Thurston County

Emergency Management
2703 Pacific Avenue SE, Suite B
Olympia, WA 98501-2036

Phone 360 754 3360
Fax 360 704 2775

Hazard Identification and Vulnerability Analysis

February 2004

EXECUTIVE SUMMARY

The Washington Administrative Code (WAC 118-30-060 (1)) requires each political subdivision to base its comprehensive emergency management plan on a hazard analysis. The hazard analysis is also a training tool, providing introductory knowledge of the hazards posing a threat to Thurston County.

To make the analysis more useful, adjective descriptors (High, Moderate, Low) are established for each hazard's probability-of-occurrence and vulnerability and a risk rating is assigned based on a subjective estimate of their combination. The risk rating is assigned on the probability of a hazard occurring over the next 25 years. This interval was chosen because it is the long term recurrence interval of a dangerous earthquake, the hazard of greatest risk to Thurston County.

The risk rating will help focus the emergency management program on the hazards of greatest risk.

< A high risk rating warrants major program effort to prepare for, respond to, recover from, and mitigate against the hazard.

< A moderate risk rating warrants modest program effort to prepare for, respond to, recover from, and mitigate against the hazard.

< A low risk rating warrants no special effort to prepare for, respond to, recover from, or mitigate against the hazard beyond general awareness training.

The following table summarizes the analysis.

HAZARD ANALYSIS SUMMARY

HAZARD	PROBABILITY OF OCCURRENCE	VULNERABLITY	RISK
Civil disturbance	Low	Low	Low
Critical shortage	Moderate	Moderate	Moderate
Dam Failure	Low	Moderate	Low
Drought	High	Moderate	Moderate
Earthquake	High	High	High
Epidemic	Low	High	Moderate
Flood	High	Moderate	High
Hazardous Material	High	Moderate	High
Heat Wave	Low	Moderate	Low
Landslide	High	Low	Moderate
Storm	High	High	High
Terrorism	Moderate	Moderate	Moderate
Tsunami	Low	Low	Low
Volcano	Low	Moderate	Low
Wild/Forest Fire	Moderate	Moderate	Moderate

(This page left blank intentionally.)

TABLE OF CONTENTS

INTRODUCTION

Thurston County is susceptible to many natural, technological and human-caused hazards. Knowledge of these hazards, their frequency, and our vulnerability to them allows the community to better assess their risk and to plan and prepare for their consequences.

The purpose of this document is twofold:

1. To provide a basic level of knowledge through limited analysis of the hazards posing a threat to Thurston County; and
2. To serve as the basis for Thurston County's Comprehensive Emergency Management Plan.

This is accomplished by identifying the hazards most likely to affect the region, profiling past hazard events, and assessing the county's vulnerability to these hazards. Not all conceivable hazards are addressed herein as some pose little threat to Thurston County, such as an avalanche, while others have such a low probability of occurrence that they do not warrant special consideration, such as a meteor impact. Regardless, proper preparation for the hazards that are addressed will prepare the community to better deal with any disaster.

The information in this document is not, nor is it intended to be, a rigorous or scientific analysis. It does provide a basic level of knowledge through limited analysis of the hazards posing the greatest risk to Thurston County, and allows for a subjective evaluation of the risk posed by certain hazards.

This document will be periodically reviewed for content and applicability. It will be reviewed following receipt of each revision to the State of Washington Hazard Identification and Vulnerability Analysis and, as a minimum, at least once per review cycle of the Thurston County Comprehensive Emergency Management Plan (CEMP). Cyclic review will be scheduled as part of the CEMP review process.

Hazard Identification

The hazards listed below are examined in this document. Each hazard is described and its historical occurrences and impacts are discussed. Based on this information, an assessment is made of probability-of-occurrence and vulnerability, and a risk rating consistent with this assessment has been assigned. For consistency, the risk rating is tied to the probability of occurrence during the next twenty-five years since that is the long term recurrence interval of a major earthquake, the hazard of greatest risk to Thurston County.

Civil Disturbance	Epidemic	Storm
Critical Shortage	Flood	Terrorism
Dam Failure	Hazardous Material Incident	Tsunami
Drought	Heat Wave	Volcano
Earthquake	Landslide	Wildfire/Forest Fire

Natural Hazards Mitigation Plan

In 2003, the Thurston County Emergency Management Council published the Natural Hazards Mitigation Plan for Thurston County, using grant funding from the Washington State Military Department, Emergency Management Division and the Federal Emergency Management Agency. Budget resources and time considerations constrained a full analysis of every potential hazard identified above. The hazards which have historically occurred most prevalently and caused the most damage were addressed based on the following criteria:

1) There is a high probability of the natural hazard occurring in Thurston County within the next 25 years.

