PART 2—RISK ASSESSMENT

CHAPTER 8.
RISK ASSESSMENT METHODOLOGY AND GENERAL CONCEPTS

8.1 INTRODUCTION

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- Hazard identification—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- Vulnerability identification—Determine the impact of natural hazard events on the people, property, environment, economy and lands of the region.
- Cost evaluation—Estimate the cost of potential damage or cost that can be avoided by mitigation.

The risk assessment for this hazard mitigation plan evaluates the risk of natural hazards prevalent in Snohomish County and meets requirements of the DMA (44CFR, Section 201.6(c)(2)).

8.2 METHODOLOGY

Chapters 10 through 18 describe the risks associated with each hazard of concern identified for Snohomish County. Each chapter elaborates on the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- Identify and profile each hazard—The following information is given for each hazard:
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity estimates
  - Warning time likely to be available for response.
- Determine exposure to each hazard—Exposure was determined by overlaying hazards with an inventory of potentially vulnerable structures, facilities, and systems to determine which of them would be exposed to each hazard. The Snohomish County geographical information system (GIS) database contains extensive coverage of infrastructure.
- Assess the vulnerability of exposed facilities—Vulnerability of the exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and FEMA's hazard-modeling program called HAZUS were used to perform this assessment for the flood, dam failure and earthquake hazards. Outputs similar to those from HAZUS were generated for other hazards, using maps generated by the HAZUS program.

8.3 IDENTIFIED HAZARDS OF CONCERN

For this update, the Steering Committee considered the full range of natural hazards that could impact the planning area and then ranked the hazards that present the greatest concern. The process incorporated review of the *Washington State Enhanced Hazard Mitigation Plan*, the initial *Snohomish County Natural Hazard Mitigation Plan*, and the annual progress reports for the initial County plan. Also considered were local, state and federal information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Additionally, relevant qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was used. Based on the review, this plan update addresses the same hazards of concern as identified for the initial plan:

- Avalanche
- Dam failure
- Earthquake
- Flooding
- Landslide and other mass movements
- Severe weather
- Tsunami/seiche
- Volcano
- Wildland fire.

With the exception of dam failure, technological hazards, such as hazardous material incidents, and man-made hazards, such as terrorist acts, are not addressed in this plan. The DMA regulations do not require consideration of such hazards, and the planning partnership chose not to include them in this plan. A profile of dam failure is provided for informational purposes only under Chapter 11 of this volume. This is consistent with the current update to the Washington State Enhanced Mitigation Plan.

8.4 RISK ASSESSMENT TOOLS

8.4.1 Dam Failure, Earthquake and Flood—HAZUS-MH

Overview

In 1997, FEMA developed the standardized Hazards U.S., or HAZUS, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. HAZUS was later expanded into a multi-hazard methodology, HAZUS-MH, with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards.

HAZUS-MH is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication and interaction with local stakeholders.

- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

The version used for this plan was HAZUS-MH MR3, released by FEMA in September 2007. New data and tools released with MR3 include the following:

- Building valuations were updated.
- Building counts for single-family dwellings and manufactured housing are based on census counts instead of calculations.
- New tools in the flood model enable the user to import user-supplied flood maps and flood depth grids or generate a flood depth grid using specified Digital Flood Insurance Rate Map (DFIRM) floodplain boundaries and digital elevation grids.

Levels of Detail for Evaluation

HAZUS-MH provides default data for inventory, vulnerability and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Application for This Plan

The following methods were used to assess specific hazards for this plan:

- **Flood**—A Level 2 analysis was performed. GIS building and assessor data (replacement cost values and detailed structure information) for 6,707 facilities were loaded into HAZUS-MH. An updated inventory was used in place of the HAZUS-MH defaults for essential facilities, transportation and utilities. Current Snohomish County DFIRMs were used to delineate flood hazard areas and estimate potential losses from the 100- and 500-year flood events. Using the DFIRM floodplain boundaries and LIDAR digital elevation grids, a flood depth grid was generated and integrated into the model.

  A special component of this plan update process involved construction of the flood model for HAZUS. Funds were provided in the FEMA grant to acquire property-specific, finished floor elevation data in the form of completed FEMA elevation certificates of targeted structures within the planning area. The planning team identified repetitive loss properties for which elevation certificate data did not exist.

  Field surveys by licensed professional surveyors were completed on 66 properties. FEMA elevation certificates were created for each property. Copies of the certificates were provided to each property owner. This data was then merged with other elevation certificate data that the County had acquired through the floodplain development permitting process. These finished floor elevations were then used to calibrate the finished floor elevations in the

HAZUS model for the user defined analysis. In all, lowest floor elevation data was entered for over 300 structures. Each major river basin in the planning area was canvassed to create regional correlations for the model.

- **Dam Failure**—Dam failure inundation mapping for Snohomish County was collected where available. This data was imported into HAZUS-MH and a modified Level 2 analysis was run using the flood methodology described above and an updated inventory of 5,065 facilities.
- **Earthquake**—A Level 2 HAZUS-MH analysis was performed to analyze the earthquake hazard. Updated general building stock and critical facilities data was used in place of the HAZUS-MH defaults. Earthquake shake maps and probabilistic data prepared by the U.S. Geological Survey (USGS) were used for the analysis.

8.4.2 Tsunami—Modified HAZUS-MH

Although HAZUS-MH does not directly model tsunami damage, model inputs, including damage functions, may be changed to help assess the hazard. HAZUS-MH MR3 has been adapted by Tetra Tech to analyze the tsunami hazard. Damage functions from coastal storm surge models contained in HAZUS-MH were modified and applied to general building stock and critical facilities inventories. This level of analysis is considered to be Level 2 or higher.

To model the tsunami hazard, a tsunami hazard zone was created using state and local map data as well as reviewing historical events. The Washington Department of Natural Resources (DNR) and the National Oceanic and Atmospheric Administration's (NOAA) Center for Tsunami Mapping Efforts have recently created a model simulating tsunami impacts from a 7.3-magnitude seismic event along the Seattle Fault. Using this simulation, the planning team created an estimated inundation area by extracting the maximum wave run-up height from the simulation model for the planning area and subtracting the still-water elevation from the FEMA flood insurance study. Depth grids were created by entering this data into the coastal flood module of HAZUS-MH. This created a map of the estimated area of inundation from this scenario. No attempt was made to assign probabilities to the event. This information is based on historically observed data and was developed primarily for emergency response planning and public education. At the time of this analysis, this is considered to be the best available information.

Two procedures were used to analyze and model the potential damage due to tsunami. The first procedure involved identifying the exposure to the tsunami hazard. The second procedure involved altering the HAZUS-MH coastal flood model to develop loss estimates.

To analyze exposure, the tsunami hazard zones were overlaid with the HAZUS-MH inventory. Buildings in the hazard zones were then added. This is not a true loss estimate since it shows all buildings in the tsunami hazard zone.

FEMA has developed a methodology to model storm surge during a hurricane using HAZUS-MH. This methodology involves setting up a coastal flood scenario using the surge height as the 100-year still-water elevation. After running the analysis, the 100-year results show damage due to the storm surge. A similar methodology was used to model the tsunami loss. Tsunami heights taken from the hazard zones created by the planning team were input into the model as the incremental still-water elevations.

The tsunami damage functions are different from those of a typical coastal storm, but damage functions may be edited in HAZUS-MH. To edit the damage functions, the tsunami damage components were compared to those of a coastal flood. The tsunami damage function includes the following:

- Breaking wave forces—Breaking wave forces typically take place offshore with the exception of very steep beaches. Due to the beaches' physical characteristics derived from the elevation data, these forces were removed from consideration.
- Hydrostatic forces—Hydrostatic forces act on buildings during a tsunami.
- Buoyant forces—Buoyant forces act vertically through the center of mass of the displaced volume and are a major concern for wood frame buildings. This component needs to be captured for certain structures.
- Hydrodynamic forces—Hydrodynamic forces occur when steady water flows around a building. These forces are captured in the model's damage function but they need to be modified slightly. In the model's damage function, water deeper than 3 feet causes substantially more damage than water less than 3 feet. In a tsunami, there may be substantial damage below 3 feet, so this component was modified accordingly.
- Surge forces—Surge forces are caused by the leading edge of a surge of water.
- Impact forces—Impact forces are caused by debris impacting the structures. This component may be significant near piers and ports, where boats may behave as missile-like debris. HAZUS was used to identify the pier and port locations. A separate damage function was developed for census tracts near these locations.

These updated damage functions were applied to the asset inventory using typical HAZUS protocol to estimate damage costs.

8.4.3 Landslide, Severe Weather, Volcano and Wildland Fire

For most of the hazards evaluated in this risk assessment, historical data was not adequate to model future losses. However, HAZUS-MH is able to map hazard areas and calculate exposures if geographic information is available on the locations of the hazards and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. No exposure analysis was performed for the avalanche hazard because no mapping was available for that hazard. County-relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. The primary data source was the Snohomish County GIS database, augmented with state and federal data sets. Additional data sources for specific hazards were as follows:

- **Landslide**—Landslide data included the following:
  - Snohomish County Critical Areas Ordinance landslide hazard areas, defined as a combination of slopes greater than 15 percent, impermeable soils, and springs or groundwater seepage
  - DNR Geology and Earth Resources Division landslide data, which includes a compilation of previously mapped landslides from a variety of sources at multiple map scales.
- **Severe Weather**—Severe weather data was downloaded from the Natural Resources Conservation Services and the National Climatic Data Center.
- **Volcano**—Volcanic hazard data was obtained from the USGS Cascade Volcano Observatory.
- **Wildland Fire**—The Washington State DNR provided data for wildland-urban interface areas (WUIAs) augmented by the Zone 11 fire chiefs within the planning partnership.

8.4.4 Limitations

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. The results do not predict precise results and should be used only to understand relative risk. Over the long term, Snohomish County and its planning partners will collect additional data to assist in estimating potential losses associated with other hazards.

