood Insurance Program (NFIP) define those areas that are affected by boat wakes, low-lying flooding from high tides, or potential tsunamis.

### **Landslides**

Kitsap has a history of fatal landslides. Landslide and marine bluff failures are common on low hills and the perimeter of Puget Sound. Significant rainfall and ground saturation affect these areas. Many areas in Kitsap County are defined as "geological critical" areas with soft soil and a higher risk of shaking during earthquakes.

### **Lakes**

Kitsap County has several lakes fed by the numerous creeks and streams in the County. Some lakes have dams to manage lake water levels and protect waterfront residence. The Casad Watershed provides drinking water to the residents of Bremerton. Other lakes provide recreational fishing and boating managed by private residences or County/City Governments.

### **Critical Areas**

The following pages show a legend and a map of the Critical Areas of Kitsap County. This map depicts Critical Areas, as defined in Title 19 Kitsap County Code (Critical Areas Ordinance) and is for informational and illustrative purposes (WAC 365-190-080). It includes wetlands, fish and wildlife habitat conservation areas (streams, lakes, and waterbodies), geologically hazardous areas, and frequently flooded areas.

# Critical Areas

## KITSAP COUNTY

### Washington

#### Geologically Hazardous Areas

 High

High Geological Hazard Areas described:

Areas of HIGH EROSION HAZARD:

- Channel Migration Zones, as mapped by the Washington Department of Ecology;
- Coastal erosion with a sediment source rating value of 0.6 to 1.0, per the Prioritization Analysis of Sediment Sources in Kitsap County.

Areas of HIGH LANDSLIDE HAZARD:

- Shallow landslide areas with Factor of Safety (FS) of 0.8 to 1.5. FS is a method (Harp, 2006) for slope stability based on the angle of the slope from LIDAR elevation data and strength parameters.
- Areas with slopes greater to or equal to 30 percent in grade and deemed by a qualified geologist or geotechnical engineer to meet the criteria of U, UOS, or URS.
- All deep-seated landslides areas.

Areas of high seismic hazard are those areas with faults that have evidence of rupture at the ground surface.

 Moderate

Moderate Geological Hazard Areas described:

Areas of MODERATE EROSION HAZARD AREA:

- Areas identified as geologically hazardous for soil erosion (soil type and slope grade) by NRCS Kitsap County Soil Survey;
- Slopes 15 percent or greater, not classified as I, U, UOS, or URS with soils classified by the U.S. Department of Agriculture NRCS as "highly erodible" or "potentially highly erodible";
- Coastal erosion with a sediment source rating value of 0.3 to 0.8 per the Prioritization Analysis of Sediment Sources in Kitsap County.

Areas of MODERATE LANDSLIDE AREA:

- Shallow landslide areas with FS of 1.5 to 2.5
- Slopes of 15 percent or greater and not classified as I, U, UOS, or URS, with soils classified by the U.S. Department of Agriculture NRCS as "highly erodible" or "potentially highly erodible"; or slopes of 15 percent or greater with springs or groundwater seepage
- Slopes in all areas equal to or greater than 40 percent.

Areas of MODERATE SEISMIC HAZARD:

- Areas susceptible to seismically induced soil liquefaction, such as hydric soils as identified by the NRCS, and areas that have been filled to make a site more suitable for development. This may include former wetlands that have been covered with fill.
- Areas identified as Seismic Site Class D, E, and F.
- Faults without recognized evidence of rupture at the ground surface.





#### Waterbodies

 Bay, estuary, Puget Sound

 Lake, Pond, Reservoir, Gravel pit or quarry filled with water

#### Watercourses (defined in WAC 222-16-030)

Fish Habitat Water Type Code

-  (S) Shoreline of the State
-  (F) Fish Habitat
-  (N) Non-fish Habitat
-  (U) Unknown, unmodeled hydrographic feature.

#### Potential Wetlands

 Marsh, wetland, swamp, bog  
Wetland data from Department of Natural Resources, National Wetland Inventory and Kitsap County Surveys

 Hydric Soils

Soils in the DNR/SCS survey area. Hydric soils include: Bellingham silty clay loam, McKenna gravelly loam, Mukilteo peat, Norma fine sandy loam, Semlahmoo muck, Shalcar muck, Shelton-McKenna complex, 0-10 percent slopes and Tacoma silt loam

#### FEMA Flood Zone

 High Risk - Coastal Area Zones

Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves.

 High Risk Areas Zones A, AE

Zone A: Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage.  
Zone AE: The base floodplain where base flood elevations are provided.

 Unincorporated Urban Growth Area

 Incorporated City

 Tax Parcels (Full Ownership)

 Salt Water Tidelands

#### Street Center Lines


 State Highway

 Major Road

 Collector / Arterial

 Railroad Lines

 Ferry Routes

 Ferry Terminals

# Critical Areas of Kitsap County

(Legend  
on previous page)

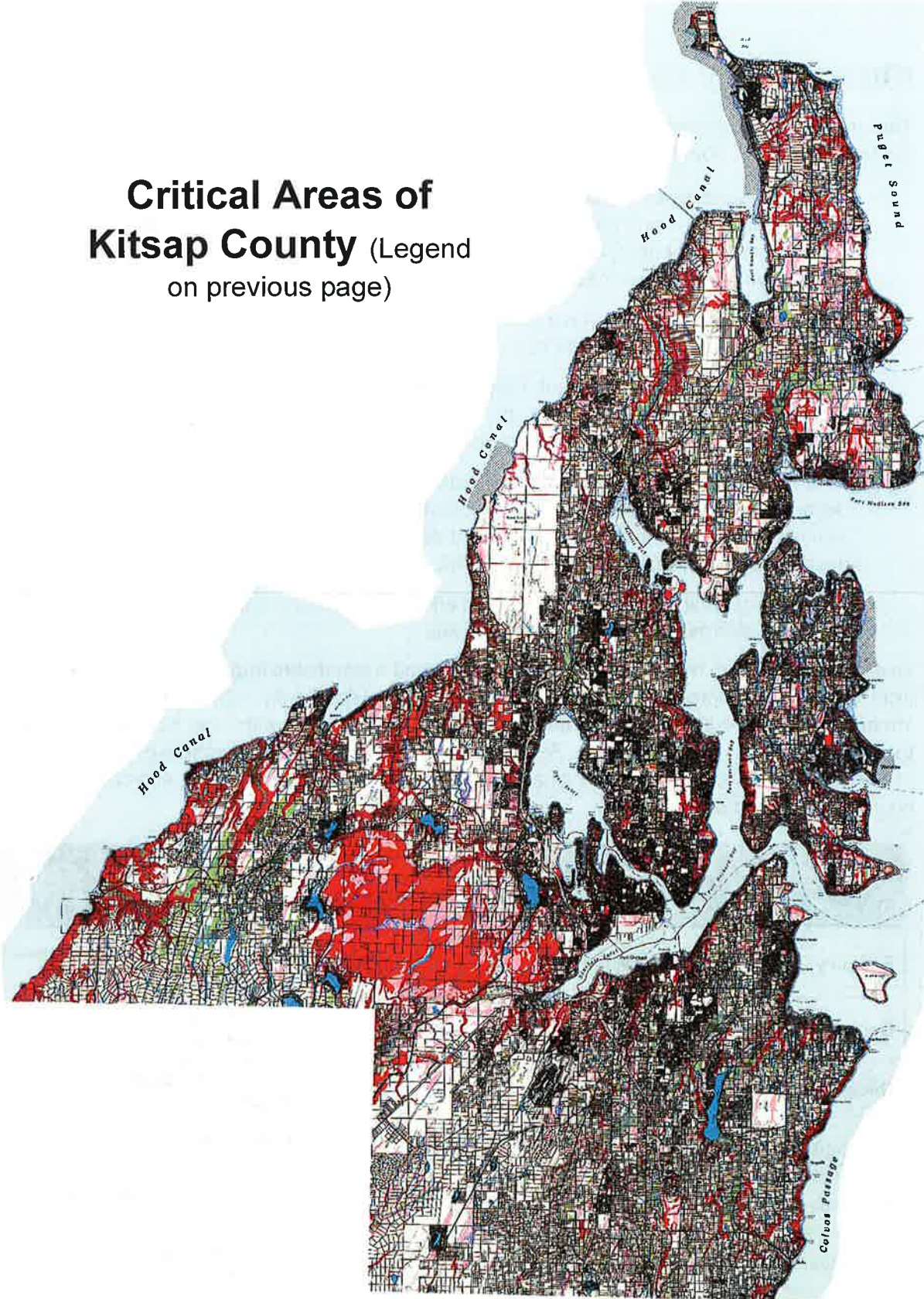


Figure 10: Critical Areas of Kitsap County

## Kitsap County Hazard & Disaster History

The frequency of historic events determines the prioritization of mitigation strategies and recommendations. Some general conclusions arise out of Kitsap County's disaster history:

- During severe winter weather in December 2018, an EF-2 tornado caused catastrophic damage to homes and commercial buildings. Tornadoes in Kitsap County are rare due to irregularities in geography and elevation of the area. The geography is not typically conducive to forming tornadoes large enough to be destructive.
- Since 1962, earthquakes have had the biggest economic impact on the county relative to costs and community disruptions.
- Winter storm events represent 77% of historical declarations at the local level. Some significant events have occurred, but, in most cases, probably did not create disruptions in the entire county or cause substantial damages.
- The Mount St. Helens catastrophic incident in 1980 is listed, but Kitsap County was not significantly affected, nor was Kitsap County part of the Presidential Declaration. It is a reminder, like the incidents of 9/11, that catastrophes outside the county can affect the local area. For example, an eruption of Mt. Rainier would affect Kitsap County.
- From a historical perspective, mitigation efforts should concentrate on reducing the impact of winter storms, flooding, and earthquakes.

Over time, projects to mitigate winter storm events had a significant impact on future damages from storms and improve the quality of life in Kitsap. Historically, winter storms and their impact are more predictable; therefore, the cause, effect, and mitigation can be quantified and therefore justified for improvements. As such, in the last 10 years, the numbers of declarations have declined due to these minor mitigation efforts to control flooding, runoff, and other issues caused by winter storms.

Kitsap County Emergency/Disaster History 1962-2019			
Date of Incident	Type	Declared	Comments
February 2019	Severe Winter Storm	Local (was undeclared locally), State	Local Public Assistance threshold not met.
December 2018	Severe Winter Storms - Tornado	Local, State, Federal	Local Public Assistance threshold not met. Local SBA declaration.
December 2016	Windstorm with Severe Rain	Local	Did not meet State declaration threshold.
December 2016	Windstorm with Severe Rain	Local	Did not meet State declaration threshold.
November 2010	Severe Winter Storm	Local	Local Public Assistance threshold not met
December 2008	Severe Winter Storm	Local, State, Federal	Local Public Assistance threshold not met
August 2008	Hurricane Katrina Evacuation	State, Federal	State: \$1.7 million. Local: None

Kitsap County Emergency/Disaster History 1962-2019			
Date of Incident	Type	Declared	Comments
December 2007	Severe Winter Storm	Local, State, Federal	State: \$82.5 million. Local: \$3.13 million.
December 2006	Severe Storm	Local, State	Local Public Assistance threshold not met.
November 2006	Severe Storm	Local, State	Local Public Assistance threshold not met.
January 2006	Severe Storm	Local, State	Local: \$544,775
December 2005	Severe Winter Storm	Local, State, Federal	Local Public Assistance threshold not met.
January 2004	Severe Winter Storm	None	Freezing rain, ice, flooding. No record of assistance on file.
October 2003	Severe Winter Storm	Local, State, Federal	State: \$11.9 million. Local Public Assistance threshold not met. Individual Assistance received.
May-Sept 2003	Drought	Local, State	No assistance requests. Losses to pasture.
January 2003	Flooding	Local, State	Local Public Assistance threshold not met.
January 2002	Flooding	Local, State	Presidential declaration denied.
September 2001	9/11 Attack on the U.S.	Local, State	No record of requests for assistance on file.
February 2001	Earthquake – Nisqually	Local, State, Federal	State \$66.7 million. Local: \$832,926
February 1999	Flooding, Slides	Local, State	Federal public assistance threshold not met. SBA declaration.
June 1997	Earthquakes	None	Series of small earthquakes between June 23 and June 27, ranging in magnitude from 3.1 to 4.9.
March 1997	Flooding	Local, State, Federal	Local Public Assistance threshold not met. Individual Assistance received.
December 1996	Severe Storm	Local, State, Federal	Total Public Assistance: \$20 million. Local: \$1.96 million.
April 1996	Mudslide	Local (City of Bainbridge Island)	Rolling Bay Mudslide. Local (City) declaration; no record of assistance on file.
January 1996	Flooding	Local, State, Federal	Received Public Assistance. No Individual Assistance received. Bainbridge Island heavily impacted.
November 1995	Severe Storm – Wind/flooding	Local, State	Local Public Assistance threshold not met.
December 1994	Flooding	Local	Local declaration; no record on file.
January 1993	Windstorm	Local, State	No record on file.
January 1992	Severe Storm	No declaration	No record on file.

Kitsap County Emergency/Disaster History 1962-2019			
Date of Incident	Type	Declared	Comments
December 1990	Severe Storm	Local, State, Federal	State: \$785k.
November 1990	Severe Storm	Local, State, Federal	No record on file.
December 1986	Severe Storm	Local, State	No record on file.
December 1982	Severe Storm	Local, State	No record on file.
May 1980	Mount St. Helens Volcano	State, Federal	No record on file.
December 1979	Severe Storm	Local, State, Federal	No record on file.
January 1974	Severe Storm	Local, State, Federal	No record on file.
May 1965	Earthquake	Local, State, Federal	No record on file.
October 1962	Severe Storm – Wind	Local, State, Federal	No record on file.
PA=Public Assistance IA=Individual/Household Assistance *No records maintained on event No FEMA financial data were available online for Federal declarations prior to 2000, only records of declarations. Unable to verify reimbursements.			

Table 13: Kitsap County Emergency/Disaster History 1962-2019

### Hazard Losses for Kitsap County

Kitsap County Hazard Losses 1960-2017 <sup>22</sup>			
Number of Hazard Events	Number of Casualties	Property Damage	Crop Damage
298	68	\$309,860,381	\$703,234

Table 14: Kitsap County Hazard Losses 1960-2017

<sup>22</sup> Washington State Enhanced Hazard Mitigation Plan (2018)



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# Bainbridge Island



Bainbridge Island is located east of the main Kitsap peninsula, separated by Agate Passage to the north, the main body of Puget Sound to the east, Rich Passage Inlet to the south, and Port Orchard Bay to the west. The island is approximately five miles wide and ten miles long, encompassing nearly 17,778 acres, and is one of the larger islands in Puget Sound. Through island annexes in 1991, the City of Winslow, 2 miles square and with a little over 3,000 residents, grew to over 27 square miles and a population today of 24,522, making it the second-largest city in the County.<sup>23</sup>

Bainbridge Island has State, County, and municipal parks, in addition to shoreline access from many City-owned roads. There are golf courses, tennis courts, and youth playfields on the island. The City is also home to the Kids Discovery Museum and the Bainbridge Historical Museum.

## People

### Population Overview

The island is characterized by professional, scientific employment, construction, and education. Many professionals transit daily to downtown Seattle. The City is mostly rural with an urban center (formerly the City of Winslow) located at the ferry landing.

Bainbridge Island Population Information <sup>24</sup>				
Population	Population Density	Number of Households	Median Household Income	Under 65 with a Disability
24,870 (2019)	901 per sq. mi (2019)	10,246 (2019)	\$118,382 (2019)	4.8% (2017)

Table 15: Bainbridge Island Population Information

### Age Distribution

The following figure shows the distribution of age on Bainbridge Island. Overall, the city's population has a typical distribution with a slightly higher "baby boomer" group. There are several senior/assist facilities on the island, mostly located in the city's urban center. The senior population has grown consistent with national trends.

<sup>23</sup> United States Census Bureau (2017)

<sup>24</sup> Esri Demographics (2019)

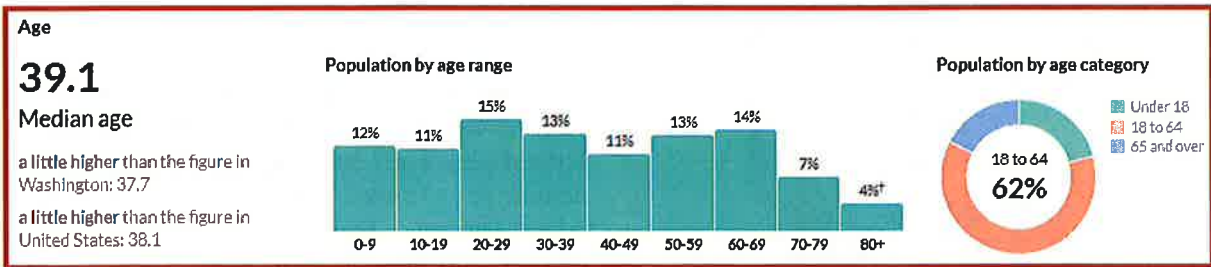


Figure 11: Age Distribution

**Bainbridge Island (Updated Jan 2019)**  
**Kitsap Sub-County Populations with Functional and Access Needs Estimates**

The Kitsap Populations with Functional and Access Needs Report is designed to provide estimated numbers of people in populations who might need additional assistance or have special needs in an emergency situation or unforeseen event. These estimates, while originally compiled for emergency preparedness planning, can be also used for other health or community planning work.

<b>Number of Births per year <sup>§</sup> (9)</b>	147	<p><b>Bainbridge Island School District and ZIP Code</b></p> <p>Legend</p> <ul style="list-style-type: none"> <li>Bainbridge Island School District</li> <li>Bainbridge Island ZIP Code</li> </ul>	<b>1,935 Persons with disability (age 5+) <sup>**</sup> (1)</b>	
<b>Children (age birth-19) <sup>#</sup> (2)</b>	5,442		<b>817 Ambulatory difficulty (age 5+) <sup>#</sup> (1)</b>	
<b>Seniors (age 85+) <sup>#</sup> (2)</b>	709		<b>691 Developmental disability <sup>*</sup> (6)</b>	
<b>Seniors (age 65+) living alone <sup>#</sup> (1)</b>	1,274		<b>811 Persons with hearing difficulty <sup>#</sup> (1)</b>	
<b>Immigrants (entered US 2010+) <sup>#</sup> (1)</b>	12		<b>12 Persons with vision difficulty <sup>#</sup> (1)</b>	
<b>Limited English or non-English proficient <sup>#</sup> (1)</b>	12		<b>97 Electricity dependent adults <sup>§</sup> (3)</b>	
<b>Persons living below 100% of poverty <sup>#</sup> (1)</b>	12		<b>4,199 Medically dependent adults <sup>§</sup> (7)</b>	
<b>Children 0-17 living below 100% of poverty <sup>#</sup> (1)</b>	12		<b>574 Serious mental illness <sup>*</sup> (5)</b>	
<b>Households with no vehicle access <sup>#</sup> (1)</b>	12		<b>1,468 Adults with substance dependence or abuse <sup>#</sup> (8)</b>	
<b>Persons commuting 45+ minutes <sup>#</sup> (1)</b>	4,637		<b>18 K-12 students experiencing homelessness <sup>#</sup> (4)</b>	
			<b>12 Persons living in group quarters <sup>#</sup> (1)</b>	

**Sources:**

- 1 American Community Survey, 2013-17
- 2 Washington State Office of Financial Management, Small Area Demographic Estimates 2017
- 3 US Dept. of Health and Human Services. Accessed at <https://www.phe.gov/empowermap/Pages/default.aspx>
- 4 Office of Superintendent of Public Instruction, 2018-19. <http://www.k12.wa.us/Homeschool/Data.aspx>
- 5 Mental Disorders in America, 2015. Accessed at <http://www.nimh.nih.gov/health/publications/the-numbers-count-mental-disorders-in-america/index.shtml>
- 6 CDC Developmental Disabilities. Accessed at <https://www.cdc.gov/nbddd/developmentaldisabilities/outlook/>
- 7 Behavioral Risk Factor Surveillance System 2016-18, Kitsap County analysis
- 8 Substance Abuse and Mental Health Services Administration, 2016-18. Accessed at: <http://www.samhsa.gov/>
- 9 WA Dept. of Health, Birth Certificate Database, 2017.

**Important Notes:**

- \*Civilian, noninstitutionalized only
- #Region estimate based on U.S. national estimates by age.
- §Region estimate based on zip code boundaries.
- #Region estimate based on a school district boundaries.
- (1) This estimate is unreliable enough that no estimate was displayed (see page 2).

<b>Bainbridge Island Population (2)</b>		
2017 Estimates <sup>#</sup>	People	Percent of Kitsap
Bainbridge Island	23,950	9%

<b>Households on Bainbridge Island (1)</b>		
2013-17	9,679	

Table 16: Bainbridge Island Vulnerable Population

## Bainbridge Island Population Density



Figure 12: Bainbridge Island Population Density, © OpenStreetMap Contributors

## Economy

The city is primarily residential, with some commercial light manufacturing, recreation, agriculture, and open space. The principal economic base consists of retail outlets/offices, Bainbridge Island School District, and light industry.

Bainbridge Island has four centers of commerce and has become noted for its active online business community. Winslow is the downtown core and has most of the shopping and dining. Lynwood Center on the south end of the island has several restaurants and a small hotel. Centrally located, Fletcher Bay has a small grocery store and one restaurant. Rolling Bay, on the east side of the island, is a small commercial center with Bay Hay and Feed, the Bud Hawk Post Office, and several shops. There are 1,767 businesses licensed

on the island; 923 are commercial-based licenses, and 844 are home-based licenses.<sup>25</sup>

## Built Environment

### Land Use

Land use on Bainbridge Island is primarily residential with some commercial, light manufacturing, recreation, agriculture, and open space. Table 18 provides information on housing units on Bainbridge Island. As also noted in the table, most of the Island's structures are recently built structures. Total building stock is 12,639 with 82 critical facilities. Critical facilities are those identified by the City as vital to emergency response and citizen safety and are part of Kitsap County's Damage Assessment Program. Table 16 includes a list of facilities and their locations.

Based on the 2015 Hazus risk assessment, the table below highlights some of the buildings in the City of Bainbridge that are affected by flooding, tsunami, earthquake, and landslide.

City of Bainbridge Areas of Mitigation Interest <sup>26</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
Single Family Home	10680 NE Gertie Johnson Road	\$501,000	\$247,000	49%	Flood
Hyla Middle School	7861 NE Bucklin Hill Road	\$290,000	\$266,000	91%	Earthquake

<sup>25</sup> COBI Finance Department, Bainbridge Island (2019)

<sup>26</sup> FEMA Risk Report for Kitsap County (2015)

City of Bainbridge Areas of Mitigation Interest <sup>26</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
Bainbridge Island Fire Department Station #22	Fire Department Station #22 7934 NE Bucklin Hill Road	\$377,000	\$202,000	53%	Earthquake
Single Family Home	5151 Crystal Springs Dr. NE	\$501,000	\$366,000	73%	Earthquake, Landslide
Shopping Center/Mixed Retail	4569 Lynwood Center Rd. NE	\$2.39 million	\$2.29 million	96%	Earthquake

Table 17: City of Bainbridge Areas of Mitigation Interest

### Housing

Eleven percent of the City of Bainbridge's buildings are located in the moderate-high liquefaction zone, with 3,082 of them built before modern building codes, increasing the risk of significant damage to an earthquake. It also has 177 buildings within the landslide zone, representing \$55M in value.<sup>27</sup>

Residential Structures		
Type	Estimate	Percent
<b>Housing Occupancy</b>		
Total housing units	10,340	10,340
Occupied housing units	9,679	93.6%
Vacant housing units	661	6.4%
Homeowner vacancy rate	0.9	(X)
Rental vacancy rate	0.0	(X)
<b>Units in Structure</b>		
Total housing units	10,340	10,340
1-unit, detached	7,907	76.5%
1-unit, attached	448	4.3%
2 units	187	1.8%
3 or 4 units	179	1.7%
5 to 9 units	375	3.6%
10 to 19 units	369	3.6%
20 or more units	609	5.9%
Mobile home	257	2.5%
Boat, RV, van, etc.	9	0.1%
<b>Year Structure Built</b>		
Total housing units	10,340	10,340
Built 2014 or later	142	1.4%
Built 2010 to 2013	326	3.2%

<sup>27</sup> FEMA Risk Report for Kitsap County (2015)

Residential Structures		
Type	Estimate	Percent
Built 2000 to 2009	2,188	21.2%
Built 1990 to 1999	2,085	20.2%
Built 1980 to 1989	1,398	13.5%
Built 1970 to 1979	1,660	16.1%
Built 1960 to 1969	662	6.4%
Built 1950 to 1959	361	3.5%
Built 1940 to 1949	495	4.8%
Built 1939 or earlier	1,023	9.9%

Table 18: Bainbridge Island Housing Characteristics 2013-2017 American Community Survey 5-Year Estimates (US Census)

## Infrastructure

### Transportation, Communications, and Utilities

Bainbridge Island is served by the Washington State Ferries system, which docks in the downtown Winslow area. State Route (SR) 305 connects the ferry terminal with SR 3 in Poulsbo. The island also has an extensive system of arterials, suburban, and local public streets. Kitsap Transit operates a commuter system in the City, which is coordinated with the ferry schedule; Kitsap Transit also offers a dial-a-ride service. There are several designated transit stops in Winslow, but, for the rest of the island, transit “stops” are generally wherever riders flag down buses on their routes.

Bainbridge Island is connected to the Kitsap Peninsula by the Agate Pass Bridge, carrying SR 305 over Agate Passage. The Agate Pass Bridge, built in the 1950s, is the only fixed transportation route to the island. The island is not serviced by any other bridge and therefore must rely on maritime service should the bridge be damaged. The only other public way off of the island is by the Seattle–Bainbridge ferry, the Washington State Ferries service from the dock at Winslow in Eagle Harbor to Colman Dock (Pier 52) in Seattle.

The City is provided electrical service by the City. The City provides sewer service to approximately 6,000 residents within two separate areas known as the Winslow Sewer Service Area and the South Island Sewer Service Area. Sewer District 7 operates the South Island wastewater treatment plant. The rest of the City is provided sewer service by on-site septic systems. The City provides water service to approximately 6,000 residents within four separate water service areas known as the Winslow, Rockaway Beach, Public Works, and Casey Street Water Systems.

Residents are also provided water service by several other water systems operated by providers known as Kitsap Public Utilities District, Washington Water, and Northwest Water. There is also a multitude of smaller water systems and individual wells operated by homeowners’ associations and individuals who serve the remaining residents in the city.

## Critical Facilities

A list of critical City-owned and non-City-owned facilities can be found at the end of this section in Table 16.

Critical City-owned facilities include:

- City Hall
- Public Works facilities
- Police station
- Fire Stations
- Main wastewater treatment facility
- Reservoir facilities at High School Road, Old Creosote Road, and Knechtel and Grand
- Well fields at the Head of the Bay, Fletcher Bay, and Rockaway Beach
- 17 sewage pumps stations

Critical non-City-owned facilities include:

- Agate Pass bridge and Winslow Ferry Terminal
- Five elementary schools
- Three middle/intermediate schools
- Two high schools
- Three alternate schools
- Four medical centers
- Senior assistance centers
- Various parks and a nature preserve

## Cultural Resources

The City of Bainbridge Island has seven historic properties registered with the federal register and 35 historic properties registered with the local historic register. There are 19 heritage trees on the island.<sup>28</sup>

The island has two museums: Kids Discovery Museum (KiDiMu) and the Bainbridge Island Historical Museum.<sup>29</sup> The island is also home to the Japanese American Exclusion Memorial, an outdoor exhibit commemorating the internment of Japanese Americans from Bainbridge Island in the state of Washington. Bainbridge Island also has several parks, learning centers, religious centers, and a nature preserve. Table 16 below includes some of the most critical cultural facilities.

Bainbridge Island Critical Facilities			
#	Name	Address	Description
<b>City-Owned</b>			
1	City Hall	280 Madison Ave	City Hall
2	Police Department	625 Winslow Way East	Police Department

<sup>28</sup> City of Bainbridge Island - Planning Department (2019)

<sup>29</sup> City of Bainbridge Island - Planning Department (2019)

### Bainbridge Island Critical Facilities

#	Name	Address	Description
3	Fire Department	8895 Madison Ave NE	Fire Department Station 21 - Headquarters
4	Fire Department	7934 NE Bucklin Hill Road	Fire Department Station 22 (as of June 2019, closed for construction)
5	Fire Department	12985 Phelps Road	Fire Department Station 23
6	Senior Center/Commons	Water Front Park	Senior Center/Commons
7	Public Works Facility	7305 Hidden Cove Road	Public Works Facility
8	Municipal Court	10255 NE Valley RD	Municipal Court
9	Head of Bay Well Site	7290 Wyatt Way	Wells, treatment, booster pumps
10	Sands Avenue Well Site	8499 Sands Avenue NE	Wells, treatment, booster pumps
11	Fletcher Bay Well Site	5579 N.E. Foster Road	Well, treatment, booster pump
12	Commodore Well Site		Well, treatment, booster pumps
13	1.0 Million Gallon Reservoir	1755 Lewis Place NW	1,000,000 gal above ground tank
14	1.5 Million Gallon Reservoir	1755 Lewis Place NW	1,500,000 gal above ground tank
15	Grand Avenue Reservoir	Cherry Avenue	300,000 gal above ground tank
16	Rockaway Reservoir	1100 Old Creosote Road	132,000 gal above ground tank
17	Rockaway Treatment Facility	1100 Old Creosote Road	Treatment
18	Rockaway Taylor Avenue Well	Taylor Avenue	Well
19	Erickson Avenue PRV	Ericson and Wyatt	Underground PRV station
20	Cherry Avenue PRV	851 Cherry Avenue	Underground PRV station
21	Grow Avenue PRV	Grow and Wyatt	Underground PRV station
22	Madison/Knechtel PRV	Madison and Knechtel	Underground PRV station
23	Weaver PRV	Weaver between HS & Wyatt	Underground PRV station
24	Madison Avenue PRV	Madison and Madrona	Underground PRV station
25	Ferndale Avenue PRV	Ferndale and Wing Point	Underground PRV station
26	Cave Avenue PRV	Cave Avenue	Underground PRV station
27	Highway 305 South	400 Harborview Drive SE	Dry pit pump station
28	Island Terrace	1174 Ferndale Avenue NE	Dry pit pump station
29	Klickitat	692 Klickitat Place NE	Dry pit pump station
30	Lower Hawley	1195 Irene Place NE	Dry pit pump station
31	Lower Lovell	426 Lovell Avenue SW	Dry pit pump station
32	Lynwood Center	4573 Point White Drive NE	Wet pit pump station
33	North Town Woods	9665 NE North Town Loop	Dry pit pump station
34	Old Treatment Plant	310 Madison Avenue S	Dry pit pump station
35	Sunday Cove	691 Winslow Way West	Dry pit pump station
36	Village	920 Hildebrand Lance NE	Dry pit pump station
37	Wing Point	6481 Wing Point Drive NE	Dry pit pump station
38	Sakai Village	1879 Sakai Loop	Wet pit pump station
39	Ferry Terminal	Olympic Drive	Wet pit pump station
40	Rockaway	3900 Rockaway Beach Road	Wet pit pump station
41	Vineyard Lane	682 State Highway 305	Wet pit pump station
42	Woodward School	9125 N.E. Sportsman Club	Wet pit pump station
43	Madrona	Madison and New Brooklyn	Wet pit pump station
44	Wastewater Treatment Plant	1220 Donald Place	Wastewater treatment facilities



<b>Bainbridge Island Critical Facilities</b>			
<b>#</b>	<b>Name</b>	<b>Address</b>	<b>Description</b>
45	Vincent Road Landfill	6400 Don Palmer Avenue	Closed landfill
46	Stormwater Decant Facility	6401 Don Palmer Avenue	Stormwater spoils handling facility
47	Fort Ward Wastewater Treatment Plant	1220 Donald PI NE	Wastewater Treatment Plant
<b>Non-City Owned</b>			
48	Agate Pass Bridge	Bainbridge Island, WA 98110	Agate Pass Bridge
49	Winslow Ferry Terminal	Bainbridge Island, WA 98110	Winslow Ferry Terminal
50	Washington State Ferry Maintenance Yard	Bainbridge Island, WA 98110	Washington State Ferry Maintenance Yard
51	Blakey Elementary School	4704 Blakely Ave NE	Elementary School
52	The Island School	8553 NE Day Rd	Elementary School
53	Montessori Country School	10994 Arrow Point Dr. NE,	Elementary School
54	Ordway Elementary School	8555 Madison Ave NE	Elementary School
55	Wilkes Elementary School	12781 N Madison Ave NE	Elementary School
56	Sakai Intermediate School	9343 Sportsman Club Rd NE	Intermediate School
57	HYLA Middle School	7861 Bucklin Hill Rd NE	Middle School
58	Woodward Middle School	9125 Sportsman Club Rd	Middle School
59	Bainbridge High School	9330 High School Rd	High School
60	Eagle Harbor High School	9530 NE High School Rd	High School
61	Commodore Options School	9530 High School Rd	Options School
62	Madrona School	219 Madison Ave S	School
63	St. Cecilia Catholic School	1310 Madison Ave N	Catholic School
64	Swedish Primary Care - Bainbridge Island	945 Hildebrand Ln NE Suite 100	Medical Center
65	Virginia Mason Medical	1344 Wintergreen Lane Northeast	Medical Center
66	CHI Franciscan/City MD	1344 Wintergreen Lane Northeast Suite 100	Medical – Urgent Care
67	Bainbridge Island Health and Rehabilitation	835 Madison Ave N	Island Health and Rehabilitation
68	Bainbridge Island Historical Museum	215 Ericksen Ave NE	Historical Museum
69	Kitsap Regional Library – Bainbridge Branch	1270 Madison Ave N	Regional Library
70	Madrona House	8800 Madison Ave N	Senior Living
71	Winslow Manor	234 Wood Ave SW	Senior Living
72	Wyatt House	186 Wyatt Way NW	Senior Living
73	IslandWood	4450 Blakely Ave NE	Learning Center
74	Bloedel Reserve	7571 NE Dolphin Dr	Nature Reserve
75	Island Church	9624 Sportsman Club Rd	Church
76	BattlePoint Park	11299 Arrow Point Dr. NE	Park
77	Ft. Ward Park	2241 Pleasant Beach Dr. NE	Park
78	Hubs (shelter) Locations	Various	Hubs (shelter) Locations
79	Two high power transmission lines across Agate Pass	Agate Pass Bridge	Two high power transmission lines across Agate Pass

Bainbridge Island Critical Facilities			
#	Name	Address	Description
80	Port Madison PSE Sub-stations	N/A	PSE Substation
81	Winslow PSE Sub-stations	N/A	PSE Substation
82	Murden Cove PSE Sub-stations	N/A	PSE Substation

Table 19: Bainbridge Island Critical Facilities

### Future Development

The City of Bainbridge Island has been undertaking its Comprehensive Plan Update in accordance with the Washington State Growth Management Act (GMA) governed by RCW 36.70A. Comprehensive Plans establish the vision for how a community wishes to grow and the features it wishes to preserve for the next 20 years. The plan can be found here: <https://www.bainbridgewa.gov/615/Navigate-Bainbridge-Comprehensive-Plan-U>.

From 2009 through 2018, a new supply of residential units, of all types, has been limited. In April of 2009, there were 10,469 units on Bainbridge Island. In April of 2018, there were 11,061 units. This translates into an average growth of 66 residential units per year. This represents a cumulative annual growth rate of .63 percent per year (less than 1 percent per year). This limited supply on Bainbridge Island is well below demand in a way that increases housing costs.

A handful of projects are planned along the Madison Avenue corridor over the next few years. Housing projects abound along the roadway, and the city is planning to make some improvements to the road's intersection with Wyatt Way in the coming years. The city's plans include sidewalk and bicycle lanes along a portion of Wyatt Way.

### Natural Environment

Bainbridge Island shorelines border the main body of Puget Sound, a large, protected embayment, Port Orchard Bay, and two high-current tidal passages, Rich Passage and Agate Pass.

The Island is characterized by an irregular coastline of approximately 53 miles, with numerous bays and inlets and a significant diversity of other coastal landforms, including spits, bluffs, dunes, lagoons, cusped forelands, tide flats, streams, tidal deltas, islands, and rocky outcrops. The highest point is 425-foot Toe Jam Hill. The topography is generally of low rolling hills with several ridges oriented mostly north to south at 250 to 300 feet elevation.

The waters of Puget Sound surround Bainbridge Island. There are numerous streams and creeks, in addition to Gazzam Lake, a year-round freshwater lake. Environmentally sensitive areas on Bainbridge Island include wetlands, aquifer recharge areas, geologically hazardous areas, continuous and seasonal streams and waters including the waters of Puget Sound, and fish and wildlife habitat. There are over 170 documented wetlands, although more exist that are unmapped. The following figure illustrates the topography of the Island, noting the rolling hills and valleys of Bainbridge Island.

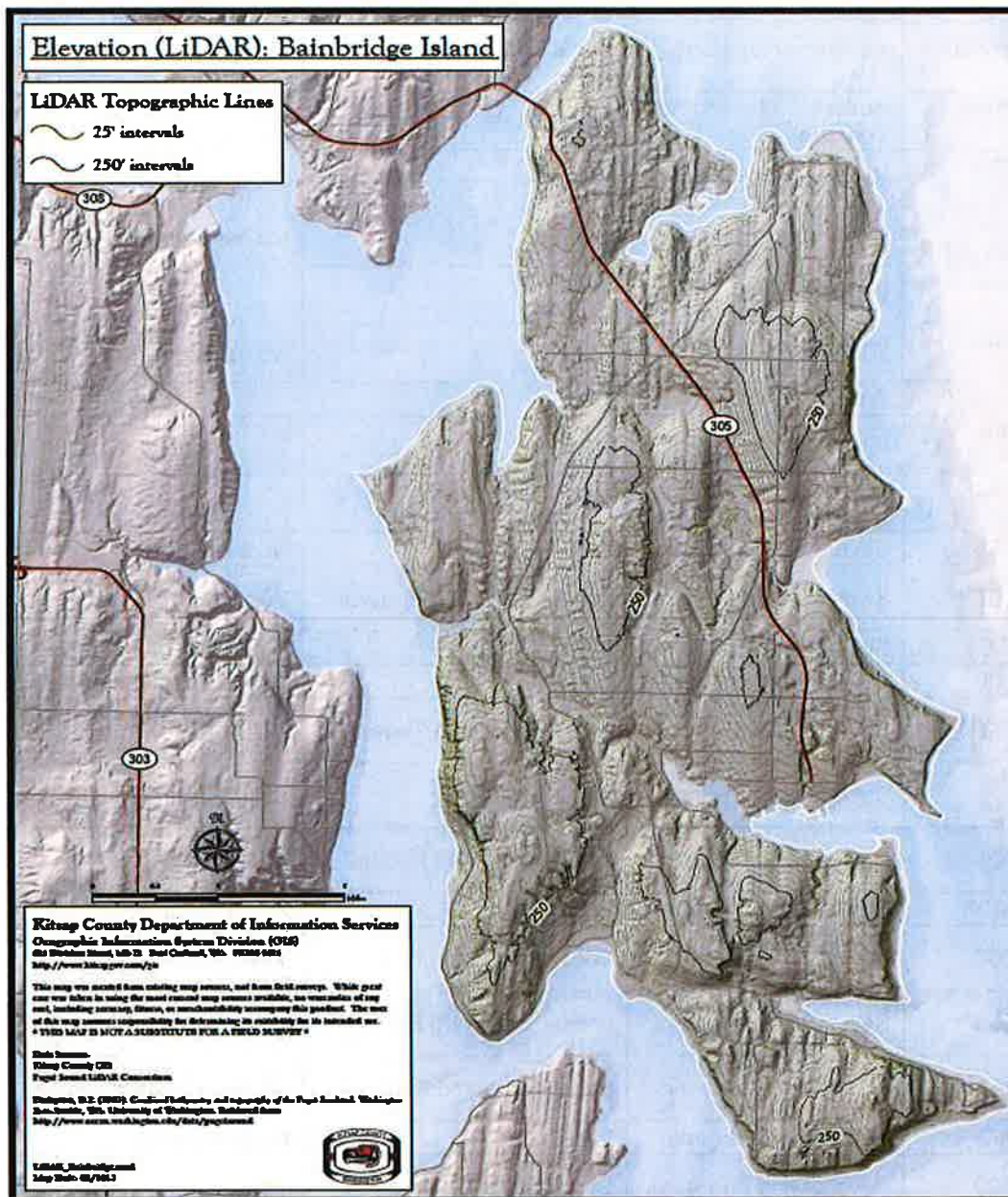


Figure 13: Topography of Bainbridge Island

## History of Disasters

Bainbridge Island, through recent studies, shows historical signs of past earthquakes. The island is obviously vulnerable to earthquakes, but also tsunamis and landslides. The table below shows the history of events on Bainbridge Island. As noted in the last 10 years, Bainbridge Island has been mostly affected by severe winter storms, but most were not serious enough to require any federal assistance.

Event Date	Type of Event	Declaration	Comments
February 2019	Severe winter storm	Local, State, Federal	Local Public Assistance threshold not met. Local SBA declaration.
December 2018	Severe Winter Storms - Tornado	Local, State, Federal	Local Public Assistance threshold not met.
December 2018	Wind and rain	No	Did not meet PA threshold
January-February 2017	Snow, heavy rain, wind	State	No assistance
December 2015	Wind and rain	No	
November 2015	Wind and rain	State	No assistance
August 2015	Wind and rain	No	
November 2012	Heavy rain	No	
December 2010	Heavy rain	No	
Dec 2008	Severe wind and rain	Local	No assistance
Dec 2007	Severe wind and rain	Local, State, and Federal	Yes
Jan 2006	Severe wind and rain	Local	Did not meet PA threshold
Dec 2006	Severe wind and rain	Local	Did not meet PA Threshold
Oct 2003	Severe wind and rain	Local, state, and Federal	Local PA Threshold not met. IA paid out
Jan 2002	Severe wind and rain	Local and State	State Only; presidential denied
Feb 2001	Nisqually Earthquake	Local, state, and Federal	YES
June 1997	Rolling Bay mudslide	Local	No assistance
Dec 1996	Severe rain and snow runoff storm	Local, State, and Federal	Yes
Nov 1995	Severe wind and rain	Local, State, and Federal	Local PA threshold not met
Jan 1993	Severe wind and rain	Local, State and Federal	No record on file
Jan 1992	Severe wind and rain	Local	No assistance
Dec 1990	Severe wind and rain	Local, State and Federal	Yes
Dec 1982	Severe wind and rain	Local	No assistance
May 1965	Earthquake	Local, state, and Federal	No record on file
Oct 1962	Severe wind and rain	Local, state and Federal	No record on file

Table 20: Emergency/Disaster History for Bainbridge Island

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# Bremerton



The City of Bremerton lies east of the Olympic Mountains directly across Puget Sound from Seattle. For over a century, Bremerton has been the home to Puget Sound Naval Shipyard that continues to service U.S. Navy ships and its 9,000 civilians and many active-duty personnel.

The City was incorporated on October 14, 1901 and operates as a charter city with a Mayor/Council form of government. The City's downtown core underwent a comprehensive revitalization with the building of a new conference center, parking garage, hotel on the waterfront, and a public safety and headquarters fire station.

## People

### Population Overview

The population of the City of Bremerton is 41,041,<sup>30</sup> making it the largest city in Kitsap County. During the day, the population swells another 9,000 with employees coming in to work at the Puget Sound Naval Shipyard and support organizations. An increase in population of 13,000 is forecast through 2025.<sup>31</sup>

Bremerton Population Information <sup>32</sup>				
Population	Population Density	Number of Households	Median Household Income	Under 65 with a Disability
43,268 (2019)	1,520 per sq. mi (2019)	16,813 (2019)	\$54,232 (2019)	15.6% (2017)

Table 21: Bremerton Population Information

### Age Distribution

The figure below shows the distribution of age and vulnerable population in the City of Bremerton. The senior population has grown consistent with statistics nationwide.