2) There is the potential for significant damage to impacted buildings and infrastructure.

3) There is the potential for loss of life.

The following natural hazards meet the above criteria: Earthquake, Flood, Landslide, and Storm. The 2004 update of this document incorporates relevant information from the Natural Hazards Mitigation Plan for Thurston County.

Document Organization

The County Profile portion of this document gives general information about Thurston County. Much of the text and data tables have come from published reports prepared by Thurston Regional Planning Council (TRPC).

The Hazards Analysis portion of this document follows with hazard specific information. The more extensive analysis on earthquake, flood, landslide, and storm hazards is followed by a briefer analysis of the other identified hazards. The list below summarizes some of the more detailed information provided for earthquake, flood, landslide, and storm:

1. Hazard Area maps which describe the location and extent of the hazard.

2. Vulnerability Assessment Data Tables:
   - Population at risk within Hazard Area
   - Estimate of the inventory of assets and their dollar value in the Hazard Area for the year 2000 and 2025
   - Number and type of Critical Facilities within the Hazard Area

3. An appendix discussion of the methodology used to calculate the inventory, forecast, and dollar value of assets.

Federal Disaster Declarations

The following table lists Federal Disaster Declarations which have included Thurston County. Thurston County is susceptible to a variety of natural hazards. The number of Federal Disaster Declarations affecting the county gives some idea of the risk natural hazards pose to the area. Since 1964, only 185 counties in the country have had more than 10 Federal Disaster Declarations. Thurston County is part of this top 6 percent of counties. Since October 1962, Thurston County has been declared a federal disaster area 18 times.

Date	Federal Declaration #	Event
Oct 1962	137	Flooding, Wind (Columbus Day Storm)
May 1965	196	Earthquake
Jan 1971	300	Flooding
Jan 1972	322	Severe Storms/Flooding
Feb 1972	328	Heavy Rains/Flooding
Jan 1974	414	Severe Storms/Flooding
Dec 1975	492	Severe Storms/Flooding
Dec 1977	545	Severe Storms/Mudslides/Flooding
May 1980	623	Volcano (Mt. St. Helens Eruption)
Jan 1990	852	Severe Storms/Flooding/Landslide/Wind
Nov 1990	883	Severe Storms/Flooding
Jan 1993	981	Windstorm (Inaugural Day Storm)
Nov 1995	1079	Flooding/Windstorm
Feb 1996	1100	Flooding
Dec 1996-Feb 1997	1159	Ice, Wind, Snow, Landslide, Flooding
Mar 1997	1172	Heavy Rains/Landslide, Flooding
Feb 2001	1361	Earthquake (Nisqually Earthquake)
Nov 2003	1499	Severe Storm, Flooding

Definitions

Adjective descriptors (High, Moderate, and Low) have been established for each hazard's probability of occurrence and vulnerability, and a risk rating has been assigned based on a subjective estimate of their combination. The risk rating is assigned on the probability of a hazard occurring over the next 25 years. This interval was chosen because it is the long term recurrence interval of a dangerous earthquake, the hazard of the greatest risk to Thurston County.

The following terms are used in this document to analyze the hazards considered:

Probability of Occurrence: An adjective description (High, Medium, or Low) of the probability of a hazard impacting Thurston County within the next 25 years. Probability is based on a limited objective appraisal of a hazard's frequency using information provided by relevant sources, observations and trends.

High:

- There is great likelihood that a hazardous event will occur within the next 25 years.

Medium:

- There is moderate likelihood that a hazardous event will occur within the next 25 years.

Low:

- There is little likelihood that a hazardous event will occur within the next 25 years.

Vulnerability: An adjective description (High, Medium, or Low) of the potential impact a hazard could have on Thurston County. It considers the population, property, commerce, infrastructure and services at risk relative to the entire county. Vulnerability is an estimate generally based on a hazard's characteristics, information on the community's characteristics including demographics, economy, infrastructure, and growth and development pattern issues.