8.5 CLIMATE CHANGE

According to the National Academy of Sciences, the earth's surface temperature has risen by about 1ºF in the past century, with accelerated warming during the past two decades. Most warming over the last 50 years is attributed to human activities. Around the world and in the Pacific Northwest, noticeable changes in natural resources and plants and animals have been associated with this warming, from shrinking glaciers and mountain snow packs to altered migratory patterns. These changes are expected to continue as global warming intensifies. Climate change could have several impacts on the occurrence and severity of natural hazards around the world:

- Higher temperatures
- Changing hydrograph
- Changing landscapes
- Wildlife at risk
- Sea level rise
- Increased risk of drought, fire and floods
- Stronger storms and increased storm damage
- More heat-related illness and disease
- Economic losses.

In the coming decades, climate change is expected to exacerbate the risks of disasters, not only from more frequent and intense hazard events but also through greater vulnerability to existing hazards. More frequent and intense storms and floods and long-lasting droughts can erode existing community capacity to prepare, respond and rebuild after successive hazard events. Adverse impacts of climate change on public health, ecosystems, food security, migration and vulnerable groups such as children and the elderly will increase the vulnerability of communities to natural hazards of all types.

This hazard mitigation plan addresses climate change as a subset or secondary impact for each identified hazard of concern. Therefore, each chapter of this plan addressing one of the hazards of concern includes

a section with an anecdotal discussion on the probable impacts of climate change for that hazard. While many models are currently being developed to assess the potential impacts of global climate change, there are currently none available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

8.6 PRESIDENTIAL DISASTER DECLARATIONS

Presidential disaster declarations are typically issued for events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Snohomish County has experienced 23 events since 1960 for which presidential disaster declarations were issued. These events are listed in Table 8-1.

TABLE 8-1.
PRESIDENTIAL DISASTER DECLARATIONS FOR HAZARD EVENTS IN SNOHOMISH COUNTY

Type of Event	Disaster Declaration #	Date
Flood, Wind	137	10/1962
Heavy Rains and Flooding	185	12/29/1964
Earthquake	196	5/1965
Severe Storms, Flooding	492	12/13/1975
Severe Storms, Mudslides, Flooding	545	12/10/1977
Storms, High Tides, Mudslides, Flooding	612	12/31/1979
Mt. St. Helens Volcanic Eruption	623	5/1980
Severe Storms, Flooding	784	12/15/1986
Flooding, Severe Storm	852	1/18/1990
Flooding, Severe Storm	883	11/26/1990
High Tides, Severe Storm	896	3/8/1991
Severe Storm, High Winds	981	3/4/1993
Storms, High Winds, Floods	1079	1/3/1996
Severe Storms, Flooding	1100	2/9/1996
Severe Winter Storms, Flooding	1159	1/17/1997
Severe Storms, Flooding, Landslides, and Mudslides	1172	4/2/1997
Nisqually Earthquake	1361	3/1/2001
Severe Storms and Flooding	1499	11/7/2003
Severe Storms, Flooding, Landslides, and Mudslides	1671	12/12/2006
Severe Winter Storm, Landslides, and Mudslides	1682	2/14/2007
Severe Storms, Flooding, Landslides, and Mudslides	1734	12/8/2007
Severe Winter Storm, Landslides, Mudslides, and Flooding	1817	1/30/2009
Severe Winter Storm and Record and Near Record Snow	1825	3/2/2009

Review of these larger scale events helps identify targets for risk reduction and ways to increase a community's capability to avoid large scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern.

8.7 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after any hazard event. Critical facilities are typically defined to include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, and the utilities that provide water, electricity and communication services to the community. Also included are "Tier II" facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event. During this update process, the Steering Committee chose to enhance the definition of critical facilities for the updated plan as follows:

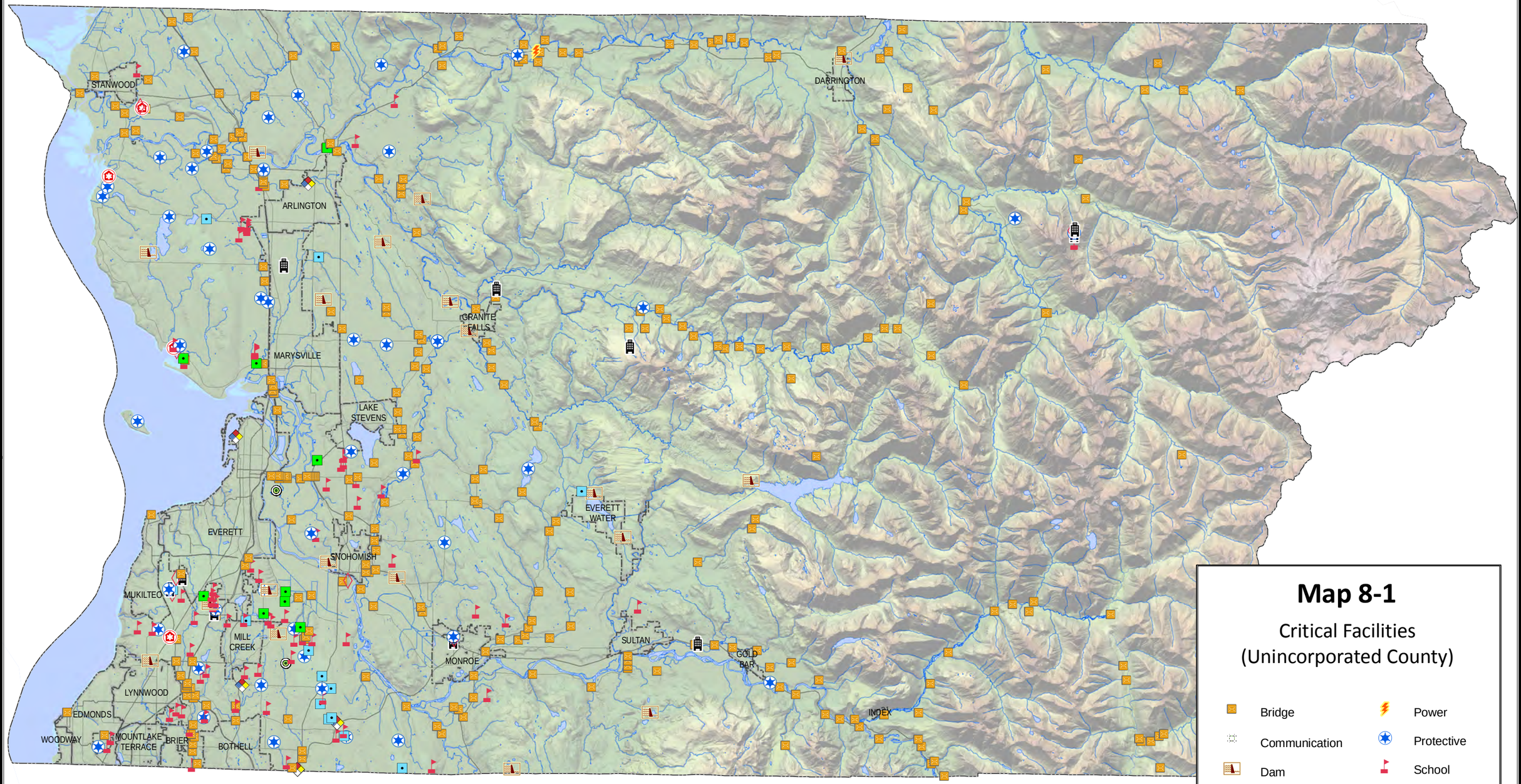
- **Critical Facilities:** Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:
  - Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials
  - Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event
  - Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events
  - Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events
  - Government facilities (city hall, judicial, emergency management).

A database of critical facilities within the planning area was created to identify vulnerabilities to each hazard addressed by this plan. Due to the sensitivity of this information, a detailed list of facilities is not provided in this plan. The list is on file with each planning partner. The risk assessment for each hazard anecdotally discusses critical facilities with regard to that hazard. Map 8-1 shows the location of critical facilities assessed by this plan.

8.8 FUTURE TRENDS IN DEVELOPMENT

Snohomish County Tomorrow, an analysis of buildable lands, was used to assess future trends in development. Buildable lands provide an evaluation of future land, housing and employment needs and define future land capacity for urban growth areas as well as rural lands. This analysis takes into account city and county comprehensive plans and zoning as well as critical areas information.

The buildable lands analysis assessed the likelihood that new development will occur in hazard-prone areas. Hazard information was overlaid on buildable lands data to determine the potential hazard for future development. GIS information on buildable lands was provided by Snohomish County. The information used for city urban growth areas (UGAs) is final data, whereas the data for rural lands was received as a draft and may have to be adjusted in the future. Future trends in development are discussed for each hazard.



Map 8-1

Critical Facilities (Unincorporated County)

- Bridge
- Communication
- Dam
- Government
- Hazmat
- Medical
- Power
- Protective
- School
- Wastewater
- Water
- Other

Snohomish County

Tetra Tech, Inc.
May 2010

Data Sources:
Snohomish County
Project Planning Partners
Washington State Department of Natural Resources
Division of Geology and Earth Resources

0 2.5 5 10 Kilometers

0 2.5 5 10 Miles

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CHAPTER 9.
SNOHOMISH COUNTY PROFILE

9.1 INTRODUCTION

Snohomish County is located on Puget Sound in Western Washington (see Figure 9-1). Given the mountainous geography in the eastern portion of the County, the bulk of Snohomish County's development and population is centered along the narrow, westernmost Puget Sound lowlands. The County is bounded on the north by Skagit County, on the east by Chelan County, on the south by King County, and on the west by Puget Sound and Island County.