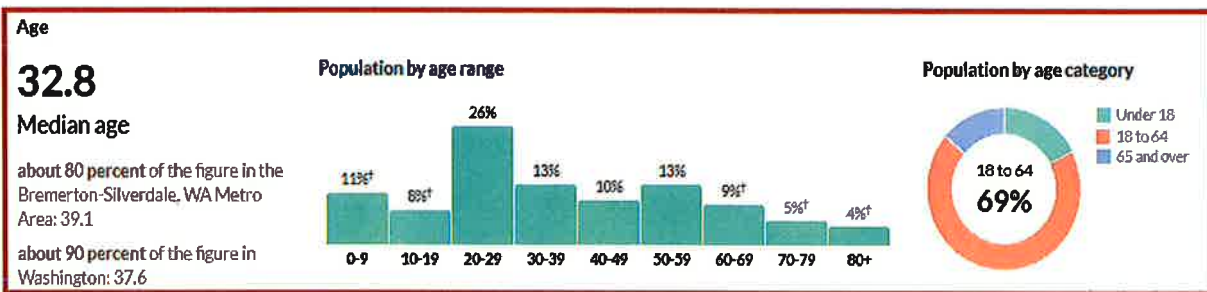


Figure 14: Population Distribution

<sup>30</sup> United States Census Bureau (2017)

<sup>31</sup> 2025 Population Forecast for City Limits and Urban Growth Area

<sup>32</sup> Esri Demographics (2019)

**Bremerton (Updated Jan 2019)**  
**Kitsap Sub-County Populations with Functional and Access Needs Estimates**

The Kitsap Populations with Functional and Access Needs Report is designed to provide estimated numbers of people in populations who might need additional assistance or have special needs in an emergency situation or unforeseen event. These estimates, while originally compiled for emergency preparedness planning, can be also used for other health or community planning work.

<b>Number of Births per year <sup>§</sup>(9)</b>	<b>870</b>	<p align="center"><b>Bremerton School District and ZIP Codes</b></p> <p align="center">Legend  <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span> Bremerton School District  <span style="background-color: orange; display: inline-block; width: 10px; height: 10px;"></span> Bremerton ZIP Codes</p>	<b>8,764</b>	<b>Persons with disability (age 5+) <sup>**</sup> (1)</b>
<b>Children (age birth-19) <sup>¶</sup> (2)</b>	<b>9,391</b>		<b>4,494</b>	<b>Ambulatory difficulty (age 5+) <sup>¶</sup> (1)</b>
<b>Seniors (age 85+) <sup>¶</sup> (2)</b>	<b>1,550</b>		<b>962</b>	<b>Developmental disability <sup>*</sup> (6)</b>
<b>Seniors (age 65+) living alone <sup>¶</sup> (1)</b>	<b>2,324</b>		<b>2,687</b>	<b>Persons with hearing difficulty <sup>¶</sup> (1)</b>
<b>Immigrants (entered US 2010+) <sup>¶</sup> (1)</b>	<b>385 to 799 <sup>‡</sup></b>		<b>1,577</b>	<b>Persons with vision difficulty <sup>¶</sup> (1)</b>
<b>Limited English or non-English proficient <sup>¶</sup> (1)</b>	<b>22</b>		<b>448</b>	<b>Electricity dependent adults <sup>§</sup> (3)</b>
<b>Persons living below 100% of poverty <sup>¶</sup> (1)</b>	<b>7,507</b>		<b>10,416</b>	<b>Medically dependent adults <sup>§</sup> (7)</b>
<b>Children 0-17 living below 100% of poverty <sup>¶</sup> (1)</b>	<b>1,664</b>		<b>1,679</b>	<b>Serious mental illness <sup>*</sup> (5)</b>
<b>Households with no vehicle access <sup>¶</sup> (1)</b>	<b>2,335</b>		<b>3,509</b>	<b>Adults with substance dependence or abuse <sup>*</sup> (8)</b>
<b>Persons commuting 45+ minutes <sup>¶</sup> (1)</b>	<b>3,512</b>		<b>322</b>	<b>K-12 students experiencing homelessness <sup>¶</sup> (4)</b>
		<b>2,849</b>	<b>Persons living in group quarters <sup>¶</sup> (1)</b>	

**SOURCES:**  
1. American Community Survey, 2013-17  
2. Washington State Office of Financial Management, Small Area Demographic Estimates, 2017  
3. US Dept. of Health and Human Services. Accessed at: <https://www.phac.gov/empowemap/People/default.asp>  
4. Office of Superintendent of Public Instruction, 2016-17. <http://www.k12.wa.us/robo/assess/Data.aspx>  
5. Mental Disorders in America, 2016. Accessed at: <http://www.mhi.org.gov/health/publication/the-numbers-count-mental-disorders-in-america/index.html>  
6. CDC Developmental Disabilities. Accessed at: <https://www.cdc.gov/nchs/data/developmentaldisabilities/about.html>  
7. Behavioral Risk Factor Surveillance System 2012-16, Kitsap County analysis  
8. Substance Abuse and Mental Health Services Administration, 2016-16. Accessed at: <http://www.samhsa.gov/>  
9. WA Dept. of Health, Birth Certificate Database, 2017.

**Important Notes:**  
\* Civilian, non-institutionalized only  
<sup>¶</sup> Region estimate based on U.S. national estimates by age.  
<sup>§</sup> Region estimate based on zip code boundaries.  
<sup>¶</sup> Region estimate based on school district boundaries.  
<sup>‡</sup> This estimate is unreliable, so a range of possible estimates was displayed (see page 2).  
<sup>§</sup> This estimate is unreliable enough that no estimate was displayed (see page 2).

Bremerton Population (2)		
2017 Estimates <sup>*</sup>	People	Percent of Kitsap
Bremerton	47,441	18%

Households in Bremerton (1)		
2013-17	19,731	

Table 23: Bremerton Vulnerable Population

## Bremerton Population Density

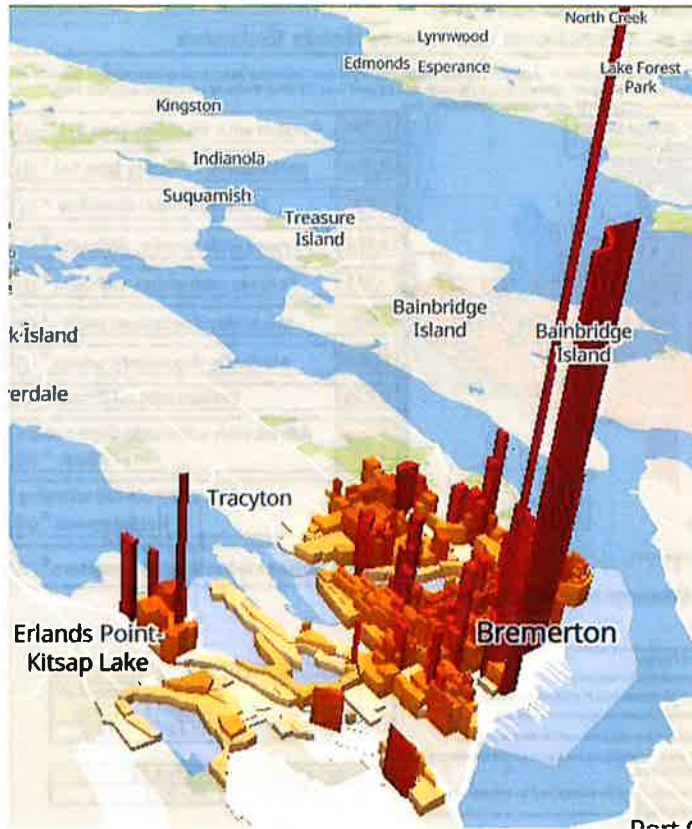


Figure 15: Bremerton Population Density, © OpenStreetMap Contributors

## Economy

Business and industry are mostly composed of retail and service-oriented organizations like the Bremerton Conference Center. The city also includes contractors that support the Shipyard and is the primary county hub for medical and health services, including Harrison Medical Center.

## Built Environment

### Existing Structures

80% of Bremerton's structures were built before modern building codes, increasing the risk of significant damage during an earthquake. Bremerton has 312 buildings in the Special Flood Hazard Area, representing \$8.2M in loss after a 1-percent annual chance flood.<sup>33</sup>

Based on the 2015 Hazus risk assessment, the table below highlights some of the buildings in Bremerton that

are affected by flooding, tsunami, earthquake, and landslide.

City of Bremerton Areas of Mitigation Interest <sup>34</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
Bremerton Post Office	602 Pacific Ave. Bremerton	\$316,000	\$302,000	96%	Earthquake
Kitsap Regional Library	612 5th St. Bremerton	\$756,000	\$724,000	96%	Earthquake
Bremerton High School (Multiple buildings)	1313 Ohio Ave. Bremerton	\$9.1 million	\$5.6 million	61%	Earthquake
Fire Station #2 Bremerton	5005 Kitsap Way	\$438,000	\$269,000	61%	Earthquake

Table 24: City of Bremerton Areas of Mitigation Interest

<sup>33</sup> FEMA Risk Report for Kitsap County (2015)

<sup>34</sup> FEMA Risk Report for Kitsap County (2015)



## Land Use

Land use in Bremerton includes residential, commercial, industrial, and open space. The city includes the Bremerton School District and Olympic College.

## Housing

The following table shows housing units in the city of Bremerton, which represent a high density of older homes that were built pre-earthquake code requirements. A relatively large number of units were built earlier than 1949.

Residential Structures		
Type	Estimate	Percent
<b>Housing Occupancy</b>		
Total housing units	18,541	100%
Occupied housing units	16,516	89.1%
Vacant housing units	2,025	10.9%
Homeowner vacancy rate	1.9	(X)
Rental vacancy rate	8.6	(X)
<b>Units in Structure</b>		
Total housing units	18,541	100%
1-unit, detached	9,096	49.1%
1-unit, attached	1,537	8.3%
2 units	1,232	6.6%
3 or 4 units	1,217	6.6%
5 to 9 units	1,527	8.2%
10 to 19 units	1,029	5.5%
20 or more units	2,468	13.3%
Mobile home	349	1.9%
Boat, RV, van, etc.	86	0.5%
<b>Year Structure Built</b>		
Total housing units	18,541	100%
Built 2014 or later	219	1.2%
Built 2010 to 2013	406	2.2%
Built 2000 to 2009	1,145	6.2%
Built 1990 to 1999	1,452	7.8%
Built 1980 to 1989	1,654	8.9%
Built 1970 to 1979	2,900	15.6%
Built 1960 to 1969	1,862	10.0%
Built 1950 to 1959	1,854	10.0%
Built 1940 to 1949	3,008	16.2%
Built 1939 or earlier	4,041	21.8%

Table 25: Bremerton Housing Characteristics 2013-2017 American Community Survey 5-Year Estimates (US Census, 2017)

## ***Infrastructure***

### **Transportation, Communications, and Utilities**

The City of Bremerton is serviced by numerous State Routes including SR 3, Kitsap Way, and Hwy 303 to the east. The city has two bridges (Manette and Warren Ave) that connect East and West Bremerton. The city also has ferry service via Washington State Ferries to downtown Seattle and local service to Port Orchard. Bremerton is connected to downtown Seattle by two ferries: a 60-minute ferry that carries both vehicles and walk-on passengers, and a 28-minute fast ferry that takes passengers and a limited number of bicycles.

### **City Infrastructure**

The city has many government and non-government structures, including libraries, dams, medical and health facilities, and City and County government buildings.

### ***Critical Facilities***

Critical structures include:

- The Norm Dicks Building, housing City government and Kitsap Public Health
- Public Works campus
- Olympic College
- Bremerton School District: As of 2019, the Old East High/Junior High School was demolished, and 10,000 square feet was added to the STEM West Hills Elementary School.
- Casad Dam
- Bremerton Fire Department and facilities
- Bremerton Police Department and Courthouse
- Kitsap Mental Health Services
- American Red Cross

Both fire stations in Bremerton are brick, are not retrofitted, and show significant damage in earthquake Hazus models.

### ***Cultural Resources***

The Bremerton Arts Commission represents the community during the creative phase of new city development or improvement projects. Bremerton has one of the largest and most diverse official fine arts districts in the northwest. There are several city parks including Blueberry Park, Evergreen Rotary Park, and other parks throughout the Bremerton. Golf resources include Gold Mountain Golf Club, disc golf courses, and other golf courses in the Bremerton area. Bremerton includes various aquatic, athletic, and recreational opportunities.

### ***Future Development***

Bremerton has a Comprehensive Plan that is a 20-year vision and roadmap for its future. The plan guides City decisions on where to build new jobs and houses, how to improve the transportation system, and where to make capital investments such as utilities, sidewalks, and parks. The Comprehensive Plan is the framework for most of Bremerton's big-picture decisions

on how to grow while preserving and improving its neighborhoods and can be found at <https://www.bremertonwa.gov/185/Comprehensive-Plan>.

## Natural Environment

The City of Bremerton is 28.44 square miles. The topography in the area is low rolling hills, generally trending north to south. There are few streams and wetlands, some high liquefaction areas to the East, and many shoreline areas. The Casad Dam provides water for the city of Bremerton. The map on the following page shows the elevation and typography of the city.

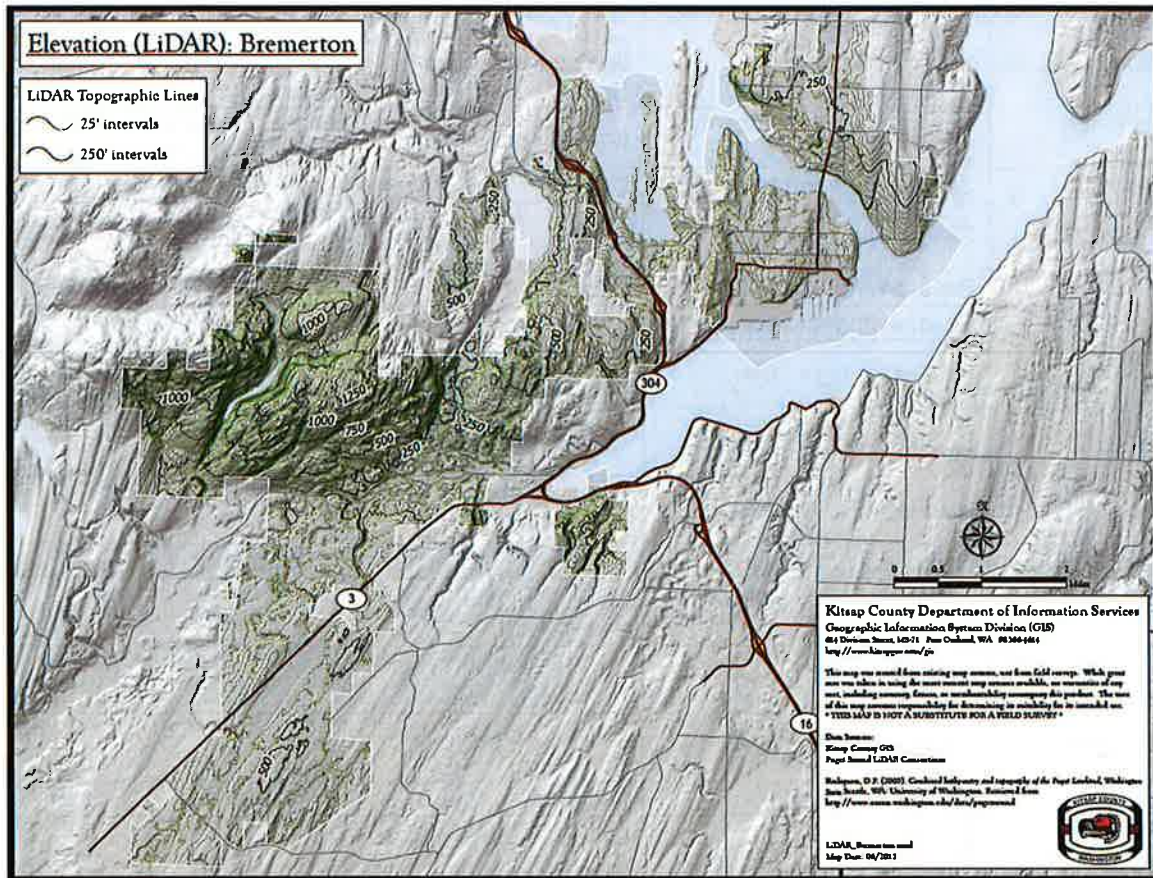


Figure 16: Topographical Feature, City of Bremerton

## History of Disasters

Bremerton's history of emergency/disasters is much like the remainder of the county. Kitsap is a micro-climatic region in which winds, rain, and temperatures can differ throughout the County. Although, like other cities, Bremerton is susceptible to earthquakes, tsunamis, urban flooding, and Landslides. As noted below, typical issues are winter storm events, although, Bremerton experienced the Nisqually earthquake and suffered damages greater than other cities in the County.

Event Date	Type of Event	Declaration	Declared Disaster
February 2019	Severe Winter Storm	Local (was undeclared locally), State	Local Public Assistance threshold not met. Local SBA declaration.
December 2018	Severe Winter Storms - Tornado	Local, State, Federal	Local Public Assistance threshold not met.
Dec 2008	Severe wind and rain	Local	No assistance
Dec 2007	Severe wind and rain	Local, State, and Federal	Yes
Jan 2006	Severe wind and rain	Local	Did not meet PA threshold
Dec 2006	Severe wind and rain	Local	Did not meet PA Threshold
Oct 2003	Severe wind and rain	Local, state, and Federal	Local PA Threshold not met. IA paid out
Jan 2002	Severe wind and rain	Local and State	State Only; presidential denied
Feb 2001	Nisqually Earthquake	Local, state, and Federal	Yes
June 1997	Rolling Bay mudslide	Local	No assistance
Dec 1996	Severe rain and snow runoff storm	Local, State, and Federal	Yes
Nov 1995	Severe wind and rain	Local, State, and Federal	Local PA threshold not met
Jan 1993	Severe wind and rain	Local, State and Federal	No record on file
Jan 1992	Severe wind and rain	Local	No assistance
Dec 1990	Severe wind and rain	Local, State and Federal	Yes
Dec 1982	Severe wind and rain	Local	No assistance
May 1965	Earthquake	Local, state, and Federal	No record on file
Oct 1962	Severe wind and rain	Local, state and Federal	No record on file

Table 26: Emergency/Disaster History for Bremerton

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# Port Orchard



The City of Port Orchard was first established along the south shore of Sinclair Inlet and has grown southward for more than 100 years. As the county seat, the City has been an important urban area for Kitsap County, and particularly South Kitsap. Its proximity along Sinclair Inlet provides an easily accessible saltwater shoreline and stunning views of the Olympic Mountains. Natural ravines protect blackjack Creek and Ross Creek and maintain a rural belt in an urban area. There is convenient access to Port Orchard with regularly scheduled passenger ferry service, with connections to Seattle via the Washington State Ferry system. The marine Park and downtown waterfront host numerous community activities, concerts, and the weekly farmers market. Boating is supported by the Port Orchard Marina and numerous other marinas and boating services.

## People

### Population Overview

Port Orchard has a diverse population of 14,390.<sup>35</sup> Many professionals transit daily to downtown Seattle. The city is characterized by professional, scientific employment, construction, and education. Table 27 shows the City’s population density and urbanization.

Port Orchard Population Information				
Population	Population Density	Number of Households	Median Household Income	Under 65 with a Disability
15,163 (2019)	1,571 per sq. mi (2019)	5,775 (2019)	\$68,287 (2019)	12.9% (2017)

Table 27: Port Orchard Population Information

### Age Distribution

Figure 17 shows the distribution of age in Port Orchard.

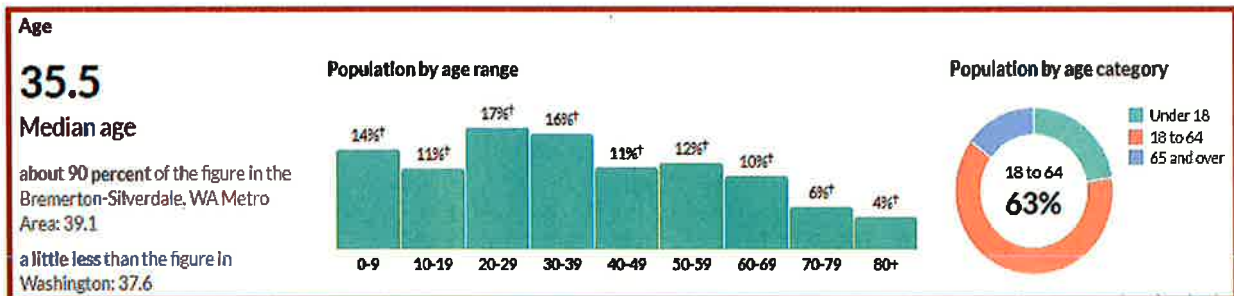


Figure 17: Population Distribution

<sup>35</sup> April 1, 2019 OFM Population Estimate for Port Orchard

**South Kitsap (Updated Jan 2019)**  
**Kitsap Sub-County Populations with Functional and Access Needs Estimates**

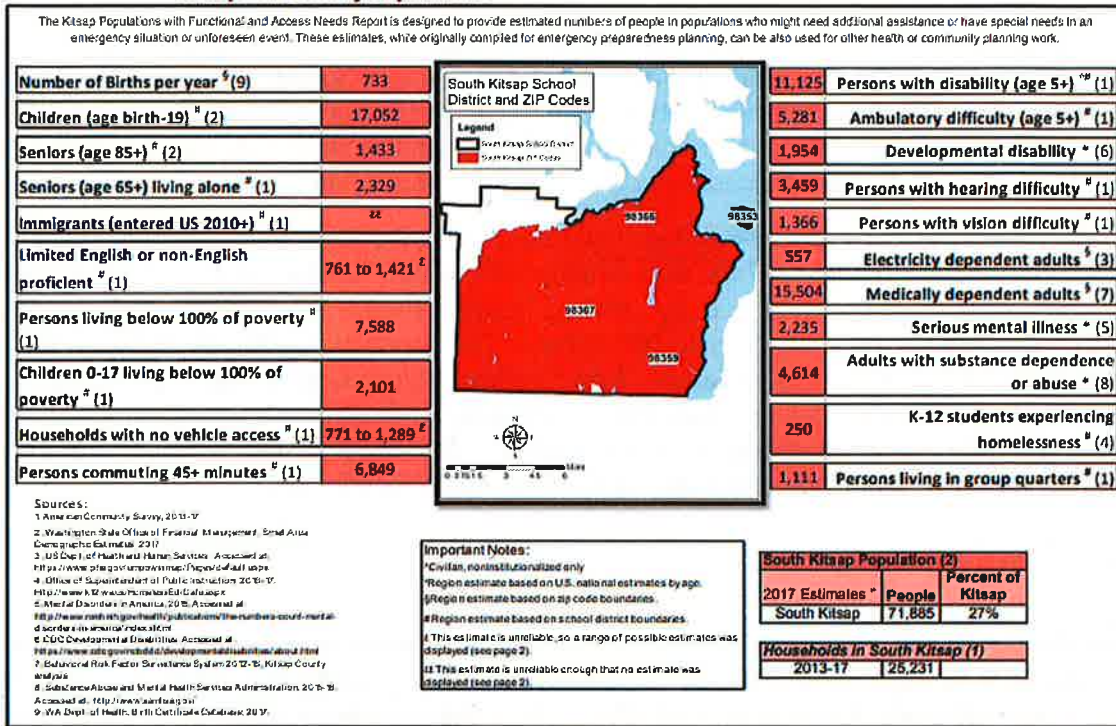


Figure 18: South Kitsap Vulnerable Population

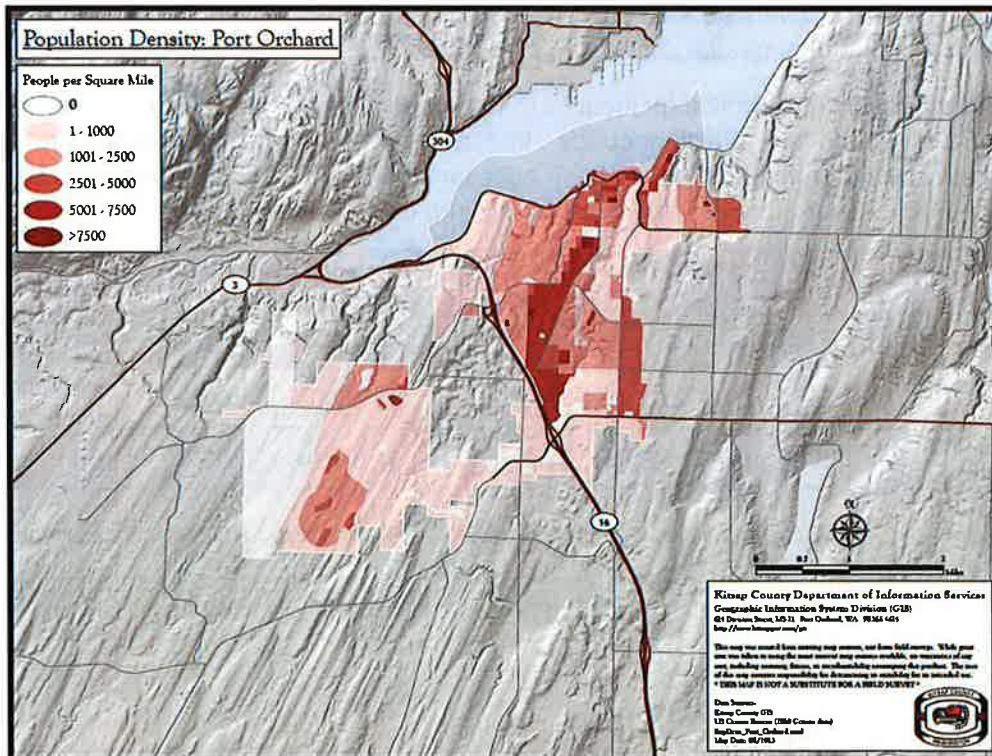


Figure 20: Port Orchard Population Density

## Economy

The most current economic census data from 2012 show the economy based (by annual revenue, highest first) in retail trade, health care, and social assistance, wholesale trade, and real estate. Based on the number of establishments (highest first), the economy is based on retail trade, professional, scientific and technical services, health care and social assistance, accommodation and food service, and other services except for public administration.<sup>36</sup>

The City's economy also supported by the Puget Sound Naval Shipyard, local commerce as seen on the Port Orchard Industrial Park, and employment in the Seattle-Tacoma area. The City's downtown corridor is characterized by working private shipyards, marinas, and merchants providing a variety of retail services to the citizens. The economic base also includes multiple federal defense agencies: Naval Station Port Orchard, Puget Sound Naval Shipyard, Naval Submarine Base Banger, Naval Keyport Center, and support facilities. The dominance of Federal employment (the Navy) drives all other economies in the county. The dominance of service industries in Port Orchard indirectly supports the Federal economic base.

## Built Environment

### Existing Structures

Land use in Port Orchard is primarily residential housing, government, retail, and waterfront marinas. As part of the Management Growth Act, Port Orchard has annexed land in recent years to accommodate city growth. Because it is the County seat, Port Orchard includes the Kitsap County Administration Building, courthouse, and adjoining Corrections Center. These facilities are part of the County's Damage Assessment Program. Land use also includes include numerous residential areas and commercial zones.

Port Orchard has 6% of its buildings located in the moderate-high liquefaction zone, with 725 of them built before modern building codes, increasing the risk of significant damage to an earthquake.<sup>37</sup> Based on the 2015 Hazus risk assessment, the table below highlights some of the buildings in Port Orchard that are affected by flooding, tsunami, earthquake, and landslide.

City of Port Orchard Areas of Mitigation Interest <sup>38</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
General Retail	205 Bethel Ave.	\$76,000	\$50,000	66%	Earthquake, Landslide
Cedar Heights Junior High School	336 Lippert Dr. W.	\$2.9 million	\$1.6 million	56%	Earthquake
Kitsap County Government Building	507 Austin Ave.	\$5.0 million	\$2.9 million	57%	Earthquake
Single Family Home	1699 Bay St.	\$61,000	\$26,000	42%	Flood

<sup>36</sup> Washington Department of Finance Management (2012)

<sup>37</sup> FEMA Risk Report for Kitsap County (2015)

<sup>38</sup> FEMA Risk Report for Kitsap County (2015)



City of Port Orchard Areas of Mitigation Interest <sup>38</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
Multiple Single-Family Homes	SW Bay St.	\$676,000	N/A	N/A	Landslide

Table 28: City of Port Orchard Areas of Mitigation Interest

## Housing

Out of just under 5,500 units in the City, over half were built before 1989. There are a significant number of structures that were constructed pre-earthquake code requirements.

Residential Structures		
Type	Estimate	Percent
<b>Housing Occupancy</b>		
Total housing units	5,460	100%
Occupied housing units	4,776	87.5%
Vacant housing units	684	12.5%
Homeowner vacancy rate	6.0	(X)
Rental vacancy rate	5.3	(X)
<b>Units in Structure</b>		
Total housing units	5,460	100%
1-unit, detached	3,379	61.9%
1-unit, attached	364	6.7%
2 units	139	2.5%
3 or 4 units	396	7.3%
5 to 9 units	395	7.2%
10 to 19 units	357	6.5%
20 or more units	263	4.8%
Mobile home	167	3.1%
Boat, RV, van, etc.	0	0.0%
<b>Year Structure Built</b>		
Total housing units	5,460	100%
Built 2014 or later	189	3.5%
Built 2010 to 2013	491	9.0%
Built 2000 to 2009	1,073	19.7%
Built 1990 to 1999	1,306	23.9%
Built 1980 to 1989	460	8.4%
Built 1970 to 1979	569	10.4%
Built 1960 to 1969	210	3.8%
Built 1950 to 1959	302	5.5%
Built 1940 to 1949	351	6.4%
Built 1939 or earlier	509	9.3%

Table 29: Port Orchard Housing Characteristics 2013-2017 American Community Survey 5-Year Estimates (US Census, 2017)

## **Infrastructure**

### **Transportation, Communications, and Utilities**

Major thoroughfares include State Highway 16, Bay Street, Tremont Street, Sidney Avenue, Sedgwick, Port Orchard Blvd, and Bethel. The City has an extensive system of local public streets with commuter service provided by Kitsap Transit. The City of Port Orchard is serviced by Puget Sound Energy, West Sound Utilities Districts, and Wave Cable for internet and television service. Xfinity also serves Port Orchard for cable television.

The City Hall was built in 1999 and serves as City administration, courts, and was the former Emergency Operations Center (EOC). Port Orchard's EOC has been relocated to South Kitsap Fire and Rescue, Station 31, which resolves the critical vulnerabilities that were inherent with the previous EOC location.

### **Critical Facilities**

Critical structures include:

- City of Port Orchard City Hall and Public Works shop;
- South Kitsap School District: South Kitsap High School, Cedar Heights Jr. High;
- Givens Community Center;
- Kitsap County Courthouse Complex and county jail;
- Fire District #7 – Fire Station #31;
- Health Facilities: Group Health Coop of Puget Sound, Harrison Memorial; and
- Joint wastewater treatment facility wells: 5 wells and one transmission main from the City of Port Orchard.

### **Cultural Resources**

Port Orchard has various cultural resources that involve the community in many ways. Some of them include The Masonic Hall on the National Register of Historic Places<sup>39</sup>, The Sidney Museum and Arts Association<sup>40</sup> with cultural assets such as a gallery, art museum, and log cabin museum, The Western Washington Center for the Arts<sup>41</sup> which acts as a community theater, The Veteran's Living History Museum<sup>42</sup>, and The Fathoms 'O' Fun Festival<sup>43</sup>, which is considered a valued community tradition.

### **Future Development**

The City's Comprehensive Plan and the Kitsap County Countywide Planning Policies include growth targets for 2036 that indicate a future Port Orchard population of 20,558 people. As of 2015, the City had sufficient land capacity to accommodate a population of 22,681 people. Port Orchard grows annually adding about 300 new residents to the city every year.

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<sup>39</sup> <https://catalog.archives.gov/id/75612725>

<sup>40</sup> <http://www.sidneymuseumandarts.com>

<sup>41</sup> <https://www.wwca.us>

<sup>42</sup> <https://www.facebook.com/pages/Veterans-Living-History-Museum/439610442816832>

<sup>43</sup> <https://www.fathomsofun.org>

## Natural Environment

The city is characterized by a typical port bordered by hills and cliffs above the downtown corridor. The city is currently 5,500 acres. Marinas, merchants, and parking areas border the waterfront. The city includes some waterways.

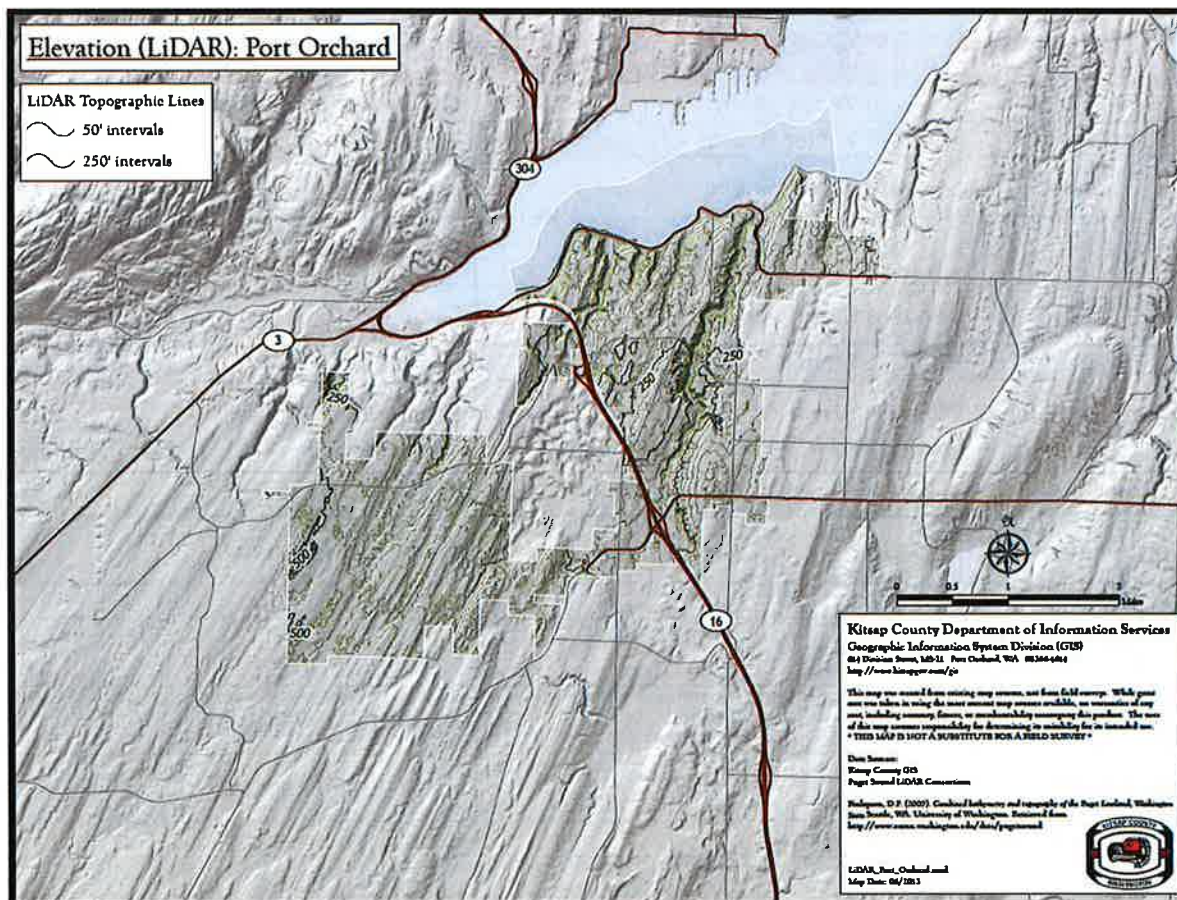


Figure 21: Elevation (LiDAR): Port Orchard

## History of Disasters

The below shows the history of natural hazards in Port Orchard. Most damage that has occurred has been associated with heavy rains, high tides, or landslides. The downtown area is prone to flooding during significant rainfall and tides. Some mitigation has been performed, but more is needed to improve the situation.

Event Date	Type of Event	Declaration
February 2019	Severe Winter Storm	Local (was undeclared locally), State
December 2018	Severe Winter Storms - Tornado	Local, State, Federal
December 11, 2008	Severe Winter Shelter	Local
December 3, 2007	Severe Winter Storm	Local, State
December 16, 2006	Severe Storm	Local
January 30, 2006	Severe Storm	Local
December 5, 2005	Severe Winter Storm	Local, State, Federal
August 29, 2005	Hurricane	Federal
October 20, 2003	Flooding	Local, State, Federal
July 2002	Flooding	Local, State
September 11, 2001	Terrorist Attack	Federal
February 1 – 28, 2001	Earthquake – Nisqually	Local, State, Federal
March 1997	Flooding	Local, State, Federal
December 1996	Severe Storm	Local, State, Federal
April 1996	Mudslide	Local
February 1996	Flooding	Local, State, Federal
November 1995	Severe Storm –Wind/flooding	Local, State, Federal
December 1994	Flooding	Local
January 1993	Windstorm	Local, State, Federal
January 1992	Severe Storm	No declaration
December 1990	Severe Storm	Local, State, Federal
December 1982	Severe Storm	Local, State, Federal
May 1980	Mt. St. Helens, volcano	State, Federal

Event Date	Type of Event	Declaration
January 1974	Severe Storm	Local, State, Federal
May 1965	Earthquake	Local, State, Federal
October 1962	Severe Storm – Wind	Local, State, Federal

*Table 30: Emergency/Disaster History for Port Orchard*

# Poulsbo



Poulsbo is located in north-central Kitsap County. Scandinavian settlers arrived on the shores of Liberty Bay more than 100 years ago. Poulsbo became a city in the early 1900s with fishing and farming as primary industries. Downtown Poulsbo is adjacent to Liberty Bay, an extension of Puget Sound. Many community and regional events, some of which celebrate the Scandinavian heritage, are hosted in Poulsbo parks and historic downtown area. Being situated among the saltwater shoreline and low hills provides exceptional views of the Cascade and Olympic mountain ranges as well as Liberty Bay. The total land area is 2,905 acres.

## People

### Population Overview

The population of Poulsbo is 11,121. Many professionals transit daily to downtown Seattle. The city is characterized by professional, scientific employment, construction, and education. Citizens of Poulsbo, like other nearby cities, are employed at the military installations in Kitsap County. The table below shows the city's population density.

Poulsbo Population Information				
Population	Population Density	Number of Households	Median Household Income	Under 65 with a Disability
11,121 (2019)	2,346 sq. mi (2019)	4,688 (2019)	\$69,072 (2019)	6.9% (2017)

Table 31: Poulsbo Population Information

### Age Distribution

The city's population is consistent with other cities in the county with a number of senior/assist facilities in the city mostly located in the city's urban center. The senior population has grown consistent with statistics nationwide.

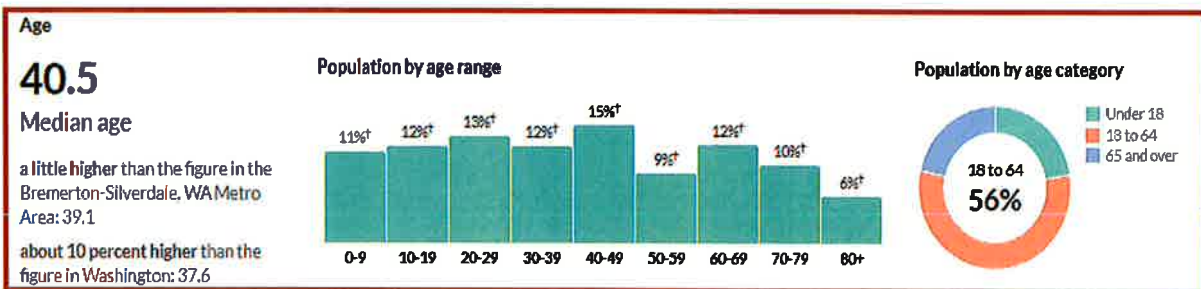


Figure 22: Poulsbo Population Distribution

**North Kitsap (Updated Jan 2019)**  
**Kitsap Sub-County Populations with Functional and Access Needs Estimates**

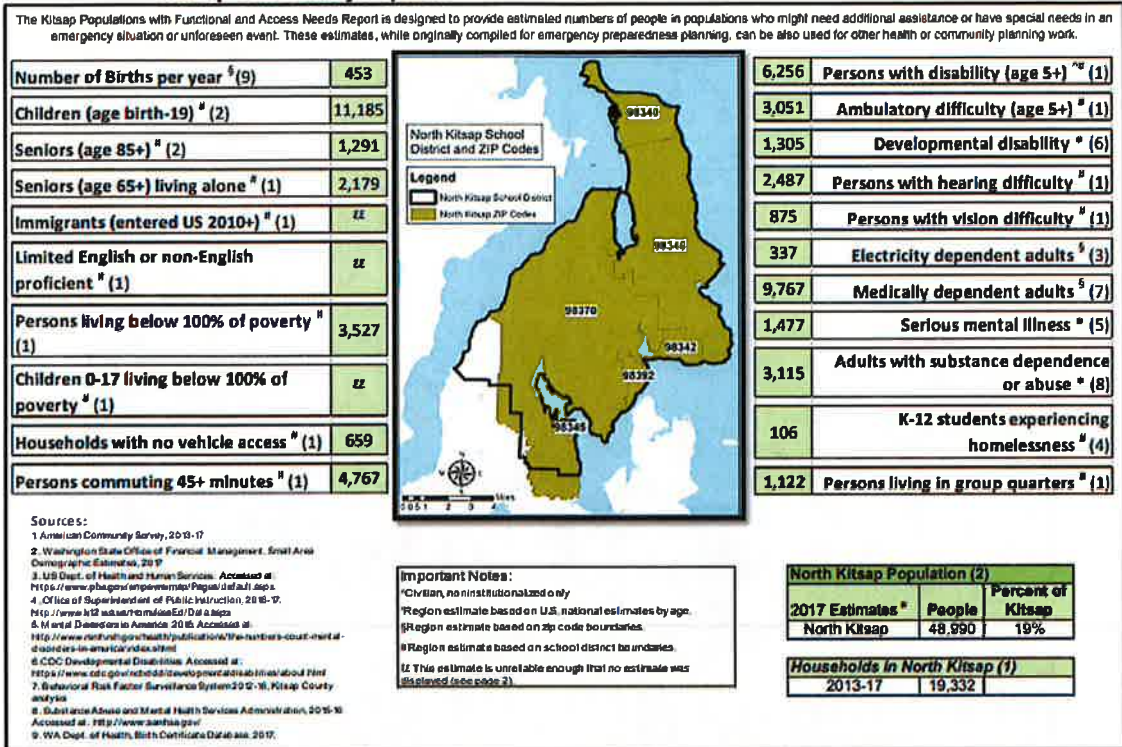


Figure 23: North Kitsap Vulnerable Population

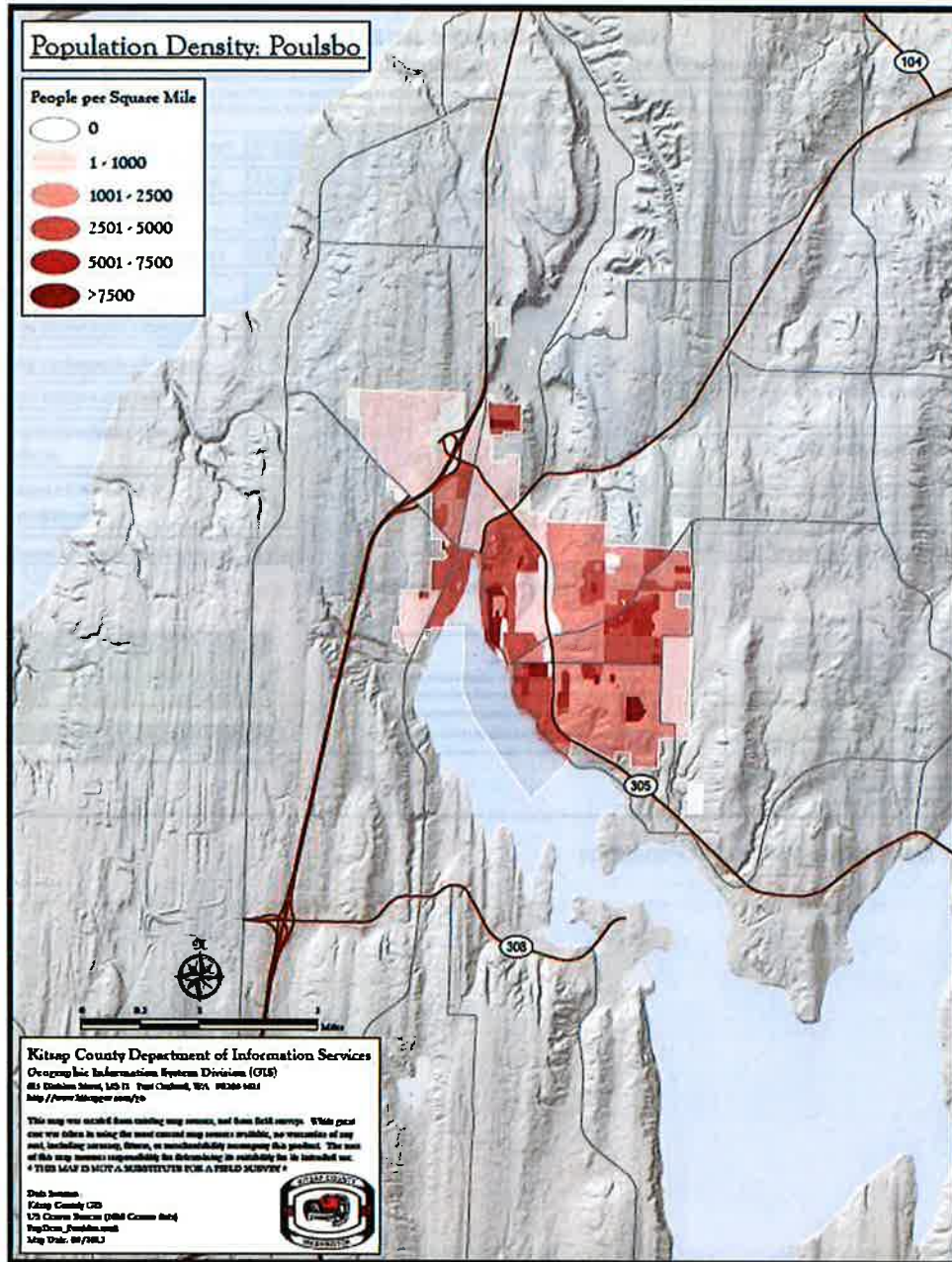


Figure 24: Population Density: City of Poulsbo

## Economy

Community leaders, residents, and business interests strive to maintain a small-town character while continuing to thrive and grow. Both residential and commercial development continues. College Marketplace, which includes the Poulsbo Branch of Olympic College, continues to develop business and residential uses. Poulsbo Place, a winner of numerous local and national awards, is one of several residential areas that continue to develop. A new city hall is one of the current public projects.