High:

- The total population, property, commerce, infrastructure and services of the county are uniformly exposed to the effects of a hazard of potentially great magnitude.
- **In a worse case scenario, there could be a disaster of major to catastrophic proportions.**

Medium:

- The total population, property, commerce, infrastructure, and services of the county are exposed to the effects of a hazard of moderate influence; or
- The total population, property, commerce, infrastructure, and services of the county are exposed to the effects of a hazard of moderate influence, but not all to the same degree; or
- An important segment of population, property, commerce, infrastructure and services of the county are exposed to the effects of a hazard.
- **In a worse case scenario there could be a disaster of moderate to major, though not catastrophic, proportions.**

Low:

- A limited area or segment of population, property, commerce, infrastructure, or service is exposed to the effects of a hazard.
- **In a worse case scenario, there could be a disaster of minor to moderate proportions.**

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

High:

- 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.
- **The threat is significant enough to warrant major program effort to prepare for, respond to, recover from, and mitigate against this hazard. This hazard should be a major focus of the County's emergency management training and exercise program.**

Medium:

- There is moderate potential for a disaster of less than major proportions during the next 25 years.
- **The threat is great enough to warrant modest effort to prepare for, respond to, recover from, and mitigate against this hazard. This hazard should be included in the county's emergency management training and exercise program.**

Low:

- There is little potential for a disaster during the next 25 years.
- **The threat is such as to warrant no special effort to prepare for, respond to, recover from, or mitigate against this hazard. This hazard need not be specifically addressed in the county's emergency management training and exercise program except as generally dealt with during hazard awareness training.**

(This page left blank intentionally.)

COMMUNITY CHARACTERISTICS – COUNTY PROFILE

(This page left blank intentionally.)

Geography and Topography

Thurston County lies in the southern part of western Washington at the terminus of Puget Sound (see Map 1-Vicinity). It is the 32nd largest county in the state with a total land mass of 737 square miles. Approximately 93 percent of the land area is unincorporated. Within the county there are seven cities and towns and two unincorporated communities: Olympia, the state capital, Lacey and Tumwater in the north, Yelm in the east, Rainier, Tenino and Bucoda in the south, and Grand Mound and Rochester in the southwest. There are several special purpose districts including fifteen fire districts in the unincorporated county, a port district, eight school districts, and a conservation district. Thurston County has three tribal areas including the Nisqually Indian Reservation in east county, the Chehalis Indian Reservation in southwest county as well as the Squaxin Indian Reservation which borders the county in the northwest. Fort Lewis Military Reservation occupies a large tract in the east county.

The area topography ranges from coastal lowlands to prairie flatlands to the foothills of the Cascades. Glacial activity in the county's geologic past left the land dotted with lakes and ponds. The northernmost boundary of the county is determined by the shoreline of Puget Sound. Inlets exclusive to the county are Budd, Henderson, and Eld Inlets. Budd and Henderson Inlets are separated by Dana Passage. Other inlets form the boundaries between Thurston and adjacent counties. Totten Inlet divides Thurston and Mason counties, and the Nisqually River separates Thurston from Pierce County.

In Thurston County, there are four watersheds that flow to the Pacific Ocean basin. Flowing to the Puget Sound basin are five watersheds. Approximately 57% of the county's waters flow into Puget Sound with 43% flowing to the Pacific Ocean.

The northwest and southeast corners of the county are marked by peaks ranging from 1,700 to 3,000 feet in elevation. Once thought to be the highest in the county, Larch Mountain and Capitol Peak, both over 2,650 feet, reign over the 40,000 acre Capitol State Forest west of Olympia. United States Geological Survey (USGS) surveyors recently discovered the highest point in the county is actually in the extreme southeast corner near Alder Lake. Standing at 2,922 feet, Quiemuth Peak was named in 1993 by the Thurston County Historic Commission to honor the Nisqually Indian chief of that name.

County Weather

Thurston County has a marine type climate with mild temperatures year-round. In the warmest months, the average high temperature ranges between 70 and 75 degrees. In the winter months, high temperatures usually hover around 45 degrees. Like most of western Washington, Thurston County's weather is characterized by sunny summers and wet winters. With about 52 clear days out of every 365, Thurston County residents live under some form of cloud cover 86 percent of the year, with more than a trace of rain falling on almost half of the days of the year.

Table 1
Thurston County Weather

	Average Temperature (Degrees Fahrenheit)				Precipitation (Inches)		Average Total Snowfall (Inches)
	2001		Normal [1]				
Month	High	Low	High	Low	2001	Normal[1]	Normal[1]
Jan	45.7	30.7	44.3	31.4	3.5	8.0	7.3
Feb	48.1	27.5	49.1	32.7	2.6	6.1	3.7
Mar	52.3	31.7	53.3	33.7	3.8	5.1	1.9
Apr	56.2	35.3	59.1	36.5	3.5	3.4	0.1
May	67.1	40.1	65.8	41.5	1.9	2.0	0.0
Jun	67.1	44.2	71.0	46.6	2.6	1.6	0.0
Jul	73.6	47.3	77.0	49.4	0.2	0.8	0.0
Aug	75.9	49.7	77.0	49.4	2.3	1.2	0.0
Sep	70.1	44.9	71.6	45.2	0.5	2.1	0.0
Oct	57.9	38.7	60.6	39.5	4.0	4.7	0.0
Nov	51.7	37.8	50.4	35.5	13.3	8.2	1.3
Dec	44.8	32.3	44.8	32.7	11.9	8.2	3.9
Average	**59.3**	**38.4**	**60.3**	**39.5**			
Total					**50.1**	**51.3**	**18.1**

Source: National Weather Service, Olympia Weather Station (www.wrcc.dri.edu).
Explanation: [1]"Normal" is the statistical average of 1948 to 2001 data.