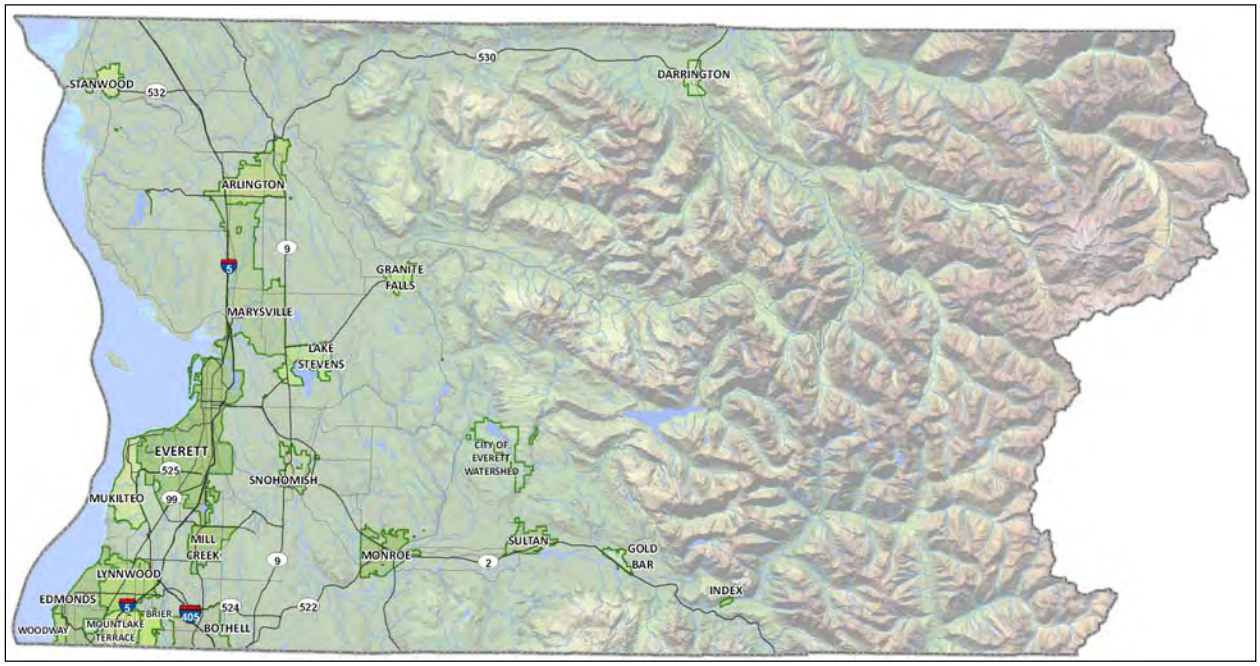


Figure 9-1. Main Features of Snohomish County

Snohomish County is ranked third in the state in population. Its major cities are Everett, Edmonds, Marysville and Lynnwood. Other cities include Arlington, Bothell, Brier, Gold Bar, Granite Falls, Lake Stevens, Mill Creek, Monroe, Mountlake Terrace, Mukilteo, Snohomish, Stanwood, Sultan and Woodway. Snohomish County is also home to the incorporated Towns of Index and Darrington, as well as the Tulalip Reservation. Much of the population is located along the transportation corridors, which are also interspersed with commercial and industrial operations. Management and professional occupations, sales and manufacturing are important base industries in the County. Snohomish County is the home of the Boeing Company's largest aerospace assembly plant.

Since a considerable portion of the land in Snohomish County consists of forestland, there is an abundance of recreational opportunity and access to natural resources. Snohomish County is a destination for those seeking golfing, boating, hiking, camping, fishing and hunting activities.

9.2 HISTORICAL OVERVIEW

Several native tribes, including the Snoqualmie, Skykomish, Sauk-Suiattle, Stillaguamish and Snohomish, occupied the region that is presently recognized as Snohomish County. Thirteen tribes are presently represented on the Tulalip Reservation, including members who are the direct descendants of the Snohomish, Snoqualmie, Skykomish and other Salish tribes. The Stillaguamish people, a division of the Coastal Salish Tribe, were formerly located on the Stillaguamish River. The Stillaguamish are closely related to the Snohomish, and are now on the Tulalip Reservation, but their numbers are not reported separately. The Sauk-Suiattle tribe, whose ancestors originally inhabited the area now known as the Town of Darrington, maintains the 33.5-acre Sauk-Suiattle Reservation near the town. Although cultural traditions vary among the tribes, the native Lushootseed language is spoken by many Salishan groups.

Archaeological records indicate that these tribes consisted of hunters, gatherers and fishermen whose vast territories covered the region's mountains, prairies and river systems. Most of the major rivers in Snohomish County are named after the Native Americans who lived on their banks, fished from their waters and used the waterways for transportation. From the foothills of the North Cascades to Puget Sound, the native people lived on wild game, salmon, shellfish, berries, roots and bulbs. In addition to being skilled hunter-gatherers, these tribes were accomplished fur traders, traveling by canoe from southern Puget Sound to Canada.

In 1792, Captain George Vancouver arrived in the coastal area to claim the Pacific Northwest for Great Britain. Captain Vancouver named much of the area, including Puget Sound, Port Gardner Bay in Everett and Port Susan Bay in Stanwood. By the 1840s, European-American settlers started to move into the Puget Sound region and the U.S. government began selling land and open areas for homesteads without having title to the land. As white settlers moved into the territory, local tribes experienced considerable losses. Contact with early settlers involving land disputes and the introduction of diseases and alcohol greatly reduced the tribal populations. In 1855, the area tribes collectively signed the Point Elliot Treaty with the U.S. government, relinquishing all tribal lands between Puget Sound and the mountains. The treaty combined the multiple allied tribes and bands into the Tulalip Tribes, but it was not until 1873 that the promised Tulalip Reservation was established by Presidential Executive Order. Today the Tulalip Tribes are a federally recognized nation whose designated reservation encompasses 22,000 acres, over half of which is in federal trust land.

Snohomish County was created on January 20, 1861 from neighboring Island County. The County was named after the dominant local Native American tribe, although the Indian interpretation of Snohomish is widely disputed. Some suggested meanings of Snohomish include, "union", "coming together" or "a style of union among them," while others have said that it means "sleeping waters" or "the braves." Chief William Shelton, last of the hereditary Snohomish chiefs, interpreted the County's namesake to mean "lowland people."

During the mid to late 1800s, settlements were founded at Mukilteo, Snohomish, Lowell (now part of Everett), Tualco (near Monroe), Stanwood and Edmonds. The county seat was originally located at Mukilteo, but was moved to the City of Snohomish in 1861 and finally to Everett in 1895.

Expansion of the Great Northern Railway down the Skykomish Valley into the City of Everett during the 1890s brought the industrial boom to Snohomish County. The small towns of Index, Sultan, Gold Bar and Startup, situated along the tracks, owe much of their existence to the railway. A nationwide depression in 1893 put a halt to much of the area's growth and prosperity, but the lull was followed by recovery with steadier growth based on timber and farming. Following World War II, growth exploded in the southwestern part of the County, as the City of Seattle influenced the development of the suburban cities of Lynnwood, Brier, Mountlake Terrace, Mill Creek and Woodway.

Snohomish County's population further expanded in the late 1960s following the construction of the Boeing 747 plant at Paine Field near Everett. Subsequent development of other high technology industries along the north Interstate 405 (I-405) corridor and north toward Lake Stevens and Marysville brought population increases in those areas as well. During the last 30 years, the older, traditional economic mainstays of farming, logging, lumber, and paper production began declining, which affected the economies and lifestyles of many of the County's natural resource based communities. The people of Snohomish County faced significant changes and challenges as they adapted to a rapidly growing population and economic growth.

During the 1990s, Snohomish County's population grew by about 30 percent. Snohomish County is consistently ranked as one of the fastest growing counties in the United States. Steady growth in regional technology industries, the construction of a U.S. Naval Station in Everett and a major expansion of the Boeing plant to accommodate larger airplanes all contributed to the County's continued prosperity. With continued expansion of the Boeing plant and an economy attuned to foreign trade, the County appears able to withstand economic downturns better than many other regions of the country.

Occupations for Snohomish County residents range from farming and ranching operations to high tech manufacturing, military operations and medical field professions. Major private employers include Boeing (with an estimated 20,000 employees), Providence Medical Center, Premera-Blue Cross and the Tulalip Tribes. Major public employers in Snohomish County include the U.S. Naval Station, the State of Washington and Snohomish County.

9.3 GEOGRAPHICAL SETTING

Its area of 2,196 square miles (2,089 square miles of land and 107 square miles of water), makes Snohomish County Washington's 13th largest county in land area. The County's topography ranges from saltwater beaches, rolling hills and rich river bottom farmlands in the west to dense forest and alpine wilderness in the mountainous east. More than half of the county is mountainous, with a number of peaks reaching elevations in excess of 6,000 feet and supporting glaciers and perennial snowfields. Glacier Peak (see Figure 9-2), at 10,541 feet, is the highest point in the County and one of the highest points in the state. Sixty-eight percent of the County's land cover is forestland, 18 percent is rural, 9 percent is urbanized and 5 percent is agricultural.

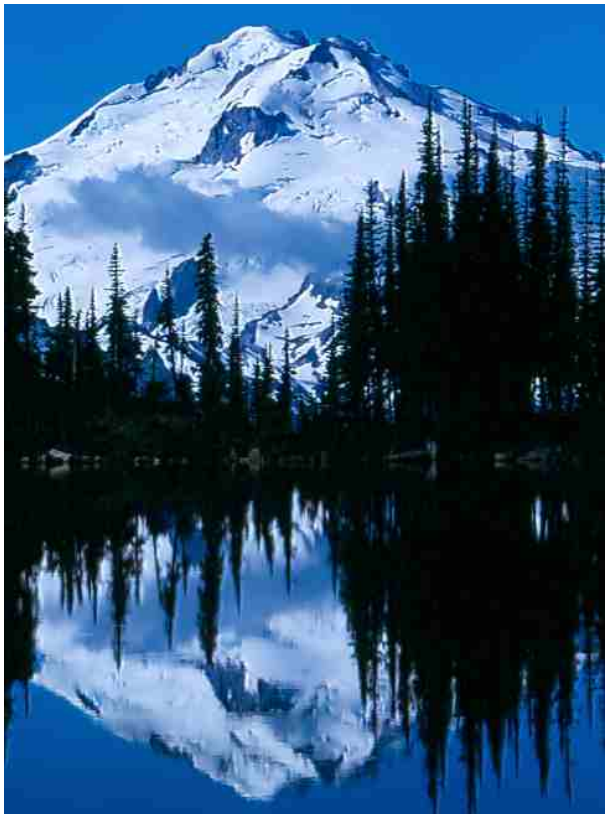


Figure 9-2. Glacier Peak (Photo courtesy of Cal State LA, Department of Geological Sciences)

Most of the County's communities are in the western lowlands near primary transportation corridors including Interstate-5, State Route-9, US Highway-2 and State Route-530. In addition to auto transportation, Snohomish County hosts multiple railways connecting the communities to Puget Sound and Canada. Many sections of the historic railways have been converted to recreational trail systems such as the Interurban Trail and Centennial Trail, while others are used for the Sound Transit commuter train and freight trains.