North Kitsap School District is also centered in Poulsbo.

The city is primarily residential with commercial businesses in the city core and College Marketplace, which is home to several big-box stores. The principal economic base is retail outlets/offices, North Kitsap School District, and light industry. Some citizens, like those on Poulsbo, commute to Seattle daily for work others are part of the military or work at military installations noted below.

Federal defense agencies include Naval Base Kitsap (NBK) Bangor, (NBK) Keyport, (NBK) Poulsbo, Puget Sound Naval Shipyard, and support facilities. Commercial entities include Home Depot, Wal-Mart, and Central Market.

## Built Environment

### Existing Structures

Land use in Poulsbo includes residential, commercial, light industrial, and open space. North Kitsap School District is also centered in Poulsbo. Commercial enterprises have increased significantly to the west with the development of the Olhava property, which includes Wal-Mart and Home Depot. This property and adjoining areas were annexed by the City as part of the County's comprehensive land growth and management program.

Poulsbo has 35 buildings in the Special Flood Hazard Area, representing \$740,000 in loss after a 1-percent annual chance flood. It also has 40 buildings within the landslide zone representing \$9.8M in value.

Based on the 2015 Hazus risk assessment, the table below highlights some of the buildings in Poulsbo that are affected by flooding, tsunami, earthquake, and landslide.

City of Poulsbo Areas of Mitigation Interest <sup>44</sup>					
Community Building Name	Address	Building Value	Loss Value	Loss Ratio	Hazard Type
Commercial Office Buildings	17791 Fjord Dr. NE	\$1.2 million	\$473,000	38%	Flood
Commercial General Retail	18969 Front St. NE	\$126,000	\$63,000	50%	Earthquake
Multiple Single-Family Homes	West side of 11th Ave. NE	\$2.6 million (12 Homes)	N/A	N/A	Landslide
Multiple Single-Family Homes	Rosebud Pl. NE	\$2.1 million (9 Homes)	N/A	N/A	Landslide

Table 32: City of Poulsbo Areas of Mitigation Interest

### Housing

Most building stock is residential homes of wood frame construction. Poulsbo is part of the County's Damage Assessment Program for disasters and has identified critical facilities as part of the program.

<sup>44</sup> FEMA Risk Report for Kitsap County (2015)

Residential Structures		
Type	Estimate	Percent
<b>Housing Occupancy</b>		
Total housing units	4,312	100%
Occupied housing units	4,126	95.7%
Vacant housing units	186	4.3%
Homeowner vacancy rate	1.2	(X)
Rental vacancy rate	6.3	(X)
<b>Units in Structure</b>		
Total housing units	4,312	100%
1-unit, detached	2,743	63.6%
1-unit, attached	210	4.9%
2 units	38	0.9%
3 or 4 units	213	4.9%
5 to 9 units	225	5.2%
10 to 19 units	265	6.1%
20 or more units	411	9.5%
Mobile home	207	4.8%
Boat, RV, van, etc.	0	0.0%
<b>Year Structure Built</b>		
Total housing units	4,312	100%
Built 2014 or later	69	1.6%
Built 2010 to 2013	195	4.5%
Built 2000 to 2009	1,049	24.3%
Built 1990 to 1999	1,000	23.2%
Built 1980 to 1989	749	17.4%
Built 1970 to 1979	723	16.8%
Built 1960 to 1969	98	2.3%
Built 1950 to 1959	166	3.8%
Built 1940 to 1949	102	2.4%
Built 1939 or earlier	161	3.7%

Table 33: Poulsbo Housing Characteristics 2013-2017 American Community Survey 5-Year Estimates (US Census, 2017)

## Infrastructure

### Transportation, Communications, and Utilities

Poulsbo is served by SR 305, the main corridor to Poulsbo and the Washington State Ferry System. This route provides cross-country traffic to and from Seattle to the east and SR 3 to the west providing service to the Olympic Peninsula and south to Poulsbo. The City has an extensive system of local public streets with commuter service by Kitsap Transit.

The City is serviced by Puget Sound Energy and maintains its own sewer and water system with nine sewer lift stations and five water pump stations. Kitsap Public Utilities District One provides water service. Communications are provided through a variety of cell phone providers, Comcast, and CenturyLink.

### ***Critical Facilities***

The City of Poulsbo has identified 62 critical facilities, including:

- City of Poulsbo City Hall
- City of Poulsbo Public Works office and shop
- North Kitsap School District:
  - Administration Building
  - North Kitsap Senior High School
  - Poulsbo Junior High School
  - Poulsbo and Vinland Elementary Schools
  - The building formerly known as Spectrum Alternative School has been repurposed after being closed in 2010. As of 2019, it is a new alternative learning program.
- Olympic College Poulsbo Branch Campus
- Fire District #18 Headquarters/Fire Station #71
- Health facilities:
  - Poulsbo Village Medical Center with Regional Hospitals as backup
  - North Kitsap Medical Center
- Wastewater treatment plant: Brownsville via pressurized pipe under Liberty Bay
- There are six operational wells and one is not online at this time.
- There are nine sewer lift stations and five water pump stations.

### ***Cultural Resources***

Parks, recreational facilities, and open space serve as vital parts of the community's character. Poulsbo has 16 city parks totaling 137 acres – about one-half of the acreage is developed while the rest is undeveloped or in open space designation. The city also has 5+ linear miles of trails. The city has been active in park development in recent years, making sure that partnerships are used to enhance park projects and activities. Volunteerism and stewardship of the natural and cultural resources within the city has helped shape many city parks projects

### ***Future Development***

Future development includes the Poulsbo Event and Recreation Center. The PERC will serve as a significant attraction for visitors in search of recreational activities; additionally the center would create an opportunity for job growth and would further cement Poulsbo's College Marketplace as an economic hub within the community.

Poulsbo's Comprehensive Plan is a policy and legal document that reflects the community's desires, goals, and needs for the future, within the context of the requirements of the Growth Management Act. On December 21, 2016, the Poulsbo City Council adopted the 2016 Comprehensive Plan by approving an adopting ordinance and exhibits. The plan can be found here: <https://cityofpoulsbo.com/comprehensive-plan-2/>.

# Natural Environment

The topography in the area is low rolling hills, generally trending north to south. Poulsbo has areas of wetlands, aquifer recharge, and geological concern, streams, and shoreline. The highest point in Poulsbo is under 500 feet. Liberty Bay along the shoreline of Poulsbo responds to high and low tides but is 80% enclosed and isolated from Puget Sound.

Natural creeks like Dogfish Creek are spawning streams for salmon and drain into Liberty Bay. Figure 64 shows topographic information on the Poulsbo area.

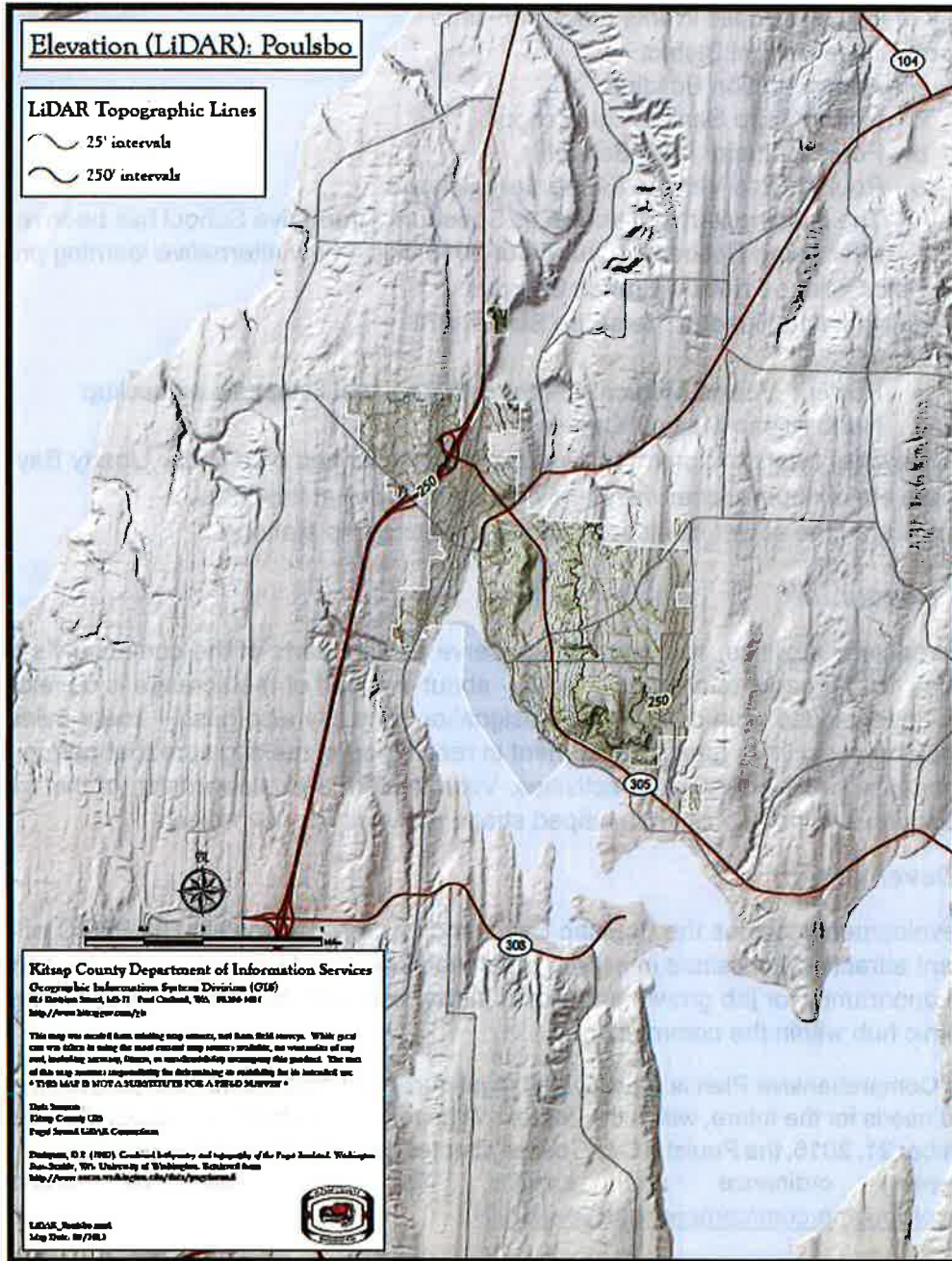


Figure 25: Poulsbo Elevation using LiDAR

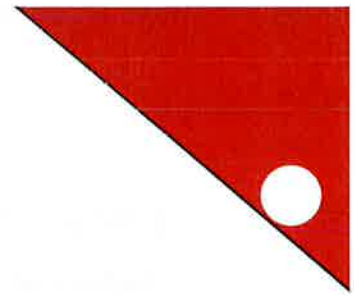
## History of Disasters

The table below shows the history of natural hazards in Poulsbo. Any damage that has occurred has associated with heavy rains and high tides or landslides. The downtown area is prone to flooding during significant rainfall and tides. Some mitigation has been performed, but more is needed to improve the situation.

Event Date	Type of Event	Declaration	Declared Disaster
February 2019	Severe Winter Storm	Local (was undeclared locally), State	Local Public Assistance threshold not met. Local SBA declaration.
December 2018	Severe Winter Storms - Tornado	Local, State, Federal	Local Public Assistance threshold not met.
Dec 2008	Severe wind and rain	Local	No assistance
Dec 2007	Severe wind and rain	Local, State, and Federal	Yes
Jan 2006	Severe wind and rain	Local	Did not meet PA threshold
Dec 2006	Severe wind and rain	Local	Did not meet PA Threshold
Oct 2003	Severe wind and rain	Local, state, and Federal	Local PA Threshold not met. IA paid out
Jan 2002	Severe wind and rain	Local and State	State Only; presidential denied
Feb 2001	Nisqually Earthquake	Local, state, and Federal	Yes
Dec 1996	Severe rain and snow runoff storm	Local, State, and Federal	Yes
Nov 1995	Severe wind and rain	Local, State, and Federal	Local PA threshold not met
Jan 1993	Severe wind and rain	Local, State and Federal	No record on file
Jan 1992	Severe wind and rain	Local	No assistance
Dec 1990	Severe wind and rain	Local, State and Federal	Yes
Dec 1982	Severe wind and rain	Local	No assistance
May 1965	Earthquake	Local, state, and Federal	No record on file
Oct 1962	Severe wind and rain	Local, state and Federal	No record on file

Table 34: Emergency/Disaster History for Poulsbo

# Natural Hazards



For each hazard affecting the planning area, the risk assessment discusses:

<b>Location</b>	Geographic areas within the planning area that are affected by the hazard.
<b>Effects</b>	The consequences or effects of a hazard on the community and its assets.
<b>Extent</b>	Strength or magnitude of the hazard.
<b>History</b>	History of previous hazard events for each hazard.
<b>Probability of Future Events</b>	The likelihood of the hazard occurring in the future.
<b>Climate Change</b>	Effects of climate change on hazards and how it may change risk in the future.
<b>Vulnerability Summary</b>	Summary of information so the community can understand the most significant risks and vulnerabilities.

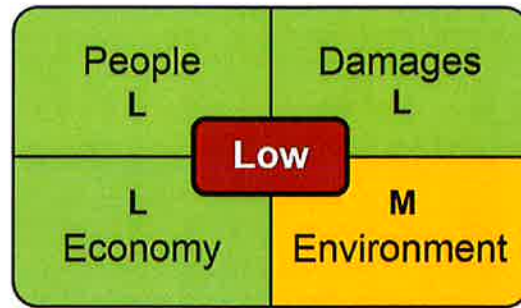
The hazards are discussed in the following order:

- Droughts
- Earthquakes
- Floods
- Forest Fires
- Landslides & Erosion
- Severe Storms/Tornadoes
- Tsunamis, High Waves, & Seiches
- Volcanic Ash Fall

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# Droughts

## Overview



According to the National Drought Mitigation Center (NDMC), “drought is defined as a deficiency of precipitation over an extended period of time (usually a season or more), resulting in a water shortage.” The condition perceived as “drought” in a given location is the result of a significant decrease in water supply relative to what is “normal” in that area, particularly relative to the demands placed by humans on the water in that place. Washington State is one of the few states to have a statutory definition of drought (Revised Code of Washington Chapter 43.83B.400): “Drought condition’ means that the water supply for a geographical area or for a significant portion of a geographical area is below 75% of normal and the water shortage is likely to create undue hardships.”<sup>45</sup>

## Location

While Kitsap County may not experience severe drought (as defined above) frequently, the county does face abnormally dry conditions, which may impact community activities and capabilities. Drought may affect the entire county, or it can affect certain areas depending on conditions such as recent rainfall activity. The possibility of a prolonged drought does exist. Typically, average annual rainfall is about 41 inches;<sup>46</sup> however, there is a considerable difference in precipitation levels within the county. Several consecutive, hot, dry summer months can create parched and tinder-dry conditions. Extremely dry conditions could force the closure of forests to recreation, hunting, camping, and hiking. Campfires and outdoor burning are often limited for a couple of months each summer and longer during arid conditions.

## Effects

The effects of drought can include loss of agricultural products, forest fires, loss of jobs in farming and forestry-related industries, loss of fish, and possible saltwater intrusion into the water table along Puget Sound, affecting local wells. Droughts are not expected to have a significant impact on the built environment. Drought conditions will increase the need for wildland fire suppression responses and limit the availability of supporting water sources. The primary impact of drought is expected to be on the agricultural sector.

Drought leads to an increased susceptibility to wildfires. In Washington State, 31% of critical environment areas are ranked moderate or higher for droughts.<sup>47</sup> Many of these regions include forested lands that are prone to wildfires during prolonged periods of dry weather. Drought conditions can impact short-term water availability and soil productivity. Persistent drought conditions for more extended periods can result in a significant threat to local ecological diversity.

<sup>45</sup> <https://app.leg.wa.gov/RCW/default.aspx?cite=43.83B.400>

<sup>46</sup> <http://kitsapeda.org/life-work/enviable-quality-of-life/location-and-climate/>

<sup>47</sup> Washington State Enhanced Hazard Mitigation Plan (2018)



Large areas supplied by one water system might have to resort to rationing. Residents on private wells may need to use water barrels if their wells become temporarily dry.

## Extent

The extent of drought is presented in the table below.

Drought Severity Classification <sup>48</sup>			
Category	Description	% of Normal Participation	Possible Impacts
D0	Abnormally Dry	<75% for 3 months	Short-term dryness slowing planting, growth of crops or pastures; fire risk above average.
D1	Moderate Drought	<70% for 3 months	Damage to crops, pastures; fire risk high; streams, reservoirs, or wells low; some water shortages are developing or imminent.
D2	Severe Drought	<65% for 6 months	Crop or pasture losses likely; fire risk very high; water shortages common.
D3	Extreme Drought	<60% for 6 months	Major crop/pasture losses; extreme fire danger; widespread water shortages.
D4	Exceptional Drought	<65% for 12 months	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.

Table 36: Drought Severity Classification

Building Stock and Critical Facilities by Jurisdiction Affected by Drought <sup>49</sup>						
Jurisdiction	Total Building Stock	Building Stock in Hazard Area	% Building Stock in Hazard Area Jurisdiction	Total Critical Facilities	Total Critical Facilities in Hazard Area	% Critical Facilities in Hazard Area Jurisdiction
Unincorporated Kitsap County	87,985	87,985	100	249	249	100
Bainbridge Island	12,639	12,639	100	83	83	100
Bremerton	13,683	13,683	100	64	64	100
Port Orchard	6,708	6,708	100	39	39	100
Poulsbo	3,516	3,516	100	66	66	100
Port Madison Suquamish Reservation	4,579	4,579	100	7	7	100
Port Gamble S'Klallam Reservation	270	270	100	5	5	100%
<b>Totals (Kitsap)</b>	<b>129,380</b>	<b>129,380</b>	<b>100%</b>	<b>513</b>	<b>513</b>	<b>100%</b>

Table 35: Building Stock and Critical Facilities by Jurisdiction Affected by Drought

<sup>48</sup> Table adapted from the US Drought Monitor Drought Severity Classification System: <https://droughtmonitor.unl.edu/AboutUSDM/AbouttheData/DroughtClassification.aspx>

<sup>49</sup> Kitsap County GIS figures 2012

## History

Historically, drought has not been considered a problem in areas west of the Cascade Mountain Range, although Kitsap County has felt its effects in the past. Multiple measurable and documented droughts have hit the region in the past 100 years, but the following three are the most notable:

- April 1934 – March 1937: The longest drought in the region's history.
- October 1976 – September 1977: The worst drought on record. Stream flows averaged between 30% and 70% of normal. Temperatures were higher than normal, which resulted in algae growth and fish kills.
- January – March 2001: the second driest winter on record in 106 years. Stream flows approached the low levels of the 1976-77 droughts.

Since 2000, the longest duration of drought in Washington State lasted 116 weeks beginning on January 7, 2014 and ending on March 22, 2016. The most intense period of drought occurred the week of August 25, 2015, when drought affected 84.64% of Washington land.<sup>50</sup>

## Probability of Future Events

Droughts will continue to occur in Kitsap County and are more likely during the warmer summer months. Predicting the future probability of drought is difficult because of the number of variables involved in modeling the underlying climatic conditions. Factors that impact whether drought will occur and how long it will last include atmospheric and ocean circulation, soil moisture, topography, land surface processes, and interactions between the air, land, and ocean, which ultimately influence temperature and precipitation. From the historical record, we know that climate is inherently variable, and that anomalies of precipitation and temperature may last from several months to several decades. However, given the number of variables involved, it is difficult to predict future drought events. Climate change is making summers warmer with a correspondingly drier watercourse, leading to prairie expansion in the Puget Sound Region and increasing the likelihood of periods of drought.

## Climate Change Impacts

Kitsap County has many creeks formed from rainfall-runoff. Kitsap thrives on rainfall filling the aquifers that provide fresh water to households and filling streams and lakes. Although the county has not experienced a serious drought in several years, dwindling aquifer and water sources could be an issue in the long term. Changes in the timing of streamflow related to shifting snowmelt patterns are already being observed, reducing the supply of water and causing far-reaching ecological and socioeconomic consequences.

Drier soils increase the risk of wildfire. Climate change is likely to more than double the area in the Pacific Northwest that is burned by forest fires during an average year by the end of the 21st century. Higher temperatures and a lack of water can make trees more susceptible to pests and disease, and trees damaged or killed burn more readily than living trees. With that said, other

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<sup>50</sup> National Integrated Drought Information System (2019), <https://www.drought.gov/drought/states/washington>

factors also contribute to fires, and forests in the Western Cascades may be less vulnerable to climate change than those in the Eastern Cascades.<sup>51</sup>

The primary economic force in Kitsap County is the Federal Government and its military bases and the supporting commercial industry. However, Kitsap County does have an agricultural and commercial fishing community, and it may need to adapt to a changing climatic environment.

The success of the agricultural system in the Pacific Northwest is rooted in its specific range of temperatures, precipitation, and growing seasons, as well as its irrigation systems. Changes to climatic cycles, snowmelt, and temperatures may put a significant burden on irrigation rivers. In some cases, however, climate change can provide positive results, providing longer growing seasons, more precipitation, and warmer winters. The region may need to adapt to changing conditions through technology and shifting its key agricultural products to offset some adverse impacts.

## Vulnerability Summary

- Based on a 1-5 assessment scale and the evaluation of our four primary assessment categories, drought vulnerability and effect on Kitsap is considered "**low**," or there is little potential for a disaster during the next 25 years.
- Droughts will continue to occur in Kitsap County. History suggests a moderate probability of occurrence. Although the entire population of the county is vulnerable to the effects of drought, severity has historically been low, being more inconvenient than threatening. Locally, actual drought conditions have been limited to a few days, even during extended dry periods. Transportation and communications infrastructure would be minimally impacted, if at all. However, as growth places more pressure on limited local resources, future impacts may be more significant, suggesting moderate vulnerability.
- Kitsap County's population and industries continue to grow, and so does the demand for water. As usage approaches the limit of available water, any decrease in the normal flow will tend to exacerbate past problems. The county does not need severe drought conditions to experience a water shortage.
- Kitsap County is vulnerable to drought in the logging and wood products industries, as well as the recreational areas. Loss of income from hunters, campers, and tourists would not have a devastating effect on Kitsap County economics.
- Aside from the forests, local agriculture can be devastated by a prolonged drought. A shortage of water will also impact industries that depend on inexpensive water supplies, such as laundries and restaurants.

## Conclusions

Droughts will continue to occur in Kitsap County. Drought-related forest and other wildfires will continue to occur in the County. During periods of drought, County and City governments must

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<sup>51</sup> What Climate Change Means for Washington, US Environmental Protection Agency (August 2016)

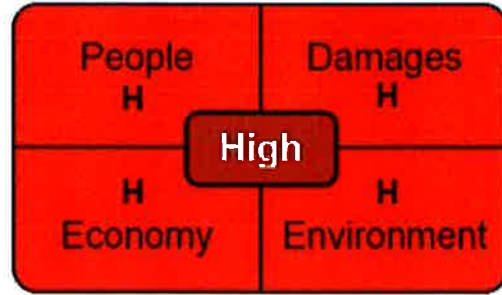
perform public education concerning water conservation and, when needed, institute water conservation activities such as the prohibition of lawn watering and car washing.

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# Earthquakes

## Overview

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock, usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Kitsap County is vulnerable to earthquakes due to its location in the Puget Sound region, which features numerous seismogenic geologic faults.<sup>52</sup> Washington has dozens of active faults and fault zones. Some of these faults are in remote areas. Others, like the Seattle fault and southern Whidbey Island fault zone, cross under major cities and pose a significant hazard. In general, larger faults make larger earthquakes. All faults, regardless of size, can be dangerous if they rupture.



Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric and phone service; and, sometimes, trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis).

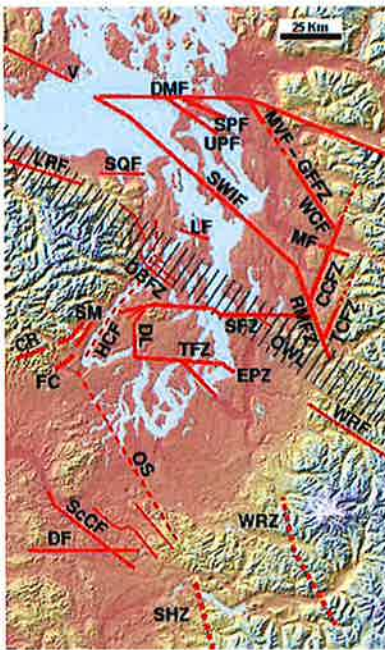


Figure 26: Puget Sound Faults

## Location

Kitsap County is vulnerable to earthquakes due to its location in the Puget Sound region, which features numerous seismogenic geologic faults. Kitsap County is susceptible to subduction as well as to fracture faults. The Puget Sound region is entirely within Seismic Risk Zone 3, requiring that buildings be designed to withstand major earthquakes measuring 7.5 in magnitude. It is anticipated, however, that earthquakes caused by subduction zone plate stress can reach a magnitude greater than 8.0.<sup>53</sup>

With recent studies greatly enhancing scientists' ability to focus on active faults, scientists have paid particular attention to seven active faults in the Puget Lowland capable of generating damaging earthquakes. These faults include the Seattle Faults (2), Tacoma Fault, Darrington Devils Mountain Fault, Utsalady Point Fault, and two Whidbey Island Faults.

The Puget Lowland faults are of particular concern because a considerable portion of the area is heavily urbanized and populated. The four-county central Puget Sound area encompassing King, Kitsap, Pierce, and Snohomish Counties,

<sup>52</sup> FEMA Risk Report for Kitsap County (2015)

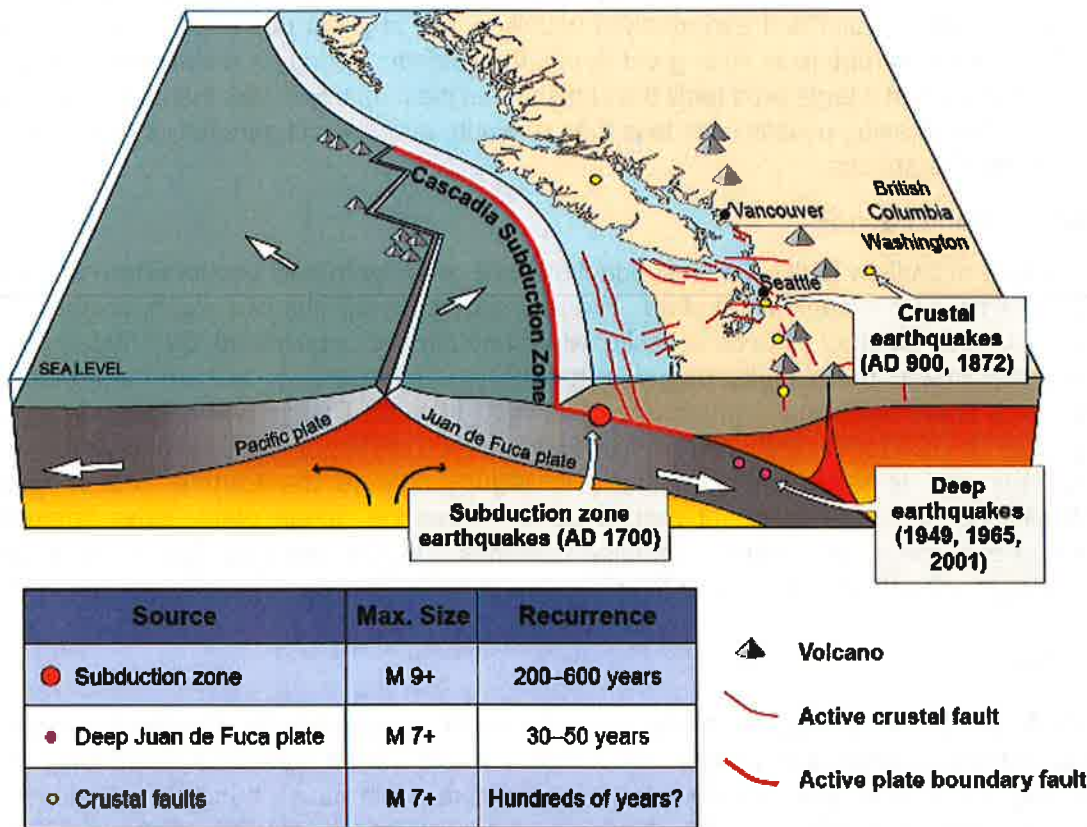
<sup>53</sup> FEMA Risk Report for Kitsap County (2015)

[https://www.bainbridgewa.gov/DocumentCenter/View/6701/Final Kitsap Risk Report UpdateStrategies?bidId=](https://www.bainbridgewa.gov/DocumentCenter/View/6701/Final_Kitsap_Risk_Report_UpdateStrategies?bidId=)

where a number of the faults are located, has a population base of approximately 3.8 million people, or about 60 percent of the state's population, and much of the state's economic base.<sup>54</sup>

## WHAT IS AN 'ACTIVE' FAULT?

The term 'active' can have different meanings. At the Washington Geological Survey, 'active' means that a fault has evidence for movement within the Holocene time period (since about 12,000 years ago). It usually also means that there are earthquakes (even small ones) on the fault.



\*figure modified from USGS Cascadia earthquake graphics at <http://geomaps.wr.usgs.gov/pacnw/pacnweq/index.html>

### Normal faults<sup>55</sup>

A normal fault occurs when two blocks are pulled away from each other. Washington has few large normal faults because it is mostly in a region of compression. Small normal faults are found along the top of folds in eastern Washington in the Saddle Mountain graben. The Eastern Sierra fault along the east side of the Sierra Nevada mountains in California is a good example of an active normal fault.

<sup>54</sup> United States Census Bureau (2017)

<sup>55</sup> Washington Department of Natural Resources (2019)

### **'Shallow' Faults<sup>56</sup>**

Shallow faults produce earthquakes in the upper 18 miles (30 kilometers) of the Earth's crust. These types of faults are common but usually small. Larger crustal faults, such as the Seattle fault and southern Whidbey Island fault zone, can produce earthquakes up to magnitude 7.5. Earthquakes on shallow faults typically last 20 to 60 seconds, and the shaking is localized to the general area of the fault. Earthquakes on faults like these may cause tsunamis in the Puget Sound region.

### **'Deep' Faults<sup>57</sup>**

Deep faults can occur where two tectonic plates collide, and one of the plates is forced beneath the other. The plate that is forced down can have faults within it that still rupture and produce earthquakes. These faults and earthquakes usually occur at great depth (tens to hundreds of miles). Because they rupture at such great depth, their seismic energy is distributed over a large area. This means that a large area feels the shaking, but the intensity is less than a similar shallow earthquake. The shaking usually lasts less than a minute and doesn't generally cause a tsunami or have many aftershocks.

### **Subduction Zone Faults<sup>58</sup>**

A special type of shallow fault called a subduction zone or 'megathrust,' occurs where an oceanic plate moves beneath a continental plate. The boundary between the two plates covers a large area and can lock together. Like other faults, when enough stress builds up, the 'megathrust' will rupture. What makes these faults 'mega' is that the amount of energy released is hundreds to thousands of times more than almost any other type of fault. The ground shaking from these earthquakes can last for several minutes. The 2011 Tohoku earthquake in Japan occurred on this type of fault and released enough energy to slightly change the Earth's axis of rotation. Additionally, because the continent moves up and over the ocean plate, large amounts of seawater are displaced and cause damaging tsunamis. The Cascadia subduction zone just off the Washington coast is this kind of fault and is one of the largest geologic hazards to our state.

## **Effects**

The effects of a major earthquake in Kitsap County could be catastrophic. Hundreds of residents could be injured or killed, and a multitude of others would be left homeless. Depending on the time of day and time of year, a catastrophic earthquake could cause hundreds of injuries and deaths and millions of dollars in critical infrastructure and private property damage (WADNR, 2012-2013). A severe earthquake could level or severely damage older buildings, especially those constructed of non-reinforced masonry. Newer structures, which were built under recent building codes, would probably sustain less damage but would remain vulnerable to the soil conditions of the building site. A severe earthquake would also cause major damage to County and City utilities.

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling materials. Other effects include, but are not limited to:

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<sup>56</sup> Washington Department of Natural Resources (2019)

<sup>57</sup> Washington Department of Natural Resources (2019)

<sup>58</sup> Washington Department of Natural Resources (2019)



- Broken water and sewer mains
- Downed electric lines
- Downed or damaged bridges
- Cracked and partially displaced roadbeds and rail lines
- Loss of telephone or other telecommunications services
- Houses knocked off their foundations
- Partial or complete collapse of buildings, building facades, cornices, or chimneys
- Fires including urban conflagration
- Chemical spills
- Ruptured gas and oil pipelines
- Riverbeds disrupted
- Broken or cracked dams with possible flooding
- Injury and death
- Psychological trauma
- Economic disruption
- Large numbers of displaced persons

The effects of a major earthquake in the Puget Sound basin area could be catastrophic, providing the worst-case disaster short of drought-induced wildfire sweeping through a suburban area. Hundreds of residents could be killed, and a multitude of others left homeless.

The following figure shows FEMA's determination of building damage during a 7.2 magnitude earthquake on the Seattle Fault.<sup>59</sup>

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<sup>59</sup> [http://mediaassets.kitsapsun.com/html/data/earthquakes/0110\\_Earthquake-HousingLosses\\_KS.jpg](http://mediaassets.kitsapsun.com/html/data/earthquakes/0110_Earthquake-HousingLosses_KS.jpg)

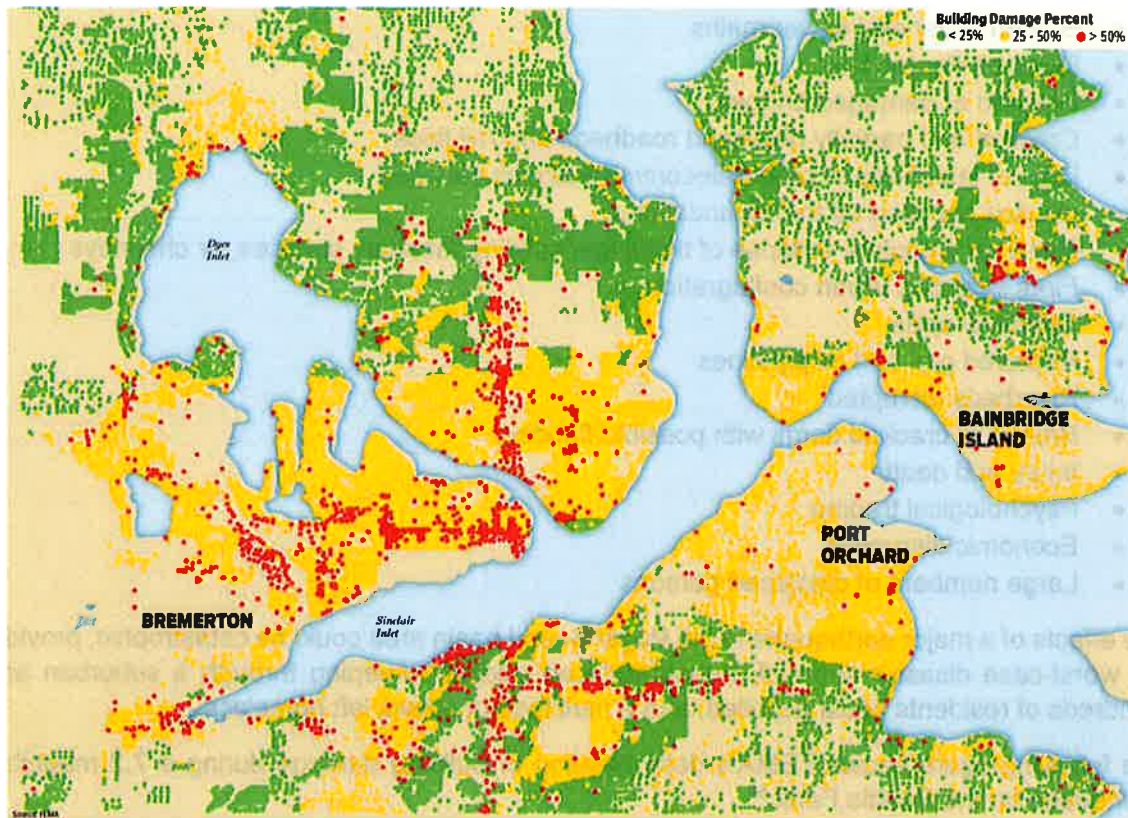


Figure 27: Building Damage Percent during a 7.2M Earthquake on the Seattle Fault

An earthquake with such a magnitude (7.0+) would cause tremendous damage and economic disruption throughout the central Puget Sound region. 2012 regional estimates of damage and loss for a magnitude 7.2 incident on the Seattle Fault showed such a quake would result in extensive or complete damage to more than 38,000 buildings, more than 31,000 displaced households, and more than 17,500 injured persons. The figure above shows the possible building damage percentage from this magnitude of earthquake. Although losses would likely be less from similar earthquakes on other Puget Sound faults away from the core of the Seattle urban area, all of the newly defined active faults represent the possibility of very high damage, loss of life, and major economic impact.

A severe earthquake would also cause major damage to County and City utilities. Depending on the earthquake epicenter and duration of the earthquake, major damage or failure of the Casad Dam could occur. Water systems in the county would suffer ruptured mains and possible failure of local water reservoirs. Electrical and natural gas utilities would also suffer major damage. Failed transformers and downed electrical lines would create massive power failures in the county. Ruptured gas lines would create conditions for large fires and explosions. Public communication facilities (i.e., radio, television, and telephone systems) would be damaged. Surviving telephone systems would likely be overloaded almost instantly. Radio and television services may take days or weeks to recover. Emergency services (i.e., fire, medical, SAR) would be immediately overwhelmed by the amount of damage and injury throughout the county.

County and City Public Works Departments would be very hard-pressed to establish a working road net for essential services, especially if bridges become damaged. At a minimum, bridges in an affected area would have to be inspected before use. Emergency food and shelter would be needed for possibly thousands of persons forced from their homes or isolated by damaged roads and bridges. Because a catastrophic earthquake would likely affect more communities than Kitsap County, the likelihood of immediate assistance from sources outside the county would be remote.

The table below shows the impacts of a Cascadia Scenario on SR bridges in Kitsap County per the Washington Department of Transportation (DOT). It is important to note that all bridges may experience some level of damage.

The following bridges in Kitsap County either on or over State Routes (SR) are expected to experience MODERATE damage during a Cascadia scenario.		
Location	Feature In	Facility
PIERCE CO	MULLENIX ROAD	SR 16
4.5 N PIERCE CO	MULLENIX ROAD	SR 16
4.5 N PIERCE CO	BURLEY CREEK	SR 16 RAMP
0.6 E JCT SR 303	PORT WASH NARROWS	CITY STREET
3.5 N JCT SR 304	SR 310/KITSAP WAY	SR 3
6.8 N BAINBRIDGE FY	AGATE PASSAGE	SR 305
1.7 N JCT SR 308	SR 3	SHERMAN HILL RD
4.3 N JCT SR 308	SR 305	SR 3
4.3 N JCT SR 308	SR 305	SR 3
7.7 N JCT SR 304	RIDGETOP ROAD N.W.	SR 303
7.7 N JCT SR 304	RIDGETOP ROAD N.W.	SR 303
0.1 N JCT SR 305	Dogfish Creek	SR307
0.3 W SR 3	SR 3 ACCESS - LUOTO ROAD	CLEAR CREEK RD NW
2.6 N JCT SR 303	SR 308 (LUOTO RD)	SR 3
2.6 N JCT SR 303	SR 308 (LUOTO RD)	SR 3
0.7 N JCT SR 304	SR 3	WERNER/LOXIE EAGAN
15.2 E JCT US 101	HOOD CANAL	SR 104
4.6 N JCT SR 302	BURLEY-OLLALA RD	NB SR 16
4.6 N JCT SR 302	BURLEY-OLLALA RD	SB SR 16
The following bridges in Kitsap County either on or over State routes are expected to experience SIGNIFICANT damage during a Cascadia scenario.		
Location	Feature In	Facility
7.6 N PIERCE CO	SIDNEY ROAD	SR 16
7.6 N PIERCE CO	SIDNEY ROAD	SR 16
8.3 N PIERCE CO	TREMONT ST	SR 16 NB
8.3 N PIERCE CO	TREMONT ST	SR 16 SB
6.2 N MASON CO	SR 16	SR 3 NB
1.3 N JCT SR 304	CALLAHAN DRIVE	SR 303
5.6 N JCT SR 304	ERLAND POINT RD	SR 3
5.6 N JCT SR 304	ERLAND POINT RD	SR 3
0.2 S JCT SR 3	SILVERDALE WAY NW	SR 303
5.6 N PIERCE CO	SR 16	BETHEL RD
6.3 N MASON CO	GORST CREEK	SR 3

JCT SR 3	SB SR 16	NB SR 16 SPUR
6.6 N JCT SR 304	SR 303	CENTRAL VALLEY RD.
4.0 E JCT SR 16	SR 166	MITCHELL AVE
JCT SR 16	SR 16	SR160
0.7 N JCT SR 304	PORT WASHINGTON NARROWS	SR 303
3.5 N JCT SR 304	SR 310/KITSAP WAY	SR 3
4.5 N JCT SR 304	SR 3	AUSTIN DRIVE
7.2 N JCT SR 304	SR 3	ELDORADO BLVD
3.8 N JCT SR 308	SR 3	FINN HILL ROAD
6.3 N JCT SR 304	CHICO WAY NW	SR 3
8.7 N JCT SR 304	NEWBERRY HILL RD	SR 3
8.7 N JCT SR 304	NEWBERRY HILL RD	SR 3
9.9 N JCT SR 304	ANDERSON HILL RD	SR 3
9.9 N JCT SR 304	ANDERSON HILL RD	SR 3
1.0 N JCT SR 303	SR 3	TRIGGER AVE
2.1 N JCT SR 303	SR 3	MOUNTAIN VIEW RD
2.6 N JCT SR 303	SR 3	N-W RAMP TO LUOTO
JCT SR 3	SR 3	SR 303 (WAAGA WAY)
JCT SR 3	SR 3	SR 303/CLEAR CK RD
9.8 N PIERCE CO	SR 166	SR 16 NORTHBOUND
JCT SR 3	SR 3	SR 304 W-S RAMP
3.1 E JCT SR 3	DOGFISH BAY	SR 308
6.3 N JCT SR 304	CHICO WAY NW	SR 3
***The Hood Canal Floating Bridge was not evaluated as part of this study due to its classification as a special bridge.		