Environment and Quality of Life

Agricultural and Forest Lands

Although Thurston County is not commonly noted for a strong agricultural base, approximately 16 percent of the county's land use is given to agricultural activities. In addition to providing economic diversity and food production for the long-term sustainability of our community, keeping these lands in agricultural use promotes land conservation.

Forest lands also promote land conservation. They are important to our community both in terms of economic sustainability, and the long-term environmental and quality of life benefits forest lands provide. If forest lands in timber production are managed correctly, they provide many environmental benefits including reduction of soil erosion, protecting wildlife habitat, enhancing water quality and air quality, mitigating the effects of storm and flood damage, and providing for recreational and scenic opportunities. The County has implemented several strategies for forest land conservation, including long-term zoning, designation of urban growth areas, protection for forest land owners against high tax rates and close monitoring of forest practice activity, especially in the designated urban areas. It is estimated

that between 1985 and 2000, almost 56,000 acres of land were in the forest harvest cycle, for an average annual rate of approximately 4,000 acres per year. Forest lands have been harvested at a rate of approximately 1.3 percent annually, which translates to 20 percent of the county's forest lands being harvested over the last 15 years. The rate of harvest is significantly higher in the rural county where most of the commercial forest lands are found.

Urbanization

Trends in urbanization over time provide insight into changes in the physical environment of Thurston County. These trends also impact natural hazard mitigation planning. As more land is urbanized, land cover that prevents flooding and landslides is lost. Forests, shrub vegetation, and agricultural lands are replaced by a more urban landscape which is composed of a variety of physical features, including distinctly urban features such as roads and buildings, as well as trees, lawns, and other non-urban land cover. Measuring the change in land cover of built or urban features over the last 15 years in Thurston County can provide insight into conditions in the future. Large-scale change detectable from satellite imagery indicates that approximately 32,000 acres of land were converted from intact forest stands, agricultural lands, or large expanses of shrub vegetation to urban landscapes over the last 15 years in Thurston County. Due to differences in density of development in the urban and rural environment, significantly more land is consumed for rural development than urban. Watersheds experiencing the greatest percent of urbanization over the last 15 years were Henderson Inlet with 14 percent and Black River with 10 percent.

Parks and Public Lands

As population grows, the demand for access to public parks and open space increases, while there is also additional pressure to develop the remaining available land. Therefore, parks and natural resource departments at all governmental levels play an increasingly important role in acquiring parcels of land that will be used for public parks and open space preserves. City and County parks and preserves offer not only recreational opportunities for residents and visitors to Thurston County, but also provide beneficial environmental services such as the protection of sensitive areas; enhancement of air and water quality, provision of flood control and landslide, and conservation of wildlife habitat.

The seven cities and towns in Thurston County provide approximately 1,741 acres of park, recreation, and open space. Facilities include memorials, playfields, natural areas, and campgrounds. Thurston County manages another 2,765 acres including sections of the Chehalis Western trail, a paved walking and bike path.

Drinking Water

Groundwater is an important natural resource as nearly the entire county relies on it for residential, agricultural, and industrial needs. There are more than 1,200 public water supplies in Thurston County that tap groundwater sources, and over 8,000 private wells. These serve approximately 99 percent of the drinking supplies for county residents. Not only is groundwater important for residential, agricultural, and business uses, it is also the primary

source of stream flows during the dry summer months, which is essential to maintaining the health of the county's ecosystems, fisheries, and recreational opportunities.

In order to protect these supplies, local jurisdictions have developed joint wellhead protection policies. These programs are designed to protect recharge areas near municipal water supplies such as wells and springs. By identifying and controlling pollution sources, the jurisdictions will develop contingency plans needed to respond swiftly in case of unexpected loss of a water supply.

More than 80 percent of Olympia's water comes from McAllister Springs located just outside the eastern boundary of the urban growth area. Olympia has a contractual agreement with the City of Lacey to wholesale a maximum of two million gallons of water per day from McAllister Springs to Lacey. The amount of water the springs are capable of producing fluctuates seasonally, producing more in the winter due to aquifer levels. While the springs currently produce high quality water, the local soils, geology, and groundwater conditions of its recharge area make the springs especially vulnerable to contamination. Monitoring and recharge area protection are important aspects of managing a resource such as McAllister Springs.