Snohomish County contains five "water resource inventory areas" (WRIAs) and two major river basins:

- Covering approximately 1,856 square miles in King and Snohomish Counties, the Snohomish River Basin contains over 2,700 miles of stream, making it the second largest basin draining to Puget Sound. The Skykomish River drains most of the southern part of the County. The headwaters of the Skykomish and Snoqualmie Rivers originate in the Cascade Mountains and flow west nearby several rural communities and state highways. The confluence of these two major rivers is at the City of Monroe where they become the Snohomish River. The Snohomish River continues to the estuary near the City of Snohomish and reaches Puget Sound between the cities of Everett and Marysville.
- The Stillaguamish River Basin is about 700 square miles in area, with about 3,100 miles in stream length. Located in the northern half of the County, the Stillaguamish River drains approximately one-half of the County's land area. With basin streams originating in Skagit and Snohomish County, the "Stilly" is the fifth largest tributary draining into Puget Sound.

The Sauk River, in the northeastern corner of the County near Darrington, drains into the Skagit River about a mile beyond the County's northern boundary. There are over 460 lakes and reservoirs in Snohomish County. Of these, 207 are at elevations above 2,500 feet. These lakes serve as popular tourist attractions and recreational sites. The larger lakes include Lake Goodwin, Lake Stevens, Silver Lake and Lake Ballinger. Lake Chaplin and Spada Lake are held by dams and are used as reservoirs.

The Cascade Range is a 1,000-mile long chain of mountains that began forming about 36 million years ago. The mountain range extends from northern California through Oregon and Washington to southern British Columbia. The Northern Cascade Range passes through the eastern two-thirds of Snohomish County. Glacier Peak, the only volcano in Snohomish County, is in the northeast quadrant of the County. The composite volcano is relatively secluded and is not easily discernible to the layperson.

9.3.1 Geology

Western Washington owes much of its geologic condition to plate tectonics. The Juan de Fuca Plate, a small, low-lying oceanic plate, is moving under the western edge of the North American Plate at the Cascadia Subduction Zone. Friction at the subduction zone causes earthquakes of considerable magnitude, which may generate tsunamis. As the dense oceanic crust is gravitationally pulled under the continental plate and deep into the mantle, parts of the crust turn into magma. The buoyant magma from the melting oceanic plate rises in plumes, resulting in the creation of volcanoes such as Glacier Peak.

Also contributing to the geology of Snohomish County were multiple periods of glaciation. Glaciers advanced from Canada and retreated four or more times. Over a few million years, Puget Sound was carved and scoured by movement of the continental glaciers. Twenty thousand years ago, glaciers covered all of the land between the Olympics and the Cascade Mountains and spread as far south as Olympia. The dense ice over the area was as much as 3,412 feet deep. When the ice finally retreated to the north about 13,000 years ago, it left behind deeply gouged channels, north-south oriented passages and bays. Weather, waves, rivers and gravity reworked the glacial sediment, molding landforms and shorelines into the beaches and bluffs that now edge the Puget Sound region.

Many faults exist in the mountains and valleys in Snohomish County as the mountains continue building. Erosion of the Cascade Range over thousands of years has filled the valleys with alluvial sediment, creating broad, flat surfaces and soft soils. The rivers cut through these valleys, transporting and re-distributing nutrient rich sediments throughout the productive floodplains. Though seismic activity in Snohomish County has been moderate to low, many active faults in the County are capable of producing high magnitude earthquakes that could damage critical infrastructure such as water mains, gas lines, roads, major highways, bridges and railways, particularly in locations with soft soil.

9.3.2 Climate

As Snohomish County's landscape varies significantly between the valley and neighboring mountains, so does its climate. Locations along Puget Sound are characterized by mild summers and rainy, wet winters with occasional snowfall. Communities in the Cascades enjoy cooler summer weather and are considerably colder and snowy during winter.

The ocean currents that flow along Washington State's coast significantly influence Snohomish County's climate. The climate is classified as "Mild Maritime" in the lowland areas, with lower temperatures and higher precipitation at higher elevations. As with most maritime climates, temperatures in Snohomish County are moderate and do not vary significantly between summer and winter. Daily coastal temperatures in the City of Everett average 62.8ºF during July and 39ºF in January. Everett is about 59 feet above sea level and its mean annual temperature is 50.5ºF. In the mountain valley town of Darrington, at 547 feet above sea level, the annual average temperate is 48.7ºF. Summer temperatures in Darrington average 63.7ºF and winter temperatures are typically around 34.2ºF. Average summer maximum temperatures in the mountains are typically about 75ºF.

Rain may be experienced year-round in Snohomish County, although most precipitation occurs during the fall and winter. Much of the rainfall is attributed to storm fronts coming from the west across the Pacific Ocean. Moisture from Pacific storms falls on the windward (western) side of the Cascade Range through orographic processes—as warm, moist air is forced over the mountains, the air cools and expands, until the dew point is reached. The moisture then condenses and precipitates on the western slope and at the top of the mountain range. Therefore, precipitation within the County varies widely depending on location. At the western boundary of the county, annual average precipitation in the City of Everett is 35 inches. The Town of Darrington near the northern County boundary and within a mountain valley receives 80.4 inches of mean annual precipitation. The Sultan Basin, a mountainous area near the center of the County, is estimated to receive in excess of 200 inches annually.

9.3.3 Soils

The U.S. Soil Conservation Service (SCS, now known as the Natural Resources Conservation Service or NRCS) published a soil survey for the Snohomish County area in 1983. Mapping units and associated maps describe the prevailing soils and include information about parent rock materials, soil depth, erosion, and slope. Snohomish County's soils may be classified into six mapping units:

- **Puget-Sultan Pilchuck**—These soils are found on the floodplains along major rivers and streams. They generally have a slope of 0 to 3 percent, and the dominant vegetation consists of conifers and hardwoods. These soils are in broad, flat locations typically used for pasture, cropland, hay and urban development. The main limitation for cultivated crops is the high water table, particularly in areas with depressions. Seasonal flooding and excessive soil moisture are common.
- **Norma-Lynnwood-Custer**—These are generally soils formed on ancient outwash plains, glacial till plains and terraces along the I-5 corridor between Marysville and Arlington, and in the area above the Stillaguamish floodplain north and northeast of Arlington. They are found on slopes of 0 to 90 percent and are vegetated by conifers and hardwoods. These soils are utilized for hay and pasture, cropland, woodland and urban development. Seasonal high water, soil wetness, water ponding and steep slopes limit the uses of these soils. Where housing density is moderate to high, community sewage systems are needed to prevent contamination of water supplies by onsite individual sewage disposal seepage.
- **Alderwood-Everett**—This soil unit is found along the coast of Puget Sound and makes up the largest soil unit in the soil survey area. This area includes the Tulalip Indian Reservation,

Everett and all of the communities west of the Snoqualmie and Snohomish Rivers. Slopes range from 0 to 70 percent and the land is vegetated mainly by conifers. These soils form on till plains, outwash plains and terraces and tend to be gravelly and sandy. This unit is used as woodland, hay/pastureland and for urban development. Hardpan, excessive wetness and slope steepness limit the types of development.

- **Tokul-Pastik**—These soils are generally found on till plains and terraces in the Cascade foothills in central Snohomish County and in the river valleys above the floodplains of the North Fork Stillaguamish, Sauk and Skykomish Rivers. Slopes range from 0 to 50 percent and are vegetated mainly by conifers. These soils developed in glacial till, volcanic ash and lake sediments. This mapping unit is mainly used for woodlands. Soil wetness, slope and hardpan limit development and use as pastureland.
- **Elwell-Olomount-Skykomish**—These soils are found in the high foothills, mountainsides and ridge tops of the central part of the county and have slopes of 30 to 90 percent. The main vegetation is conifers. The soils formed in glacial till, outwash, volcanic ash and in igneous rock parent material. Given the gravelly loam subsoil and the igneous rock substratum and outcrops, this unit is limited to use as woodland, watershed and wildlife habitats.
- **Getchell-Oso**—These soils are found on the high mountainsides and ridge tops and have slopes ranging from 3 to 90 percent. The main vegetation is conifers. These soils formed in dense alpine glacial till, volcanic ash and andesite parent material. Slope steepness limits timber harvesting, so the unit is primarily used as woodland, watershed and wildlife habitats.

The general soil types apply primarily to the western half of the county. Soil types in the mountainous eastern half are similar to the Elwell-Olomount-Skykomish and Getchell-Oso soils.

The soils have varying levels of susceptibility to weathering and erosion, but all soils benefit from conservation management techniques to prevent accelerated erosion. Topsoil erosion reduces crop productivity and may cause sedimentation in streams. Sedimentation fills in streambeds, diminishing water quality, limiting water transportation and possibly damaging sensitive riparian habitats. Erosion may be most severe where urbanization, development, recreational activities and agricultural practices take place. Extreme rainfall events, lack of vegetative cover, fragile soils and steep slopes combine to accelerate erosion. The ubiquitous conversion of agricultural lands to housing and other development may cause exposed soils to become susceptible to erosion. With proper drainage construction and landscaping techniques, these altered soils may return to pre-construction stability and condition.