Earthquakes of lesser magnitude or farther from the county would cause less damage and displacement, but the county could find itself faced with a large influx of displaced persons. Depending on the damage and injuries caused by an earthquake, businesses may close, unemployment may rise, and economic loss might occur.

Volcanic earthquakes, often centered within or beneath the volcano, are usually one of three kinds: (1) pre-eruption earthquakes caused by explosions or steam or underground magma movements, (2) eruption earthquakes caused by explosions and collapse of walls inside the volcano, or (3) post-eruption earthquakes caused by magma retreat and interior structural collapse. Although volcanic earthquakes are strong near the volcano, they are generally confined there. There are some exceptions, as with the "St. Helens Fault Zone," where a tectonic fault (earth's crustal structure) is closely associated with the volcano. Tremors may cause large rockfalls, snow avalanches, landslides, and building collapse. Since all Pacific Northwest volcanoes are in a regular seismic zone, tremors should be evaluated for their volcanic potential by qualified geophysicists or seismologists.

The following page shows a map of seismic hazards such as fault hazard zones, liquefaction susceptibility, and site classes in Kitsap County. Liquefaction susceptibility describes the likelihood of saturated sediments to liquefy during an earthquake, resulting in permanent ground deformations. When liquefaction occurs, the ability of soil to support buildings and infrastructure is diminished.

**Legend**

**Kitsap Fault Hazard Zone**

- High Geologic Hazard
- Moderate Geologic Hazard
- Kitsap Seismogenic Faults

**Kitsap Liquefaction Susceptibility**

- High; Moderate-High
- Moderate; Low-Moderate

**Kitsap Site Class**

- High Geologic Hazard

**Tax Parcels**

- Unincorporated Urban Growth Area
- Incorporated City

**Reservation Boundaries**

- Reservation Boundaries

**Limited Areas of More Intense Rural Development**

- Type I  
Type I Limited Area of More Intense Rural Development. Part I of WAC 222-16-030.
- Type III  
Type III Limited Area of More Intense Rural Development. Part III of WAC 222-16-030.

**Street Center Lines**

- State Highway
- Major Road
- Collector / Arterial
- Local Access; Local Road

**Railroad Lines**

- Ferry Terminals
- Ferry Routes

**Waterbodies (defined in WAC 222-16-030)**

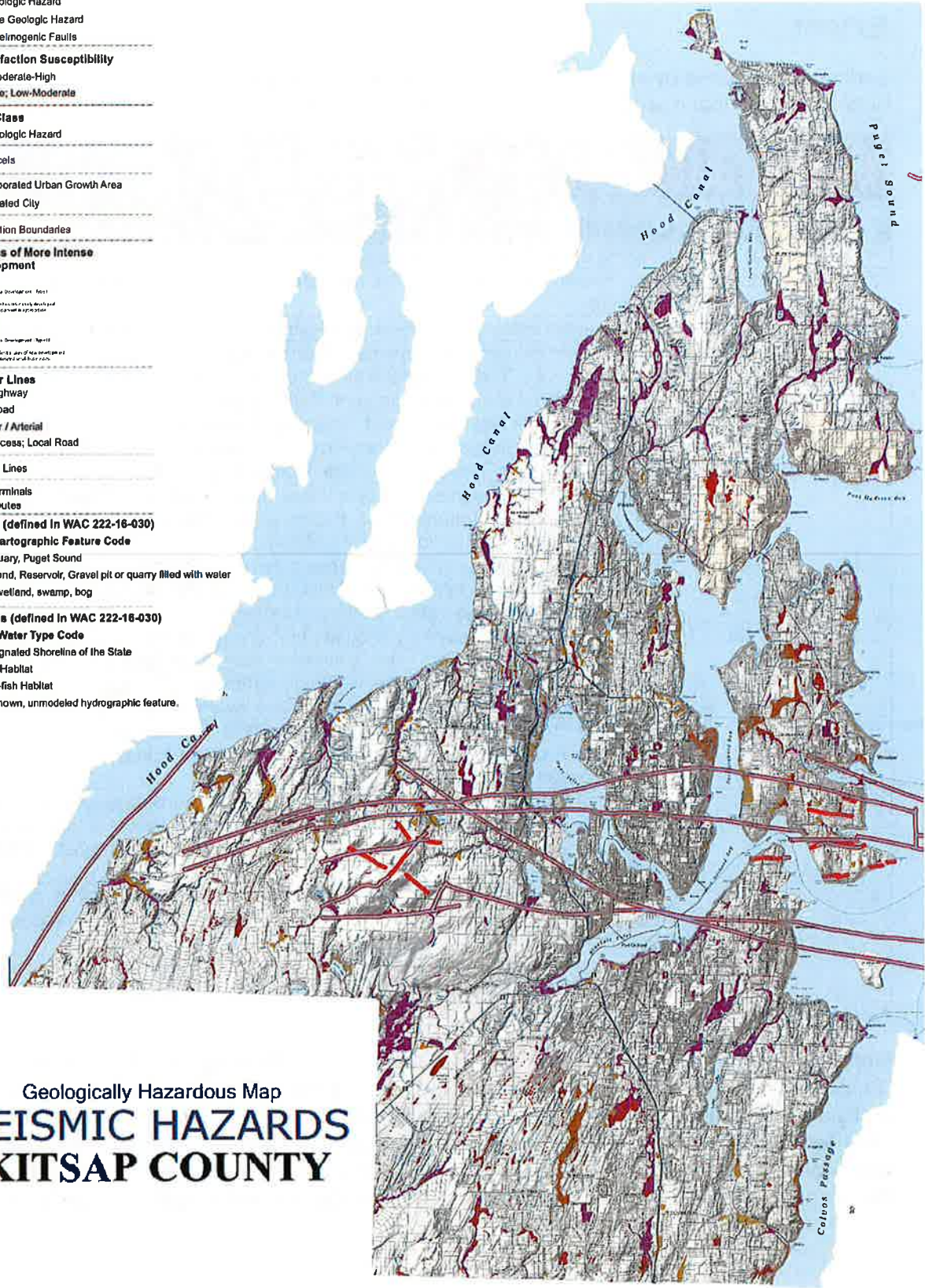
**WaterBody Cartographic Feature Code**

- Bay, estuary, Puget Sound
- Lake, Pond, Reservoir, Gravel pit or quarry filled with water
- Marsh, wetland, swamp, bog

**Watercourses (defined in WAC 222-16-030)**

**Fish Habitat Water Type Code**

- (S) Designated Shoreline of the State
- (F) Fish Habitat
- (N) Non-fish Habitat
- (U) Unknown, unmodeled hydrographic feature.



Geologically Hazardous Map  
**SEISMIC HAZARDS  
KITSAP COUNTY**

Figure 29: Seismic Hazards

## Extent

Earthquakes caused by subduction zone plate stress can reach a magnitude greater than 8.0. Below is a table that discusses earthquake effects at each magnitude.

Comparison of Earthquake Measurements		
Magnitude Richter	Degree Mercalli	Description
<3.5	I	People do not feel any earth movement.
3.5	II	Few people notice movement if they are at rest or on the upper floors of tall buildings.
4.2	III	Many people indoors feel movement. Hanging objects swing back and forth.
4.5	IV	Most people indoors feel movement. Hanging objects swing. Dishes, windows, and doors rattle. The earthquake feels like a heavy truck hitting the walls. A few people outdoors may feel movement. Parked cars rock.
4.8	V	Almost everyone feels movement. Sleeping people are awakened. Doors swing open or closed. Dishes are broken. Pictures on walls move. Small objects move or are turned over. Trees might shake. Liquids might spill.
5.4	VI	Everyone feels movement. People have trouble walking. Objects fall from shelves, off walls. Furniture moves. Plaster walls might crack. Trees and bushes shake. Slight damage in poorly built buildings.
6.1	VII	People have difficulty standing. Drivers feel cars shaking. Some furniture breaks. Loose bricks fall from buildings. Considerable damage in poorly built buildings, slight to moderate in well-built buildings.
6.5	VIII	Drivers have trouble steering. Houses that are not bolted down may shift on their foundations. Towers and chimneys may twist and fall. Poorly built structures suffer severe damage, well-built suffer slight damage. Tree branches break. Wet ground hillsides may crack. Water levels in wells may change.
6.9	IX	Well-built buildings suffer considerable damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks. Reservoirs suffer serious damage.
7.3	X	Most buildings and foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. The ground cracks in large areas. Railroad tracks are bent slightly.
8.1	XI	Most buildings collapse, some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed. Railroad tracks are badly bent.
>8.1	XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Table 37: Comparison of Earthquake Measurements

Maps depicting shaking intensity and ground motion following an earthquake, called “ShakeMaps,” can be produced in near-real-time for incidents or created for specific scenarios by regional seismic network operators in cooperation with the USGS. These ShakeMaps can be used for response, land use, and emergency planning purposes. The following map shows a ShakeMap modeled after a Seattle Fault 7.2 magnitude incident showing the shaking intensity for this scenario. The central and eastern portions of Kitsap County, including Bainbridge Island, Port

Orchard, and Bremerton, are located in the severe (instrumental intensity VIII) to extreme (instrumental intensity X+) shake zones.<sup>60</sup>

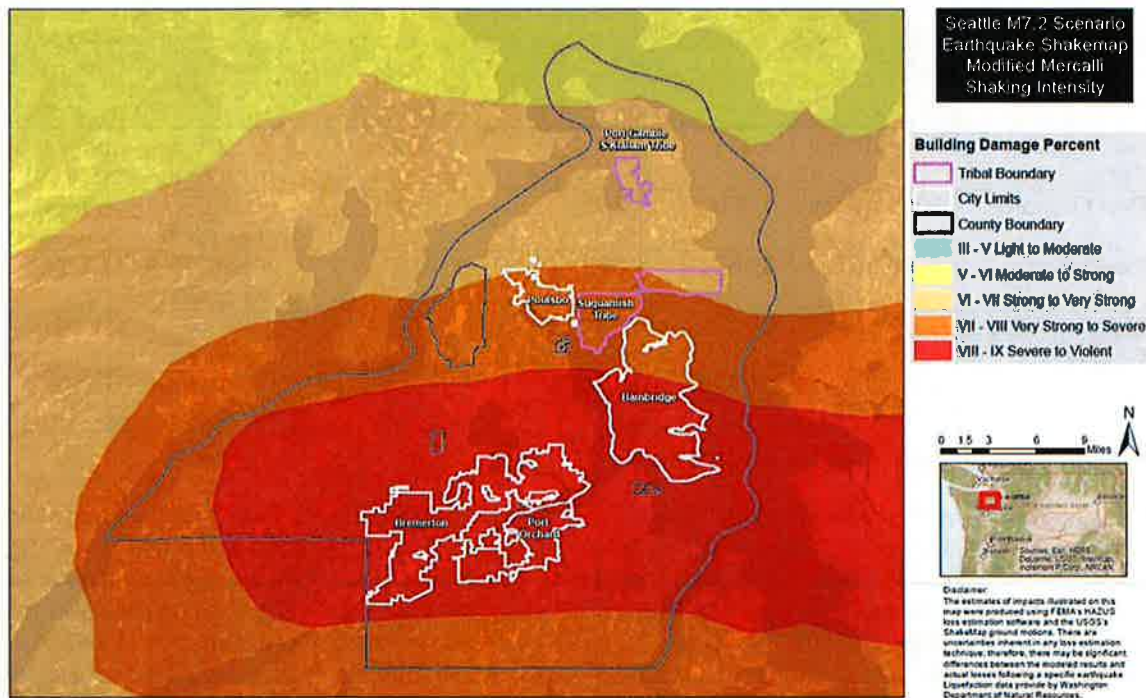


Figure 30: Shaking Intensity for a 7.2 Seattle Fault Earthquake

All communities in Kitsap County would be affected if a Seattle Fault incident were to occur. The Cities of Bainbridge Island and Port Orchard have the most significant percentage of buildings located in the moderate-high liquefaction zone, while unincorporated areas of the county have the highest total number of buildings located in these zones. The total building dollar loss in Kitsap County for an earthquake of this magnitude is estimated at \$3.6 billion.

Hazus Earthquake Results for a Seattle M 7.2 Earthquake <sup>61</sup>						
Community	Total Est. Building Value	Total Number of Buildings	Number of Buildings in the Moderate-High Liquefaction Zone	Percentage of Buildings in the Moderate-High Liquefaction Zone	Building Dollar Loss for a Seattle 7.2 Incident	Loss Ratio (Dollar Losses /Total Building Value)
Bainbridge	\$2.6 billion	9,094	384	4%	\$538 million	21%
Bremerton*	\$1.7 billion	10,899	116	1%	\$760 million	45%
Port Gamble S'Klallam Tribe**	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

<sup>60</sup> FEMA Risk Report for Kitsap County (2015)

<sup>61</sup> FEMA Risk Report for Kitsap County (2015)

Hazus Earthquake Results for a Seattle M 7.2 Earthquake <sup>61</sup>						
Community	Total Est. Building Value	Total Number of Buildings	Number of Buildings in the Moderate-High Liquefaction Zone	Percentage of Buildings in the Moderate-High Liquefaction Zone	Building Dollar Loss for a Seattle 7.2 Incident	Loss Ratio (Dollar Losses /Total Building Value)
Suquamish Tribe	\$474 million	3,093	97	3%	\$29.8 million	6.3%
Port Orchard	\$966 million	4,076	258	6%	\$377 million	39%
Poulsbo	\$865 million	3,160	50	2%	\$67.5 million	7.8%
Unincorporated County	\$9.7 billion	57,801	1,921	3%	\$1.8 billion	18%
Total	\$16.3 billion	88,123	2,826	3%	\$3.6 billion	18%

Table 38: Hazus Earthquake Results for a Seattle M 7.2 Earthquake

**Note:** The above table shows the total estimated building value by community, total number of buildings by community, total number of buildings within the moderated to high liquefaction zone, and percentage of buildings within the moderate to high liquefaction zone. In addition, building losses are reported for a Seattle Fault 7.2 magnitude incident as well as a loss ratio. A loss ratio is calculated by dividing the dollar loss by the total building value. The loss values are for building losses only; additional damages to infrastructure and building contents are not captured in this table. \*Information from the military base was not included in the assessment for the City of Bremerton. \*\*No building data was available for the Port Gamble S'Klallam Indian Reservation from Kitsap County, so the results are shown as unknown.

In addition to the building analysis in the 2015 FEMA Risk Report, essential facilities (schools, fire, police, and medical facilities) were analyzed to determine if they would experience damage from the earthquake incident. Anything labeled greater than 50 percent would be considered damaged. For the entire study area, 155 schools buildings of 292 are expected to have a greater than 50 percent chance of being damaged; 93 medical facilities out of 184 are expected to have a greater than 50 percent chance of being damaged; and 19 fire stations out of 48 are expected to have a greater than 50 percent chance of being damaged. Transportation damage is not shown in the report.

Pre-Code versus Moderate Code Building in Kitsap County <sup>62</sup>				
Community	Number of Pre-Code Buildings (before 1975)	Percent Pre-Code Buildings	Number of Moderate Code Buildings (after 1975)	Percent of Moderate Code Buildings
Bainbridge Island	3,082	34%	6,012	66%
Bremerton	8,698	80%	2,201	20%
Port Orchard	1,415	35%	2,661	65%
Poulsbo	725	23%	2,435	77%
Squamish Tribe	780	25%	2,313	75%

<sup>62</sup> FEMA Risk Report Kitsap County 2015



Pre-Code versus Moderate Code Building in Kitsap County <sup>62</sup>				
Community	Number of Pre-Code Buildings (before 1975)	Percent Pre-Code Buildings	Number of Moderate Code Buildings (after 1975)	Percent of Moderate Code Buildings
Port Gamble S'Klallam Tribe	Unknown	Unknown	Unknown	Unknown
Unincorporated County	17,278	30%	40,523	70%
<b>Total</b>	<b>31,978</b>	<b>36%</b>	<b>56,145</b>	<b>64%</b>

Note: Pre-code buildings are those that are built prior to 1975. Moderate code are those built after 1975. These dates were chosen based on when the seismic provisions were incorporated into the building code statewide which was 1975. Please note that the analysis in Hazus used the following dates: Pre-code are any buildings prior to 1941. Moderate Code were any buildings after 1941, which is the default Hazus methodology. Please refer to the appendix for additional information.

Table 39: Pre-Code versus Moderate Code Building in Kitsap County

## History

Since 1962, earthquakes have had the most significant impact of any hazard on the county in terms of monetary costs and disruptions to daily life.

In the Puget Sound region, the most dramatic earthquake identified so far is associated with the Seattle Fault, which runs from the east side of King County across West Seattle and the south end of Bainbridge Island, extending into Central Kitsap.

When the ground broke free about 1,100 years ago, geologic forces pushed the ground upward about 20 feet from Restoration Point on Bainbridge Island to Alki Point in West Seattle. Tideflats were left high and dry, and a tsunami drowned low-lying estuaries throughout Puget Sound. Evidence suggests that the tremendous earthquake caused forested slopes to slide into Lake Washington and Lake Sammamish. Farther away, the quake may have unleashed rockslides that blocked streams and created new lakes in the Olympic Mountains.<sup>63</sup>

Researchers believe the earthquake probably measured around magnitude 7.2, yet the shaking was far greater than deep earthquakes of the same size. In fact, for residents of Kitsap and King counties, a Seattle earthquake today like the one 1,100 years ago would probably cause more damage than the largest Cascadia subduction earthquake.

The Nisqually earthquake of 2001 was the most recent earthquake incident that caused significant damage to Kitsap County and the Puget Sound region and is the last major deep earthquake. This 6.8 magnitude earthquake struck the Puget Sound region on February 28, 2001, and created minor to moderate damage to the properties of over 750 Kitsap County residents.<sup>64</sup> According to the U.S. Geological Survey (USGS) Earthquake Hazards Program, damage estimates from this incident amounted to \$1 billion to \$4 billion dollars throughout the region.<sup>65</sup> Previous deep

<sup>63</sup> <http://archive.kitsapsun.com/earthquake/multiple-geologic-forces-make-region-vulnerable-to-quakes-26673853-0bb3-5925-e053-0100007f83d4-364560781.html>

<sup>64</sup> Kitsap County Department of Emergency Management, 2012

<sup>65</sup> USGS, 2012

earthquakes included a 6.5-magnitude quake near Des Moines in King County in 1965 and a 7.0-magnitude quake near Olympia in 1949.<sup>66</sup>

The part of Washington State east of the Cascades has historically been subject to shallow, though infrequent, smaller earthquakes up to a magnitude of 6.0. The western part of Washington State is vulnerable to the following earthquake risks:

- A magnitude of 7.5 incident of 40 or more kilometers in depth.
- A magnitude of 6.5 incident at a shallow depth in the vicinity of Mount St. Helens.
- A magnitude of 7.5 incident at a shallow depth anywhere in western Washington of uncertain probability.
- Subduction plate earthquakes of magnitudes greater than 8.0.

Washington State Significant Earthquakes					
Date	Time (PST)	Latitude Longitude	Depth (Km)	Mag	Location
December 14, 1872	2140	48°48' 121°24'	shallow	7.4	North Cascades
December 12, 1880	2040	47°30' 122°30'		5.5	Puget Sound
April 30, 1882	2248	47°00' 123°00'	deep	6.0	Olympia area
November 29, 1891	1521	48°00' 123°30'		5.0	Puget Sound
March 6, 1893	1703	45°54' 119°24'	shallow	4.9	Southeast Washington
January 3, 1896	2215	48°30' 122°48'		5.7	Puget Sound
March 16, 1904	2020	47°48' 123°00'		5.3	Olympics eastside
January 11, 1909	1549	48°42' 122°48'	deep	6.0	Puget Sound
August 18, 1915	0605	48°30' 121°24'		5.6	North Cascades
January 23, 1920	2309	48°36' 123°00'		5.5	Puget Sound
July 17, 1932	2201	47°45' 121°50'	shallow	5.2	Central Cascades
July 15, 1936	2308	46°00' 118°18'	shallow	5.7	Southeast Washington
November 12, 1939	2346	47°24' 122°36'	deep	5.7	Puget Sound
April 29, 1945	1216	47°24' 121°42'		5.5	Central Cascades
February 14, 1946	1914	47°18' 122°54'	40	6.3	Puget Sound
April 13, 1949	1155	47°06' 122°42'	54	7.1	Puget Sound
August 5, 1959	1944	47°48' 120°00'	35		Northwest Cascades
April 29, 1965	0728	47°24' 122°24'	63	6.5	Puget Sound
February 13, 1981	2209	46°21' 122°14'	7	5.5	South Cascades
April 13, 1990	2133	48°51' 122°36'	5	5.0	Deming
January 28, 1995	1911	47°23' 122°21'	16	5.0	17.6 km NNE of Tacoma
May 2, 1996	2104	47°46' 121°57'	7	5.3	10.2 km ENE of Duvall

<sup>66</sup> <http://archive.kitsapsun.com/earthquake/multiple-geologic-forces-make-region-vulnerable-to-quakes-26673853-0bb3-5925-e053-0100007f83d4-364560781.html>

Washington State Significant Earthquakes					
Date	Time (PST)	Latitude Longitude	Depth (Km)	Mag	Location
June 23, 1997	1113	47°36' 122°34'	7.4	4.9	5.5 km NE of Bremerton
July 2, 1999	1743	47°05' 123°28'	41	5.1	8.2 km N of Satsop
February 28, 2001	1054	47.19°N 122.66°W	57	6.8	Southern Puget Sound, NE of Olympia

Table 40: Washington State Earthquakes

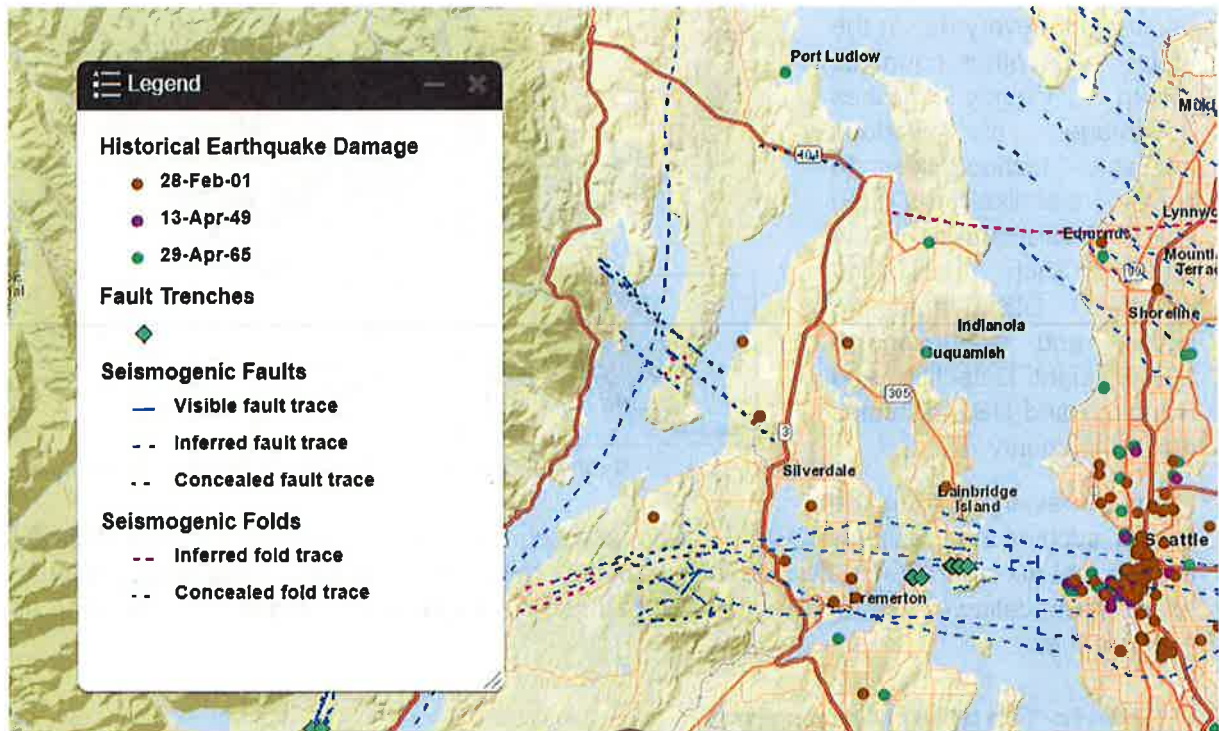


Figure 31: Historical Earthquake Damage

## Probability of Future Events

The largest active fault that will affect Washington (and the whole Pacific Northwest) is the Cascadia subduction zone. This fault produces some of the largest and most damaging earthquakes in the world (M9). A damaging earthquake is inevitable on this fault, but we do not know exactly when it will happen.<sup>67</sup>

According to the Washington State Department of Natural Resources, earthquakes occur nearly every day in the state. Like other counties, Kitsap County takes advantage of various available technologies to assess the likelihood and effect of earthquakes in the region. Such technology includes GIS mapping, Hazus, and evaluation of LIDAR (Light, Detection, and Ranging) and USGS studies about the county.

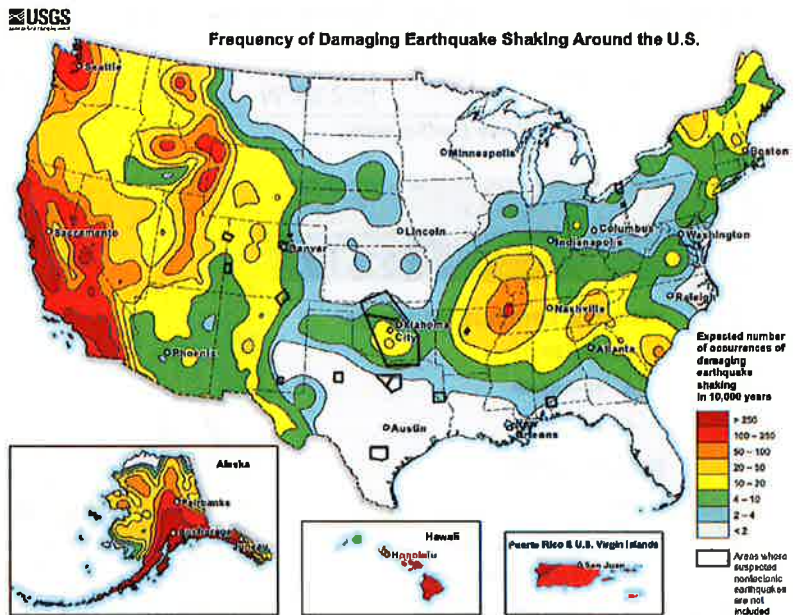


Figure 32: Frequency of Damaging Earthquake Shaking Around the US

Programs available from the USGS, such as the Washington State Earthquake Scenario Catalog, provide a variety of HAZUS modeling studies on different faults. These studies provide valuable insight into vulnerability and exposure modeling of earthquakes that can be used in mitigation planning and as a training and exercise tools.

## Climate Change Impacts

There is debate over how climate change impacts earthquake activity explicitly, and there is currently no substantial and universally accepted information to provide in this section

## Vulnerability Summary

- The overall risk rating for earthquakes is “**high**.” Damages are also considered “**high**” as the incident will affect the county’s infrastructure. The rating is defined as a strong potential for a disaster of major proportions in the next 25 years. Although the 2018 Washington State HIVA rated earthquake risk in Kitsap County as “**moderate-high**,” it rated area, population, and critical infrastructure with “**high**” and state and first responder facilities with “**moderate-high**” exposure risks. Due to high ratings and potential damage to people,

<sup>67</sup> Washington Department of Natural Resources (2019)

infrastructure, and critical facilities, Kitsap County views earthquakes as a high-risk hazard.

- Earthquakes are the number one catastrophic threat to Kitsap County. The largest estimated magnitude is 8.0, which would be catastrophic. Although less damaging earthquakes similar to Nisqually in 2001 are more likely, they can still cause damage in the millions across the county.
- The damaging shaking from an earthquake could cause minor tsunamis, liquefaction in Kitsap County's small cities, and building and infrastructure damage that would take years of recovery. Small businesses may not survive, and damages to ferry systems, bridges, and highways will impact the economy.
- All of the critical infrastructure facilities, fire stations, and EMS facilities are located in areas with moderate or higher exposure to earthquake hazards. Mitigation efforts will help lessen the potential impact, but a significant earthquake will still create substantial damage to infrastructure, and potentially to the economy
- Damage to highway infrastructure outside Kitsap County could have a direct impact on Kitsap County's economy. In particular, damage to Highway 16 and I-5 in Pierce County will directly impact access to Kitsap County. Also, damage to the Junction of I-5 and US 101 in Thurston County could also directly impact Kitsap County, especially if they were affected at the same time.
  - The State Ferries routinely operate at near capacity. If an incident caused damage to critical transportation infrastructure, the ferry system would be challenged to pick up the slack.

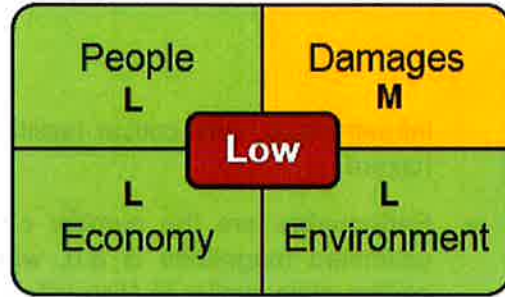
## Conclusions

Kitsap County will experience major earthquake effects. Mitigation efforts must be instituted and maintained to decrease potential problems from major earthquakes. They are:

- Examination, evaluation, and enforcement of effective building and zoning codes.
- Public education on what to do before, during, and after an earthquake.
- Development of appropriate County and City government response plans. Response should include detailed, immediate action to save resources such as water and gas supplies. Plans should be realistically exercised at the County and City levels to ensure workability and relevance to disaster response.

# Floods

## Overview



Flooding is the most common hazard occurring in Kitsap County, affecting all of the county. Approximately 10-15% of the county area lies within flood zones with a 1% and 0.2% percent chance of flooding annually. Heavy, prolonged rain in the fall, winter, or spring months often results in saturated ground, and high stream flows. Due to ground saturation, Kitsap County businesses and homes located in low-lying areas may flood during prolonged periods of rain. Wind-driven tidal flooding is also possible along the inland waters. Flooding is due to runoff, ground saturation, or tidal flooding. Structures located within floodplain areas also are susceptible to frequent flooding.

## Location/Extent

Special Flood Hazard Area Assessment <sup>68</sup>						
Community	Total Estimated Building Value	Percentage of Buildings in the Special Flood Hazard Area	Building Dollar Loss for a 1% Annual Chance Flood Event	Loss Ratio (Dollar Losses/Total Building Value)	Number of Buildings in Zones AE, A	Number of Buildings in Zone VE
Bainbridge Island	\$2.6 Billion	1.5%	\$3.6 Million	1.4%	136	8
Bremerton*	\$1.7 Billion	<1%	\$404,000	<1%	21	0
Port Gamble S'Klallam Tribe**	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Suquamish Tribe	\$474 Million	<1%	\$175,000	<1%	3	0
Port Orchard	\$966 Million	<1%	\$579,000	<1%	24	0
Poulsbo	\$865 Million	<1%	\$3.4 Million	<1%	7	0
Unincorporated County	\$9.7 Billion	<1%	\$5.2 Million	<1%	164	175
<b>Total</b>	<b>\$16.3 Billion</b>	<b>&lt;1%</b>	<b>\$13.4 Million</b>	<b>&lt;1%</b>	<b>355</b>	<b>183</b>

<sup>68</sup> FEMA Risk Report for Kitsap County 2015

Special Flood Hazard Area Assessment <sup>68</sup>						
Community	Total Estimated Building Value	Percentage of Buildings in the Special Flood Hazard Area	Building Dollar Loss for a 1% Annual Chance Flood Event	Loss Ratio (Dollar Losses/Total Building Value)	Number of Buildings in Zones AE, A	Number of Buildings in Zone VE
<p>Note: Loss information is included for communities in the coastal floodplain. The table includes both dollar losses and a loss ratio, which is calculated as total losses/total building value. Also included is a count of the buildings in Zone VE, which is the 1-percent-annual-chance coastal flood zone with wave action, and in Zones A and AE, which are riverine or coastal 1-percent-annual-chance floodplains. The loss information for the county is only for coastal SFHAs; the rest of the county's SFHAs are identified as Zones AE or A. *Information from the military base was not included in the assessment for the City of Bremerton. **No building data was available from Kitsap County for the Port Gamble S'Klallam Indian Reservation, so the results are listed as unknown.</p>						

Table 41: Special Flood Hazard Area Assessment

Flooding is the most common hazard occurring in Kitsap County, affecting its entirety. The City of Bainbridge has the largest number of buildings in the Special Flood Hazard Area (1% annual chance flood zone, also known as a 100-year flood zone) and has the highest loss ratio, which compares the losses due to flooding to the overall building value within the community. However, not all buildings within the floodplain experience damage because of flooding level and current floodplain regulations.<sup>69</sup> Figure 32 shows the Flood Hazard Areas of Kitsap County.

Kitsap County Public Works is currently updating the Stormwater Comprehensive Plan to identify areas that may require additional flood mitigation or water quality improvements. The update is planned to be completed in 2020 with areas of emphasis including climate change, coastal flooding, and severe storm impacts.

In 2015, FEMA created new Flood Insurance Rate Maps (FIRMSs) for Kitsap County, which included updated flood modeling for the coastline for Bainbridge, Bremerton, Port Orchard, Poulsbo, Port Gamble S'Klallam Tribe, Suquamish Tribe, and the unincorporated areas of Kitsap County. In addition to new FIRMSs, flood risk assessment products were developed and used in this risk report. Depth grids for the 1% annual chance flood were created for the coastal areas and show the level of flooding in feet for each pixel. Depth grids were used in this risk assessment to determine which properties would be affected by flooding. The figure on the next page shows the 1% annual chance depth grid for the Bremerton area.

In addition to the depth grid, a Base Flood Elevation (BFE)+ grid the following figures show the locations where flooding is 1, 2, and 3 feet above the elevation of the 1-percent-annual-chance flood (BFE). This grid can be used to represent flood events greater than the 1% annual chance flood, including potential sea-level rise. The BFE+ grid can be used to identify areas affected by increased storm surge, storms greater than the 1% annual chance event, and areas potentially

<sup>69</sup> FEMA Risk Report for Kitsap County (2015)

affected by sea-level rise. This dataset can be used for future land use and comprehensive planning.



Figure 33: 1% Annual Chance Depth Grid (in feet) for the City of Bremerton Area

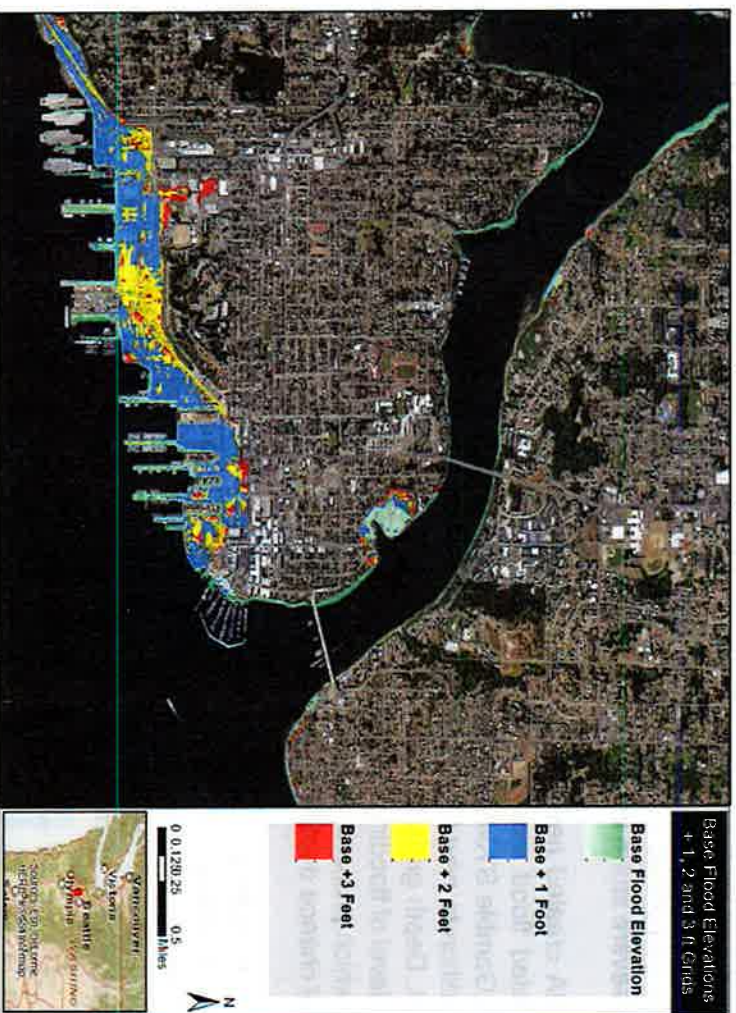


Figure 34: BFE Plus 1-, 2-, and 3-Foot Grids for the City of Bremerton Area



## Effects

The types of floods in Washington State are primarily river and creeks, surface water, flash, and tidal. Floods may result in loss of life as well as damage to residences, business establishments, public buildings, roads and bridges, utilities, agricultural land, fish and shellfish habitats, stream banks, and flood control structures.

## History

Kitsap County issued disaster or emergency declarations for flooding in 1990, 1994, 1995, 1996, 1997, 1999, 2003, 2006, and 2007. Historically, flooding occurs to some extent in Kitsap County every year, especially in floodplain zones of streams. In 2007, significant rainfall following a snow event caused creeks to turn into rivers and high tides to create flooding along Kitsap's shoreline. The event resulted in a Presidential Declaration with damages to over 400 residences and \$1 million in public infrastructure damage. Hood Canal and Puget Sound beaches are often affected by flood tides compounded by heavy rainfall and high tides.<sup>70</sup>

The information in the following figures highlights communities that are already affected by flooding, including those with repetitive loss properties and flood claims, and summarizes characteristics at the community level. Data were obtained from FEMA and the U.S. Census and were current as of 2015.

---

<sup>70</sup> Kitsap County HIVA (2015)

**Legend**

**FEMA Flood Zone Designation**

**High Risk - Coastal Areas**

Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 38% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

**High Risk Area Zones**

**A**

Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.

**AE**

The base flood elevations where base flood elevations are provided. AE Zones are now used as new formal FIRMs instead of A1-A30 Zones.

**Designated Urban Growth Areas**

**Unincorporated Urban Growth Area**

**Incorporated City**

**Limited Areas of More Intense Rural Development**

**TYPE**

**Type I**

Limited Area of More Intense Rural Development - Type I  
RCW 36 70A 070(5)(a)(i)  
Mixed-use areas or small communities intensively developed by 1990, where limited rural development is appropriate.

**Type III**

Limited Area of More Intense Rural Development - Type III  
RCW 36 70A 070(5)(a)(ii)  
Lots containing isolated non-residential uses of new development of limited cottage in-lots and isolated small businesses.

**Reservation Boundaries**

**Tax Parcels**

**Street Center Lines**

**State Highway**

**Major Road**

**Collector / Arterial**

**Local Access; Local Road**

**Watercourses (defined in WAC 222-16-030)**

**(S) Designated Shoreline of the State**

**(F) Fish Habitat**

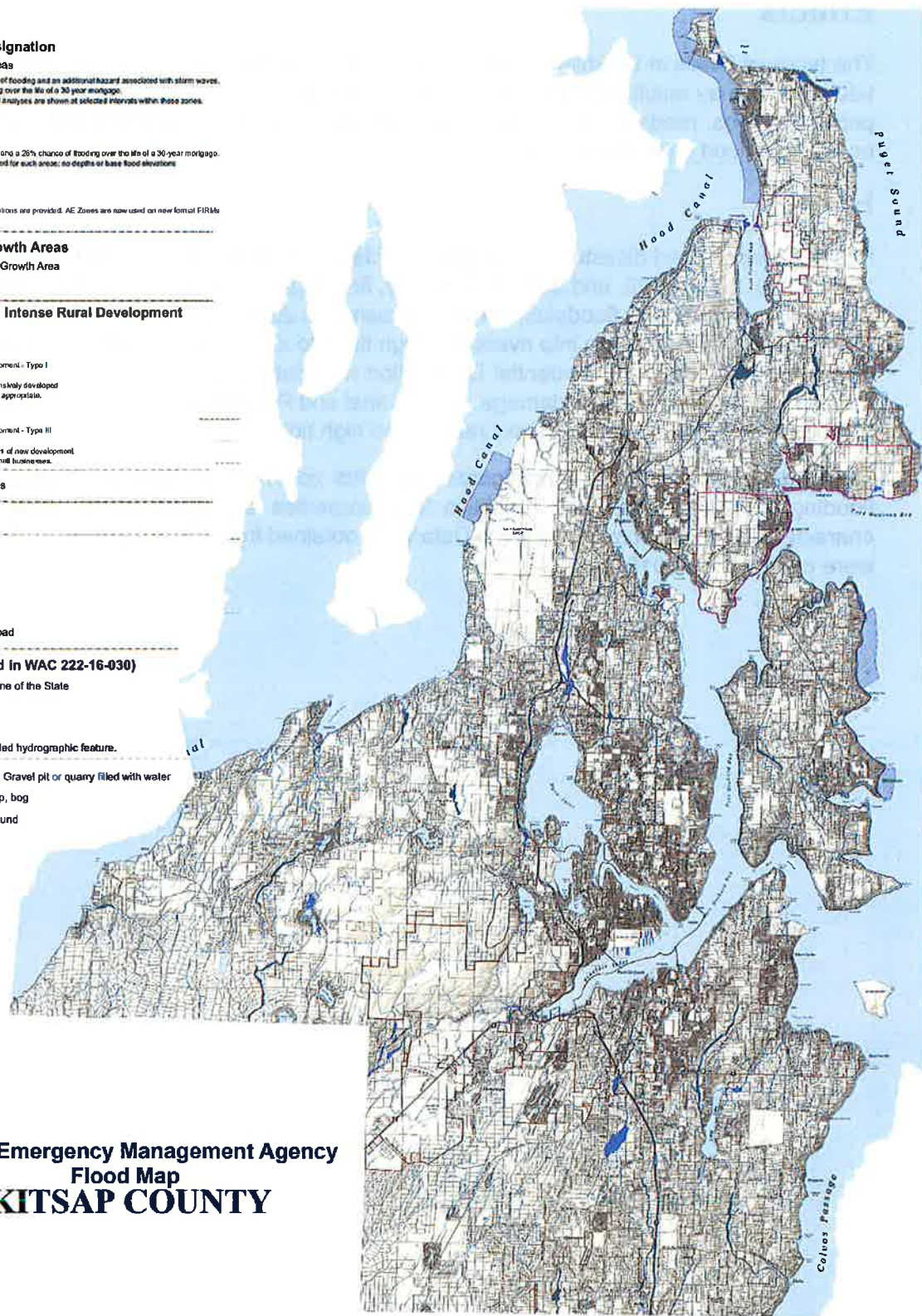
**(N) Non-fish Habitat**

**(U) Unknown, unmodeled hydrographic feature.**

**Lake, Pond, Reservoir, Gravel pit or quarry filled with water**

**Marsh, wetland, swamp, bog**

**Bay, estuary, Puget Sound**



**Federal Emergency Management Agency  
Flood Map  
KITSAP COUNTY**

Figure 35: FEMA Flood Zone Designation

**Legend**

**Watercourse**

**Fish Habitat Water Type Code**

- (S) Designated Shoreline of the State
- (F) Fish Habitat
- (N) Non-Fish Habitat
- (U) Unknown, unmodeled hydrographic feature.