Wastewater Management Systems

The LOTT Wastewater Alliance helps preserve and protect public health, the environment, and water resources by providing wastewater management and disposal services for the urbanized area of north Thurston County. The acronym **"LOTT"** stands for its four government partners -- **L**acey, **O**lympia, **T**umwater, and **T**hurston County.

LOTT was formed in 1976 through an intergovernmental agreement between the three cities and the County. The agreement provided for cooperative use and development of the Olympia wastewater treatment plant, established major sewer lines (interceptors) servicing multiple jurisdictions and initiated a major 1983 upgrade of the treatment plant to provide secondary treatment of wastewater. Today, the LOTT partners serve about 78,000 people over a 14,000-acre area. In addition to the central wastewater treatment plant and major sewer lines, the LOTT partners are also responsible for flow management and long-range planning.

Growth - Population and Development Trends

Population Trends

Thurston County has been one of the fastest growing counties in the State since the 1960s, exceeding the State's overall rate of growth consistently. During the 1990's Thurston County grew at a rate of 2.5 percent annually. This growth added over 46,000 new residents to the county's population between 1990 and 2000. Reflecting state trends, Thurston County experienced the most growth of the last three decades in the 70s, with a population increase of over 61 percent. Population increased by 40 percent in the 60s, 30 percent in the 80s, and 29 percent in the 90s.

Between 1980 and 1990 the incorporated county grew at nearly the same rate as the unincorporated county. This is in stark contrast with the previous decade, where growth was concentrated in the unincorporated county. In 1970, 47 percent of the population lived in the unincorporated county. By 1980, 58 percent of the population was living in the unincorporated county. In 2002, it was estimated that 55 percent of the population lived in the unincorporated county. Close to half of all of the population is in the unincorporated area of the county. Often people in unincorporated areas have fewer public support services readily available to them and can be more impacted by widespread disasters.

In 1988, when urban growth areas were defined around most of the incorporated jurisdictions within Thurston County, the relationship between incorporated and unincorporated population distribution became secondary to the relationship between urban and rural population jurisdiction. Analysis of trends in the 1990s reveal that while Thurston County's cities have been receiving an increasing share of the population throughout this decade, it is often through annexation of existing homes rather than redirection of new growth. Overall, the percentage of the county's population living in our rural areas has remained relatively constant.

As mandated by the 1990 Growth Management Act, each of the incorporated jurisdictions has defined its own Urban Growth Area (UGA). This identifies the area that each jurisdiction will incorporate into its city limits and provide city services within the next 20 years.

Population growth has not been evenly distributed among Thurston County's cities during this decade. Several of the urban areas of our smaller towns and cities have experienced high rates of growth. The Yelm urban area (5.1%) and the Rainier urban area (4.3%) experienced the highest average annual growth rates in population between 1990 and 2000. In the northern regions of the county, the Lacey urban area (2.5%) has been growing at a higher annual rate than the Tumwater (2.3%) and Olympia urban areas (2.2%).

Table 2
Small Area Population Estimates and Population Forecast, Thurston County Jurisdictions, 1990-2025