9.4 DEMOGRAPHICS

Hazard mitigation plans must consider community demographics. Information about population directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Knowledge of the composition of the population, how it has changed in the past, and how it may change in the future facilitates making informed decisions about the future.

9.4.1 Population

The Washington State Office of Financial Management (OFM) estimated Snohomish County's population at 704,300 as of April 1, 2009, making it the third largest of Washington's 39 counties. The County's largest city is Everett, with an estimated 2009 population of 103,500. Edmonds is the second largest city, with over 40,000 residents, followed by Marysville and Lynnwood, each with populations over 35,000. According to January 2009 Census population estimates, over 46 percent of County residents live in unincorporated areas. Table 9-1 shows the population of incorporated municipalities and the combined unincorporated areas in Snohomish County along with their growth from 2000 to 2009.

TABLE 9-1.
POPULATION OF CITIES AND UNINCORPORATED COUNTY

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Arlington	11,927	12,770	13,280	14,330	14,700	14,980	15,430	16,720	17,050	17,150
Bothell part	13,965	14,160	14,490	14,660	14,680	14,750	15,090	15,450	15,730	15,980
Brier	6,383	6,440	6,445	6,450	6,460	6,475	6,480	6,480	6,485	6,490
Darrington	1,136	1,307	1,335	1,385	1,405	1,435	1,465	1,485	1,500	1,505
Edmonds	39,544	39,590	39,460	39,580	39,620	39,860	40,360	40,560	40,760	40,900
Everett	91,488	95,990	96,070	95,470	96,840	97,500	101,100	101,800	102,300	103,500
Gold Bar	2,014	2,035	2,055	2,075	2,075	2,085	2,125	2,175	2,210	2,150
Granite Falls	2,347	2,540	2,760	2,915	3,010	3,060	3,095	3,195	3,290	3,375
Index	157	160	160	160	157	155	155	160	160	155
Lake Stevens	6,361	6,590	6,640	6,910	7,135	7,185	9,650	13,350	14,560	14,800
Lynnwood	33,847	34,010	33,990	34,500	34,540	34,830	35,230	35,490	35,680	35,740
Marysville	25,315	26,770	27,580	28,370	28,800	29,460	32,150	36,210	37,060	37,530
Mill Creek	11,525	11,970	12,055	12,260	12,760	14,320	17,460	17,620	17,770	18,480
Monroe	13,795	14,210	14,670	15,160	15,480	15,920	16,170	16,290	16,550	16,710
Mountlake Terrace	20,362	20,370	20,470	20,380	20,390	20,390	20,390	20,810	20,930	20,960
Mukilteo	18,019	18,340	18,520	19,190	19,220	19,360	19,620	19,940	20,050	20,110
Snohomish	8,494	8,565	8,575	8,640	8,585	8,700	8,920	8,970	9,020	9,145
Stanwood	3,923	3,975	4,085	4,190	4,315	4,580	4,940	5,200	5,445	5,590
Sultan	3,344	3,775	3,910	4,095	4,135	4,225	4,440	4,530	4,550	4,555
Woodway	936	945	990	1,050	1,075	1,140	1,165	1,180	1,180	1,190
Incorporated Total	***314,882***	***324,512***	***327,540***	***331,770***	***335,382***	***340,410***	***355,435***	***367,615***	***372,280***	***376,015***
Unincorporated	291,142	294,088	300,460	305,730	309,418	315,390	316,365	318,685	324,320	328,285
Total	**606,024**	**618,600**	**628,000**	**637,500**	**644,800**	**655,800**	**671,800**	**686,300**	**696,600**	**704,300**

9.4.2 Growth Trends

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a declining population signifies economic decline. Snohomish County's total population increased by 98,276 between 2000 and 2009, an increase of 16.22 percent. Based on OFM's population estimates, about 56 percent of the growth was due to net in-migration and about 44 percent was attributed to natural increase.

From 2000 to 2009, the County's unincorporated areas experienced a growth rate of 19 percent, while the unincorporated areas experienced a growth rate of 13 percent. Unincorporated growth was greatest near the Cities of Everett, Lynnwood and Mill Creek. Cities experiencing particularly rapid growth included Lake Stevens (132.7 percent), Mill Creek (60.3 percent), Marysville (48.3 percent), Granite Falls (43.8 percent), Arlington, (43.8 percent), Stanwood (42.5 percent) and Sultan (36.2 percent). The major growth in Lake Stevens and Mill Creek has been largely the result of sizable annexations.

Between 1990 and 2005, Washington state's total population grew by over 25 percent while Snohomish County's population increased by 34 percent. The County's population grew by 26.72 percent from 1990

to 2000, but the growth rate has since declined, falling from 3.44 percent per year for 1997-1998 to 1.11 percent per year for 2008-2009. Despite the slowing growth rate, the County's total population is projected to reach 1,109,202 by 2030. Figure 9-3 shows the growth rate of Snohomish County from 1990 to 2005, compared to that of the State of Washington.

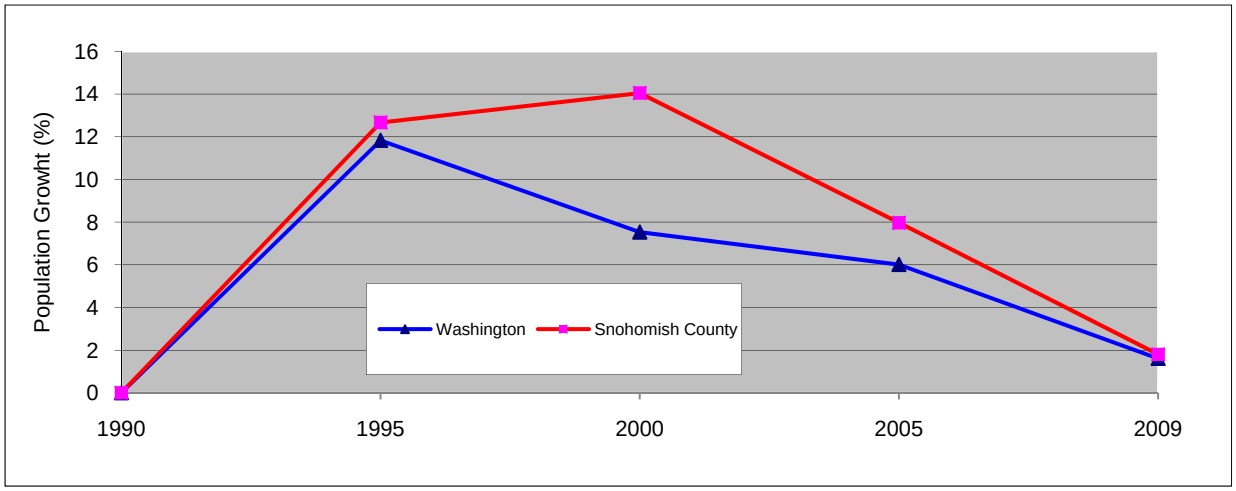


Figure 9-3. Snohomish County and Washington State Population Growth Rates 1990-2005

9.4.3 Vulnerable Populations

Some populations experience greater risk from hazard events not because of their geographic proximity to the hazard but because of decreased resources and/or physical abilities. Elderly people, for example, are more likely to be injured in a disaster and more likely to require assistance before, during and after a disaster. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population.

Vulnerable populations may vary from the general population in risk perception, living conditions, access to information, capabilities during a disaster event, and access to resources for post-disaster recovery. Despite the fact that they often disproportionately experience the effects of a disaster, vulnerable populations were rarely accounted for in past hazard planning processes. There is a need for increased awareness of and sensitivity to these demographic differences.

Indicators of vulnerability, such as disability, age, poverty, and minority race and ethnicity, often overlap spatially, and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas with higher concentrations of vulnerable community members (e.g., people with low incomes, people who are elderly or with disabilities, and people of minority ethnicity) would assist the County in extending focused public outreach and education to these citizens.

Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes, tsunamis and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below

the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impacted people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on U.S. Census Bureau – American Community Survey (ACS) estimates for 2006-2008, per capita income in Snohomish County was $30,858, and the median household income was $65,886 (in 2008 dollars, adjusted for inflation). It is estimated that there are 11,442 households with less than $10,000 in income and benefits per year and 25,960 households with $10,000 to $25,000 in income and benefits per year. About 14.4 percent of the households in Snohomish County make less than $25,000 per year and are therefore below the poverty level. As defined by the Office of Management and Budget and updated for inflation using the Consumer Price Index, the weighted average poverty threshold for a family of four in 2008 was $22,025; for a family of three, $17,163; for a family of two, $14,051; and for unrelated individuals, $10,991.

Age Distribution

The vulnerability of elderly citizens can vary significantly based on health, age, and economic security. However, as a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences, making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

According to U.S. Census ACS estimates for 2006-2008, 9.5 percent of Snohomish County's population is 65 or older. According to the 2000 U.S. Census data, 42.8 percent of the County's over-65 population has disabilities of some kind and 7.8 percent have incomes below the poverty line. Children under 18 account for 7.8 percent of individuals who are below the poverty line. It is estimated that 20.8 percent of the County's population is 14 or younger, slightly less than the state average of 21.3 percent. The overall age distribution for Snohomish County is illustrated in Figure 9-4.

Race, Ethnicity and Language

Many disaster researchers have focused on the increased vulnerability that ethnic minorities experience in the United States. Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since the proportion of ethnic minorities living below the poverty line is greater than that of the majority white population, poverty can compound vulnerability.