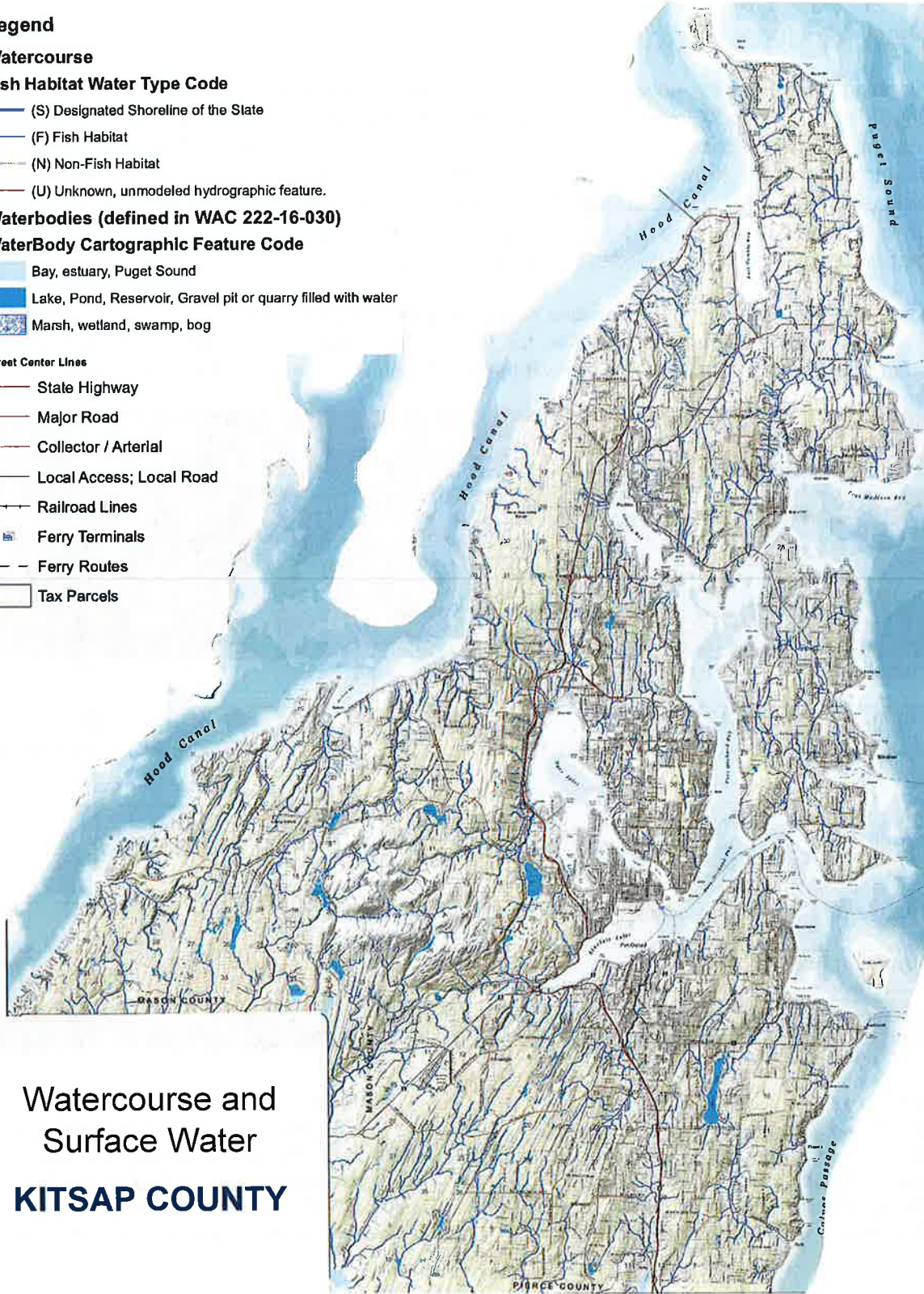
**Waterbodies (defined in WAC 222-16-030)**

**WaterBody Cartographic Feature Code**

- Bay, estuary, Puget Sound
- Lake, Pond, Reservoir, Gravel pit or quarry filled with water
- Marsh, wetland, swamp, bog

**Street Center Lines**

- State Highway
- Major Road
- Collector / Arterial
- Local Access; Local Road
- Railroad Lines
- Ferry Terminals
- Ferry Routes
- Tax Parcels



**Watercourse and  
Surface Water  
KITSAP COUNTY**

Figure 36: Watercourse and Surface Water

## Probability of Future Events

Flooding will continue to occur in Kitsap County. Heavy rains are projected to intensify, increasing flood risk to all Puget Sound watersheds. The potential for major floods exists in any year and may occur at any time during the flood season. In snow accumulating watersheds, winter floods will increase as the snow line recedes. Summer flows will reduce, and the corresponding flooding will become less likely as Cascade drainages change from rain-snow systems to rain-dominant ones. It is unusual for a flood to occur without warning due to the sequential pattern of meteorological conditions needed to cause severe flooding.

The table below highlights the building value and percentage of buildings within the Special Flood Hazard Area by community. Losses for the mapped coastal floodplains are highlighted by community, and a count of buildings within the 1% annual chance floodplain is included.

Special Flood Hazard Area Assessments <sup>71</sup>						
Community	Total Estimated Building Value	Percentage of Buildings in the Special Flood Hazard Area	Building Dollar Loss for a 1% Annual Chance Flood Event	Loss Ratio (Dollar Losses/Total Building Value)	Number of Buildings in Zones AE, A	Number of Buildings in Zone VE
<b>Bainbridge</b>	\$2.6 billion	1.5%	\$3.6 million	1.4%	136	8
<b>Bremerton*</b>	\$1.7 billion	<1%	\$404,000	<1%	21	0
<b>Port Gamble S'Klallam Tribe**</b>	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
<b>Suquamish Tribe</b>	\$474 million	<1%	\$175,000	<1%	3	0
<b>Port Orchard</b>	\$966 million	<1%	\$579,000	<1%	24	0
<b>Poulsbo</b>	\$865 million	<1%	\$3.4 million	<1%	7	0
<b>Unincorporated County</b>	\$9.7 billion	<1%	\$5.2 million	<1%	164	175
<b>Total</b>	\$16.3 billion	<1%	\$13.4 million	<1%	355	183

Table 42: Special Flood Hazard Area Assessments

Note: Loss information is included for communities in the coastal floodplain. The table includes both dollar losses and a loss ratio, which is calculated as total losses/total building value. Also included is a count of the buildings in Zone VE, which is the 1% annual chance coastal flood zone with wave action, and in Zones A and AE, which are riverine or coastal 1-percent-annual-chance floodplains. The loss information for the county is only for coastal SFHAs; the rest of the county's SFHAs are identified as Zones AE, or A. \*Information from the military base was not included in the assessment for the City of Bremerton. \*\*No

<sup>71</sup> FEMA Risk Report for Kitsap County (2015)

building data was available from Kitsap County for the Port Gamble S'Klallam Indian Reservation, so the results are listed as unknown.

## National Flood Insurance Program (NFIP)

Kitsap County and its four cities participate in the National Flood Insurance Program (NFIP). Each community entered into the Program at various times. Below is a brief history of Kitsap County's participation in the NFIP.

Community Flooding Characteristics <sup>72</sup>						
Community	Total Population	CRS Community	Flood Claims	Repetitive Loss Properties	Total Policies	Total Insurance Coverage
Bainbridge	23,025	N	6	1	234	\$64 million
Bremerton	37,729	N	5	0	52	\$15 million
Port Gamble S'Klallam Tribe	851	N	0	0	0	\$0
Suquamish Tribe	7,434	N	0	0	0	\$0
Port Orchard	11,144	N	0	0	25	\$6.8 million
Poulsbo	9,200	N	0	0	49	\$8.7 million
Unincorporated County	170,035	N	58	1	566	\$155 million
<b>Total</b>	<b>259,418</b>	<b>0</b>	<b>69</b>	<b>2</b>	<b>926</b>	<b>\$318 million</b>

Table 43: Community Flooding Characteristics

### Kitsap County

In 1978 unincorporated Kitsap County entered the National Flood Insurance Program (NFIP). The most recent review of Kitsap County's participation in the NFIP was conducted in February 2010. The review called a Community Assistance Visit (CAV) found that the discrepancies identified in the previous CAV (2002) had resulted in amendments to Kitsap County Code Title 15 (Flood Ordinance). These amendments resulted in improved processes for development in flood-prone zones, enhanced GIS map layering to identify flood hazard areas and permit tracking processes for flood hazard area development. The Kitsap County Board of Commissioners approved these amendments in KCC Title 15; the most recent amendment approval process was February 2010. The following map and table show the NFIP FIRM Panels and jurisdiction information from the FEMA Flood Insurance Study on Kitsap County from 2017.

<sup>72</sup> FEMA Risk Report for Kitsap County (2015)

# NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

KITSAP COUNTY, WASHINGTON AND INCORPORATED AREAS

PANELS PRINTED:

0025, 0050, 0075, 0085, 0094, 0095, 0100, 0105, 0110, 0115, 0120, 0140, 0150, 0170, 0185, 0190, 0195, 0205, 0206, 0207, 0208, 0209, 0212, 0214, 0215, 0216, 0218, 0220, 0230, 0235, 0240, 0243, 0244, 0246, 0255, 0263, 0265, 0300, 0310, 0325, 0330, 0335, 0340, 0343, 0344, 0351, 0352, 0353, 0384, 0380, 0384, 0385, 0386, 0387, 0388, 0389, 0379, 0380, 0381, 0382, 0383, 0384, 0389, 0390, 0395, 0396, 0405, 0415, 0450, 0455, 0467, 0460, 0470, 0477, 0480, 0485, 0490, 0495, 0505



MAP NUMBER  
53035CND0C  
MAP REVISED  
FEBRUARY 3, 2017

<b>OTHER AREAS OF FLOOD HAZARD</b>	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard - Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Zone X Protected by Accredited Levee: Areas protected by an accredited levee, dike or other flood control structures. See Notes to Users for important information.
<b>OTHER AREAS</b>	
	Zone D (Area of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
	Unshaded Zone X: Areas determined to be outside the 0.2% annual chance floodplain.
<b>FLOOD HAZARD AND OTHER BOUNDARY LINES</b>	
	Flood Zone Boundary (gray line)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet.
<b>GENERAL STRUCTURES</b>	
	Channel, Culvert, Aqueduct, or Storm Sewer
	Dem, Jetty, Weir
	Levee, Dike or Floodwall accredited or provisionally accredited to provide protection from the 1% annual chance flood.
	Levee, Dike or Floodwall not accredited to provide protection from the 1% annual chance flood.
	Bridge

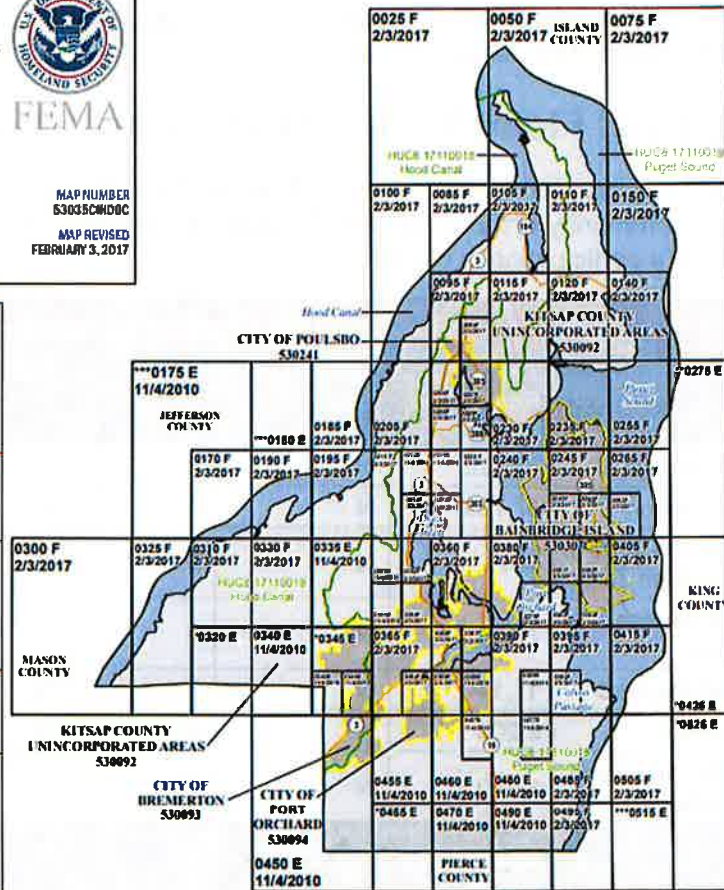


Figure 37: NFIP FIRMS Panel Map

Community	CID	HUC-8 Basin(s)	Sub-	Located on FIRM Panel
City of Bainbridge Island	530307	17110019		53035C0230F, 53035C0235F, 53035C0240F, 53035C0243F, 53035C0244F, 53035C0245F, 53035C0263F, 53035C0265F, 53035C0379F, 53035C0380F, 53035C0381F, 53035C0382F, 53035C0383F, 53035C0384F, 53035C0405F
City of Bremerton	530093	17110018, 17110019		53035C0335E, 53035C0343E, 53035C0344E, 53035C0345E*, 53035C0352F, 53035C0353E, 53035C0354F, 53035C0360F, 53035C0364F, 53035C0365F, 53035C0366F, 53035C0367F, 53035C0368F, 53035C0380F, 53035C0390F, 53035C0450E, 53035C0455E
City of Port Orchard	530094	17110019		53035C0364F, 53035C0365F, 53035C0366F, 53035C0367F, 53035C0368F, 53035C0369E, 53035C0390F, 53035C0455E, 53035C0457E, 53035C0460E
City of Poulsbo	530241	17110019		53035C0094F, 53035C0095F, 53035C0115F, 53035C0206F, 53035C0207F, 53035C0209F, 53035C0230F
Kitsap County Unincorporated Areas	530092	17110019		53035C0025F, 53035C0050F, 53035C0075F, 53035C0085F, 53035C0094F, 53035C0095F, 53035C0100F, 53035C0105F, 53035C0110F,

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel		
			53035C0115F,	53035C0120F,	53035C0140F,
			53035C0150F,	53035C0170F,	53035C0185F,
			53035C0190F,	53035C0195F,	53035C0205F,
			53035C0206F,	53035C0207F,	53035C0208F,
			53035C0209F,	53035C0212E,	53035C0214F,
			53035C0215F,	53035C0216E,	53035C0218F,
			53035C0220F,	53035C0230F,	53035C0235F,
			53035C0240F,	53035C0244F,	53035C0245F,
			53035C0255F,	53035C0263F,	53035C0265F,
			53035C0275E*,	53035C0300F,	53035C0310F,
			53035C0320E*,	53035C0325F,	53035C0330F,
			53035C0335E,	53035C0340E,	53035C0343E,
			53035C0344E,	53035C0345E*,	53035C0351E,
			53035C0352F,	53035C0353E,	53035C0354F,
			53035C0360F,	53035C0364F,	53035C0365F,
			53035C0366F,	53035C0367F,	53035C0368F,
			53035C0369E,	53035C0379F,	53035C0380F,
			53035C0381F,	53035C0382F,	53035C0383F,
			53035C0384F,	53035C0389E,	53035C0390F,
			53035C0393F,	53035C0395F,	53035C0405F,
			53035C0415F,	53035C0450E,	53035C0455E,
			53035C0457E,	53035C0460E,	53035C0465E*,
			53035C0470E,	53035C0477E,	53035C0480E,
			53035C0485F,	53035C0490E,	53035C0495F,
			53035C0505F		

Table 44: Community FIRM Information

### City of Bainbridge Island

The City of Winslow entered the Emergency Program on August 14, 1975, then converted to the National Flood Insurance Program (NFIP) effective February 5, 1986. The Island was incorporated in 1991 and became the City of Bainbridge Island with an NFIP Effective Date of March 1, 1991. The most recent review of the city's participation in the NFIP was conducted in 2004. During this Community Assistance Visit (CAV) the summarized findings from the CAV included the need for an amendment to the City's flood chapter 15.16, preparation of procedures to implement Chapter 15.16, and additional information on eleven specific cases that were cited in their fieldwork. As of February 2005, all these items were cleared, and our CAV was closed.

In 2019, the City updated the Flood Damage Protection Ordinance (FDPO) to update the requirements for FEMA compliance related to the NFIP. The City has also been involved with a Community Assistance Visit (CAV) process as FEMA has audited for compliance measures of the City's Flood Ordinance as adopted. The City continues to enforce regulations related to our FDPO and compliance with the National Flood Insurance Program (NFIP) related to the potential for flooding events.

### City of Bremerton

The City of Bremerton entered the National Flood Insurance Program on May 27, 1975. The most recent review of the city's participation in the NFIP was conducted on July 23, 2008. During the visit, the City issued 2 permits that were properly conditioned for the flood elevation certificates; however, the final Elevation Certificate was inadvertently missed. The corrective action taken by

the city was to modify the permitting system computer software to more definitively request flood zone information at the time of initial application for a building permit and at construction inspection stages including prior to framing and prior to the release of final inspection certification.

Like most communities in Kitsap County, after the last major flood, 2007, we reviewed our flooding issues and once again determined we have no repetitive loss areas in the City of Bremerton. The City of Bremerton has amended its processes as recently as August 2007 resulting in a successful CAV in July 2008.

Bremerton Municipal Code Chapter 17.60 Floodplain Management was updated under Ordinance #5231 to maintain compliance with the NFIP on December 7, 2013.

### ***City of Port Orchard***

The City of Port Orchard entered the National Flood Insurance Program in 1978. The most recent review of the city's participation in the NFIP was conducted in 2005. During this Community Assistance Visit (CAV) the summarized findings from the CAV included the need for an amendment to the City's flood chapter 15.38, preparation of procedures to implement Chapter 15.38, and additional information on three specific cases that were cited in their fieldwork.

On September 16, 2005, the Floodplain Management Specialist responded to the City's transmittal of information by approving Ordinance No. 016-05 bringing the city into full compliance with Federal and State floodplain management requirements.

The City provided the Floodplain Management Specialist with additional information on the 3 specific cases cited during their visit which cleared all of the findings and closed the CAV for Port Orchard. Their conclusion was that the City is effectively regulating development in the City's flood hazard areas and they would notify FEMA of this certification.

The most recent review of the city's participation in the NFIP was completed in 2013. The City adopted amendments to its Flood Damage Prevention Standards Chapter of the Port Orchard Municipal Code at that time. This code has since been moved into the new title 20 of the Port Orchard municipal code. On September 16, 2013, the city received written confirmation that its code was compliant with 44 CRF 60.3 and 86.16 RCW.

### ***City of Poulsbo***

The City of Poulsbo entered into the National Flood Insurance Program in 1979. The most recent review of the city's participation in the NFIP was conducted in 2017. During this update, Community Assistance Visit (CAV) found no deficiencies related to city code.

### ***NFIP Updates***

In recent years, NFIP Flood Insurance Rates Maps (FIRM) have been revised. Some zones changed to reflect better data and evaluation regarding coastlines and their related issues, such as the effects of wakes and tides. Changes are not significant. However, the changes have increased the need for some homeowners to file for flood insurance in the NFIP.

### ***Community Rating System***

The Community Rating System (CRS) is a voluntary program for National Flood Insurance Program communities with the intent to reduce flood damages to insurable property,



strengthen and support the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management. It provides an incentive for premium discounts for communities that go beyond the minimum and impose extra measures to provide protection from flooding.

Flood Risk Community Characteristics <sup>73</sup>						
Community	Total Population	CRS Community	Flood Claims	Repetitive Loss Properties	Total Policies	Total Insurance Coverage
Bainbridge Island	23,025	No	6	1	234	\$64 Million
Bremerton*	37,729	No	5	0	52	\$15 Million
Port Gamble S'Klallam Tribe**	851	No	0	0	0	\$0
Suquamish Tribe	7,434	No	0	0	0	\$0
Port Orchard	11,144	No	0	0	25	\$6.8 Million
Poulsbo	9,200	No	0	0	49	\$8.7 Million
Unincorporated County	170,035	No	58	1	566	\$155 Million
<b>Total</b>	<b>259,418</b>	<b>0</b>	<b>69</b>	<b>2</b>	<b>926</b>	<b>\$318 Million</b>

Note: The community overview summarizes characteristics at the community level. Data were obtained from FEMA and the U.S. Census and were current as of November 23, 2015

Table 45: Flood Risk Community Characteristics

Kitsap County is currently not eligible and has not met the full compliance with the NFIP. In 2007, Kitsap County compared the cost to implement CRS versus the savings to citizens which proved insignificant. The County does not have significant flood-prone areas that would benefit from this program.

## Climate Change Impacts

Climate change is increasing the extent, and the frequency of flooding, and this trend will continue. Regional warming has been linked to changes in the amount of water available in basins from seasonal snowmelt and streams. The response to change will depend on precipitation in the watersheds and other geographical changes to the landscape. In the future and as early as 2050, snowmelts are expected to be as much as four weeks earlier in the season resulting in lower summer flows. River-related issues, including flood risk, may increase in certain areas but decrease in others.

Consequently, these changes will affect reservoir systems, flood control, and the preservation of habitats. It will also affect irrigation, industrial use, and hydropower production. There will be an

<sup>73</sup> FEMA Risk Report Kitsap County 2015

effect on freshwater species, like salmon, steelhead, and trout. Adaptive measures will depend on strengthening water resource infrastructure, technology, and water consumption efforts.<sup>74</sup>

In the coastal zone, the effects of sea-level rise, erosion, inundation, threats to infrastructure and habitat, and increasing ocean acidity collectively pose a significant threat to the region. With diverse landforms (e.g., beaches, rocky shorelines, estuaries), the Northwest coast may experience a wide range of climate impacts. Global sea levels have risen about 8 inches since 1880 and are projected to rise another 1-4 feet by 2100. Much of the Pacific Northwest coastline is rising due to tectonic uplift, which raises the land surface. A major earthquake along the Cascadia subduction zone would immediately reverse centuries of uplift and potentially increase relative sea level 40 inches or more. Increased ocean acidity can affect marine species and consequently affect commercial harvests. Increasing coastal water temperatures and changing ecological conditions may alter the ranges, types, and abundances of marine species. Many people use the coasts for a variety of reasons as well as live there where future erosion, inundation, and flooding could adversely affect human habitats.

Kitsap County has approximately 170 miles of coastline that could potentially be affected by ocean temperature changes and changing sea levels. Kitsap County is surrounded by sensitive sea conditions that can affect water species, water quality, and the fishing industry. Any increase in sea levels will also affect coastal towns and beaches.

## Vulnerability Summary

- Flood vulnerability and effect on Kitsap is considered “**moderate**” meaning there is moderate potential for a disaster of less than major proportions during the next 25 years. The risk rating is driven by infrastructure and individual residence damage. Life safety and the economy would also be impacted, and effects will be dependent on associated hazards like landslides, hazardous materials events, and dam issues.
- More than any other natural hazard, flooding represents the single biggest repetitive event that has a damaging impact on Kitsap County property and resources. Looking back over twenty years, Kitsap County has flooded (Presidentially declared disaster) at least five times with no major river causing the flooding. Kitsap County is vulnerable to urban stream flooding and localized flooding due to drainage system overload during, especially large or intense storm events. This will continue to occur until more effective flood mitigation strategies can be developed and implemented for urbanized areas that are subject to inundation by floodwater. Engineering and mitigation will have a measure of success, but it is expected that flooding will always occur during extreme storm events.
- In urban areas, flooding is primarily a product of development and its impact on watersheds and rural areas. Kitsap County has numerous large creeks and lakes and can experience significant daily rainfall during the winter, which is influenced by Puget Sound convergence zones. The Kingston area may be most susceptible to convergence zone weather.

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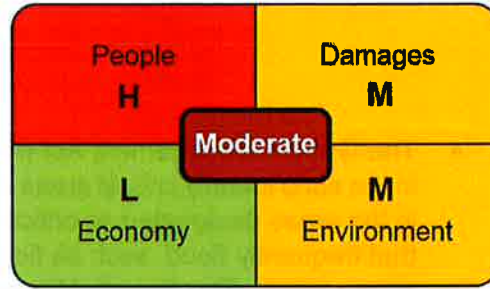
<sup>74</sup> A Summary of the Climate Change Impacts in the United States (2014)

- The Growth Management Act (RCW 36.07A) requires that all cities, towns, and counties in the state identify critical areas and establish regulations to protect and limit development in the areas designated as critical areas. Critical areas, as defined by state law, are areas that frequently flood, such as floodplains, as well as areas subject to high tides driven by strong winds. The Growth Management Act is a fundamental tool in mitigation planning. Floodplain mitigation planning and management are coordinated by local, State, and Federal agencies. RCW 86.12, Flood Control by Counties, provides counties with the power to take flood control action by levying taxes, condemning property, and undertaking flood control activities directed toward a public purpose located within their jurisdiction.
- RCW 82.26, State Participation in Flood Control Maintenance, which establishes the Flood Control Assistance Account Program, provides state funding for local flood hazard management planning and implementation efforts. RCW 86.16, Floodplain Management, states that the prevention of flood damage is a matter of statewide public concern. Statewide building codes and regulations applied to structures during construction also aid in mitigation. FEMA Flood Maps provide additional avenues for information to residents, while the NFIP provides homeowners and renters the ability to purchase insurance coverage for flood damage. In 2011, FEMA initiated a coastal flood study to determine the effects on Kitsap's coastline from earthquake activity, tides, flooding, and potential sudden tsunamis and seiches. The study was completed in 2015 information is included and cited throughout this document.

## Conclusions

Mitigation involves flood plain planning and management coordinated by local, state, and federal agencies. Building codes and regulations applied to structures aid in mitigation. Residents should have access to information on flood insurance. Where building has already occurred on flood plains, emergency preparedness in the form of sandbags, building materials, three-day evacuation kits, and alternate shelter should be part of each resident's preparation for possible flooding.

# Wildfires & Urban Fires



## Overview

Wildfires and urban fires are unplanned fires that burn in a natural area such as a forest, grassland, or prairie, or in an urban setting such as a town or city. They can be caused by humans, lightning, machinery, and utilities. Fires can disrupt transportation, gas, power, and communications, and the risk increases during periods of little rain and high winds.

## Location



Figure 38: Federal Fire Occurrence Map 1980-2016 (USGS)

Most recent fires in Kitsap County were human-caused and extinguished before major damage occurred.

Forest fires may result in the loss of timber resources, wildlife habitats, watersheds, and recreational areas, as well as increased vulnerability to flooding and landslides. It would take a significant fire to cause severe effects on Kitsap County, but an urban fire affecting an economic corridor could also be detrimental.

With much of the county in various stages of forestation, nearly all areas are vulnerable to fire. Human-caused fires in both urban and wild environments can happen during all times of the year. More prevalent use of synthetic building and furniture materials can also significantly accelerate fires once ignited.

## Effects

Many individual homes and developments border forestland. Drought conditions often increase the fire danger in early fall. Urban forest fires can be caused by a number of different scenarios, but are most likely to be started by campfires, along highways from sparking sources or careless drivers, or electrical fires from high wind events.

Most recent fires in Kitsap

In Kitsap County, approximately \$4.2 million worth of general building stock lies in areas with moderate or higher wildfire exposure.<sup>75</sup>

## Extent

Historically, wildland fire burns approximately 23,000 acres of State-owned or protected land annually. The cost of wildland fire on these lands is more than \$28 million annually in firefighting and damage to timber, habitat, property, soil mobilization, landslides, and flooding. Between 1960 and 2017, the state experienced 170 wildfire incidents.<sup>76</sup>

## History

It is difficult to trace the fire history of this area back more than 350 years. However, old-growth trees and fire scars suggest fires about 450, 480, 540, and 670 years ago. Fire is a normal part of most forest and range ecosystems, so fires historically burned on a fairly regular cycle. The latest forest fires to occur took place in Kitsap and Mason Counties in 2013. These fires were contained but required the response of State Fire Mobilization to help in this effort. As of 2019, there have been no more recent forest/urban fires that have required State Fire Mobilization.

The burning cycle in western Washington appears to have occurred about every 100-150 years. Logging of old-growth trees, old trees felled by major windstorms, and more recent fires in the area have erased or compromised evidence of historic forest fires in Kitsap County, making it difficult to determine if the historic burning cycle remains true today. However, recorded information indicates Kitsap County has had an active history of fire. As communities expand farther into forested lands, and there is a desire to maintain the wilderness ambiance, urban interface fires are becoming a significant hazard. Urban interface fires create the potential for loss of life and destruction of property.

## Probability of Future Events

Wildfires and urban interface fires are possible and will occur in Kitsap County. Sources of ignition include lightning, arson, recreational activities, debris burning by individuals or logging companies, and carelessness with fireworks. Human negligence causes about 84% of forest fires,<sup>77</sup> such as failing to extinguish smoking materials or campfires properly.

Washington State's fire season usually runs from July through October,<sup>78</sup> although large fires can occur during the winter. The probability of an interface fire in any one locality on a particular day depends on any of the following activities and events: fuel conditions, topography, time of year, past and present weather conditions, construction, and human activities (e.g., debris burning, land clearing, camping). Any prolonged period of lack of precipitation presents a potentially dangerous impact. Prolonged periods of strong winds can also create dry conditions.

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<sup>75</sup> Washington State Enhanced Hazard Mitigation Plan (2018)

<sup>76</sup> Washington State Enhanced Hazard Mitigation Plan (2018)

<sup>77</sup> Human-started wildfires expand the fire niche across the United States (2017)  
<https://www.pnas.org/content/114/11/2946>

<sup>78</sup> Washington State Enhanced Hazard Mitigation Plan (2018)

Population by Jurisdiction Affected by Fire in Kitsap County (2012) <sup>79</sup>			
Jurisdiction	Total Population	Population in Hazard Area	% Population Affected by Hazard
Unincorporated Kitsap County	164,595	164,595	100
Bainbridge Island	22,010	22,010	100
Bremerton	37,729	37,729	100
Port Orchard	11,144	11,144	100
Poulsbo	9,200	9,200	100
Port Madison Suquamish Reservation	5600	5600	100
Port Gamble S'Klallam Reservation	1200	1200	100
<b>Totals</b>	<b>258,278</b>	<b>258,278</b>	<b>100%</b>

Table 46: Population by Jurisdiction Affected by Fire in Kitsap County (2012)

Building Stock and Critical Facilities by Jurisdiction Affected by Fire <sup>80</sup>						
Jurisdiction	Total Building Stock	Building Stock in Hazard Area	% Building Stock in Hazard Area Jurisdiction	Total Critical Facilities	Total Critical Facilities in Hazard Area	% Critical Facilities in Hazard Area Jurisdiction
Unincorporated Kitsap County	87,985	87,985	100	249	249	100
Bainbridge Island	12,639	12,639	100	83	83	100
Bremerton	13,683	13,683	100	64	64	100
Port Orchard	6,708	6,708	100	39	39	100
Poulsbo	3,516	3,516	100	66	66	100
Port Madison Suquamish Reservation	4,579	4,579	100	7	7	100
Port Gamble S'Klallam Reservation	270	270	100	5	5	100
<b>Totals (Kitsap)</b>	<b>129,380</b>	<b>129,380</b>	<b>100%</b>	<b>513</b>	<b>513</b>	<b>100%</b>

Table 47: Building Stock and Critical Facilities by Jurisdiction Affected by Fire

## Climate Change Impacts

Climate change, coupled with the current high fuel and vegetation status of the forest, suggests that high-intensity fires will continue to degrade the landscape. Winters are becoming shorter and

<sup>79</sup> Kitsap County GIS figures 2012

<sup>80</sup> Kitsap County GIS figures 2012

wetter with less snow, while summers are becoming drier and more protracted. This process is resulting in the generation of flash fuels (highly combustible fine fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, which ignite readily and are consumed rapidly when dry<sup>81</sup>), and uncharacteristically denser forests and are stressing normal regenerative processes and increasing wildfire risk.

The ecosystem in Kitsap County thrives from its rainfall each year. Kitsap County water supply is based on large aquifers that are replenished each year with rain. Rain fills many creeks and rivers in Kitsap. Less rain and drier conditions may produce an increase in forest fires and potentially residential communities as well. The combined impacts of increasing wildfire, insect outbreaks, and tree diseases are already causing widespread tree die-off and long-term transformation of forest landscapes. More effort in managing forested areas including ground thinning of potential fuel sources will help to mitigate forest fires, as well as reducing the thinning of forest canopies and surfaces.

## Vulnerability Summary

- Forest and urban fire vulnerability and effect on Kitsap are considered "**moderate**," meaning there is moderate potential for a disaster of less than major proportions during the next 25 years.
- Kitsap County's forests will remain vulnerable to forest and wildland fires. The probability of forest and wildland fires will continually change depending on variables such as drought effects, lightning strikes, careless campers, etc.
- The existence of large forested areas, increasing population and recreational activities, and the uncertain impact of a changing climate combine to suggest a moderate probability of occurrence. The destruction of large tracts of forest land would have an immediate economic impact to the community through lost jobs, reduced taxes, and increased public support while collateral economic and social effects could impact the county for years, suggesting moderate vulnerability.

## Conclusions

The following steps should be accomplished to preclude major loss of life and reduce the actual number of fires and hazard areas:

- Since the vast majority of forest and wildland fires are started by humans, fire prevention education and enforcement programs can significantly reduce the total number of forest fires.
- Urban wildfires can be extremely hazardous if not contained, causing loss of life and property. Increasing public education on wildland fires and improving agency response will help to minimize the spread of fires.

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<sup>81</sup> National Wildfire Coordinating Group <https://www.nwccg.gov/term/glossary/flash-fuels>

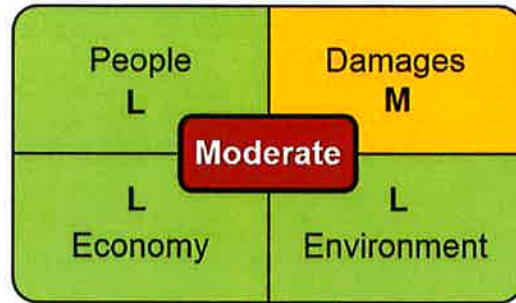
- An effective early fire detection program and emergency communications system are essential. The importance of immediately reporting any forest fire must be impressed upon local residents and people utilizing the forest areas.
- An effective warning system is essential to notify local inhabitants and visitors in the area of the fire. An evacuation plan detailing primary and alternative escape routes is also essential.
- Fire-safe development planning by County and City government planners is essential.
- Encourage citizens to incorporate defensible space planning when landscaping their property.
- Road criteria should ensure adequate escape routes for new sections of development in forest areas with both ingress and egress planned.
- Road closures should be increased during peak fire periods to reduce access to fire-prone areas.



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# Landslides & Erosion

## Overview



The term landslide refers to the down-slope movement of masses of rock and soil. Slides range in size from thin masses of earth a few yards wide to deep-seated bedrock slides. The form of initial failure commonly categorizes them, but they may travel in a variety of ways along their paths. This travel rate may range in velocity from a few inches per month to many feet per second, depending largely on the slope, material, and water content. The recognition of ancient, dormant slide masses is essential, as they can be reactivated by earthquakes or unusually wet winters. Also, because they consist of broken materials and disrupted groundwater, they are more susceptible to construction-triggered sliding than adjacent undisturbed material.

Erosion refers to the gradual removal of soil through wind or water action. Erosion may be induced or increased by failure to use ground covers to protect soil from wind or drainage systems that allow effective dispersal of stormwater. Slopes on waterfronts can also be severely undercut by regular wave action or large waves produced by storms. The following factors contribute to landslides and earth movements:

- Erosion caused by rivers, glaciers, or ocean/sound waves.
- Earthquakes shaking the ground and creating stress in vulnerable soils.
- Increased loads from man-made structures like roads and the weight of rain/snow and/or vegetation.
- Hydrologic issues caused by high water tables, freezing, and thawing of ground or weak soils.
- Development of land, grading of roads, and the removal of vegetation
- Increases in lateral pressures like tree roots, crystallizations weakening slopes.

## Location/Extent

Kitsap County is subject to landslides and soil erosion due to wind, water, and flooding at all times of the year. Landslides can cause deaths, significant damage to properties and infrastructure, and in some cases, losses of the use of land for many years due to the extensive cost of restoration. Earthquakes also have the potential to trigger landslides. The 2001 Nisqually earthquake caused approximately \$34.3 million in damage due to earthquake-induced landslides throughout the region. Landslide occurrences in Kitsap County have been concentrated along its coastal bluffs as well as within river valleys near the coastline.

Over 1,000 buildings are located in the defined landslide zone, which have a total estimated value of approximately \$211 million. The majority of these buildings are located in unincorporated areas; these 766 buildings have an estimated value of \$137 million and comprise nearly 72 percent of all buildings that are susceptible to landslides in the county. These buildings are concentrated in the northeastern part of the county along Puget Sound, in the southwestern section of the county along Hood Canal, and in the southeastern portion of the county along Colvos Passage. Bainbridge Island also contains a significant number of buildings that are exposed to the effects

of landslides, and Port Orchard contains 66 buildings near the Sinclair Inlet that are in the landslide zone<sup>82</sup>.

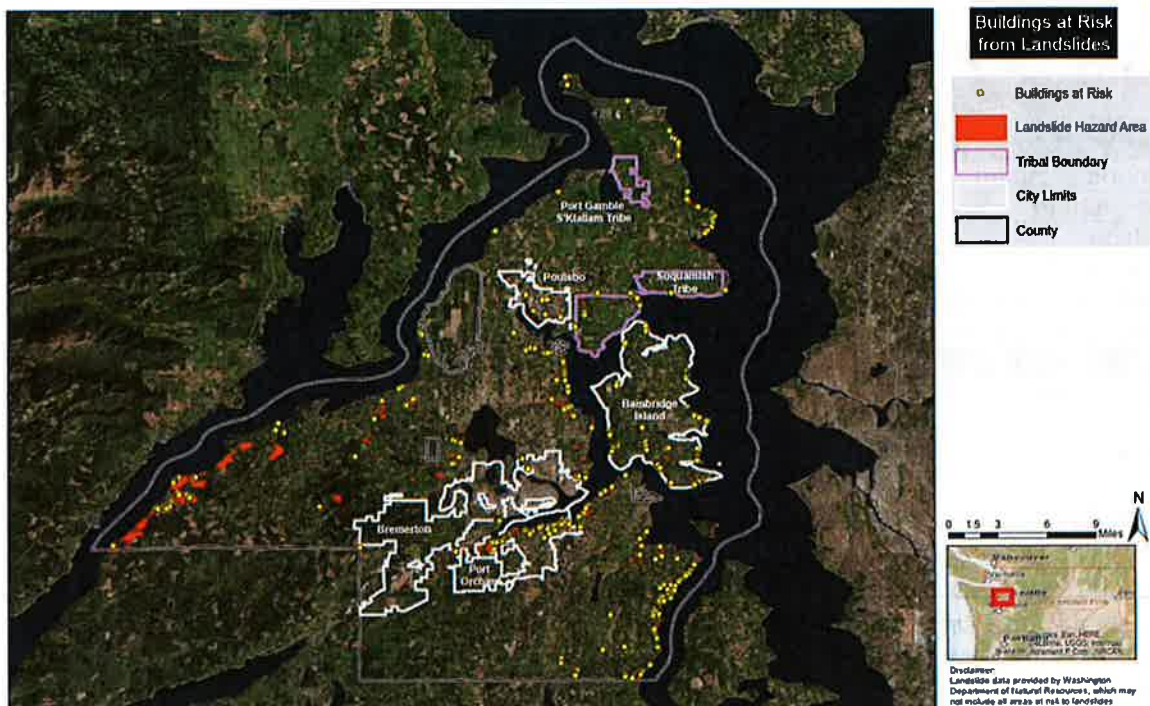


Figure 39: Shallow Landslide Susceptibility Zones and Building Impacts

## Effects

Landslides typically and primarily cause damage to roads, railroads, sewer, and water lines, homes, and commercial buildings. They can occur as a result of flooding areas or can cause localized flooding if they impact the drainage system within the slope or bluff. The most significant effects of landslides are injury or death, disruption of transportation, and the destruction of property.

Severe slides may affect shipping and travel routes to the extent that economic loss results. This loss can be particularly severe for tourism and recreational businesses. Uncontrolled water flow creates an erosion effect, which in turn can cause landslides. Erosion can also result in gullies, which ruins land and deltas by covering the more valuable ground.

The effects of erosion are usually much less dramatic than landslides, but the final results may be more costly. Soil erosion can be a slow process that continues relatively unnoticed or can occur at an alarming rate, causing severe loss of topsoil. Soil compaction, low organic matter, loss of soil structure, poor internal drainage, salinization, and soil acidity problems are other serious soil degradation conditions that can accelerate the soil erosion process.

<sup>82</sup> FEMA Risk Report of Kitsap County 2015

Kitsap County continues to be impacted by landslides and erosion issues with each new winter storm. Soil erosion continues to occur, especially at steep slopes and construction sites during wind and rainstorms.

Building Exposure to Landslides <sup>83</sup>		
Community	Buildings within Landslide Zone	Building Value with Landslide Zone
Bainbridge Island	177	\$55 Million
Port Orchard	66	\$8.1 Million
Poulsbo	40	\$9.8 Million
Squamish Tribe	21	\$1.9 Million
Port Gamble S'Klallam Tribe	Unknown	Unknown
Unincorporated County	766	\$137 Million
<b>Total</b>	<b>1070</b>	<b>\$243.8 Million</b>

Table 48: Building Exposure to Landslides

## History

Several landslides have impacted Kitsap County over the last 20 years. Landslides can cause deaths, significant damage to properties, and in some cases, losses of the use of land for many years due to the extensive cost to restoration. The deadly landslide on Bainbridge Island is probably the one single event that demonstrates the unpredictability and destructiveness of a landslide. In the winter of 1996, a landslide in the Rolling Bay area of Bainbridge Island forced a house off its foundation and down a hill into Puget Sound.<sup>84</sup> It caused the death of a family of four and destroyed millions of dollars in both public and private property. The tragedy of Oso Landslide of 2014 was a slide that left 43 people dead, many injured, devastating the town of Oso, the Stillaguamish River, and surrounding infrastructure.<sup>85</sup>

Kitsap County LIDAR Defined Landslides (2012) <sup>86</sup>			
Jurisdiction	Number of Landslides	% of Total Landslides	Affected Area per Jurisdiction in Sq. Mi.
Unincorporated Kitsap County	137	76.5	24.5
Bainbridge Island	27	15	4.8
Bremerton	6	3.4	1.1
Port Orchard	3	1.7	0.54
Poulsbo	0	0	0
Port Madison Suquamish Reservation	4	2.2	0.7
Port Gamble S'Klallam Reservation	2	1.1	0.35
<b>Totals</b>	<b>179</b>	<b>100%</b>	<b>32</b>

Table 49: Kitsap County LIDAR Defined Landslides (2012)

<sup>83</sup> FEMA Risk Report Kitsap County 2015

<sup>84</sup> <https://www.bainbridgewa.gov/767/Hazard-and-Risk-Info>

<sup>85</sup> <https://www.usgs.gov/news/revisiting-oso-landslide>

<sup>86</sup> Kitsap County GIS figures 2012

## Probability of Future Events

Washington is one of the most landslide-prone states in the country and annually experiences hundreds to thousands of events across the state. It is difficult to predict precisely when and where a landslide will occur. There are, however, seasonal predictions in locations commonly affected by heavy rains near shorelines. In some cases, the amount of precipitation that falls over a particular period of time can predict the vulnerability of a slope. The severity of any landslide is the loss of life and the destruction of property. LIDAR technology, ongoing studies, and managing land use helps improve mitigation practices. Although the County no longer has the LIDAR program, the studies during its implementation created comprehensive maps and valuable hazard information.