Jurisdiction		Census		Estimate	Forecast				
		1990	2000	2003	2005	2010	2015	2020	2025
Bucoda	**Total**	**536**	**628**	**645**	**619**	**629**	**633**	**637**	**641**
Lacey	City	19,279	31,226	32,240	36,218	39,856	42,882	45,757	48,049
	UGA	25,127	28,632	29,652	31,746	35,624	40,082	43,768	46,648
	Total	**44,406**	**59,858**	**61,892**	**67,964**	**75,479**	**82,964**	**89,525**	**94,697**
Olympia	City	33,729	42,514	42,860	45,440	48,080	51,034	54,020	56,969
	UGA	7,195	9,269	9,859	10,639	12,940	16,467	19,627	22,057
	Total	**40,924**	**51,783**	**52,719**	**56,078**	**61,019**	**67,501**	**73,647**	**79,025**
Rainier	City	991	1,492	1,515	1,626	1,794	1,914	2,022	2,127
	UGA	65	163	169	157	166	173	179	186
	Total	**1,056**	**1,655**	**1,684**	**1,783**	**1,961**	**2,088**	**2,201**	**2,314**
Tenino	City	1,292	1,447	1,495	1,502	1,503	1,510	1,538	1,566
	UGA	193	151	155	130	149	170	186	365
	Total	**1,485**	**1,598**	**1,650**	**1,632**	**1,652**	**1,680**	**1,724**	**1,931**
Tumwater	City	9,976	12,698	12,740	14,200	15,179	16,461	17,991	19,423
	UGA	6,053	7,281	7,542	8,849	10,157	12,025	14,768	18,742
	Total	**16,029**	**19,979**	**20,282**	**23,050**	**25,336**	**28,486**	**32,758**	**38,165**
Yelm	City	1,337	3,289	3,830	4,377	5,561	6,681	7,730	8,559
	UGA	1,360	1,095	1,123	1,221	1,268	1,635	2,128	2,827
	Total	**2,697**	**4,384**	**4,953**	**5,597**	**6,829**	**8,316**	**9,858**	**11,386**
Grand Mound UGA	**Total**	**708**	**811**	**824**	**1,316**	**1,517**	**1,700**	**1,876**	**2,064**
Total Cities		**67,140**	**93,294**	**95,325**	**103,982**	**112,601**	**121,116**	**129,696**	**137,334**
Total UGAs		**40,700**	**47,401**	**49,324**	**54,057**	**61,821**	**72,252**	**82,532**	**92,890**
Total Urban Areas		**107,840**	**140,695**	**144,649**	**158,039**	**174,422**	**193,368**	**212,228**	**230,223**
Rural Unincorporated Cou		**53,398**	**66,660**	**70,151**	**78,368**	**85,365**	**91,931**	**98,502**	**104,035**
Thurston County Total		**161,238**	**207,355**	**214,800**	**236,406**	**259,787**	**285,299**	**310,730**	**334,258**

Sources: U.S. Bureau of the Census 1990, 2000; Washington State Office of Financial Management; Thurston Regional Planning Council.

Explanation: UGA is unincorporated Urban Growth Area. UGA figures include that population outside the city limits but within the long-term Urban Growth Management boundary. Includes population growth by annexation. Census and estimates are for April 1 of each year.

Dwelling Unit Trends

The share of total dwelling units in the urban areas has been steadily decreasing in the second half of the 1990s. Correspondingly, the share of total dwelling units which are located in the rural area has been steadily increasing. Interestingly, the rural area's average rate of growth in dwelling units has generally been declining over this same time period. Although the urban areas continue to be the location of the majority of the county's dwelling units, the above trends indicate that the amount of growth going into the rural area is large enough that even when it is declining in its rate of growth, it is still occurring at a high enough level to cause the rural area to have a steadily increasing share of the county's total dwelling units.

The urban area's share of new dwelling units has declined, moving from 61.8 percent in 1995 to 58.7 percent in 2002. Correspondingly, the rural area's share of new dwelling units has increased from 38.2 percent in 1995 to 28.6 percent in 2002. The decline in the share of new dwelling units which are locating within city limits is significant, from 57.6 percent in 1995 to 28.6 percent in 2002. Not this entire decline reflects a movement of new dwelling units to the rural areas. Much of it is attributable to an increase in new dwelling units locating in the UGAs. A positive trend is the significant increase in the UGA share of new dwellings, moving from only 6.5 percent of new dwellings in 1994 to 28.4 percent of new dwellings in 2002.

Table 3 provides information on dwelling unit trends.

Monitoring Land Supply - 2002 Buildable Lands Report

In 1997, the state Growth Management Act (GMA) was amended to add a new growth monitoring section. Meeting the requirements of this new legislation came to be commonly known as the "buildable lands program" because of the law's emphasis on determining how much buildable land is in the urban areas.

The Buildable Lands Report for Thurston County, September 2002 and accompanying Buildable Lands Technical Documentation for Thurston County, September 2002 were prepared by Thurston Regional Planning Council (TRPC) to meet the requirements of this legislation for the affected jurisdictions in Thurston County.

Tables 4 and 5 provide summary data from these reports regarding residential, commercial, and industrial Land Supply and Demand.