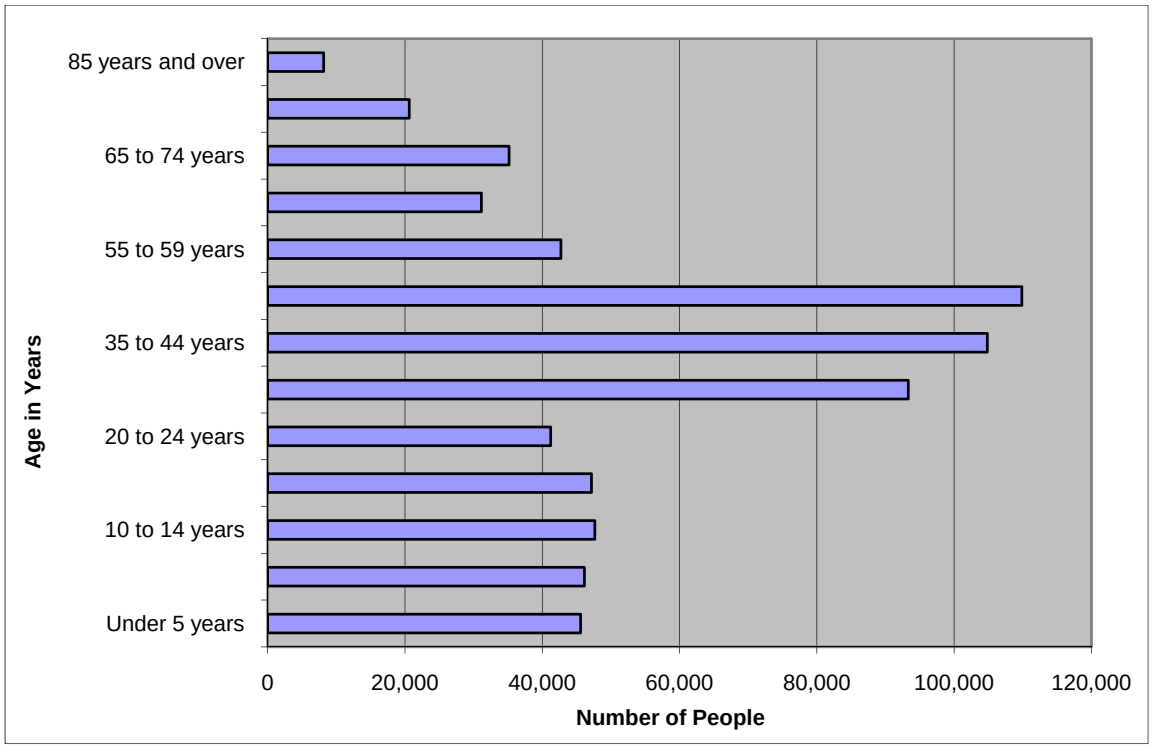


Figure 9-4. Snohomish County Age Distribution

According to the U.S. Census, the Snohomish County racial composition is predominately white at about 82 percent of the population. The largest minority population is Asian, at about 9 percent of the total county population; 7 percent of the population is of Hispanic descent. Figure 9-5 shows the racial distribution in Snohomish County.

Snohomish County has a 12.9 percent foreign-born population, with the majority born in Asia according to U.S. Census ACS estimates for 2006-2008. Other than English, the most commonly spoken languages in Snohomish County are of Asian or Pacific Islander origination. The Census estimates that approximately 7.4 percent of the county's residents reported speaking English "less than very well."

Disabled Populations

Because the disabled are significantly more likely to have difficulty responding to a hazard event than the general population, people living with disabilities have a special stake in emergency planning efforts. According to U.S. Census figures, roughly one-fifth of the U.S. population lives with a disability. These numbers are rising; furthermore, disabled populations are increasingly integrated into society. This means that a relatively large segment of the population will require assistance during the 72 hours post-event, the period generally reserved for self-help. Disabilities can vary greatly in severity and permanence, making populations difficult to define and track. There is no "typical" disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Furthermore, disability is likely to be compounded with other vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard.

While the percentage of disabled in Snohomish County does not differ much from that of the state as a whole, the overall numbers are significant and warrant special attention from planners and emergency managers (see Table 9-2). According to 2000 U.S. Census data, 16.8 percent of the County's population over the age of 5 has a disability.

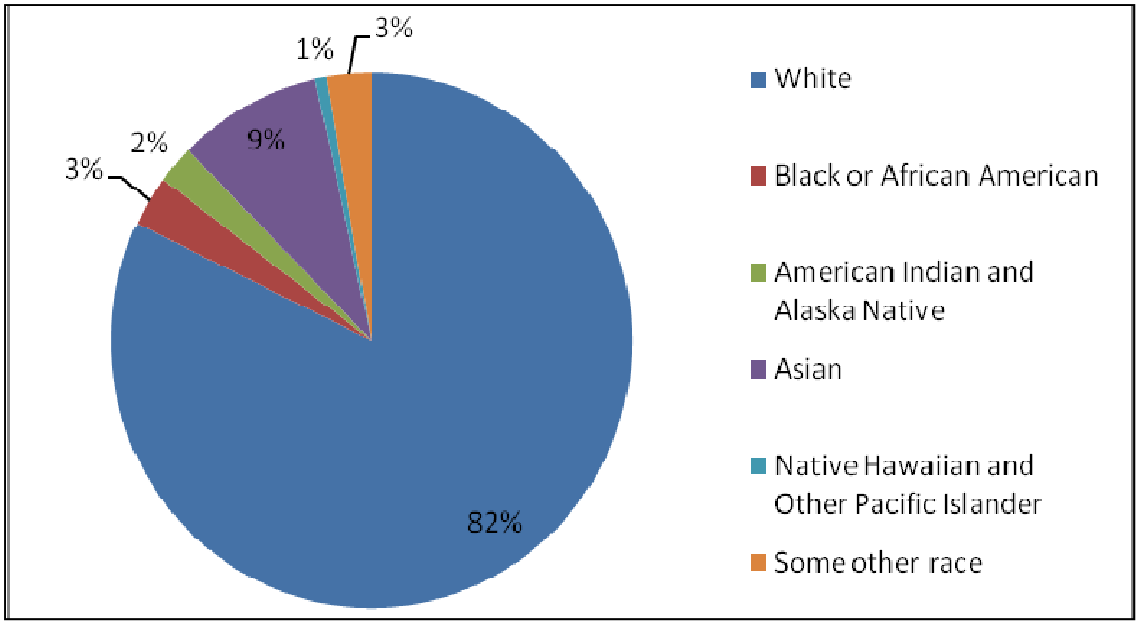


Figure 9-5. Snohomish County Race Distribution

TABLE 9-2.
DISABILITY STATUS OF NON-INSTITUTIONALIZED POPULATION

Age	Persons with a Disability	Percent of Age Group
Age 5 to 20 years	10,243	7.1
Age 21 to 64 years	59,598	16.7
Age 65 years and over	23,280	42.8

9.5 ECONOMY

Snohomish County's economy is strongly based in the biotech industry, clean technology and aerospace engineering and production. The County's highly technical skilled workforce produces products ranging from airplanes to sustainable/green technology and also conducts research for the cure of diseases. In spite of recent economic stresses, Snohomish County possesses many assets that contribute to the economic vitality of the region. The County is in the heart of the Puget Sound basin and is adjacent to the Seattle metropolitan area. Several large vacant industrial properties available for development exist within the County at prices considerably lower than those found in King County. The Port of Everett is close to the Everett Boeing Plant, providing direct deepwater access for shipping containers. The county's largest communities are located along Interstate 5, the state's major north-south corridor, which links numerous truck and transportation routes throughout the Puget Sound. The BNSF Railway provides valuable rail service, for both freight and passengers, to many locations in the country.

9.5.1 Employment Trends

According to the 2006-2008 U.S. Census ACS, about 70.9 percent of Snohomish County's population is in the labor force. The County's unemployment trends have closely mirrored the state's pattern; though the County's annual average unemployment rates are slightly lower (see Figure 9-6). The County's unemployment rates were lowest in 2007, at 4.3 percent, and peaked at close to 10 percent in 2010.

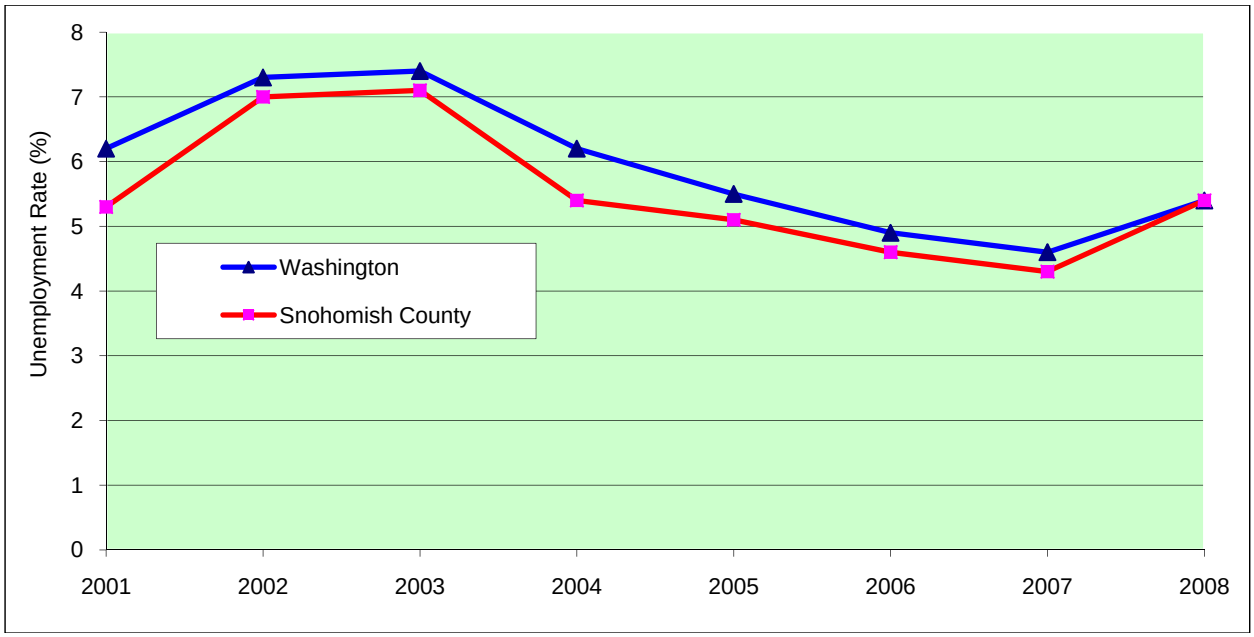


Figure 9-6. Snohomish County and Washington State Unemployment Rate, 2001-2008

9.5.2 Industry

According to the 2006-2008 ACS, the largest industry in Snohomish County (17.6 percent) is educational services, health care and social assistance. About 15.6 percent of the County's industry is in manufacturing. Retail trade makes up 12.2 percent of the County's industry, followed by professional, scientific, management, administrative and waste management services at 10.7 percent. Only about one percent of the industry in the County is involved with agriculture, forestry, fishing, hunting and mining related businesses (see Figure 9-7).