Landslide events often occur within the boundaries of pre-existing deep-seated landslide deposits. In a 2008 study using LIDAR, a total of 231 landslides were identified, all of which were assigned a confidence interval of high or moderate to indicate how confident the USGS was that the event occurred. According to this study, landslides represented 0.8% of the land area of Kitsap County. Landslide events in Kitsap County were concentrated in the coastal areas on Puget Sound, Port Orchard Channel, Hood Canal, and Colvos Passage. The largest cluster of landslide deposits appeared near Holly and Hoods Point along Hood Canal, as well as near Kingston in the northeastern part of Kitsap County along Puget Sound.<sup>87</sup>

City	Buildings within Landslide Zone	Building Value with Landslide Zone
Bainbridge Island	177	\$55 million
Port Orchard	66	\$8.1million
Poulsbo	40	\$9.8 million
Unincorporated County	766	\$137 million
Suquamish Tribe	21	\$1.9 million
<b>Total</b>	<b>1070</b>	<b>\$211 million</b>

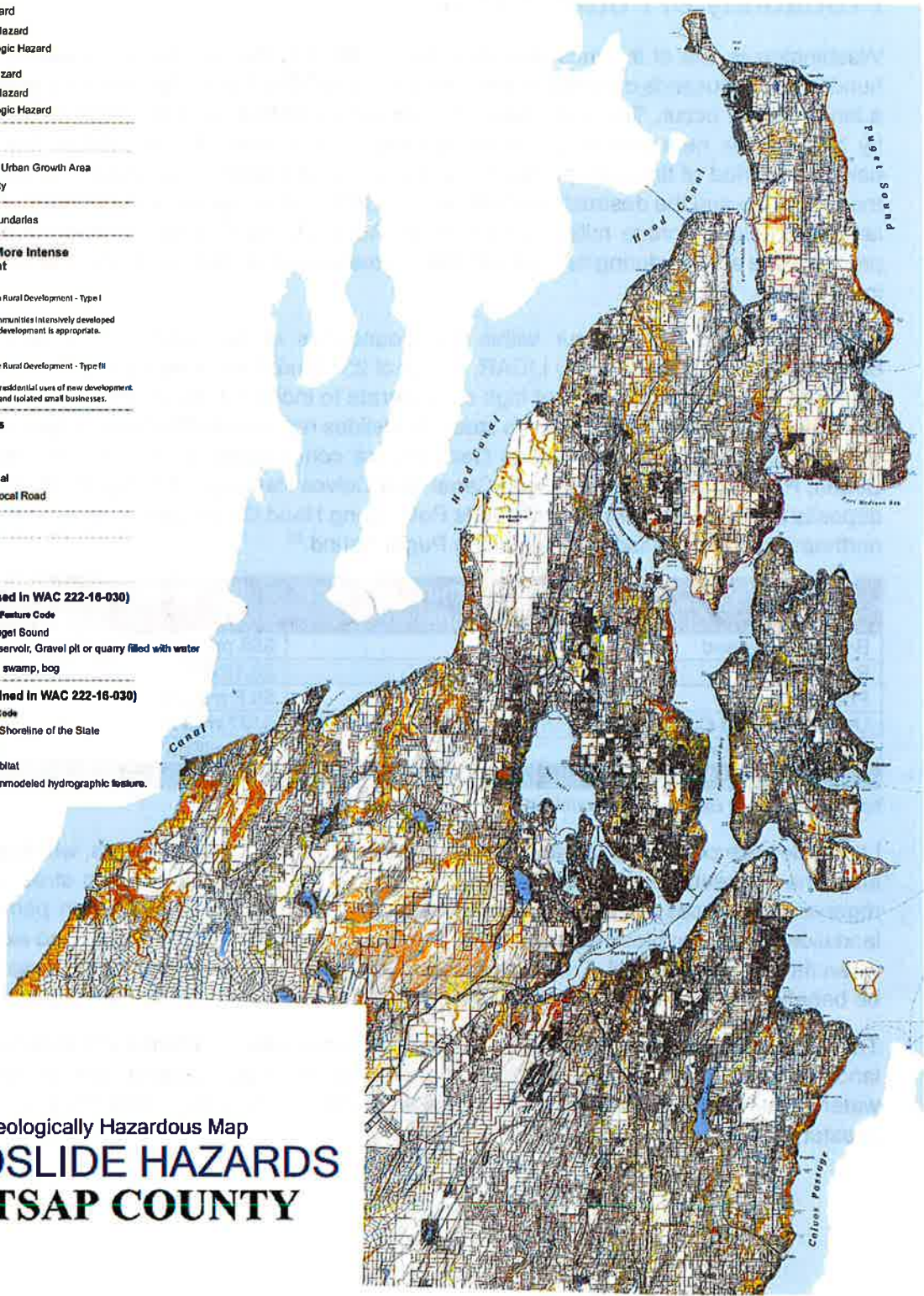
Table 50: Building Exposure to Landslides

Landslides are common in areas with steeper slopes and wet environments, which are also often locations of greater ecological diversity. Landslides mobilize soil and often stress rehabilitative regeneration processes within upland denuded areas. This soil loss is often permanent. Also, landslide debris can block watercourses, damming flows resulting in flooding and extreme surges when these blockages fail. These impacts often result in long-term changes. These changes can be beneficial to fluvial habitats while, as a result of soil losses, detrimental to upland ones.

The Landslide Hazard map on the following page shows detailed information on deep and shallow landslides, as well as limited areas of more intense rural development, waterbodies, and watercourses of Kitsap County. Figure 21 is an Erosion Hazard map moderate to severe land and coastal erosion

<sup>87</sup> FEMA Risk Report for Kitsap County (2015)

- Landslide Hazard**
- Deep Landslide Hazard**
- High Geologic Hazard
  - Moderate Geologic Hazard
- Shallow Landslide Hazard**
- High Geologic Hazard
  - Moderate Geologic Hazard
- 
- Tax Parcels
  - Unincorporated Urban Growth Area
  - Incorporated City
- 
- Reservation Boundaries
- 
- Limited Areas of More Intense Rural Development**
- Type I  
 Limited Area of More Intense Rural Development - Type I  
 RCW 36.70A.070(5)(d)(i)  
 Mixed use areas or small communities intensively developed by 1990, where limited infill development is appropriate.
  - Type III  
 Limited Area of More Intense Rural Development - Type III  
 RCW 36.70A.070(5)(d)(ii)  
 Lots containing isolated non residential uses of new development of isolated cottage industries and isolated small businesses.
- 
- Street Center Lines**
- State Highway
  - Major Road
  - Collector / Arterial
  - Local Access; Local Road
- 
- Railroad Lines**
- Railroad Lines
- 
- Ferry Terminals**
- Ferry Terminals
  - Ferry Routes
- 
- Waterbodies (defined in WAC 222-16-030)**
- Waterbody Cartographic Feature Code**
- Bay, estuary, Puget Sound
  - Lake, Pond, Reservoir, Gravel pit or quarry filled with water
  - Marsh, wetland, swamp, bog
- 
- Watercourses (defined in WAC 222-16-030)**
- Fish Habitat Water Type Code**
- (S) Designated Shoreline of the State
  - (F) Fish Habitat
  - (N) Non-fish Habitat
  - (U) Unknown, unmodeled hydrographic feature.



Geologically Hazardous Map  
**LANDSLIDE HAZARDS**  
**KITSAP COUNTY**

Figure 40: Landslide Hazard Map

**Legend**

**Erosion Hazard**

- Very severe
- Severe
- Moderate

**Channel Migration Zone**

- High Geologic Hazards
- Big Beef Creek, Chico Creek, Curley Creek and Tahuya

**Coastal Erosion**

- High
- Moderate
- Low

**Tax Parcels**

- Unincorporated Urban Growth Area
- Incorporated City

**Reservation Boundaries**

**Limited Areas of More Intense Rural Development**

- Type I  
Unincorporated Area of More Intense Rural Development - Type I  
 RCW 36.70A.070(5)(b)  
 Mixed use areas or small communities intensely developed by 1990, where limited in-fill development is appropriate.
- Type III  
Unincorporated Area of More Intense Rural Development - Type III  
 RCW 36.70A.070(5)(c)  
 Lots containing isolated non-residential uses of new development of isolated cottage industries and isolated small business.

**Street Center Lines**

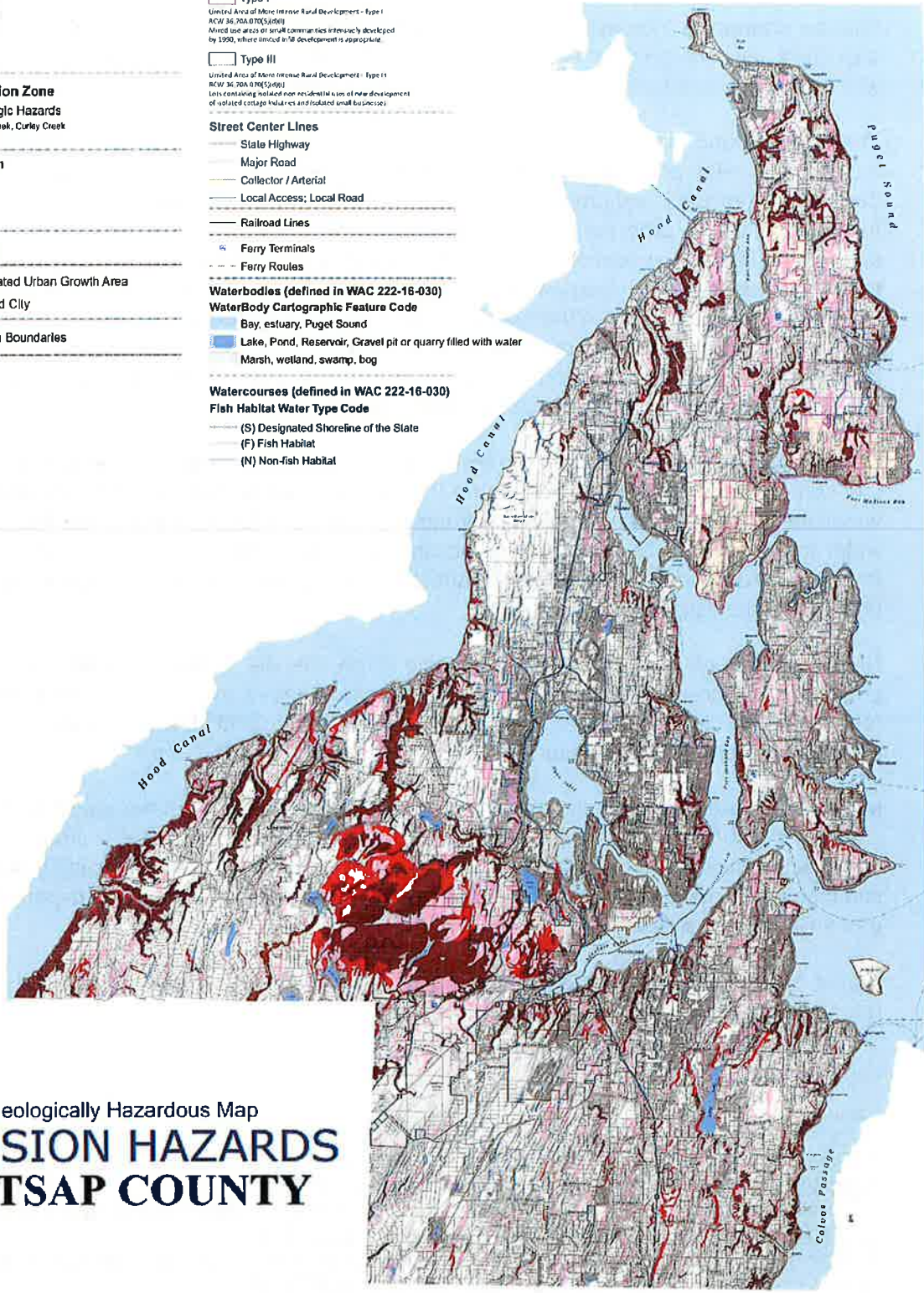
- State Highway
- Major Road
- Collector / Arterial
- Local Access; Local Road
- Railroad Lines
- Ferry Terminals
- Ferry Routes

**Waterbodies (defined in WAC 222-16-030)**

- WaterBody Cartographic Feature Code**
- Bay, estuary, Puget Sound
  - Lake, Pond, Reservoir, Gravel pit or quarry filled with water
  - Marsh, wetland, swamp, bog

**Watercourses (defined in WAC 222-16-030)**

- Fish Habitat Water Type Code**
- (S) Designated Shoreline of the State
  - (F) Fish Habitat
  - (N) Non-fish Habitat



Geologically Hazardous Map  
**EROSION HAZARDS**  
**KITSAP COUNTY**

Figure 41: Erosion Hazard Map

## Climate Change Impacts

Climate change is increasing landslides and sediment transport through changes in rainfall, snowpack, and streamflow. Climate change is also increasing the probability of wildland fires, which, in turn, contribute to increases in the likelihood of landslides.

The Puget Sound region is expected to experience increases in the frequency of landslides and the rate of erosion and sediment transport in winter and spring, primarily as a result of continued declines in snowpack and projected increases in the frequency and intensity of heavy rain events. In summer, these processes are expected to become less important in the future, due to diminishing streamflow and drier soils. Both natural climate variability and human modification to the landscape have a strong effect on landslide and sediment processes and will continue to influence these processes in the future. While a lack of direct observations makes it challenging to make robust projections, communities in the Puget Sound region are preparing for changing landslide and sediment risk through targeted regulations, climate-informed design, and floodplain infrastructure aimed at mitigating anticipated impacts.<sup>88</sup>

Observations show a clear warming trend, and all scenarios project continued warming during this century. Most scenarios project that this warming will be outside of the range of historical variations by mid-century. Increasing air temperatures can facilitate soil breakdown, allow more water to penetrate soils, reduce snow accumulation, and increase the risk of wildfire and other threats to forest health, all of which can affect the rates of erosion and sediment transport and the likelihood of landslides.<sup>89</sup>

Heavy rain events are projected to become more intense. Current research is consistent in projecting an increase in the frequency and intensity of heavy rain events.<sup>9</sup> These changes could result in greater erosion, higher sediment transport in rivers and streams, and a higher likelihood of landslides, primarily as a result of higher soil water content.<sup>90</sup>

Most models are consistent in projecting a substantial decline in summer precipitation. Projected changes in other seasons and for annual precipitation are not consistent among models, and trends are generally much smaller than natural year-to-year variability. Declining precipitation in summer could result in decreased erosion, a reduced rate of sediment transport, and a lower probability of landslides.<sup>91</sup>

Higher seas could limit the transport of sediment from rivers to Puget Sound and increase the rate of erosion in some coastal areas.

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<sup>88</sup> Climate Impacts Group, Collect of the Environment, University of Washington [https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok\\_sec05\\_sediment\\_2015.pdf](https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok_sec05_sediment_2015.pdf)

<sup>89</sup> Climate Impacts Group, Collect of the Environment, University of Washington [https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok\\_sec05\\_sediment\\_2015.pdf](https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok_sec05_sediment_2015.pdf)

<sup>90</sup> Climate Impacts Group, Collect of the Environment, University of Washington [https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok\\_sec05\\_sediment\\_2015.pdf](https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok_sec05_sediment_2015.pdf)

<sup>91</sup> Climate Impacts Group, Collect of the Environment, University of Washington [https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok\\_sec05\\_sediment\\_2015.pdf](https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok_sec05_sediment_2015.pdf)



Although climate is a major driver of erosion, sediment transport, and landslide hazards, there are other factors that can have an important effect on these processes. In particular, changes in land use and land cover – both due to development and forest management – can dramatically affect the likelihood of a landslide, the exposure of sediments to erosion, and the rate of streamflow and sediment transport.<sup>92</sup>

## Vulnerability Summary

- Landslide/erosion vulnerability and effect on Kitsap is considered **"moderate,"** meaning there is moderate potential for a disaster of less than major proportions during the next 25 years.
- The State of Washington rates landslide losses second to flood losses for the state as a whole. The Puget Sound basin has the greatest vulnerability because of increased population density and development on and below bluffs and slopes. The county has several landslide hazard areas ranging from low to very high hazard rating. Areas with the largest landslide risk are generally at some distance from development, although an event would likely impact roads and lifelines.
- More than 50% of the county critical infrastructure facilities are located in areas exposed to landslides. (This does not include indirect impacts that may be caused by damaged road segments.) There are residential areas that could be affected by these slide areas, as well as roads and other utility infrastructure.
- The most significant effects of landslides are injury or death, disruption of transportation, and the destruction of property.
- Kitsap County continues to be impacted by landslides and erosion issues with each new winter storm. Soil erosion continues to occur, especially at steep slopes and construction sites during wind and rainstorms.
- Landslides mobilize soil and often stress rehabilitative regeneration processes within denuded areas. This soil loss is often permanent. Also, landslide debris can block watercourses, damming flows resulting in flooding and extreme surges when these blockages fail. These impacts often result in long-term changes. These changes can be beneficial to fluvial habitats while, as a result of soil losses, detrimental to upland ones.
- In conjunction with the Growth Management Act (RCW 36.70A), Kitsap County and its local jurisdictions have identified slide hazard areas and require geotechnical investigation and preventative improvements before development can take place on top of or below slopes subject to sliding through the various Critical Areas Ordinances passed within each city.
- Despite the difficulty in predicting landslides, recent research conduct by USGS in Kitsap County has been instrumental in mapping landslide areas. Using LIDAR provides essential information about Kitsap County landmass and geological history.

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<sup>92</sup> Climate Impacts Group, Collect of the Environment, University of Washington [https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok\\_sec05\\_sediment\\_2015.pdf](https://cig.uw.edu/wp-content/uploads/sites/2/2014/11/ps-sok_sec05_sediment_2015.pdf)

## Conclusions

The most significant effects of landslides are injury or death, disruption of transportation, and the destruction of property. Future studies and effective land use management will help to mitigate landslide-prone areas and minimize the effect on the public and infrastructure.

Kitsap County has identified slide hazard areas and required geotechnical investigation and preventative improvements before development can take place on top of or below slopes subject to sliding through the:

- Kitsap County Critical Areas Ordinance, December 2017<sup>93</sup>
- City of Bainbridge Island Critical Area Ordinance, January 2019<sup>94</sup>
- City of Poulsbo Chapter 16.20 Critical Area Ordinances, July 2007<sup>95</sup>
- Port Orchard Critical Ordinance, December 2009<sup>96</sup>
- *Port Orchard Municipal Code, June 11, 2019*
- City of Bremerton Critical Lands Ordinance, June 2016<sup>97</sup>

However, the County needs to conduct more public education concerning the construction of single-family structures in slide hazard areas and to reduce efforts to develop these areas. Human-caused erosion at building sites must be controlled through good engineering and construction practices, i.e., the removal of trees from slopes in or near residential areas. Farming must conform to established erosion control practices to conserve topsoil.

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<sup>93</sup> <https://www.codepublishing.com/WA/KitsapCounty/#!/Kitsap19/Kitsap19100.html#19.100>

<sup>94</sup>

<https://www.codepublishing.com/WA/Bainbridgelsland/#!/Bainbridgelsland16/Bainbridgelsland1620.html#16.20>

<sup>95</sup> <https://cityofpoulsbo.com/wp-content/uploads/2017/02/AdoptionDocumentallsections.pdf>

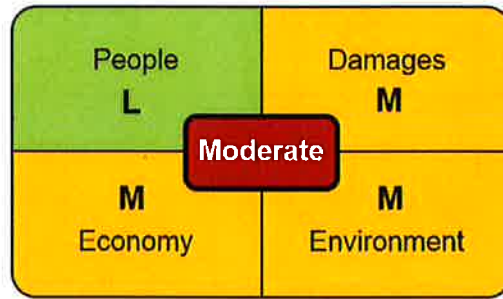
<sup>96</sup> <https://www.codepublishing.com/WA/PortOrchard/html/PortOrchard20/PortOrchard20162.html>

<sup>97</sup> <https://www.bremertonwa.gov/401/Critical-Area-Ordinance>

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# Severe Storms/ Tornadoes

## Overview



Although Kitsap County has a moderate marine climate, storm activity involving rain, wind, snow, and ice does affect the County. Severe weather can happen any time, with or without notice. Severe weather can include hazardous conditions produced by thunderstorms, including damaging winds, tornadoes, large hail, flooding and flash flooding, and winter storms associated with freezing rain, sleet, snow, and strong winds.

## Location

Severe weather can occur at any time or place in the county. Storms have caused significant damage to portions of Kitsap County. An EF-2 tornado occurred in December 2018, causing substantial damage in Port Orchard, including 250 homes. Lightning storms and hailstorms are less frequent but do occur.

## Effects

The general effects of most severe storms are immobility and loss of utilities. Transportation routes can become blocked, travelers and commuters can become stranded, and families can be separated. Additionally, when electrical lines are damaged, other utilities such as telephones (cell and landlines), natural gas, and water and sewer systems can become inoperable. Physical damage to homes and facilities can occur from winds or the accumulation of snow, ice, or hail. Even a small accumulation of snow can adversely affect transportation systems.

High winds have caused extensive damage throughout the county in past years. The main effects of local storms include disruption of electrical power, accidents and transportation problems, flooding and landslides, and damage to residences and other buildings. Schools may close for several days. Businesses may function at reduced capacity for a time as employees may have difficulty getting to work or are dealing with storm-related problems at home.

There are many private roads in the county, which individuals must maintain themselves or as a cooperative group. Some communities may have one road for ingress and egress. Citizens can become frustrated if private snow removal equipment is inoperable or if extensive damage occurs to private roads and bridges. These concerns were discussed in one of the public town halls.

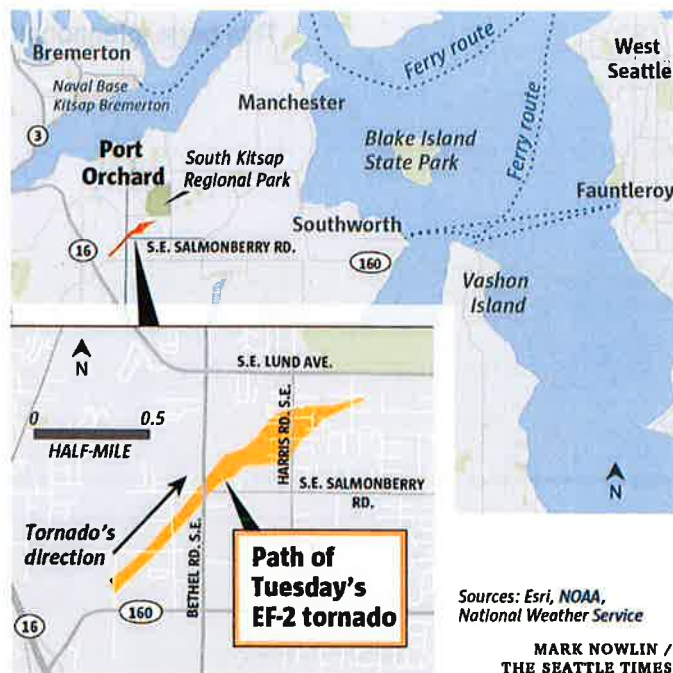


Figure 42: Port Orchard 2018 Tornado Path

Information on floods can be found in the Floods Mitigation Strategies section.

## Extent

Severe weather may strike during any time of the year and any time of the day. The extent depends on the type of event, duration, and severity. The 2018 Port Orchard EF-2 tornado was the strongest tornado to hit Washington State since 1986. The tornado had estimated wind speeds of 120-130 mph and was on the ground for approximately 1.4 miles. The path of the twister started at Geiger Road and ended at SE Kerri Court. It was approximately 250 to 300 yards wide.<sup>98</sup> Severe weather may strike during any time of the year and any time of the day. The extent depends on the type of event, duration, and severity. The table below describes the Fujita Intensity Scale for tornados.

Fujita Tornado Intensity Scale			
F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown, and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel-reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified

<sup>98</sup> National Oceanic and Atmospheric Administration National Weather Service Seattle (2018) <https://nwschat.weather.gov/p.php?pid=201812192212-KSEW-NOUS46-PNSSEW>

Fujita Tornado Intensity Scale			
F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
			as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

Table 51: Fujita Tornado Intensity Scale

Building Stock and Critical Facilities by Jurisdiction Affected by Severe Storms <sup>99</sup>						
Jurisdiction	Total Building Stock	Building Stock in Hazard Area	% Building Stock in Hazard Area Jurisdiction	Total Critical Facilities	Total Critical Facilities in Hazard Area	% Critical Facilities in Hazard Area Jurisdiction
Unincorporated Kitsap County	87,985	87,985	100	249	249	100
Bainbridge Island	12,639	12,639	100	83	83	100
Bremerton	13,683	13,683	100	64	64	100
Port Orchard	6,708	6,708	100	39	39	100
Poulsbo	3,516	3,516	100	66	66	100
Port Madison Suquamish Reservation	4,579	4,579	100	7	7	100
Port Gamble S'Klallam Reservation	270	270	100	5	5	100
<b>Totals (Kitsap)</b>	<b>129,380</b>	<b>129,380</b>	<b>100%</b>	<b>513</b>	<b>513</b>	<b>100%</b>

Table 52: Building Stock and Critical Facilities by Jurisdiction Affected by Severe Storms

## History

As stated above, the 2018 Port Orchard EF-2 tornado was the strongest tornado to hit Washington State since 1986. High winds and tornadoes have caused extensive damage through the county in past years. Another notable storm includes the "Columbus Day" storm of 1962, with hurricane-force winds.<sup>100</sup> Severe winds also occurred during the Inauguration Day storm of 1993.<sup>101</sup> Other storms that have severely impacted Kitsap County have occurred in 1986, 1985, 1980, 1979, 1973, and 1971. The most severe snowstorms that have occurred in Kitsap County were in 1996, 1990, 1985, 1971, 1969, 1961, 1951, 1950, and 1949. Historically, the most severe storms occur

<sup>99</sup> Kitsap County GIS figures 2012

<sup>100</sup> [https://products.kitsapsun.com/archive/2002/10-12/357425\\_the\\_big\\_blow\\_that\\_blew.html](https://products.kitsapsun.com/archive/2002/10-12/357425_the_big_blow_that_blew.html)

<sup>101</sup> [https://products.kitsapsun.com/archive/1993/01-21/279795\\_high\\_winds\\_claim\\_5\\_lives\\_in\\_was.html](https://products.kitsapsun.com/archive/1993/01-21/279795_high_winds_claim_5_lives_in_was.html)

during the autumn and winter months from October through February. On average, KCDEM will make preparations for three potentially dangerous storms each winter season.<sup>102</sup>

## Probability of Future Events

There is a high likelihood of numerous severe weather events annually in 100% of the county. However, many of these storms are likely to be small weather anomalies that may not develop into a large event. The frequency, duration, and intensity of extreme heat are expected to increase in Washington State. This will, in turn, increase other weather extremes including, severe/high winds, hail, lightning, tornadoes, and winter storms.

## Climate Change Impacts

Severe weather events are a part of the natural climatic cycle. As such, these events play an important role in the maintenance and sustenance of local biodiversity. However, climate change, by its very nature, and following the fundamental laws of thermodynamics and the conservation of energy, is adding energy to many systems.

One can think of this process as weather having a grand volume dial, a climate-directed rheostat in which climate change is turning up the energy volume, and all atmospheric systems are impacted. This added energy in the atmosphere can result in a cascading effect of stronger winds, increased severe weather, hailstorms, greater rain intensity, and accelerated flooding.

## Vulnerability Summary

- Severe storm vulnerability and effect on Kitsap is considered “**moderate**,” meaning there is moderate potential for a disaster of less than major proportions during the next 25 years.
- Kitsap County remains highly vulnerable to the effects of rain, snow, and windstorms. In Kitsap County, March 2014 saw the highest amount of rain in one month—with over 12 inches recorded—and December 2018 with the most powerful tornado to ever occur in Kitsap County.
- Severe storms are a fact of life in Kitsap County. Severe wind and rainstorms do not generally impact the region for long periods, but winter snow/ice storms have shut down schools and businesses for several days. Therefore, the most severe storm Kitsap County is likely to face will be a snow/ice storm. It is not unprecedented for a winter storm to leave a long-lasting mark on the community by inflicting substantial financial damage on the area. In 2019, severe winter weather lasted from February 3-12, with temperatures dipping to 25 degrees or below for six nights with copious snowfall. By the time the storm ended, Bremerton had received 20.7 inches of snow, with other areas reporting higher numbers.<sup>103</sup>

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<sup>102</sup> Kitsap County Hazard Identification Risk Assessment (2015)

<sup>103</sup> National Oceanic and Atmospheric Administration National Weather Service Seattle (2018)

- Based on historical data, the probable future severity for severe storms in the region is moderate. The probability is high, but the risk factor is reduced because of the moderate-to-low overall effect on the county.

## Conclusions

Mitigation efforts include effective warning through the media. Three-five-day preparedness kits help people weather the storm if they are without normal utilities and comforts. Well-packed kits could be easily transported if an evacuation was necessary/possible. For those residents living in elevations prone to snowstorms, a 14-day preparedness kit is highly recommended. Any kit should include prescription medications.

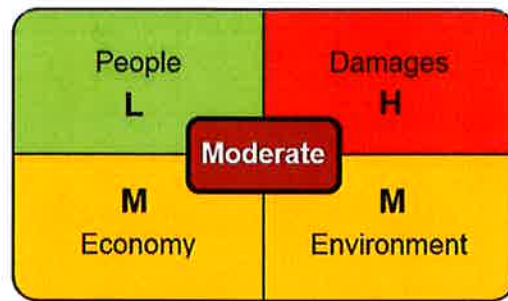
Annually, Kitsap County conducts pre-storm season preparations to include briefings with County Officials to include schools, first responders and utilities; conduct winter season public education programs; and prepare equipment and resources for these types of events. In the past few years, Kitsap County DEM has developed and implemented new programs for winter storm mitigation, including the County's Alert and Warning Program and Damage Assessment Program.

The Alert and Warning System provides hazard information, preparedness tips, and the ability to alert the public on impending hazardous events. The Damage Assessment Program, although used primarily for assessing private and public damage during an event, provides post-event analysis to use in future predictions of storm damage and potential mitigation efforts. The program contains over 700 identified critical facilities by type and response prioritization to better assess the damage in the county and coordinated response.



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# Tsunamis, High Waves, & Seiches



## Overview

A tsunami consists of a series of high-energy waves that radiate outward like ripples from the area in which the generating incident occurred. These waves can travel 500 miles per hour in the open ocean. As they approach the coast, their speed decreases, and their amplitude increases, potentially reaching heights of over 100 feet. All tsunamis are potentially dangerous, even though they may not damage every coastline they strike. Damaging tsunamis are very rare. Typically, they are triggered by earthquakes, volcanic activity, and submarine landslides or, in the case of Puget Sound, most often by local landslides from surrounding bluffs. Unlike regular ocean waves, which are generated by wind or tides, a tsunami is generated by the displacement of water.

Seiches are a series of standing waves in an enclosed or partially enclosed body of water. Seiches are normally caused by an earthquake and can affect harbors, bays, lakes, rivers, and canals. Seiches are created when strong winds and rapid changes in atmospheric pressure push water from one end of a body of water to the other. When the wind stops, the water rebounds to the other side of the enclosed area. The water then continues to oscillate back and forth for hours or even days. Similarly, earthquakes, tsunamis, or severe storm fronts may also cause seiches along ocean shelves and ocean harbors.

## Location

Kitsap County's coastlines are vulnerable, but tsunamis are infrequent. Areas at highest risk are generally 25 feet from sea level, and above to 25 feet, and within one mile of the shoreline. Most deaths are caused by drowning. Associated risks include flooding, contamination of drinking water, and fire from ruptured tanks and gas lines. Earthquakes or landslides can also cause inland tsunamis. Landmasses falling into the water can create a wave that would affect low-lying areas such as Dyes Inlet and Sinclair Inlet. Waves created by inland tsunamis can cause damage to ports, marinas and other structures or businesses on the waterfront. The figures on the following page show maximum inundation depths and potential inundation zones.

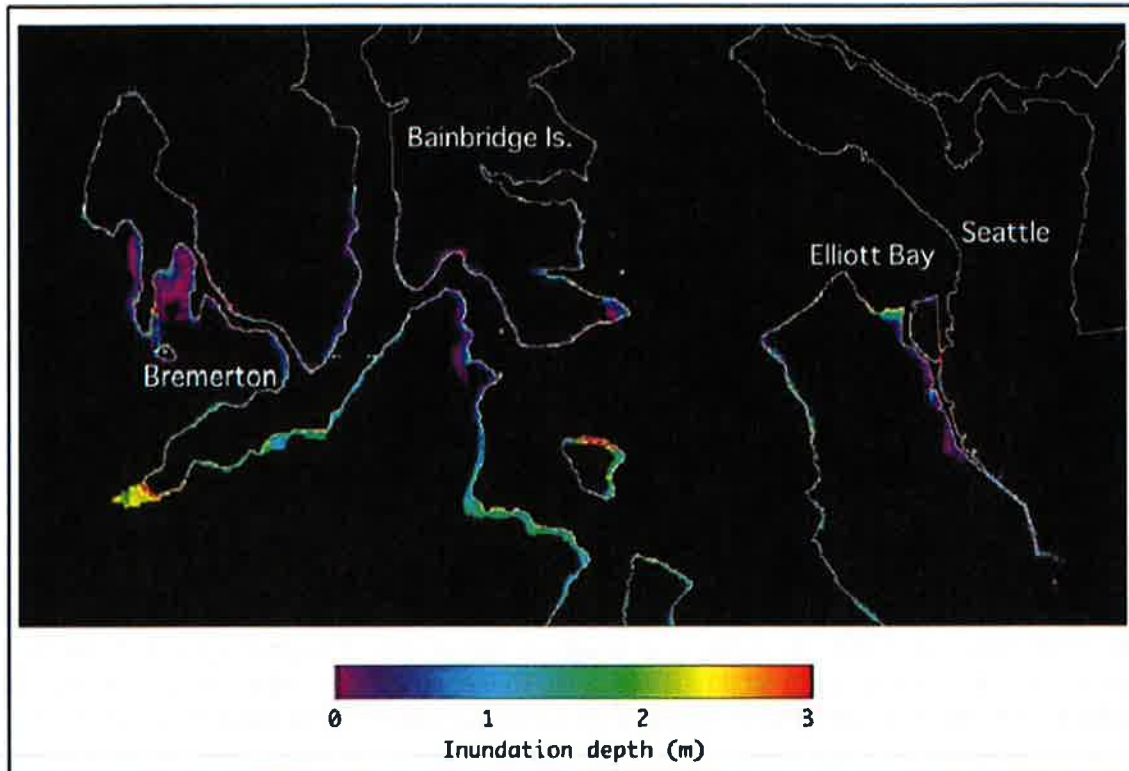


Figure 43: Maximum Inundation Depths for the Tsunami Generated by the Seattle Fault Scenario

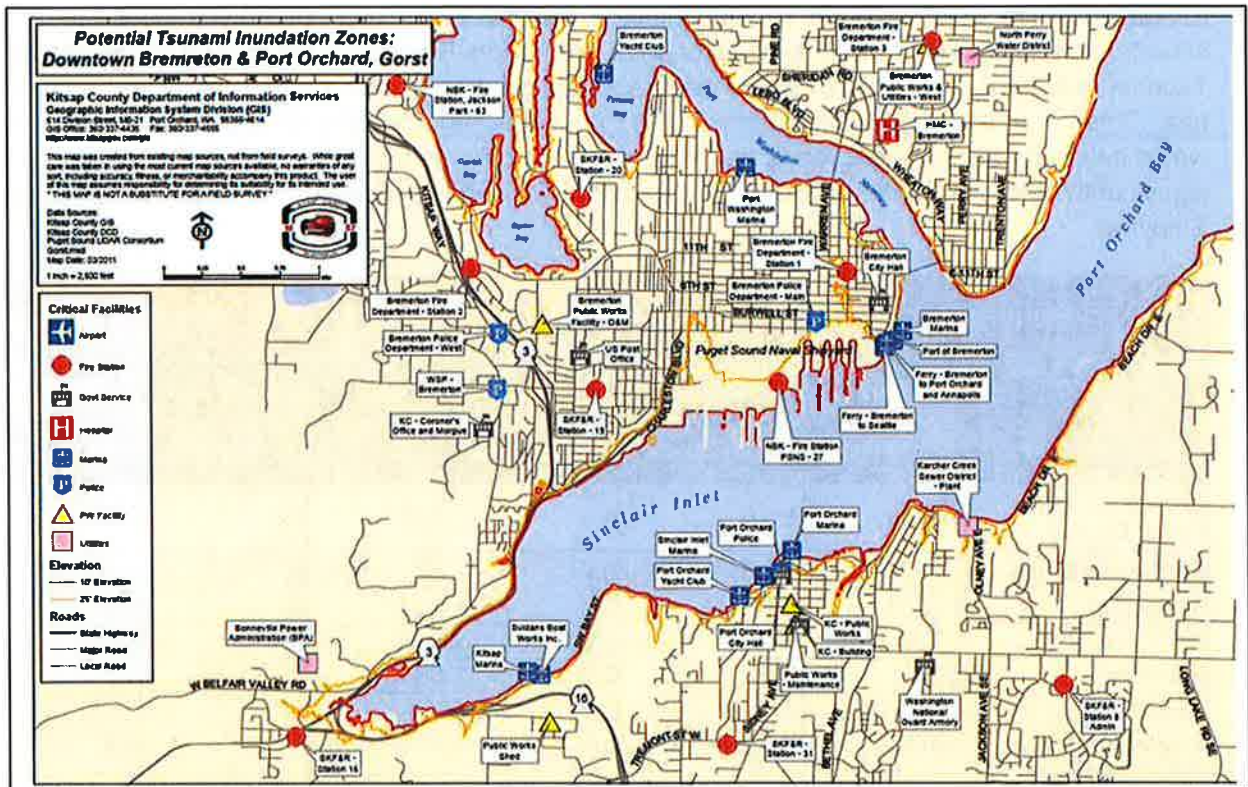


Figure 44: Potential Tsunami Inundation Zone showing the Cities of Bremerton and Port Orchard (Kitsap County GIS 2011)

Much of Kitsap County is surrounded by water, from the Puget Sound to the Hood Canal. With so much shoreline in the county, a tsunami, high waves, or a seiche would have a devastating effect on Kitsap County residents. Flooding would occur, property damage would be sustained, and residents would be displaced.

Aside from the tremendous hydraulic force of the tsunami waves themselves, floating debris carried by a tsunami can endanger human lives and batter inland structures. Ships moored at piers and in harbors often are swamped and sunk or are left battered and stranded high on the shore. Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the waves.

Port facilities, naval facilities, ferry terminals, fishing fleets, and public utilities are frequently the backbone of the economy of the affected areas, and these are the very resources that generally receive the most severe damage. Until debris can be cleared, wharves and piers rebuilt, utilities restored, and the fishing fleets reconstituted, communities may find themselves without fuel, food, transportation, and employment. Wherever water transport is a vital means of supply, disruption of coastal systems caused by tsunamis can have far-reaching economic effects. Seiches create a “sloshing” effect on bodies of water and liquids in containers. This primary effect can cause damage to moored boats, piers, and facilities close to the water. Secondary problems, including landslides and floods, are related to accelerated water movements and elevated water levels.

## Extent

Simulated wave heights of 13-17 feet indicate that tsunamis are not only a threat to the infrastructure in Gorst but also the naval base at Bremerton. Even an order-of-magnitude smaller Tacoma fault-generated tsunami would generate strong currents in the narrow straits and harbors near Gorst. Further tsunami simulations in the Puget Lowland, including different fault scenarios, would help determine the degree of hazard posed by locally generated tsunamis. A tsunami can significantly affect the Cities of Bremerton and Port Orchard as well as the Puget Sound Naval Shipyard.

Building Stock and Critical Facilities by Jurisdiction Affected by Tsunami <sup>104</sup>						
Jurisdiction	Total Building Stock	Building Stock in Hazard Area	% Building Stock in Hazard Area Jurisdiction	Total Critical Facilities	Total Critical Facilities in Hazard Area	% Critical Facilities in Hazard Area Jurisdiction
Unincorporated Kitsap County	87,985	3826	4.3	249	12	4.8
Bainbridge Island	12,639	1238	9.7	83	5	6.0
Bremerton	13,683	739	5.4	64	4	6.2
Port Orchard	6,708	194	2.9	39	2	5.1
Poulsbo	3,516	115	3.3	66	3	4.5
Port Madison Suquamish Reservation	4,579	265	5.9	7	1	1.4

<sup>104</sup> Kitsap County GIS figures 2012

Building Stock and Critical Facilities by Jurisdiction Affected by Tsunami <sup>104</sup>						
Jurisdiction	Total Building Stock	Building Stock in Hazard Area	% Building Stock in Hazard Area Jurisdiction	Total Critical Facilities	Total Critical Facilities in Hazard Area	% Critical Facilities in Hazard Area Jurisdiction
Port Gamble S'Klallam Reservation	270	4	1.5	5	0	0
<b>Totals (Kitsap)</b>	<b>129,380</b>	<b>6377</b>	<b>4.9%</b>	<b>513</b>	<b>27</b>	<b>5.2</b>

Table 53: Building Stock and Critical Facilities by Jurisdiction Affected by Tsunami

Figure 24 describes the four main types of tsunami risk in Washington and their areas of greatest risk. Each type affects different parts of the State. Emergency planners and hazard geologists are working hard to learn more about these risks. The Seattle Fault presents the biggest know tsunami threat to Kitsap County.<sup>105</sup>

Types of tsunami risk		
Type of tsunami	Description	Area of greatest impact
Distant	A tsunami is created by a distant earthquake or landslide and travels across the ocean	Pacific coastal communities
Cascadia subduction zone	Tsunami created by large Magnitude 8–9 earthquake off the Washington, Oregon, or British Columbia coasts	Pacific coastal communities
Local earthquake (for example, the Seattle or Tacoma faults)	Tsunami created in large body of water from an earthquake on local faults	Communities close to the body of water
Landslide-caused tsunami	Large landslide occurs underwater or slides from land into water	Depends on where the landslide occurs

Figure 45: Types of Tsunami Risk (WADNR)

<sup>105</sup> Washington Department of Transportation

Washington has three major earthquake sources that have the potential to cause tsunamis: subduction zone earthquakes, deep (Benioff Zone) earthquakes, and shallow crustal fault earthquakes.

Deep (Benioff zone) earthquakes do not produce tsunamis. However, they may trigger landslides that could generate tsunamis. Image adapted from USGS.

### Cascadia Subduction Zone Earthquakes<sup>106</sup>

The Cascadia subduction zone off the coast of Washington, British Columbia, Oregon, and northern California is the biggest tsunami hazard for Washington State. Subduction zone earthquakes are capable of generating some of the largest and most damaging earthquakes in the world, the Cascadia Subduction Zone off our coast is one of these faults. These earthquakes also cause very large and damaging tsunamis. The following series of diagrams show how tsunamis are created along the Cascadia subduction zone.