Table 3
Dwelling Unit Estimates of Cities and UGAs, Thurston County, 1994-2002

Jurisdiction		1994	1995	1996	1997	1998	1999	2000	2001	2002
Bucoda	**Total**	**212**	**214**	**220**	**228**	**232**	**235**	**236**	**238**	**242**
Lacey	City	10,332	11,036	11,594	12,121	12,477	12,898	13,160	13,304	13,491
	UGA	10,534	10,419	10,525	10,602	10,758	10,900	11,014	11,132	11,492
	Total	**20,866**	**21,455**	**22,119**	**22,723**	**23,235**	**23,798**	**24,174**	**24,436**	**24,983**
Olympia	City	17,689	18,138	18,464	18,820	19,049	19,325	19,738	19,742	19,889
	UGA	3,453	3,474	3,436	3,512	3,616	3,694	3,806	3,942	4,039
	Total	**21,142**	**21,612**	**21,900**	**22,332**	**22,665**	**23,019**	**23,544**	**23,684**	**23,928**
Rainier	City	486	492	502	530	542	547	551	549	551
	UGA	60	62	63	62	67	67	66	67	68
	Total	**546**	**554**	**565**	**592**	**609**	**614**	**617**	**616**	**619**
Tenino	City	531	568	581	592	601	610	615	621	627
	UGA	83	54	56	56	57	59	60	60	62
	Total	**614**	**622**	**637**	**648**	**658**	**669**	**675**	**681**	**689**
Tumwater	City	5,281	5,626	5,716	5,749	5,793	5,897	5,953	5,987	6,031
	UGA	2,795	2,844	2,844	2,899	2,939	2,999	3,089	3,117	3,167
	Total	**8,076**	**8,470**	**8,560**	**8,648**	**8,732**	**8,896**	**9,042**	**9,104**	**9,198**
Yelm	City	847	952	1,039	1,110	1,163	1,230	1,323	1,379	1,487
	UGA	429	408	414	415	425	433	425	431	439
	Total	**1,276**	**1,360**	**1,453**	**1,525**	**1,588**	**1,663**	**1,748**	**1,810**	**1,926**
Grand Mound UGA	**Total**	**302**	**305**	**307**	**310**	**313**	**316**	**316**	**318**	**324**
Chehalis Reservation		**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**
Nisqually Reservation		**211**	**211**	**212**	**212**	**212**	**212**	**212**	**212**	**213**
Total Cities		**35,378**	**37,026**	**38,116**	**39,150**	**39,857**	**40,742**	**41,576**	**41,820**	**42,318**
Total UGAs		**17,656**	**17,566**	**17,645**	**17,856**	**18,175**	**18,468**	**18,776**	**19,067**	**19,592**
Total Urban Areas		**53,034**	**54,592**	**55,761**	**57,006**	**58,032**	**59,210**	**60,352**	**60,887**	**61,910**
Rural Unincorporated County		**22,005**	**22,789**	**23,511**	**24,205**	**24,882**	**25,593**	**26,300**	**26,934**	**27,655**
Thurston County Total		**75,039**	**77,381**	**79,272**	**81,211**	**82,914**	**84,803**	**86,652**	**87,821**	**89,565**

Sources: Thurston Regional Planning Council; U.S. Bureau of the Census; Washington State Office of Financial Management; Lacey, Olympia, Rainier, Tenino, Yelm, and Thurston County Building Departments

Explanation: UGA is unincorporated Urban Growth Area. UGA figures include those dwelling units outside the city limits but within the long-term Urban Growth Management boundary. City and UGA boundaries may change over time due to annexations. Data are for April 1 of each year.

Note: Dwelling unit estimates incorporate housing starts data, however, the methodology also includes calibrating to U.S. Census and OFM data, includes demolitions, and does not include replacements and activity in manufactured home parks.

Table 4
Residential Land Supply and Demand, Thurston County

Jurisdiction	2000 Residential Land Supply (acres)	20 Year Forecast		25 Year Forecast	
		2020 Residential Land Demand (acres)	Percent Remaining in 2020	2025 Residential Land Demand (acres)	Percent Remaining in 2025
Bucoda	81	26	67%	30	63%
Lacey & Lacey UGA	5,697	3,583	37%	4,106	28%
Olympia & Olympia UGA	4,192	2,305	45%	2,713	35%
Rainier & Rainier UGA	554	322	42%	360	35%
Tenino & Tenino UGA	505	319	37%	353	30%
Tumwater & Tumwater UGA	4,459	1,788	60%	2,340	48%
Yelm & Yelm UGA	3,144	1,365	57%	1,594	49%
Grand Mound UGA	158	76	52%	87	45%
Total Urban Areas	**18,789**	**9,785**	**48%**	**11,582**	**38%**
Rural Unincorporated County	**145,553**	**56,900**	**61%**	**67,733**	**53%**
Thurston County Total	**164,343**	**66,685**	**59%**	**79,314**	**52%**

Sources: Buildable Lands Work Program, Thurston Regional Planning Council (TRPC); Forecast of Land Demand - Population and Employment Forecast for Thurston County, 1999, TRPC