9.5.3 Occupation

Management and professional occupations make up over 35 percent of the occupations in Snohomish County, according to the 2006-2008 ACS. Sales and office occupations make up about 26 percent followed by service-related occupations with 15.3 percent. Only about 1 percent of the employment in Snohomish County is in farming, forestry, and fishing related occupations (see Figure 9-8).

The U.S. Census estimates that nearly 75 percent of Snohomish County workers commute alone (by car, truck or van) to work; mean travel time to work is approximately 30 minutes, compared to the state average of 25.5 minutes. This suggests that the work force in Snohomish County lives relatively close to the workplace.

According to the Economic Development Council of Snohomish County, production of aircraft and parts accounts for roughly half of Snohomish County's manufacturing employment**.** One of every three to six Washington State jobs is supported either directly or indirectly by the aerospace industry. In Snohomish County, as many as 45,000 people are employed in the aerospace field and related electronics industries. The County is the home of Boeing's largest commercial jetliner assembly operation, including production of the Boeing 747, 767 and 777 wide body jets and the new 787. The market potential for new commercial airplanes over the next 20 years remains high, and Snohomish County has the skilled and experienced aerospace workers to meet the demand.

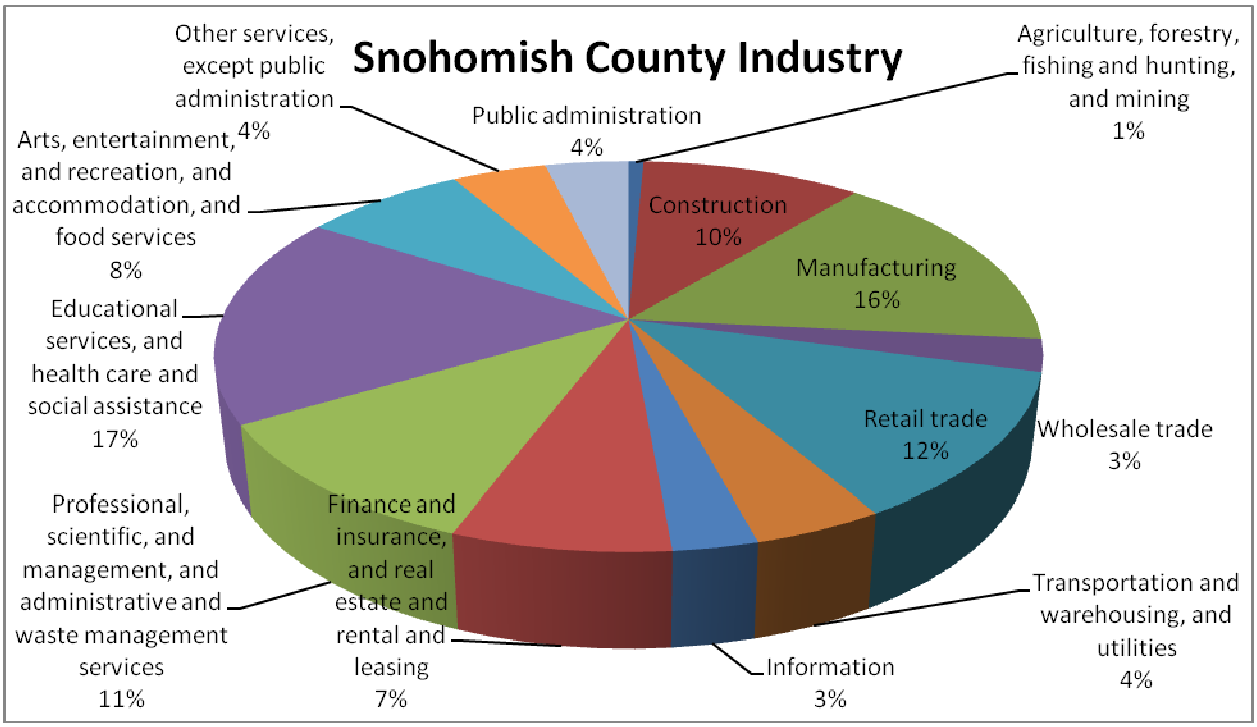


Figure 9-7. Industry in Snohomish County

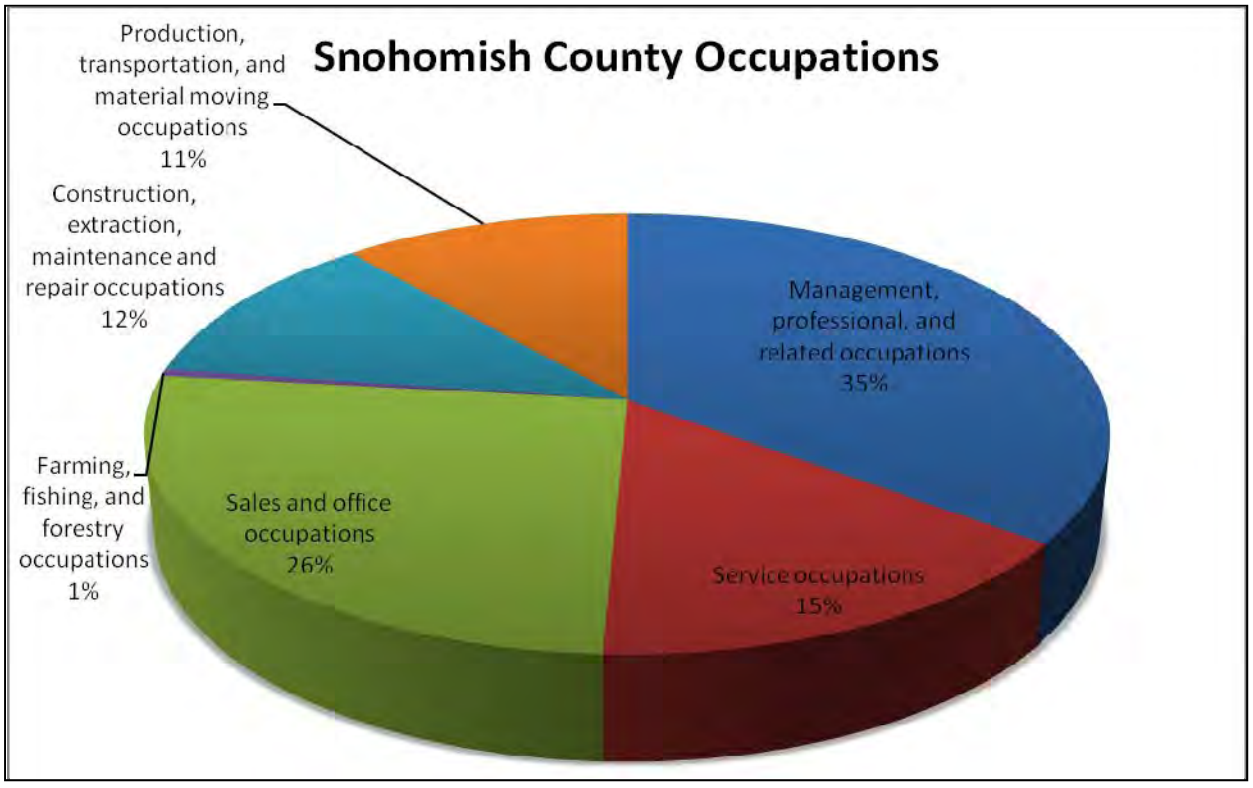


Figure 9-8. Occupations in Snohomish County

9.6 LAWS, ORDINANCES AND PROGRAMS

This section reviews the laws, ordinances and programs that can support or impact hazard mitigation initiatives identified in this plan, focusing on state and federal programs. Each planning partner for this effort individually reviews existing local plans, studies, reports, and technical information under its jurisdictional annex in Volume 2.

9.6.1 Federal

Disaster Mitigation Act

The Disaster Mitigation Act (DMA) reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program funds are available to communities. The Snohomish County Natural Hazard Mitigation Plan is designed to meet the requirements of DMA, improving the planning partnership's eligibility for future hazard mitigation funds.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species that are facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation in the U.S. for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

The purposes of the ESA are to provide a means of conserving the ecosystems upon which endangered and threatened species depend; provide a program for conserving those species; and take steps necessary to achieve the purposes of international treaties and conventions. The policy of Congress is that federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations for a threatened species may be less restrictive than if it were endangered.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- **Section 4: Listing of a Species**—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to

18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.

- **Section 7: Consultation**—Even when a listing has only been proposed, all federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will harm a species in some way ("take"), it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- **Section 9: Prohibition of Take—**It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

With the listing of salmon and trout species as threatened or endangered, the ESA has impacted most of the Pacific Coast states. Although some of these areas have been more impacted by the ESA than others due to the known presence of listed species, the entire region has been impacted by mandates, programs and policies based on the presumption of the presence of listed species. This has had a tremendous impact on counties such as Snohomish County in that they must take into account the impact of their programs on habitat.