Areas uplifted offshore will create a tsunami wave that will inundate coastal areas that have already subsided from the earthquake as seen in the graphic to the right (Zones of uplift and subsidence during a Cascadia subduction zone earthquake. Image modified from a diagram by Carrie Garrison-Laney (WA SeaGrant).

### Crustal Faults

Other faults in Washington, such as the Seattle Fault, can also move the ocean floor and cause tsunamis. The Seattle Fault is known to have had an earthquake event that directly produced a tsunami and other crustal faults (Tacoma Fault and Darrington-Devils Mountain fault zone, for example) could produce tsunamis (Williams and others, 2000).

Additionally, there are numerous landslide-generated tsunami deposits that were triggered by local earthquakes found throughout Puget Sound. For this reason, we consider all active crustal faults that are near to Puget Sound to be a possible direct or indirect source of future tsunamis. Models for tsunami inundation in parts of the Puget Sound exist for the Seattle and Tacoma faults and can be found on the [Geologic Information Portal](#).

### Distant Events

Tsunamis generated from earthquakes at other subduction zones and faults around the Pacific Ocean have the potential to impact our shores. Of the numerous historical events that have occurred, only the 1964 Alaska earthquake-generated tsunami has caused damage to the

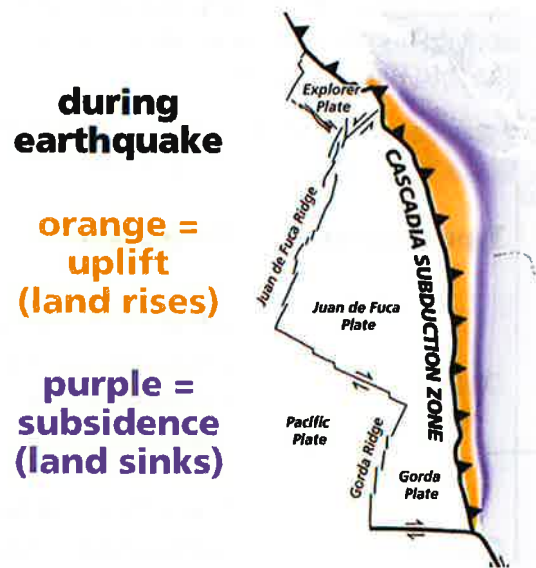
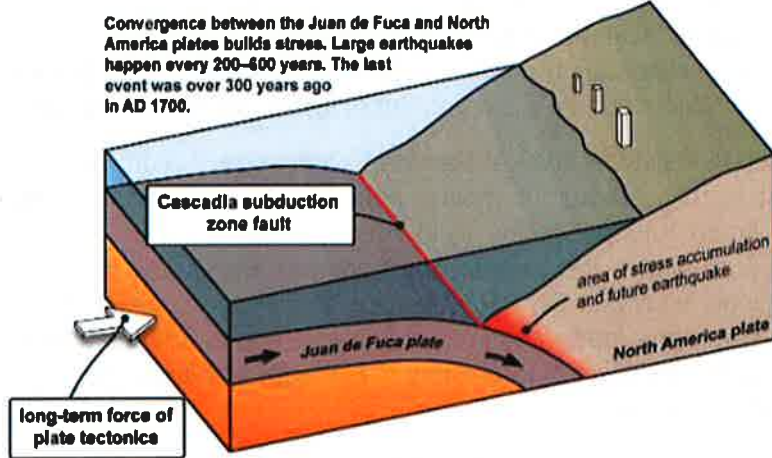


Figure 47: Schematic diagram of the sequence of events in a Cascadia Subduction Zone earthquake.

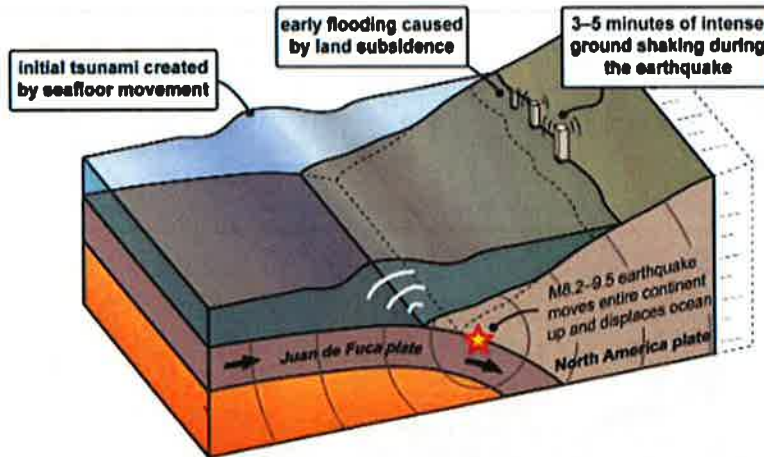
<sup>106</sup> <https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/Tsunamis#tsunamis-in-washington.4>

Washington coast. Most tsunami alert messages received for Washington are related to earthquakes in Alaska.

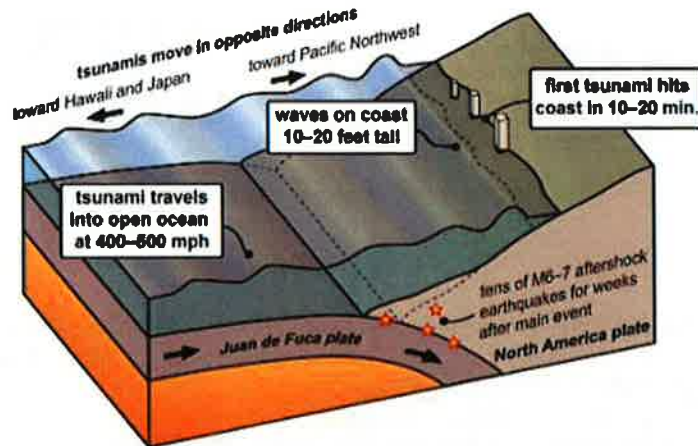
### Before an earthquake



### During an earthquake



### After an earthquake



## History

It is believed that the magnitude 7.0 earthquake that occurred on the Seattle fault 1,100 years ago caused a tsunami. Recent studies suggest historical evidence of a 13-17-foot tsunami hitting the Gorst area of Sinclair Inlet. The tsunami may have been an outcome of a Seattle fault earthquake or possibly other incidents cataclysmic enough to cause an 18-foot tidal wave in the Puget Sound.<sup>107</sup> The study reiterates the threat of multiple hazards associated with earthquakes in the Puget Lowland, of which tsunamis are prominent in the case of Sinclair Inlet.

An earthquake-induced landslide in 1949 at Salmon Beach in the Tacoma Narrows generated a 6-8-foot tsunami that hit Gig Harbor. It moved both directions within the Narrows probably reaching portions of south Kitsap County. East Passage and Colvos Passage form a direct connection from the area where the Seattle Fault crosses Puget Sound and Kitsap County. Because of this, it is highly likely that any tsunami generated by the large earthquake on that fault approximately 1100 years ago propagated south to at least some portions of the county.<sup>108</sup> The following figure is a graphic depiction of the history of tsunamis in Washington by the Washington Department of Natural Resources.

### Tsunamis in Washington

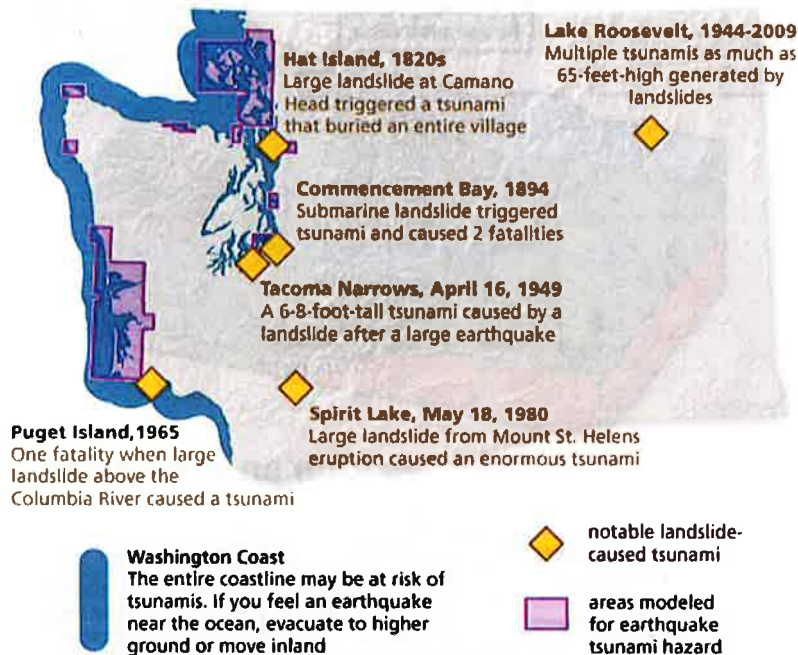


Figure 48: Tsunamis in Washington

<sup>107</sup> The A.D. 900–930 Seattle-Fault-Zone Earthquake with a Wider Coseismic Rupture Patch and Postseismic Submergence: Inferences from New Sedimentary Evidence, Maria Arcos.

[http://faculty.washington.edu/cpetroff/wordpress/wp-content/uploads/2012/10/Arcos\\_2012\\_Seattle\\_fault.pdf](http://faculty.washington.edu/cpetroff/wordpress/wp-content/uploads/2012/10/Arcos_2012_Seattle_fault.pdf)

<sup>108</sup> Kitsap County Hazard Identification & Vulnerability Assessment (2015)



## Probability of Future Events

Tsunamis generated elsewhere on the Pacific Rim are the ones that strike Washington most often, although effects on Kitsap County are lessened due to the location of the County's shoreline in the Puget Sound. The Seattle Fault presents the biggest known tsunami threat to Kitsap County. Impacts would be diminished due to not being located directly on the Pacific Coast. It is therefore difficult to estimate the future probability of tsunamis. It is estimated that an earthquake (M8 or M9) in the Washington portion of the Cascadia Subduction Zone would likely produce a significant tsunami with major damaging and life-threatening impacts along the coastal shoreline communities. According to the Pacific Northwest Seismic Network, there is a 10-20% chance of a Cascadia Subduction Zone earthquake in the next 50 years.<sup>109</sup>

The Seattle fault is active and capable of generating a large earthquake with a magnitude greater than 7.0. A 2005 study by Koshimura and Mofjeld modeled the potential effects of a tsunami caused by a 7.0 magnitude earthquake at major ports and harbors in Puget Sound as well as at several communities in Kitsap County, such as Bremerton and Port Orchard. The model indicated that at Bremerton and Port Orchard, the local seismic uplift would generate a 1.5m tsunami at the moment of the earthquake, with inundation occurring primarily along the southern shore of Sinclair Inlet and the northern and southern shore of Dyes Inlet. The estimated flow depths range between two meters at the shore of Port Orchard, 4m at the northern shore of Dyes Inlet, and two meters at the southern shore of Dyes Inlet. The results of this model are shown in the following figure. A tsunami in these developed areas would affect homes, schools, businesses, ports, harbors, shipyards, marinas, transportation infrastructure, utilities, and coastal ecosystems.

Great earthquakes in the North Pacific or along the Pacific coast of South America historically generate tsunamis that sweep through the entire Pacific basin occur at a rate of about six every 100 years.<sup>110</sup> Local earthquakes and landslides that generate tsunamis occur more frequently, although scientists have not calculated a specific rate of occurrence. The communities within the county that are potentially at risk are Bainbridge Island, Navy Yard City, Silverdale, Bremerton, Parkwood, Suquamish, Erlands Point, Port Orchard, Tracyton, Manchester, and Poulsbo.

A tsunami cannot be precisely predicted, even if the magnitude and location of an earthquake are known. Geologists, oceanographers, and seismologists analyze each earthquake and, based on many factors, may issue a tsunami warning. However, there are some warning signs of an impending tsunami, and automated systems can provide warnings immediately after an earthquake in time to save lives. One of the most successful systems uses bottom pressure sensors, attached to buoys, which constantly monitor the pressure of the overlying water column.

## Climate Change Impacts

In the coastal zone, the effects of sea-level rise, erosion, inundation, threats to infrastructure and habitat, and increasing ocean acidity collectively pose a significant threat to the region.

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<sup>109</sup> Washington State Enhanced Hazard Mitigation Plan (2018)

<sup>110</sup> International Tsunami Information Center [http://itic.ioc-unesco.org/index.php?option=com\\_content&view=article&id=1163:where-and-how-frequently-are-tsunamis-generated&catid=1340&Itemid=2055](http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1163:where-and-how-frequently-are-tsunamis-generated&catid=1340&Itemid=2055)

With diverse landforms (e.g., beaches, rocky shorelines, estuaries), the Northwest coast may experience a wide range of climate impacts. Global sea levels have risen about 8 inches since 1900, with about 3 of those inches (about 7 cm) occurring since 1993. Much of the Pacific Northwest coastline is rising due to tectonic uplift, which raises the land surface. A major earthquake along the Cascadia subduction zone would immediately reverse centuries of uplift and potentially increase relative sea level by a meter or more.<sup>111</sup> Changes to sea level have an inherent impact on the potential reach of a tsunami.

## Vulnerability Summary

- Tsunami vulnerability and effect on Kitsap County is considered “**moderate**,” meaning there is a moderate potential for a disaster of less than major proportions during the next 25 years. The tsunami threat to the County comes from local earthquakes, rather than distant ones. The 2018 Washington State Hazard Mitigation Plan rates tsunami risk in Kitsap County as “low,” but the plan’s tsunami risk analysis is limited to the coastal shoreline counties in Washington State. It also does not address distant tsunami impacts or incidents caused by crustal shallow zone earthquakes.<sup>112</sup>
- Kitsap County is vulnerable to tsunamis, high waves, and seiches due to its vulnerability to storms and earthquakes. Among the most susceptible elements of the community are the marine enterprises, public port facilities, defense establishments and the hundreds of private residences lining the shorelines of Sinclair and Dyes Inlets; these entities either need or prefer a shore location. Located on filled ground, over water, or at the foot of steep shoreline bluffs, the structures housing employees, customers, military personnel, visitors, or residents are in harm’s way for tsunami inundation and strong currents, landslides, and soil failure during and after strong ground shaking.
- Vulnerability issues include loss of life, debris, natural resources damage, transportation infrastructure, utilities, and shoreline development.
- Earthquakes will occur and could cause a tsunami. Earthquakes and other underwater disturbances could occur and cause general or localized damage from a tsunami or a seiche. Damage from a tsunami or a seiche may range from insignificant to catastrophic.
- In the past few years, Kitsap County GIS has developed maps and data on the potential for a worst-case tsunami scenario defined as a 25-foot wave height hitting anywhere along the coastline of Kitsap County. In the future, updates to this HIVA will continue to revise the shoreline analysis and evaluate tsunamis based on more credible data.

## Conclusions

Earthquakes will occur and could cause a tsunami. Earthquakes and other underwater disturbances could occur and cause general or localized damage from a tsunami or a seiche. Damage from a tsunami or a seiche may range from insignificant to catastrophic.

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<sup>111</sup> National Research Council,

<http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=13389>

<sup>112</sup> Washington State Enhanced Hazard Mitigation Plan (2018)

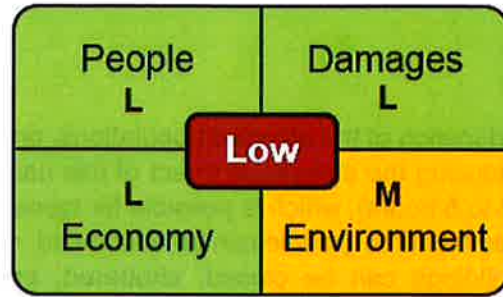
Education of the affected populations, proper zoning, and suitable structural design can aid in reducing the disastrous effect of this natural hazard. If the warning is received early enough (2 to 5 hours), which is possible for tsunamis generated at a distance, hasty preventive action can be taken: people can be evacuated, ships can clear harbors or seek safer anchorage, and buildings can be closed, shuttered, and sandbagged. For tsunamis generated by local earthquake or landslide events, however, the time from initiation of a tsunami to its arrival at the shore can be less than a minute. Residents in areas susceptible to tsunamis should be made aware of the need to seek high ground if they feel strong ground shaking.

Tsunamis or seiches that occur in Kitsap County have the potential to cause property damage and casualties. Public education on tsunamis and seiches is normally included in disaster preparedness classes as a subset of earthquake damage. Although much work has been done on disaster preparedness for the public, local governments, emergency planners and the citizenry need to recognize the dangers and effects of tsunamis and seiches as a component of the earthquake hazard.

# Volcanic Ash Fall

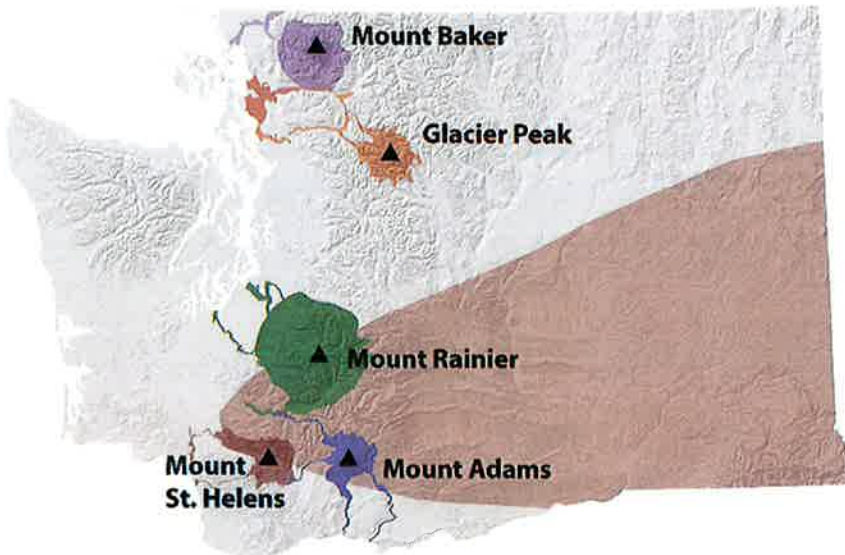
## Overview

Volcanic ash consists of tiny jagged particles of rock and natural glass blasted into the air by a volcano. Ash can threaten the health of people and livestock, pose a hazard to flying jet aircraft, damage electronics and machinery, and interrupt power generation and telecommunications. Wind can carry ash thousands of miles, affecting far greater areas and many more people than other volcanic hazards. Even after a series of ash-producing eruptions has ended, wind and human activity can stir up fallen ash for months or years, presenting a long-term health and economic hazard.<sup>113</sup> While rare, volcanic eruption can cause damage in Kitsap County primarily by ash fall.



## Location

The degree of hazard depends on the kind of eruption and proximity to the vent. Most of the dangers are to persons in the near vicinity of the volcano. Other dangers, such as mudflows and ash fall, may exist tens of miles downstream and downwind. Prevailing winds have a significant effect on potential ash fall in Kitsap County from a Cascadia volcano, such as Mount Rainier.



Data from USGS OFR 1996-0178 and Professional Paper 1250

Figure 49: Volcano Hazards

## Volcanoes

▲ Active stratovolcanoes

## Hazards

blasts, lahars, pyroclastic flows, lava flows, avalanches, and others

- Mount Baker**
- Glacier Peak**
- Mount Rainier**
- Mount Adams**
- Mount St. Helens**
- Mount St. Helens 1980 ash plume path \***

\*Significant volcanic ashfall would likely accompany a major eruption of any Cascade Range volcano.

<sup>113</sup> <https://pubs.usgs.gov/fs/fs027-00/>

## Effects

One potential effect on Kitsap County from a volcanic eruption from active volcanoes, all of which are in the Cascade Mountain Range on the eastern side of Puget Sound, is ash fall. Prevailing winds, however, are to the east.

Ash fall typically accompanies the eruptions of andesitic and dacitic volcanoes. These volcanoes tend to erupt lava so thick and charged with gases that they explode into ash rather than flow. A one-inch deep layer of ash weighs an average of ten pounds per square foot. Ash is harsh, acid, gritty, smelly, and thoroughly unpleasant. Although the gases are usually too diluted to constitute a danger to an adult in normal health, the combination of acidic gas and ash may cause lung damage to the very young, very old or infirm, or those already suffering from respiratory problems. Extremely heavy ash can clog breathing passages and cause death. Short-term exposure has not been found to be harmful to persons in normal health. When an ash cloud combines with rain, sulphur dioxide combines with water to form diluted sulfuric acid that may cause minor, but painful burns to skin, eyes, and mucous. Acid rains may affect water supplies, strip and burn foliage, strip paint, corrode machinery, and dissolve fabric.

Heavy ash fall blocks out light. Sudden heavy demand for electric light and air conditioning may cause a drain on power supplies, leading to a partial or full power failure. Ash clogs watercourses and machinery of all kinds and causes electrical short circuits. It drifts onto roadways, railways, and runways, where it is slippery. Its weight may cause structural collapse. Because winds and air currents easily carry it, it remains a hazard to machinery and transportation for months after the eruption.

Ash fall would be expected to vary from non-existent to light, depending on wind direction at the time of the eruption and the amount and type of tephra ejected. Any significant ash fall would cause damage to the unprotected moving parts of any machinery, especially motor vehicles. Damage would also occur to electrical equipment due to short circuits. Persons with respiratory ailments may be affected. Clean-up of ash would tend to be long-term because the earth must eventually absorb the ash. Ash fall in Kitsap County would probably not cause significant damage except to equipment used extensively in areas most affected by ash fall.

Although volcanic earthquakes are strong near the volcano, they are generally confined there. There are some exceptions, as with the "St. Helens Fault Zone," where a tectonic fault is closely associated with the volcano. Tremors may cause large rockfalls, snow avalanches, landslides, and building collapse.

Ash fall is not the only consideration. If economies and transport are disrupted along the I-5 corridor by Mt Rainier, then Kitsap County may see a direct economic impact. If transport corridors to the east are compromised, goods coming into Kitsap County have to come through the south via Mason County and Highway 3, which may measurably affect the price of goods and what resources are available. It may also impact employment for the many residents who work in Pierce and King counties.

## History

There are no volcanoes in Kitsap County; however, the proximity to potentially active volcanoes in the Cascade Mountains to the east could impact the county. When Mount St. Helens erupted

on May 18, 1980, heavy ash from a west wind blanketed much of Eastern Washington. The 1980-1986 eruptions claimed 57 lives and caused nearly a billion dollars in damage and response costs. The effects were felt throughout the Northwest. Counties in close proximity to the incident were affected by extensive ash fall which damaged internal combustion engines, caused transportation problems due to reduced visibility, and was a general nuisance.

## Probability of Future Events

In recent decades, Mount St. Helens had two significant instances or periods of eruption. The March 27, 1980, Mount St. Helens produced its first major eruption in over 100 years; smaller episodes continued through summer and fall of that year.<sup>114</sup> Then, “[o]n October 1, 2004, the first of several explosions shot a plume of volcanic ash and gases into the atmosphere from a vent on the southwest margin of the growing welt. Four additional steam and ash explosions occurred through October 5, and three produced noticeable fallout of fine ash downwind.”<sup>115</sup> According to the U.S. Geological Survey (USGS), “[w]e know that Mount St. Helens is the volcano in the Cascades most likely to erupt again in our lifetimes. Thus, it is likely that the types, frequencies, and magnitudes of past activity will be repeated in the future. However, neither a large debris avalanche nor a major lateral blast like those of May 18, 1980, is likely now that a deep crater has formed.”<sup>116</sup> The probability of ash fall depends on wind direction and the volcanic source of the eruption causing the ash fall. Cascade volcanoes are considered among the most active in the world and will likely erupt again. While it is possible to have sufficient lead time for warning dissemination in the event of an imminent eruption through appropriate monitoring, it is often difficult to predict the future likelihood of volcanic incidents. Based on a study done by USGS, there is a one in 500 chance that portions of two counties will receive four inches or more of volcanic ash from a Cascades volcano in any given year, and a one in 1,000 chance that parts or all of three or more counties will receive that quantity of ash.<sup>117</sup>

## Climate Change Impacts

Rather than be influenced by the climate, the gases and dust particles thrown into the atmosphere during volcanic eruptions can themselves influence the climate. Most of the particles spewed from volcanoes cool the planet by shading incoming solar radiation. The cooling effect can last for months to years, depending on the characteristics of the eruption. Volcanoes have also caused global warming over millions of years when extreme amounts of volcanism occurred, releasing greenhouse gases into the atmosphere.

Even though volcanoes are in specific places on Earth, their effects can be widely distributed as gases, dust, and ash get into the atmosphere. Materials can make their way from volcanic eruptions into the atmosphere such as particles of dust and ash, sulfur dioxide, and greenhouse gases like water vapor and carbon dioxide. Volcanic ash or dust released into the atmosphere during an eruption can shade sunlight and cause temporary cooling. Larger particles of ash have little effect because they fall out of the air quickly. Small ash particles form a dark cloud in the

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<sup>114</sup> <https://www.usgs.gov/volcano/mount-st-helens/1980-cataclysmic-eruption>

<sup>115</sup> <https://www.usgs.gov/volcano/mount-st-helens/2004-2008-renewed-volcanic-activity>

<sup>116</sup> <https://www.usgs.gov/volcano/mount-st-helens/future-eruptions-mount-st-helens>

<sup>117</sup> Washington State Enhanced Mitigation Plan 2018

troposphere that shades and cools the area directly below. Most of these particles fall out of the atmosphere within rain a few hours or days after an eruption, but the smallest particles of dust get into the stratosphere and are able to travel vast distances, often worldwide. These tiny particles are so light that they can stay in the stratosphere for months, blocking sunlight and causing cooling over large areas of the Earth.

Volcanoes also release large amounts of greenhouse gases such as water vapor and carbon dioxide. The amounts put into the atmosphere from a large eruption do not change the global amounts of these gases very much. However, there have been times during Earth history when intense volcanism has significantly increased the amount of carbon dioxide in the atmosphere and caused global warming.

## Vulnerability Summary

- Volcanoes in Washington State have a history of eruption and will continue to do so. History suggests a low probability of occurrence and low impact on Kitsap County, therefore assigned a “**low**” risk rating to volcanoes.
- An eruption of the closest volcano, Mount Rainier, is possible, but the actual effect on Kitsap County would likely be minor to moderate. The eruption would cause collateral damages and impact on Kitsap. The catastrophic effect on Pierce and King Counties could affect Kitsap County as it supports response and recovery efforts. County and City government must maintain plans to ensure essential services are available in the event of significant ash fall.
- Although Kitsap County is vulnerable to minimal ash fall, the transportation routes to the County could be severely impacted. Evacuation from Pierce and Thurston Counties might also impact Kitsap County should Mt. Rainier erupt.
- Ash fallout could seriously affect human health through increased respiratory problems. It would also have impacts on fish and wildlife, mechanical equipment, and agriculture.



# Technological Hazards & Human-Caused Threats

Technological hazards result from accidents or the failure of systems and structures, such as hazardous materials spills or airplane accidents. Some human-caused incidents result from the intentional actions of an adversary, such as a cyber-attack or active shooter incident. FEMA Local Planning Mitigation Guidance does not require a discussion of technological hazards. Kitsap County elects to include these threats in its HIVA to ensure that the whole community establishes and maintains awareness of these potential incidents and their impacts.

The hazards are discussed in the following order:

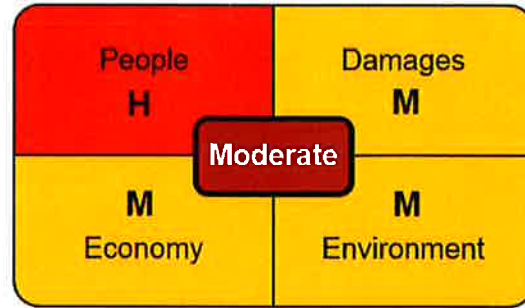
- Cybersecurity
- Dam Failure
- Energy Emergency
- Hazardous Sites/Materials
- Radiological Emergencies
- Search & Rescue Emergencies
- Terrorism
- Transportation Mass Casualty Incident
- Epidemics
  - Human Epidemics
  - Animal Epidemics



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# Cyber Attack

## Overview



Today, much of the nation's infrastructure is controlled by elaborate systems, whether managed or automated via data acquisition, process control, or web access. Such examples are government systems, banking, and industrial sites that support critical infrastructure and service to communities.

These systems are constantly under attack (or attempted attack) by a variety of malicious sources. Attacks (and attack attempts) stem from hackers or state-supported actors intending to damage equipment or gain access to vital national security information. Some researchers now suggest that society has arrived at a near-constant state of hacking attempts to internet-connected devices.<sup>118</sup> The likelihood of a successful breach into any organization's computer network is high for all systems directly or indirectly connected to the internet. Attackers use a variety of techniques to infiltrate systems and gain access to private and sensitive information.

## Effects

Attacks can occur on critical infrastructure systems like military installations, dams, or industrial complexes that control hazardous materials or other systems that may affect large populations. Kitsap County has very few critical infrastructure systems outside the five military installations. A cyberattack on a military system may adversely affect the area, but military systems belong to a comprehensive cybersecurity program managed by the Department of Homeland Security.

Infrastructure systems may include electrical and natural gas grids, banking systems, hospitals, and local government entities like 911 centers, courts, hospitals, and County/City administration. Attacks may result in stolen personal and critical data, damaged equipment, or shutdown of a vital system in a ransomware attack. The size and complexity of an attack and the ability to quickly recover and return to normal would determine the effect on Kitsap County.

## History and Probability of Future Occurrence

While there have been no official reports of significant cybersecurity incidents in Kitsap County, public agencies, private entities, and citizens are continually at risk. As systems continue to become reliant on electronic software and hardware, the threat of a cybersecurity incident increases. Kitsap County participates in cybersecurity training and education to better prepare its employees and citizens for cyber-related issues.

## Vulnerability Summary

- Cyberterrorism is a relatively new phenomenon used to potentially disrupt our society and exploit our increasing reliance on computers and telecommunication networks.

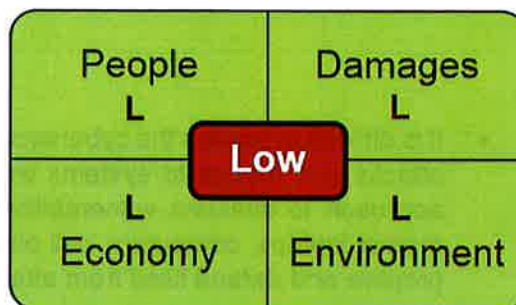
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<sup>118</sup> <https://eng.umd.edu/news/story/study-hackers-attack-every-39-seconds>

- It is difficult to assess the cybersecurity vulnerabilities within Kitsap County. The increased attacks and threats to systems worldwide have created the need to take a community approach to evaluate vulnerabilities. Public education on types of threats and how to protect laptops, computers, cell phones, and private information can help the community prepare and defend itself from attacks.
- The Cybersecurity Division of the Cybersecurity and Infrastructure Agency (CISA), under the Department of Homeland Security, leads efforts to protect the federal ".gov" domain of civilian government networks and to collaborate with the private sector (the ".com" domain) to increase the security of critical networks.

# Dam Failure

## Overview



Dam failure or levee breaches caused by flooding, earthquakes, poor construction, lack of maintenance and repair, incorrect operational activities, or acts of vandalism or terrorism can occur with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods can occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching.

Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow. Kitsap County has 25 dams listed with the State Department of Ecology.<sup>119</sup>

Kitsap County Dams				
Dam Name	Location	Hazard Category	Storage (ac-ft)	Dam Height (ft)
Casad Dam	Wildcat Lake	1B	4100	136
Tahuya River Dam	Wildcat Lake	1B	1650	16
McCormick Woods Pond RC-8	Ross Creek	1B	4	17
William Symington Dam	Wildcat Lake	1C	670	38
Bremerton Reservoir No. 4	Bremerton	1C	34	7
McCormick North Phase I East Pond	Anderson Creek	1C	30	8
Koura Dam	Suquamish	2	9	28
Mac's Pond Dam	Kitsap	2	12	26
Olympic View Landfill Leachate Lagoon No. 1	Bremerton	2	10	19
Cattail Lake	Lofall	3	52	10
Devils Hole	Poulsbo	3	69	11
Lewis Dam	Wildcat Lake	3	300	12
Temporary Sewage Lagoon	Poulsbo	3	75	13
Kitsap Lake Dam	Kitsap	3	3684	5
C & H Johnson Dam No. 3	Suquamish	3	10	22
David Lake Dam	Bremerton	3	10	16
James Dam	Bremerton	3	10	4
Erickson Reservoir Dam	Kitsap	3	16	8
Glud Pond Dam	Poulsbo	3	9	14

<sup>119</sup> <https://fortress.wa.gov/ecy/publications/documents/94016.pdf>

Kitsap County Dams				
Dam Name	Location	Hazard Category	Storage (ac-ft)	Dam Height (ft)
Jarstad Lake Dam	Bremerton	3	6	7
Battlepoint Park Reservoir Dam	Suquamish	3	16	13
McCormick Woods Division 1 - Dam No. 1	Kitsap	3	0	16
Olympic View Landfill Detention Pond	Bremerton	3	0	11
Bremerton National Airport Detention Dam	Bremerton	3	0	47
Ludvick Lake Dam	Ludvick Lake Creek	3	60	17

Table 54: Kitsap County Dams

## Effects

Dam failure can result in loss of life and damage to property, including structures, roads, utilities, and crops. Depending on location, dam failure can result in a lowered tax base, lack of power profits, or other significant economic loss.

A failure at Casad Dam would result in extensive property damage and endangerment to life. The City of Bremerton, which is the owner and operator of the dam, carefully monitors the dam and maintains updated emergency plans and holds emergency exercises. The dam has been evaluated by State Department of Ecology Dam Safety Engineers as a very stable structure, able to withstand anticipated seismic incidents.<sup>120</sup> Local authorities are responsible for warning and evacuation should a break occur. While located in Kitsap County, the dam could affect residents and businesses along the Union River, located in Mason County.

## History and Probability of Future Occurrence

Dam failure has not been a significant concern for the residents of Kitsap County. There has been no history of lives lost, property loss, or other damage as the result of dam failures. Natural hazards can also cause technological hazards. For example, an earthquake can result in damage to a dam in Kitsap County, causing flooding and infrastructure damage.

## Vulnerability Summary

- The rating for dams is “**low.**” The assessment assumes a low potential for failure, loss of life, and minimal damage to downstream homes. A catastrophic failure of the Casad Dam, although remote, has the potential of flooding homes downstream of the dam and resulting in a shortage of water supplies for the City of Bremerton.

<sup>120</sup> <https://www.bremertonwa.gov/297/Casad-Dam>

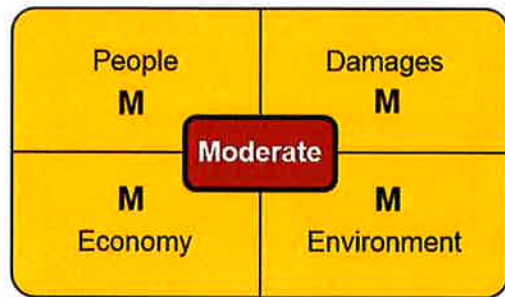
- Kitsap County is vulnerable to dam failure with twenty dams inside Kitsap County. Dams would mostly fail as a result of a significant earthquake.
- The State Department of Ecology inspects all dams in Kitsap County. Most dams have plans to mitigate potential failure or damages as a result of severe storms or respond to catastrophic incidents that may affect the dam's performance.

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# Energy Emergency

## Overview

Energy emergencies can include fuel shortages in the form of gasoline, heating fuel, and electricity. Oil embargos, terrorism, and economic turmoil can help to create these shortages. Severe storms or other natural disasters may disrupt power, creating electrical interruption and shortages.



## Effects

Any disruption in the supply of energy, no matter the source, causes human suffering and economic loss. Most of the possible shortages are beyond the local capabilities to control. The county is vulnerable to localized short-term energy emergencies brought about by accidents and storms, and the affected industry handles most of these emergencies. The effects of energy shortages could include inconvenience to consumers, reduced heating and lighting capability, reduced production in all sectors, and potential failure of transportation, water and waste, communication, information, and banking systems. Secondary hazards associated with these events could include traffic accidents as traffic lights are out, limited patient care at local hospitals due to power capacities of backup generators, injuries due to downed power lines, and fires due to gas leaks.

## History and Probability of Future Occurrence

The most common type of energy incident is a power outage. Although short-term (a few hours) outages frequently occur, during winter windstorms in particular, no significant countywide outages have occurred that have required long-term remedial attention. In addition to windstorms, power outages of multiple days' duration for portions of the county have happened during snow and ice storms. The last significant example of an ice storm was the December 1996 storm, which left some people in the rural areas of the county without power for several days. Past major windstorms that impacted Kitsap County occurred in March 2010, October 2009, and December 2006. These storms left many people in the rural areas of the county without power for several days and, in some cases, in excess of one week. During a snowstorm in November 2010, wind gusts of up to 65 miles per hour disrupted power for tens of thousands of utility customers in Western Washington. Puget Sound Energy stated most of its 90,000 outages were in Kitsap County.<sup>121</sup>

In the fall of 2000, major producers of electricity on the West Coast created an energy emergency through market manipulation, artificially inflating prices that grossly increased the cost/kilowatt hour. Doing this was highly detrimental, not only to the financial wellbeing of power distributors, but to homeowners, business owners, and industries that relied on large quantities of very cheap power.

One serious threat to the reliability of electric power is geomagnetic storms. These are severe disturbances caused by solar storms in the upper layers of our atmosphere that induce currents

<sup>121</sup> <https://www.cbsnews.com/news/vicious-snowstorm-hits-pacific-northwest/>



in long conductors on the Earth's surface, such as power lines. Due to Kitsap's northern latitude and aging and proprietary grid of the Bonneville Power Administration, the County is vulnerable to severe geomagnetic storms. These additional currents can overload the electric grid system to trigger voltage collapse, or worse, damage a significant number of expensive extra-high voltage transformers. The economic costs of such an incident would be catastrophic. Large transformer repairs/replacements occur on the timescale of weeks to months and could result in widespread long-term blackouts.<sup>122</sup>

Extreme solar storms pose a threat to all forms of high technology. They begin with an explosion—a "solar flare"—in the magnetic canopy of a sunspot. X-rays and extreme UV radiation reach Earth at light speed, ionizing the upper layers of our atmosphere; side-effects of this "solar EMP" include radio blackouts and GPS navigation errors. Minutes to hours later, the energetic particles arrive. Moving only slightly slower than light itself, electrons and protons accelerated by the blast can electrify satellites and damage electronics. Then come billion-ton clouds of magnetized plasma that take a day or more to cross the Sun-Earth divide. Analysts believe that a direct hit by an extreme incident such as the one that missed Earth in July 2012 could cause widespread power blackouts that could disable everything that plugs into a wall socket.<sup>123</sup>

While the probability of an extreme storm occurring is relatively low at any given time, it is almost inevitable that one will occur eventually. Historical auroral records suggest a return period of 50 years for Quebec-level storms and 150 years for very extreme storms, such as the Carrington Event that occurred 154 years ago.<sup>124</sup>

In recent years, disruption to gasoline supply has not been an issue. Gasoline shortages during 1973-1974 and in 1979 created long lines at gas stations for both commercial and private vehicles.

## Vulnerability Summary

- Kitsap County residents could be affected by an energy emergency and should prepare, as with all other hazards that could affect the community, for a minimum of 3-5 days. Over the years, aggressive programs to trim trees and upgrade power lines have been in place to minimize power outages in Kitsap County. Energy emergencies will continue to affect Kitsap County, so a rating of **"moderate"** is applied.
- Kitsap County, like other rural communities, is vulnerable to energy emergencies. By adhering to rationing rules and implementing emergency plans, the effects on the public during such a crisis can be reduced.
- The most likely scenario creating a significant long-term outage would be a catastrophic earthquake, which is not the subject of this assessment.

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<sup>122</sup> Solar Storm Risk to the North American Electric Grid, Lloyd's and the Atmospheric and Environmental Research, Inc. (2013)

<sup>123</sup> Near Miss: The Solar Superstorm of July 2012, NASA (2014) [https://science.nasa.gov/science-news/science-at-nasa/2014/23jul\\_superstorm](https://science.nasa.gov/science-news/science-at-nasa/2014/23jul_superstorm)

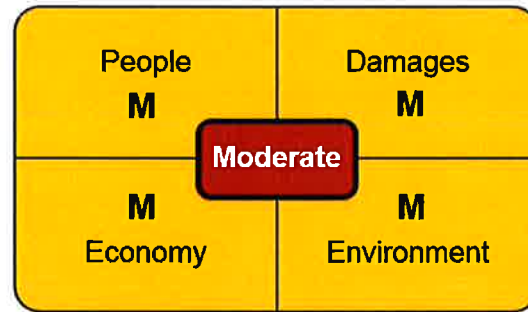
<sup>124</sup> Solar Storm Risk to the North American Electric Grid, Lloyd's and the Atmospheric and Environmental Research, Inc. (2013)

- Pockets of power outages for even a week would have little effect on life, damages, environment, and economy.

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# Hazardous Sites/ Materials

## Overview



The Kitsap County HIVA limits discussion of hazardous materials to etiological/biohazardous materials (i.e., those organisms that have a pathogenic effect on life and the environment and can exist in normal ambient environments) and chemical materials (i.e., those materials that do not exhibit etiological or radiological properties). Radioactive materials (i.e., those materials that emit alpha or gamma radiation) are addressed in a different section of this assessment.

Hazardous materials are classified into three states: gas, solid, and liquid. They may be stored at high or low pressure and may be affected by the environment in which an incident takes place (e.g., heat, cold, rain, wind). Hazardous chemicals are stored and used in many locations within the county. Bulk users of hazardous chemicals are included in the Superfund Amendments and Reauthorization Act (SARA) Title III Kitsap County Facilities 2002 Tier II Reporters (available upon request to KCDEM).

Small amounts of non-regulated chemicals (usually household materials) are routinely disposed of by dumping them into the environment through waste collection systems or directly into the ground or water. Hazardous etiological materials include infectious waste, such as laboratory cultures and samples, blood and blood products, bandages, hypodermic needles, and scalpels. Generators of such waste include hospitals, clinics, nursing homes, home care agencies, veterinarians, and drug users.

Kitsap County Cleanup & Superfund Sites		
City	Title/Location	Type of Site
Silverdale	Naval Base Kitsap Bangor	NPL
Silverdale	Bangor Ordnance Disposal	NPL
Bremerton	Bremerton Gasworks Superfund Site	Oil
Bremerton	Jackson Park Housing Complex (U.S. Navy)	NPL
Keyport	Naval Undersea Warfare Center (4 areas)	NPL
Manchester	Old Navy Dump/Manchester Lab (USEPA/NOAA)	NPL
Bremerton	Puget Sound Naval Shipyard Complex	NPL
Bainbridge Island	Wychoff-Eagle Harbor Superfund Site	NPL
NPL is the National Priorities List		
Oil is an oil contaminated Site		
Source: Environmental Protection Agency (EPA), Region 10, May 2014		

Table 55: Kitsap County Cleanup & Superfund Sites

### Closed & Abandoned Landfills in Kitsap County

	#	Landfill Name	Parcel #	Location
Abandoned	1	Akamai Inert Waste Landfill	092702-1-023-2005	Solid Waste Rd, Hansville
	2	Arper-Dickey Road	192501-1-011-2000	9546 Dickey Road, Silverdale
	3	Bremerton Auto Wrecking Landfill	012301-4-022-1005	4275 State Hwy 3, Bremerton
	4	City of Bremerton Landfill	012301-1-001-1006	Gold Mountain Golf Course
	5	Constitution Avenue Navy Fill Site	222401-2-070-2002	520 National Avenue, Bremerton
	6	Crown Hill Elementary School Landfill	152401-2-027-2005	1537 Bertha Ave, Bremerton
	7	Eglon Dump	042702-1-029-2003	Hansville Road NE by Old Hansville Hwy
	8	Evergreen Park	132401-2-014-2002	1500 Park Ave, Bremerton
	9	Fairgrounds Fill Site	272501-2-009-2002	Kitsap County Fairgrounds
	10	Haddon Elementary Landfill site	3787-000-006-0403 3774-004-0040006	Lafayette Ave & NW 15th St, Bremerton\
	11	Head-of-Bay Dump	332401-3-016-2004	3050 West State Highway 16, Port Orchard
	12	Holly Dump	162402-4-001-1001	NW Seabeck-Holly Road, Seabeck
	13	Howerton-Silverdale Dump	182501-4-011-2005 4-048-2002 182501-4049-2001	Dickey Road NW & NW Cascade Street, Silverdale
	14	Indianola Dump	022602-3-007-2009	South Kingston Road NE & Maloney Lane NE, Indianola
	15	KCSL Silverdale Landfill	192501-2-001-2000 192501-2-002-2009	Dickey Road NW, Silverdale
	16	Lofall Community Dump	272701-1-058-2002	Lofall Rd and Pioneer Way, Poulsbo
	17	Pioneer Towing	322401-1-091-2007 322401-1-1322008	State Highway 3, Gorst
	18	Port Orchard Dump	342401-3-015-2004	SW Old Clifton Road, Port Orchard
	19	Poulsbo Dump	252601-1-019-2003	Stenbom Lane NE, Poulsbo
	20	Roosevelt Field*	3804-007-008-0002	Main Parking Lot @ OC, Bremerton
	21	Ross Dump Site	242501-4-002-2008 242501-4-004-2006 242501-4-005-2005	North side of Winters Rd, Brownsville
	22	Rural Garbage Service	062401-4-031-2006 062401-4-006-2007	NW Windjammer Court, Bremerton
	23	Skirving Dump	202401-4-001-2004 202401-3-005-2002	Werner Road, Bremerton
	24	Spain Property	052302-1-006-2004	3939 Menzies Rd SW, Port Orchard

Closed & Abandoned Landfills in Kitsap County				
	#	Landfill Name	Parcel #	Location
	25	Suquamish Dump	302602-1-001-2005	East side of Totten Road & Widme Rd, Suquamish
	26	Victory Station	062301-1-007-2003	Victory Drive SW, Port Orchard
	27	VIP'S - Oyster Bay Navy Fill Site	3748-001-014-0003	Oyster Bay Ave, Bremerton.
	28	Vockrodt Dump	4502-003-023-0002	National Ave, Bremerton
	29	Warren Avenue Playfield*	142401-4-017-2004	1017 Warren Ave, Bremerton
	30	Westpark Landfill	162401-4-089-2005	Oyster Bay Rd , Bremerton
	31	Zink Dump	122301-4-012-2002	Bonneville Place SE & Perdemco Place SE, Port Orchard
Closed	32	Bainbridge Island Landfill	332502-2-001-2001	6400 Don Palmer Ave NE, Bainbridge Island
	33	Bangor Floral Point Landfill	062601-4-001-2000	NSB Kitsap-Bangor
	34	Blue Cascade Childress Dump	4751-000-0030000 4751-000-0040009	North side of Berry Lake Road SW, Port Orchard
	35	Hansville Landfill	092702-1-005-2007	Solid Waste Site Road, Hansville
	36	Keyport Landfill	362601-1-004-2007	NUWC Keyport
	37	Kitsap Reclamation & Materials	282401-3-068-2008	3010 W. Sherman Heights Rd., Bremerton
	38	Manchester Old Navy Dump	092402-4-004-2005	Between EPA Lab and NOAA at Manchester Fuel Depot
	39	Morrison Gravel Demolition Landfill	232301-3-008-2007	1004 SE Spencer Road, Port Orchard
	40	NAD Demolition Landfill	042401-3-030-2001	NAD Marine Park, Bremerton
	41	Norseland Landfill	112301-3-001-1000	State Hwy 3 and Imperial Way SW, Bremerton
	42	Olalla Landfill	012201-1-001-2005	13250 Bandix Road SE, Olalla
	43	Olympic View Sanitary Landfill	102301-1-001-1005 102301-1-004-1002 102301-1-003-1003	Barney White Rd, Bremerton
	44	Spurling Yard Waste Landfill	192501-1-010-2001	9592 Dickey Road NW, Silverdale
	* unconfirmed, prior to Health District Records			
Source: Kitsap County Public Health District, May 2014				

Table 57: Closed & Abandoned Landfills in Kitsap County

## Effects

A major spill of a bulk chemical stored in Kitsap County—such as stored fuels at gas stations—could cause loss of life, injuries, and property damage. Building private homes, schools, and public facilities on abandoned landfills or at Superfund sites could be devastating to building occupants, causing unsafe working or living conditions. Chemicals may also seep into the ground or contaminate water sources, affecting humans, insects, and other animals.

## History

Kitsap County, along with State and Federal agencies, has been aggressively identifying contaminated or suspected contaminated sites throughout the county.

- A comprehensive list of hazardous sites can be found on the Washington Department of Ecology website. This is a list of registered sites, ranking and the status of cleanup. By law, this list is updated twice per year.<sup>125</sup>
- Table 55 is a current list of the EPA-known Superfund sites.
- **Error! Reference source not found.** is a current list of Closed and Abandoned Landfills as defined by the Kitsap County Public Health District.
- A comprehensive list of bulk users of chemical can be found on the Washington Department of Ecology Website. This registered list of commercial and public entities that store bulk chemicals are required maintain their status with DOE in accordance with SARA Title III.

Kitsap County has been a major military community since World War II and the home to many forest/wood treatment facilities. The disposal of waste products, both military and civilian generated, has changed dramatically throughout the years. Kitsap County and its Cities are identifying both contaminated and suspected contaminated sites, closed and abandoned landfills, and current generators of bulk chemicals and their locations throughout Kitsap County.

Hazardous chemical incidents and accidents have occurred in Kitsap County. Areas surrounding Kitsap County have also experienced hazardous chemical accidents, such as the 1994 incident in Dalco Passage between Tacoma and Vashon Island, which impacted 21 miles of coastal area from the Narrows Bridge to Eagle Harbor on Bainbridge Island. Releases of hazardous substances contaminated approximately 500 acres of Eagle Harbor. The levels of these contaminants were high enough in sediments to make them toxic to bottom-dwelling organisms. Consumption advisories recommending against eating seafood from Eagle Harbor have been in effect since 1985.<sup>126</sup>

## Probability of Future Occurrence

As required under the Emergency Planning and Community Right-to-Know Act (EPCRA) and SARA III Act, Kitsap County has an active Local Emergency Planning Committee (LEPC) that

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<sup>125</sup> Hazardous Sites List (February 2019):

<https://fortress.wa.gov/ecy/publications/documents/1909042a.pdf>

<sup>126</sup> Damage Assessment, Remediation, & Restoration Program, NOAA: Eagle Harbor (2018)

<https://darrp.noaa.gov/hazardous-waste/eagle-harbor>

monitors hazardous materials in Kitsap County, develops and evaluates emergency response plans, and reviews TIER II reports filed by organizations that maintain large quantities of hazardous materials. Hazardous materials spills can happen anywhere, especially when materials are exposed during transport by car, truck, rail, or airplane. Human error or system failure very often plays a role in hazardous materials releases, so preparedness education is critical.

## Vulnerability Summary

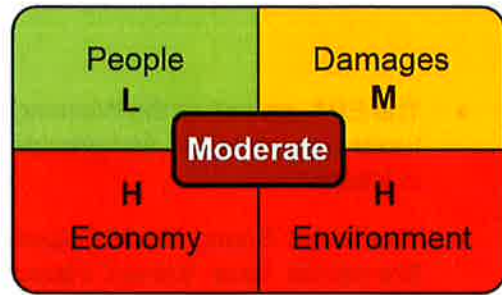
- The risk from Hazardous Site/Materials is rated “**moderate**” overall. The rating is primarily based on the potential for an incident associated with military bases in the county, although they have a long history of safety and security of hazardous materials. An incident, such as a Manchester fuel spill, has the potential to be an environmental disaster affecting the economy and environment of Kitsap.
- A bulk hazardous materials spill could result in fire, explosion, toxic cloud, or direct contamination of people and property. The effects may involve a local site or square miles. Health problems may be immediate, as from corrosive effects on skin and lungs, or may take time to display symptoms, such as cancer from a carcinogen. Property damage could range from immediate destruction through explosion to permanent contamination by a persistent hazardous substance.
- Improperly disposed of unregulated household chemicals present a significant danger, particularly to the environment. Small amounts of some materials, such as pesticides, can have a disastrous effect if they reach a water supply. The Kitsap County Household Hazardous Waste Facility accepts most hazardous household products and is a system to collect and properly dispose of discarded household chemicals. Services include public education as well as a collection system.
- The most significant danger connected with small amounts of unregulated substances, however, is improper disposal of material connected with automobiles. Illegal dumping of gasoline, oil, solvents, anti-freeze, etc. is common and widespread. The danger is the steady accumulation in the earth, water supplies and on salt-water beaches.
- Kitsap County has limited response capability to hazardous material incidents through its fire districts/departments, the Washington State Patrol, and the Department of Ecology. Washington State Patrol is Incident Commander for hazardous material incidents in areas of Kitsap County not designated otherwise. For large incidents involving hazardous materials outside the scope of response capabilities by local responders, the local military installations respond.
- Transporting chemicals to destinations both within and outside the county also creates a hazard. Accidents involving the transportation of chemicals can be just as catastrophic as accidents involving stored chemicals and possibly more so because the location of a transportation accident is not predictable. Hazardous chemical shipments to bulk users, wholesalers, and retailers are done in accordance with Federal and State law, yet this does not eliminate risk.



- The EPA, as well as the Washington Department of Ecology, are responsible for managing hazardous materials and provide information on various known hazardous materials sites in Kitsap.
- The Puget Sound Naval Shipyard, Naval Base Kitsap-Bangor, and Naval Base Kitsap-Bremerton have trained Hazardous Materials Response Teams. Kitsap County fire agencies have limited hazardous material response capabilities, which could place the community at risk in the event of a major incident. However, the State of Washington and private industry, along with the military, will offer support when necessary.

# Radiological Emergencies

## Overview



Nuclear facilities exist in the Puget Sound area, such as Puget Sound Naval Shipyard and Naval Submarine Base-Bangor, which are both located in Kitsap County. Puget Sound Naval Shipyard decommissions nuclear submarines, recycles gray water, and stores, until shipped, spent fuel rods from the nuclear submarines. It is also the home of modern nuclear aircraft carriers and submarines. Navy Base Kitsap Bangor is home to numerous nuclear power submarines, some of which are designed to carry nuclear weapons.

## Effects

Radioactive materials from a release or accident may cause harm to humans and animals. Material may enter the human food chain via crops or dairy products. Even if not exposed to an actual physical threat, many people may panic, believing radiation may have affected them. There would also be long-term issues with potentially contaminated public and private properties.

## History and Probability of Future Occurrence

In Washington State, there have been no radiological releases affecting local jurisdictions from any naval nuclear power generating system or nuclear weapons. There is always a remote possibility of an incident involving a radiological release.

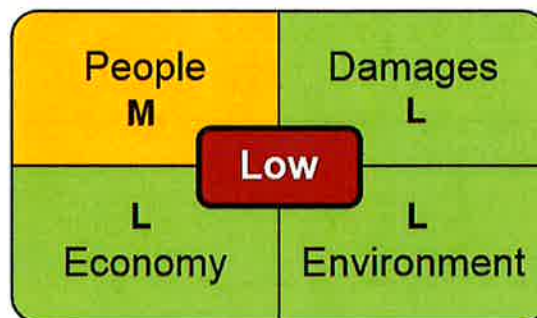
## Vulnerability Summary

- This hazard is rated “**moderate**” primarily based on a history of safety, an increase in safety and security measures, and the incorporation of an emergency management program on all military bases. Should an incident occur, it could undoubtedly affect lives, property, economy, and the environment for many years. As such, higher ratings are applied based on the effect or “perceived effect” on people and properties, resulting in a cascading impact on the economy of Kitsap County.
- Military bases receive, ship, and store nuclear materials. There is always a remote possibility of an incident involving a radiological release, but the considerable safeguards and extraordinary safety record of personnel and systems, consider this vulnerability small.
- Because of the local military installations and proximity to major cities, Kitsap County could be regarded as a target for terrorists. The potential terrorist use of “dirty bombs,” creating a radiological release scenario, is a remote possibility. There are no fallout shelters and little indoor space to place refugees.

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# Search & Rescue Emergencies

## Overview



Search and rescue (SAR) involves the location, rescue (extrication), and initial medical stabilization of individuals trapped in confined spaces or lost in the wilderness. SAR is considered a "multi-hazard" discipline, as it may be needed for a variety of emergencies or disasters, including earthquakes, storms, tornadoes, floods, dam failures, and terrorist attacks.

Structural collapse is the most frequent cause of people being trapped, but individuals may also be trapped in transportation accidents, mines, collapsed trenches, and in wilderness accidents. Kitsap County has many recreational areas attracting hunters, hikers, fishermen, etc. who may find themselves lost or in trouble. Brush picking and mushroom picking also bring possibilities for SAR missions.

## Effects

Due to heavy terrain and vast rural recreation areas in Kitsap County, hikers and campers may become lost. Injury or death may occur if rescuers do not locate them within a reasonable amount of time. Small children and the elderly often wander off and require search operations. Individuals may encounter wildlife, severe weather, or face dangerous situations that threaten injury or death. Conditions involving criminal activity, such as an active shooter situation or terrorist attacks, may require more complex SAR planning due to various elements such as the potential for explosives, violence, or hazardous materials release.

## History and Probability of Future Occurrence

Kitsap County has been conducting SAR operations since 1971 and continues to train and coordinate resources with surrounding counties. The Kitsap County Sheriff's office and the Kitsap County Department of Emergency Management coordinate all SAR operations in Kitsap County.<sup>127</sup> Conditions that may create SAR emergencies will never go away.

## Vulnerability Summary

- SAR emergencies have been rated "low" due to the likelihood of events and the effect on citizens. The number of persons at risk will probably increase as the population of the County grows or when a catastrophic incident occurs, but rates will not be high enough to constitute an emergency.
- Kitsap County, due to the terrain, heavily forested areas, and high number of recreational areas, is vulnerable to having missing/lost individuals.

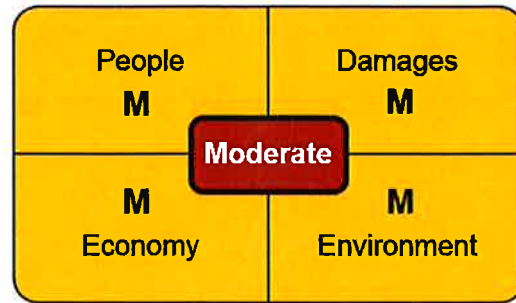
<sup>127</sup> <http://www.kitsapdem.org/search-and-rescue.aspx>

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# Terrorism

## Overview

Terrorism involves any despicable act directed against the government, business, or society in general that is meant to cause death or injury, destroy property, or disrupt normal agency or business functions. It comprises a political effort to oppose the status quo by inducing fear in the civilian population through the widespread and publicized use of violence, including murder, injury, and destruction. The Federal Bureau of Investigation (FBI) defines terrorism as “the unlawful use of force or violence against persons or property to intimidate or coerce a government; the civilian population; of any segment of it, in furtherance of political or social objectives,”<sup>128</sup> though there is no universally agreed upon definition, even among Federal entities.



Kitsap County has five military installations with highly protective military assets associated with the U.S. Strategic Deterrent Doctrines. As such, there is a potential for terrorist activity as well, as attacks on military service personnel. Kitsap County does not otherwise have any high-profile facilities, monuments, or other nationally-known sites considered a terrorist target.

## Effects

The effects of terrorism include, but are not limited to, death, injury, and a feeling of fear and helplessness in the general population. It can destroy property, lifelines, and the underlying social fabric of society. On a large scale, it may destroy major portions of a large city’s infrastructure, creating physical and economic hardship for some time in addition to the initial death and destruction. Long-term psychological damage to a portion of the population is also possible. Recovery efforts may be incredibly timely and costly, and area reputations may change rapidly, causing disruptions to business, industry, education, and daily life.

A terrorist attack can take several forms depending on the technological means available to the terrorist, the nature of the political issue motivating the attack, and the points of weakness of the terrorist’s target.

## History

Although Kitsap County has not experienced major civil disorders, it is a community made up of a very diverse population, including members of nationally recognized militia organizations. The incidents of 9/11 and the creation of the Department of Homeland Security have set in place a framework of terrorism mitigation and an extraordinary system of detection and prevention of potential terrorist incidents. As such, Kitsap County has developed and executed a homeland security program and implemented numerous strategic, tactical, and interoperable plans and systems to mitigate and prevent terrorist attacks in Kitsap County.

## Vulnerability Summary

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<sup>128</sup> 28 CFR § 0.85, <https://www.law.cornell.edu/cfr/text/28/0.85>

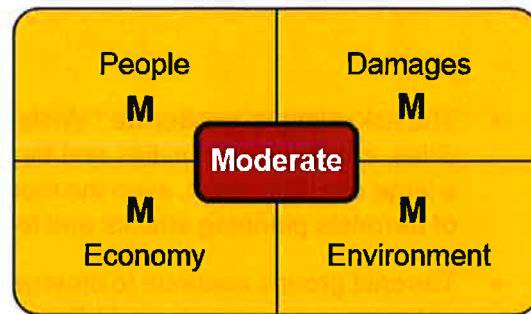
- The risk rating is “**moderate**.” While many assume that terrorist incidents will occur in large cities, smaller communities and targets might be used as “test sites” for a future strike at a large city. Moreover, even the most remote areas may find themselves to be the location of terrorists planning attacks and for the manufacturing of weapons.
- Terrorist groups continue to emerge and evolve. Copy groups taking their cues from other notorious groups such as Al Qaeda and ISIS would not hesitate to utilize chemical and biological materials. Incidents such as the 2001 spread of *Bacillus anthracis* spores through the postal system receive national and international attention. The terrorist threat is not only attacks from large, organized elements like Al Qaeda, but may come from small groups or individuals. These may be local or regional groups or individuals.
- There is no known record or documentation of terrorist activities within Kitsap County. However, there is always a threat to military installations. As a partner in this community, the military and local communities partner on training and exercise activities.
- A terrorist attack would have a long-term effect on the County, which can ultimately affect property, the economy, and the environment depending on the scale and complexity of the incident.
- As home to important military installations and Kitsap County's proximity to Seattle's economic, financial, and population centers, Kitsap County's vulnerability to the effects of terrorism is substantial.
- Kitsap Transit is a moderate profile facility. As such, and with available homeland security funding, Kitsap Transit was involved in a Buffer Zone Protection Program designed to mitigate potential threats.<sup>129</sup>

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<sup>129</sup> <https://www.fema.gov/pdf/government/grant/BZPP.pdf>

# Transportation Mass Casualty Incident

## Overview



Transportation in Kitsap County includes road, air, and maritime systems. The use of these systems and supporting vehicles creates the opportunity for accidents, emergencies, and disasters. Transportation hazards may be natural or human-caused.

Aside from normal vehicular traffic accidents, the main highway system of Kitsap County represents a relatively moderate transportation mass casualty incident (MCI) threat. The main highway system includes Highway 16, Highway 3, Highway 303, Highway 305, and other major roadways. However, all road surfaces are potential locations of vehicular emergencies. Ice and excessive rainfall, frequently a contributing factor in highway MCIs, are relatively rare meteorological events in Kitsap County.

The Washington State Ferry System operates ferry runs from four locations in Kitsap County: Southworth, Bremerton, Bainbridge Island, and Kingston. Ferries run from approximately 4 a.m. until after midnight seven days a week. The ferries transport a substantial number of passengers, especially during summer weekends. The outstanding safety features of the vessels, the effective control of Puget Sound marine vehicular traffic by the U.S. Coast Guard's Vessel Traffic System (VTS), and the Ferry System's excellent safety record are all responsible for ensuring that risk of a marine transport MCI as a result of a ferry accident is low in Kitsap County. However, the threat of a terrorist attack on a ferry is a real one.

Although Kitsap County's Bremerton National Airport does not house any commercial carriers offering regularly scheduled flights at this time, it is used by general and corporate aviation.<sup>130</sup> Because Kitsap County lies in the flight path of Seattle-Tacoma International Airport (Sea-Tac), there is always the potential of an airline accident occurring over the county. Air traffic hazards include a single aircraft accident involving a large number of passengers, a mid-air collision, an accident involving ground structures (e.g., residential area, industrial complex), or any combination of thereof.

## Effects

In the unlikely event of an emergency involving a ferry or other vessel on the Sound, Kitsap County response forces will most likely only play a supporting role. The U.S. Coast Guard has the primary responsibility for safety and rescue on the open waterways. The cities of Bremerton and Bainbridge Island, as well as County fire and law agencies, could be requested to provide emergency medical assistance, traffic and crowd control, media facilities, staging areas, temporary morgues, and other disaster support.

<sup>130</sup> <https://www.portofbremerton.org/bremerton-national-airport>



The effects of a major disaster involving the highway system would depend on the location of the accident. As is the case with most emergencies, rural areas would be impacted more than urban areas. Local fire and law enforcement resources could quickly be overtaxed. All fire districts have contracted assistance in the form of mutual aid available to them; thus, the problem of emergency resources being overtaxed by a highway accident should only be temporary.

Emergency medical services resources could be temporarily overextended in the event of a transportation MCI, as emergency transportation will probably be lacking initially. Consequently, on-scene personnel may have to set up a triage system or rely on aid cars for emergency transportation until enough ambulances can respond. Hospitals are generally not staffed for handling a large number of emergency cases at one time.

The convergence of humanity often accompanying major accidents may also be a problem, especially if an accident were to block a major roadway. If the detour has to rely on a minor roadway or one containing a traffic bottleneck, it could tie up several more law enforcement personnel. Relatives of victims, media personnel, and curious bystanders could cause problems if effective crowd control measures are not established immediately.

## History

Over the years, there have been several major accidents in Kitsap County caused by dense fog, freezing rain, wind, or ice forming on bridges, roadways, and overpasses. These types of accidents happen every year, occasionally involving tank trucks, chemical trucks, and buses. Some of these have closed down the highways for portions of a day; however, none have caused large long-term evacuation or closure of the highways for long periods.

Kitsap County has been the scene of airplane crashes over the years. Most of these have been small craft with one or two people on board.

Kitsap County has not experienced a major accident involving a State ferry, but a few smaller incidents have occurred.

- 1991: The ferries Sealth and Kitsap collided in heavy fog just north of Bremerton, injuring one woman.<sup>131</sup>
- 1994: The ferry Kitsap collided with a pleasure craft as it was proceeding to a Bremerton dock.<sup>132</sup>

## Vulnerability Summary

- The possibility of a major transportation accident involving mass casualties taking place in Kitsap County is substantial and is growing as the county population and industrial base expand. The two major effects of transportation accidents are personal injury and hazardous materials releases. Therefore, transportation emergencies with an MCI are rated “**moderate**,” primarily due to the potential loss of life and damage to the environment.

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<sup>131</sup> [https://products.kitsapsun.com/archive/2001/01-07/0093\\_where\\_are\\_they\\_now\\_1991\\_ferry\\_c.html](https://products.kitsapsun.com/archive/2001/01-07/0093_where_are_they_now_1991_ferry_c.html)

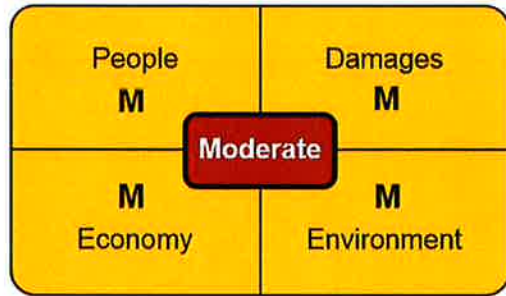
<sup>132</sup> [https://products.kitsapsun.com/archive/1994/09-21/298677\\_ferry\\_crash\\_kitsap\\_hits\\_pleasu.html](https://products.kitsapsun.com/archive/1994/09-21/298677_ferry_crash_kitsap_hits_pleasu.html)

- The most significant threat posed by the highway transportation system would be an accident involving one or more passenger-carrying vehicles.
- The ferry system has an inherent risk for an emergency. This could arise from a collision with another vessel, striking an object, structural failure, or adverse weather. However, based on the past safety record, the potential for an accidental incident is small. The potential exists for a terrorist attack on a ferry, and the ferry system is addressing this possibility by creating new surveillance and preparedness plans.
- All parts of Kitsap County are vulnerable to an aircraft accident. Any area containing a significant flight pattern has the potential for a mid-air collision or incident arising from an equipment malfunction or pilot error. However, because most incidents occur during takeoff or landing, the threat to Kitsap County is small.

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# Epidemics (Human & Animal)

## Overview



An epidemic refers to the outbreak and rapid spread of a disease in a community affecting a significant number of people or animals in a relatively short period. This section focuses first on human epidemics and secondly on animal epidemics. However, many diseases can infect both animals and humans. These diseases are called zoonotic diseases; a zoonotic disease agent has a nonhuman vertebrate as its usual host but possesses the capability to infect humans. Zoonotic diseases are a serious and growing public health concern throughout the world. Most of the recent emerging and re-emerging infections have involved zoonotic disease agents. If a zoonotic disease, such as influenza, can spread widely within human populations, or if a zoonotic disease, such as rabies, spills over frequently from animal reservoirs, it can have serious socioeconomic impacts.

## Human Epidemics

Some of the most recent health concerns Kitsap County has faced are the resurgence of vaccine-preventable diseases (e.g., measles and pertussis), the emergence of high-consequence infectious disease (e.g., pandemic influenza, MERS, Ebola), infectious disease outbreaks among individuals experiencing homelessness (e.g., hepatitis A), and the potential for bioterrorism.

The 2019 measles outbreak mainly affected Clark and King Counties, with 74 cases as of April 2019. Health officials urge immunization, especially among populations with unvaccinated children. The Washington State Department of Health continues to remind people to take precautions to help stop the spread of measles due to its high rate of infectiousness.<sup>133</sup> Other diseases of concern include influenza and norovirus.

A safe water supply, effective sewage and waste disposal, and aggressive monitoring and treatment of potential disease outbreaks by public health officials have kept Kitsap County relatively free of many of the serious epidemics in existence.

### Effects

Epidemic impacts may include loss of life or either short- or long-term debilitation for the victims. It could also include economic hardship for individuals and their families. Lost work time affects not only the employee but also the employer. Loss of productivity due to individual illnesses is a significant business problem today without taking into account the effects of a major epidemic. In addition, a severe epidemic would likely cause a strain on current public health and medical resources in Kitsap County.

Any upward trend in disease cases could potentially strain medical resources and charitable organizations that support patients without other resources. This could put a greater financial

<sup>133</sup> Washington State Department of Health (2019)

drain on the medical system, which will have to either absorb some of the costs, of at least emergency room care if not long-term care, or begin refusing service to the indigent who cannot pay for treatment. Because refusing treatment to the poor has unacceptable moral and social overtones, medical facilities will have to absorb the costs in some other way or charge higher fees to offset the costs.

### **History**

Neither the state of Washington nor Kitsap County is immune to epidemics. Some, such as seasonal influenza, pass through regularly. Others are either much more irregular, such as measles, or are perhaps still developing as a full-blown epidemic. A number of diseases have had an effect on the population's health in the County. A few of these include:

- The 2019 measles outbreak mainly affected Clark and King Counties with 74 cases as of April 2019. A vast majority of patients were not vaccinated against the disease. Prior to this, in 1990, Washington experienced the largest measles outbreak since 1979. The virus is known for its high rate of infection and can remain viable in the environment for up to two hours. Individuals with measles are infectious up to four days before they develop a rash and up to four days after. According to the Centers for Disease Control and Prevention (CDC), "measles is so contagious that if one person has it, up to 90% of the people close to that person who are not immune will also become infected."<sup>134</sup>
- Human immunodeficiency virus (HIV), which causes acquired immune deficiency syndrome (AIDS), remains an epidemic in the United States.<sup>135</sup> Between 2012 and 2017, Kitsap County saw new HIV cases diagnosed at a rate of 6-11 per year.<sup>136</sup>
- Hepatitis B, a serious, highly contagious liver disease, has been frequent in Washington, although Kitsap County has experienced few cases. In 2018, only one case of hepatitis B was reported in Kitsap County.<sup>137</sup>
- Tuberculosis (TB) has been around for many years. The development of strains that resist treatment, combined with lifestyles that allow the disease to be transferred easily, has allowed its resurgence the past few years. Many people, once they become symptomatic, will continue to infect others until they themselves are located and given treatment. When left to themselves, many of those who initially resist treatment will also fail to complete treatment once the symptoms begin to disappear. This could lead to a later resurgence and also contribute to the development of resistant strains. This is especially true in the denser urban cores. To counter this, many health departments have initiated a program of aggressive follow up to make sure that individuals complete a full course of their treatment. Kitsap Public Health District works with local health care providers to prevent, treat, and control tuberculosis in Kitsap County.<sup>138</sup> Without these preventative measures we could in the future see a dramatic increase in the disease rate.

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<sup>134</sup> Kitsap County Public Health Department (2019)

<sup>135</sup> <https://www.cdc.gov/nchhstp/newsroom/docs/factsheets/todaysepidemic-508.pdf>

<sup>136</sup> <https://www.doh.wa.gov/Portals/1/Documents/Pubs/150-030-WAHIVSurveillanceReport2018.pdf>

<sup>137</sup> [https://kitsappublichealth.org/CommunityHealth/files/Region2\\_NotifiableConditions.pdf?pdf=Notifiable-Conditions](https://kitsappublichealth.org/CommunityHealth/files/Region2_NotifiableConditions.pdf?pdf=Notifiable-Conditions)

<sup>138</sup> [https://kitsappublichealth.org/CommunityHealth/cdc\\_tb.php](https://kitsappublichealth.org/CommunityHealth/cdc_tb.php)

- The standard fall/winter influenza season creates its own epidemic on a yearly basis with some strains causing more considerable damage than others do. In cases like this, the elderly are hit the hardest, resulting in several deaths attributable to flu each year. There is always the potential for a novel strain of influenza that can cause unusually high mortality and morbidity, potentially resulting in a severe pandemic.
- In early 2015, Kitsap County experienced a pertussis outbreak that was largely concentrated in Bainbridge Island and North Kitsap with reports of over 100 cases. In 2018, the Health District received one report of pertussis in the county. Pertussis, also known as whooping cough, is a highly contagious respiratory disease that is especially harmful to infants and is vaccine-preventable.<sup>139</sup>
- Kitsap County has seen norovirus outbreaks at Horseshoe Lake (a popular lake in South Kitsap) in 2014 and 2018. In 2014, the Health District received approximately reports of over 260 individuals with norovirus-like illness related to the lake, and in 2018, the Health District received reports of 155 individuals with norovirus-like illness related to the lake. According to the CDC, norovirus is a very contagious virus and is “the leading cause of vomiting and diarrhea from acute gastroenteritis (inflammation of the stomach and intestines) among people of all ages in the United States.”<sup>140</sup>
- While Kitsap County has not experienced a recent hepatitis A outbreak, there is concern regarding outbreaks of infectious disease, like hepatitis A, among at-risk individuals, like those who use drugs or who are experiencing homelessness. From November 2016 to January 2018, San Diego County experienced a hepatitis A outbreak that resulted in 592 cases and 20 deaths. Individuals experiencing homelessness were especially affected during that outbreak.<sup>141</sup>
- The first reported case of Lyme disease in Washington was in 1987. Kitsap County has experienced instances of Lyme disease, and the vector species of tick is present in Kitsap County.<sup>142 143</sup>
- Hantavirus pulmonary syndrome (HPS) is another emerging disease. Hantavirus-infected deer mice (*Peromyscus maniculatus*) can excrete the virus in their urine, saliva, and droppings. Infected deer mice live throughout the state, and people are at risk for HPS in any part of Washington. Deer mice pass the virus to each other, and some of the population is usually infected, but deer mice do not get sick or have any symptoms. Since the disease’s recognition in 1993 through 2017, there have been 51 reported cases of hantavirus pulmonary syndrome in Washington State with 11 (32%) associated deaths. Between 1 and 5 cases occur annually with a geographic distribution throughout the state. The median age of cases in Washington State is 36 years (range 19–75 years). The death rate and median age of cases in Washington are similar to the national rates. There have been no cases of HPS reported within Kitsap County.<sup>144</sup>

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<sup>139</sup> Kitsap County Public Health Department (2019)

<sup>140</sup> Kitsap County Public Health Department (2019)

<sup>141</sup> Kitsap County Public Health Department (2019)

<sup>142</sup> [https://kitsappublichealth.org/CommunityHealth/files/Disease\\_Data\\_Summer\\_2013.pdf](https://kitsappublichealth.org/CommunityHealth/files/Disease_Data_Summer_2013.pdf)

<sup>143</sup> [https://kitsappublichealth.org/CommunityHealth/files/Lyme\\_Provider\\_Advisory\\_20130422.pdf](https://kitsappublichealth.org/CommunityHealth/files/Lyme_Provider_Advisory_20130422.pdf)

<sup>144</sup> Washington Department of Health (2017)

### ***Probability of Future Occurrence***

While the effects of disease on the population have been minor, the potential for large epidemics continues to exist. A disease of epidemic proportions in Kitsap County would very likely be brought in by persons, animals, or materials from elsewhere. In addition, the potential for an epidemic would increase dramatically in the event of a major disaster, such as an earthquake. In such a case, disease may reach a larger population due to the absence or breakdown of normal intervening factors.

### ***Vulnerability Summary***

- A risk rating of “**moderate**” is assigned overall. A large-scale epidemic with the likelihood of deaths could have a devastating impact on the economy and environment for an extended period.
- While the effects of disease on the population have been minor, the potential for large epidemics continues to exist. A disease of epidemic proportions in Kitsap County would very likely be brought in by persons, animals, or materials from elsewhere. The potential for an epidemic would increase dramatically in the event of a major disaster, such as an earthquake. In such a case, the disease may reach a larger population due to the absence or breakdown of standard intervening factors and disruption of usual hygiene practices.

## **Animal Epidemics**

### ***Overview***

Washington Administrative Codes (WAC 246-101-101 and WAC 246-101-405) detail public health responsibilities of veterinarians. All veterinarians are required to report certain conditions to their local health district and/or the Washington Department of Health. The list of diseases includes those that are of significant public health concern, such as anthrax, West Nile Virus, plague, and rabies. Certain diseases with zoonotic potential, eradicated animal diseases, and suspected foreign animal diseases (foot and mouth disease, exotic Newcastle disease) are also reportable to the Washington Department of Agriculture.<sup>145</sup>

Concern regarding zoonotic diseases in Kitsap County focuses on rabies, vector-borne illnesses, and highly pathogenic avian influenza.<sup>146</sup>

### ***Effects***

Reasons for an increase in emerging infections include globalization of the economy, increased world travel, ecological changes such as agricultural shifts, migration, urbanization, deforestation, or dam construction, and increased contact with animals due to development. Globalization and increased travel place more people at risk for these diseases, as well as increase the spread and emergence of infectious diseases in the United States. In many cases, animal epidemics are the result of poor animal husbandry.

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<sup>145</sup> <https://apps.leg.wa.gov/WAC/default.aspx?cite=16-70-020>

<sup>146</sup> Kitsap County Public Health Department (2019)

Most zoonotic diseases are preventable through educating the public of the zoonotic potential of these diseases so that they may take precautions to minimize the risks of infection. For example, the spread of bovine spongiform encephalopathy (BSE), also known as "Mad Cow Disease," made headlines throughout the world in the 1990s. BSE is a transmittable, slowly progressive, and ultimately fatal neurological disorder of adult cattle. The discovery of an infected cow leads to the destruction of a large portion of herds. The primary source of transmission is from the feeding of sheep and cow remains to livestock, and possibly through the injection of hormones taken from the pituitary glands of slaughtered cows to improve breeding.

Foot and mouth disease is a highly contagious viral disease of cattle and swine, as well as sheep, goats, deer, and other cloven-hooved animals. Although rarely transmissible to humans, foot and mouth disease is devastating to livestock and has critical economic consequences with potentially severe losses in the production and marketing of meat and milk. The condition is difficult to control and has occurred in over 60 percent of the world. In today's highly mobile environment, there exists the potential that foot and mouth disease could be accidentally introduced and disseminated in the United States. If foot and mouth disease were to spread in Kitsap County, the cost of containment and eradication could reach billions of dollars, causing extraordinary economic damage.

Psittacosis, an infectious disease-causing diarrhea, wasting, nasal discharge, and sometimes death in birds, is another zoonotic disease that occurs sporadically throughout the county. It can be transmitted to humans and manifests itself as atypical pneumonia accompanied by a high fever. It has occasionally been brought into the county with migratory flocks or through birds imported by pet stores for sale to the general public.

A threat to disease control in the animal population in the county is the popularity of exotic pets, such as potbellied pigs or unusual rodents. Potbellied pigs can become infected with many diseases that could infect not only other potbellied pigs but also agricultural swine and in some cases humans. A monkeypox outbreak in 2003 in the Midwestern United States resulted in 47 confirmed and probable human monkeypox cases resulting from direct or indirect contact with infected prairie dogs.<sup>147</sup> The outbreak was traced to rodents imported from Ghana and destined for the pet trade. These rodents spread the virus to several susceptible non-African species with which they were co-housed, including prairie dogs.

The effects of animal epidemics include such diverse problems as economic loss due to either the direct death of livestock and/or the necessity for euthanasia due to exposure; the need for disposal of the carcasses before they become a secondary health hazard; loss of primary food supplies, such as the possible loss of meat and/or dairy products and animal byproducts such as wool; and the loss of recreation, such as has happened in Washington State with the death of a majority of the coastal razor clam population.

Another effect, the one which threatens Kitsap County the most, is the possibility that an animal epidemic may also infect the human population. Two examples of zoonotic diseases are Lyme disease and West Nile virus. Both of these diseases are zoonotic and were only more recently transferred to human populations. Another example mentioned previously, rabies, is an obvious case of a zoonotic disease that has been with us for centuries. It is also very possible that many

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<sup>147</sup> <https://www.cdc.gov/poxvirus/monkeypox/outbreak.html>



of the epidemics that decimated portions of the world's population had their origin in animal populations.

While no animal or human infections with Asian H5N1 virus have occurred in the United States, in January 2014, Canada reported the first human infection with HPAI Asian H5N1 virus in the Americas. This was an "imported" case. Influenza is a virus that can mutate into potentially harmful strains that can be transmitted from human to human and is a virus that is of higher concern to public health officials.<sup>148</sup>

### ***History***

In Kitsap County there has been historic evidence of rabies and psittacosis, as well as a few other diseases. Most of these have not occurred in epidemic proportions. In the United States, one to three human rabies deaths occur each year.<sup>149</sup> Worldwide, however, there are more than 59,000 human rabies deaths per year, most in developing countries.<sup>150</sup> In Washington State, bats are the primary carrier for rabies; bats in Kitsap County have tested positive for rabies as recently as 2018.<sup>151</sup> Generally, bats do not attack people, although there are incidents where animals and people have been bitten without provocation or have had bats in their sleeping areas without knowing that they were bitten. In other parts of the country, various other species, such as raccoons, coyotes, and skunks, are known rabies reservoirs. Between 2008 and 2018, two cats and two "other domestic" animals have tested positive for rabies statewide.<sup>152</sup> Nonetheless, due to the serious consequences of rabies, the Health Department monitors it carefully.

### ***Probability of Future Occurrence***

Except for pets, all animals entering Washington are required to have a certificate of health. For some species, tests or vaccinations are required. Dogs, cats, and ferrets are required to have a current rabies certificate. However, there is limited control over companion animals entering from other states. Many people with pets move into Washington on a regular basis. This is especially true in areas such as Kitsap County, where military personnel are continually transferring into or out of the area. In many instances, pet owners do not know that current rabies vaccination status is required to legally bring their pets into the State. The lack of entrance stations to enforce the certification regulations leaves our community open to the importation of diseased animals from other parts of the country. Department of Agriculture enforcement officers have occasionally caught dog and cat breeders attempting to bring in animals with forged health certificates.

Diseases that can cause epidemics in animals could gain a foothold in Kitsap County in a number of ways. Exotic diseases could be brought in with legally or illegally imported animals from some other part of the country or world. Another potential disease source includes infected animals traveling across the border from neighboring states or British Columbia. Avian diseases could be brought in by birds on their annual migration between Alaska and Canada or from areas as far south as Mexico or South America. Contaminated garbage tossed overboard from a ship off the

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<sup>148</sup> Kitsap County Public Health Department (2019)

<sup>149</sup> [https://www.cdc.gov/rabies/location/usa/surveillance/human\\_rabies.html](https://www.cdc.gov/rabies/location/usa/surveillance/human_rabies.html)

<sup>150</sup> <https://www.cdc.gov/features/rabies/index.html>

<sup>151</sup> [https://kitsappublichealth.org/CommunityHealth/rabies\\_bats.php](https://kitsappublichealth.org/CommunityHealth/rabies_bats.php)

<sup>152</sup> <https://www.doh.wa.gov/Portals/1/Documents/5100/rabiested-past1988-2018.pdf>

coast has been identified as a potential disease vector when it washes up on shore and is eaten by animals.

With warmer temperatures due to climate change, Kitsap County is likely to see more vector-borne illnesses, especially those transmitted by mosquitoes and ticks. West Nile Virus is present in Washington State (although no recent cases were acquired in Kitsap County).<sup>153</sup>

Climate change is also causing concern regarding the county's freshwater and marine environments. Toxic blue-green algae blooms, for example, favor warmer temperatures and can endanger human health, the environment, and the economy. Blue-green algae can lead to poisoning from nerve toxin (neurotoxins) and liver toxins (hepatotoxins). It can also kill fish, waterfowl, or other animals. Climate change not only will affect temperatures but also the chemistry of our oceans. According to the Washington State Department of Health, "shellfish shells are less likely to form in an acidic environment, which compromises the future of this valuable high-protein, low-fat food source)."<sup>154</sup>

### ***Vulnerability Summary***

- The possibility of catastrophic disease affecting animals within the confines of Kitsap County is a genuine, although seldom considered, threat. Epidemics, both animal and human, are usually introduced from outside the immediate area, in many cases by vectors or from foreign countries.
- Diseases imported from other countries could create the worst epidemics in the future. Many diseases that public health officials have not worried about for years, if not decades, not to mention some that have never existed in Washington, still exist in many parts of the world. These include such diseases as African swine fever, African horse sickness, foot and mouth disease, and anthrax. Diseases such as BSE and avian influenza demonstrate the potential severity of an epidemic on both livestock and humans.
- The frequency of emerging and re-emerging infections has been increasing. A disease is classified as emerging if it has appeared for the first time, has increased in incidence, or has been reported in new areas. The majority of these emerging diseases are zoonotic diseases, which may present as an epidemic in animals. Mitigation for animal epidemics revolves around prevention and exclusion from the County and State.
- While many animals entering Washington are required to have testing and vaccinations, many of their owners are unaware of the requirements. There is limited control over companion animals coming from other states, and without controlled entrance stations at Washington's borders, this will never be fully effective.
- Generally, the public is unaware that the State requires that all animal bites be reported to their local public health jurisdiction.
- Interstate movement of animals is regulated by the U.S. Department of Agriculture Animal/Plant Inspection Services and the Washington Department of Agriculture Food Safety/Animal Health Division. Both agencies also cooperate in the detection, diagnosis,

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<sup>153</sup> Kitsap County Public Health Department (2019)

<sup>154</sup> Kitsap County Public Health Department (2019)

and control of foreign animal disease, as well as cooperative disease eradication programs such as for brucellosis, tuberculosis, pseudo rabies, salmonella in poultry, and scrapie in sheep.

- Following through with the State's requirements that all garbage from foreign ships be incinerated, or, in the case of food waste, "cooked" by licensed cookers before being used for animal food, will continue to help prevent the importation of diseases from foreign ports.
- With warmer temperatures due to climate change, the county is likely to see more vector-borne illness, especially transmitted by mosquitoes and ticks. Abatement and public education activities should help prevent the spread of disease.

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