The Clean Water Act

The Clean Water Act (CWA) is the cornerstone of surface water quality protection in the United States. (The Act does not deal directly with groundwater or with water quantity issues.) The statute employs a variety of regulatory and non-regulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical and biological integrity of the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining state water quality and other environmental goals is another hallmark of this approach

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting and enforcing floodplain regulations. Since its inception in 1968, the NFIP has been successful in requiring new buildings to be protected from probable damage by 100-year flood events. Requirements for participation in this program are stipulated in Parts 59 through 79 of 44CFR. The County and all the partner cities participate in the NFIP and have adopted and enforced floodplain management regulations that meet or exceed the requirements of the NFIP. At the time of the preparation of this plan, all NFIP participating jurisdictions in the partnership were in good standing with the requirements of the NFIP. It should be noted that participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act.

Presidential Disaster Declarations

Presidential declared disasters are disaster events that cause more damage than state and local governments/resources can handle without federal assistance. There is not generally a specific dollar threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities. A Presidential Emergency Declaration can also be declared, but assistance is limited to specific emergency needs.

9.6.2 State

Washington State Enhanced Mitigation Plan

The Washington State Enhanced Hazard Mitigation Plan was approved by the FEMA Region X office on January 28, 2008. It provides policy guidance for hazard mitigation throughout Washington. The plan identifies hazard mitigation goals, objectives, actions and initiatives for Washington state government that will reduce injury and damage from natural hazards. This plan meets federal requirements for an enhanced state plan (44CFR parts 201.4 and 201.5). Meeting the federal requirements keeps the State of Washington and all eligible local jurisdictions and non-profit organizations that provide like-government services qualified to obtain disaster assistance, including hazard mitigation grants. The enhanced portion of the plan allows the state to seek significantly higher funding for the Hazard Mitigation Grant Program following presidential declared disasters (20 percent of federal disaster expenditures vs. 15 percent with a standard plan).

Growth Management Act

In 1990, the Washington State Legislature adopted the Growth Management Act (Revised Code of Washington (RCW) Chapter 36.70A), which mandates that local jurisdictions adopt ordinances that classify, designate, and regulate land use in order to protect "critical areas." According to the code, critical areas include the following:

- Wetlands
- Critical aquifer recharge areas
- Fish and wildlife habitat conservation areas
- Frequently flooded areas
- Geologically hazardous areas.

Critical areas pertinent to this plan update include wetland areas, geologically hazardous areas (landslide and erosion areas), and frequently flooded areas (floodplains). The Growth Management Act (GMA) regulates development in these areas, and therefore has the potential to affect hazard vulnerability and

exposure at the local level. Snohomish County and its planning partners are in compliance and good standing with the provisions of the GMA as of this plan update process. Map 9-1 shows land use designations within the planning area generated as a response to the GMA.

Shoreline Management Act

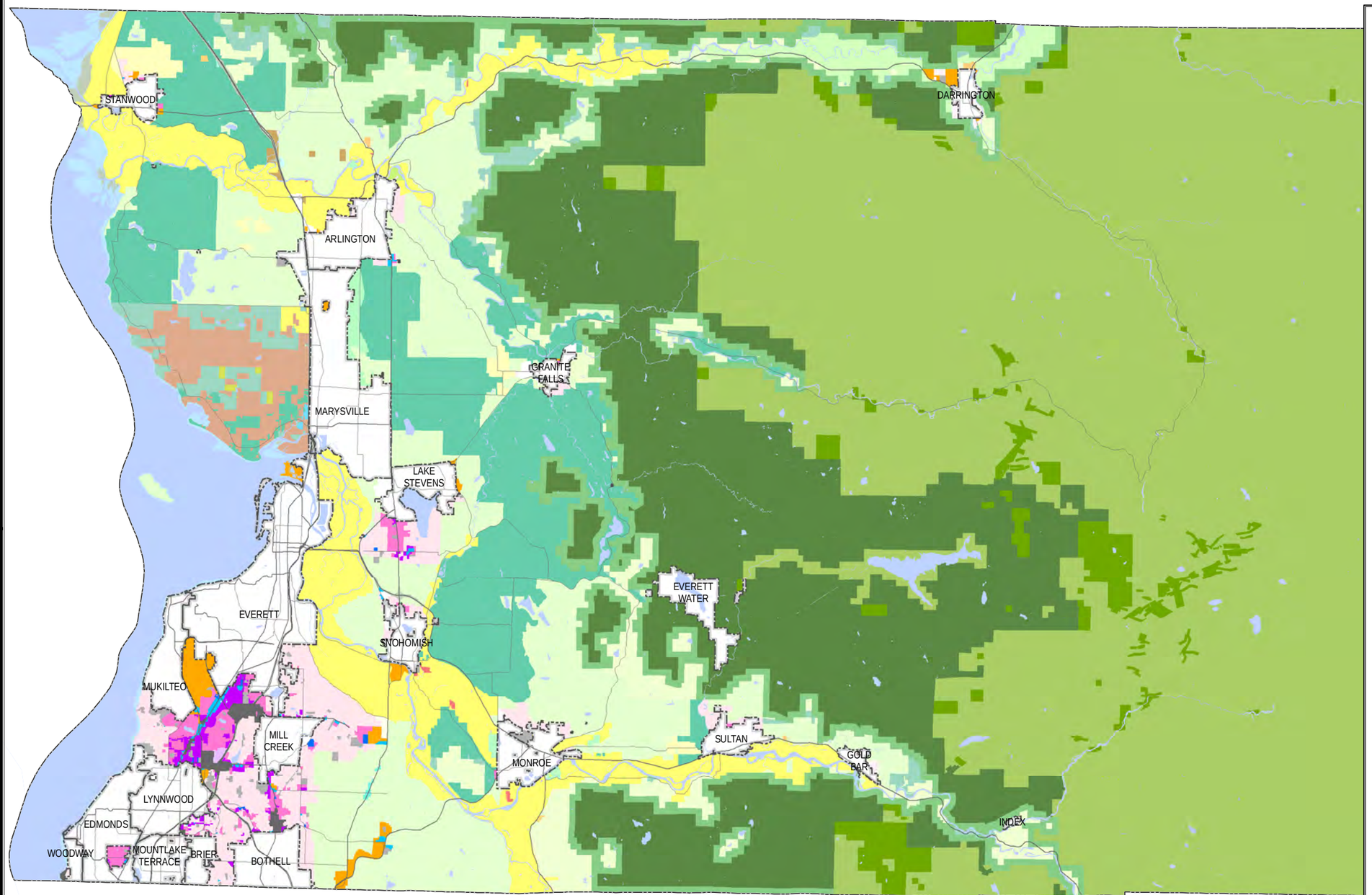
The Shoreline Management Act (RCW 90.58) was enacted in 1971 to manage and protect the shorelines of the state by regulating development in the shoreline area. A major goal of the act is to prevent the "inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Its jurisdiction includes the Pacific Ocean shoreline and the shorelines of Puget Sound, the Strait of Juan de Fuca, and rivers, streams and lakes above a certain size. It also regulates wetlands associated with these shorelines.

Washington State Building Code

On November 17, 2006, the Washington State Building Code Council adopted the 2006 editions of the national model codes, with some new amendments and changes. The Council also adopted changes to the Washington State Energy Code and Ventilation and Indoor Air Quality Code. Washington's state-developed codes are mandatory statewide for residential and commercial buildings. The residential code exceeds the 2006 International Energy Conservation Code standards for most homes, and the commercial code meets or exceeds standards of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE 90.1-2004). For residential construction covered by ASHRAE 90.1-2007 (high-rise buildings with four or more stories), the state code is more stringent. The 2009 IBC went into effect as the Washington model code on July 1, 2010.

9.6.3 Cities and County

Each planning partner has completed a jurisdiction-specific annex to this plan (see Volume 2). In completing these annexes, each partner was asked to complete a ***capability assessment*** that looked at its regulatory, technical and financial capability to carry out proactive hazard mitigation. Readers can refer to these annexes for a review of regulatory codes and ordinances applicable to each planning partner.



Map 9-1

Snohomish County Land Use

- Clearview Rural Commercial
- Commercial Forest
- Commercial Forest - Forest Transition Area
- Incorporated City
- Local Commercial Farmland
- Local Forest
- MBSNF - National Forest Administered Lands
- MBSNF - Other ownership within National Forest boundary
- Other Land Use
- Public/Institutional Use
- Recreational Land
- Reservation Commercial
- Riverway Commercial Farmland
- Rural Freeway Service
- Rural Industrial
- Low Density Rural Residential (1 DU/20 Acres)
- Rural Low Density Residential (1 DU/20 Acres)
- Rural Residential (1 DU/5 Acres Basic)
- Rural Residential - RD (1 DU/5 Acres)
- Rural Residential-10 (1DU/10 Acres)
- Rural Residential-10 Resource Transition (1 DU/10 Acres)
- Rural Residential-5 (1 DU/5 Acres)
- Stillaguamish Tribes
- Transit/Pedestrian Village
- Tulalip Tribes Lands
- Upland Commercial Farmland
- Urban Center
- Urban Commercial
- Urban High Density Residential (12-24 DU/Acre)
- Urban Horticulture
- Urban Industrial
- Urban Low Density Residential (3 DU/Acre)
- Urban Low Density Residential (4 - 6 DU/Acre)
- Urban Low Density Residential (4 DU/Acre)
- Urban Low Density Residential (6 DU/Acre)
- Urban Low Density Residential - Limited (4 - 5 DU/Acre)
- Urban Low Density Residential - Limited (5 - 6 DU/Acre)
- Urban Medium Density Residential (6-12 DU/Acre)
- Urban Village

Snohomish County

Tetra Tech, Inc.
May 2010

Data Sources:
Snohomish County
FEMA Digital Flood Insurance Rate Maps
Washington State Department of Natural Resources
Division of Geology and Earth Resources

0 2.5 5 10 Kilometers

0 2.5 5 10 Miles

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