Table 5
2000 Land Supply Compared to 2025 Land Demand, Thurston County

Jurisdiction	Industrial Lands				Commercial Lands			
	2000 Land Supply (acres)	2015 Land Demand (acres)	2025 Land Demand (acres)	Percent Remaining in 2025	2000 Land Supply (acres)	2015 Land Demand (acres)	2025 Land Demand (acres)	Percent Remaining in 2025
Bucoda	1	0	0	69%	9	0	1	94%
Lacey & Lacey UGA	1,254	79	132	89%	2,598	383	639	75%
Olympia & Olympia UGA	108	32	54	50%	1,006	313	521	48%
Rainier & Rainier UGA	0	1	2	0%	50	8	13	73%
Tenino & Tenino UGA	34	1	2	95%	26	6	9	64%
Tumwater & Tumwater UGA	2,768	63	105	96%	1,008	294	490	51%
Yelm & Yelm UGA	251	13	22	91%	400	111	185	54%
Grand Mound UGA	296	5	8	97%	145	18	30	79%
Total Urban Areas	**4,712**	**195**	**325**	**93%**	**5,242**	**1,133**	**1,889**	**64%**
Rural Unincorporated County	**611**	**122**	**203**	**67%**	**371**	**223**	**372**	**0%**
Thurston County Total	**5,323**	**317**	**528**	**90%**	**5,613**	**1,356**	**2,261**	**60%**

Source: Buildable Lands Work Program, Thurston Regional Planning Council.

Vulnerable Populations

Demographic information helps to identify vulnerable populations. Seniors, the disabled, children, and those living in poverty are all segments of the population that have special needs in times of a disaster. Also, they often have more challenges during the recovery period. Although the percentage of poverty in Thurston County is lower than the state average, 9.8% of county residents living in poverty are under 18 years of age and 9.8% are over 65.

Age Distribution

Overall the county's population is getting older. Census figures show that in 2000, the median age of the county's population was 36.5 years, up from 33.6 years in 1990. However, there are some interesting distinctions in the age characteristics between the cities within Thurston County. For example, Yelm has the youngest population. Its median age of 30.8 years is significantly lower than the county's median age, while its proportion of children (32%) is significantly higher than the county average (25%).

The senior population continues to be a growing segment of the population, at national and state levels as well as in Thurston County. Because of health and mobility issues that can sometimes limit life activities, this population is a vulnerable segment of the population in Thurston County. In 2000, persons age 65 and over constituted 11 percent of the total county population. The percentage of residents in the county over 65 years of age is expected to climb to roughly 13 percent by 2010 and should reach 17 percent by 2020. The first of the "baby boomers" will reach 65 in 2011.

Table 6 provides information on the age characteristics of the county.

Poverty

Poverty statistics can be a useful tool when assessing the special needs of vulnerable populations in disaster planning processes and targeting out-reach efforts. Data from the 2000 Census provides a glimpse of how wealth and poverty is distributed throughout the county. Census data historically have only been available every 10 years.

The county-wide average of households earning less than $15,000 was 12 percent. In Yelm and Olympia, approximately 18 percent of households earned less than $15,000 annually. Analysis of the census data at a fine level of detail reveals that the households with the highest incomes are located in the unincorporated County, specifically, in the urban growth areas of Lacey, Olympia, and Tumwater.

Table 6
Census 2000, Thurston County
Population and Age Characteristics
Distribution by Jurisdiction, 2000

Jurisdiction	Median age	0-17 Years		18-64 Years		65 & Over		Total Population	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Bucoda	34.4	187	29.8%	388	61.8%	53	8.4%	628	100%
Lacey	34.2	8,226	26.3%	18,841	60.3%	4,159	13.3%	31,226	100%
Olympia	36.0	9,120	21.5%	27,722	65.2%	5,672	13.3%	42,514	100%
Rainier	34.0	456	30.6%	908	60.9%	128	8.6%	1,492	100%
Tenino	34.2	431	29.8%	809	55.9%	207	14.3%	1,447	100%
Tumwater	36.2	2,943	23.2%	8,035	63.3%	1,720	13.5%	12,698	100%
Yelm	30.8	1,051	32.0%	1,884	57.3%	354	10.8%	3,289	100%
Total Incorp.	N/A	22,414	24.0%	58,587	62.8%	12,293	13.2%	93,294	100%
Total Unincorp.	N/A	30,113	26.4%	72,612	63.7%	11,336	9.9%	114,061	100%
Thurston County	**36.5**	**52,527**	**25.3%**	**131,199**	**63.3%**	**23,629**	**11.4%**	**207,355**	**100%**
Chehalis Reservation	24.5	284	41.1%	366	53.0%	41	5.9%	691	100%
Nisqually Reservation	25.8	215	36.6%	344	58.5%	29	4.9%	588	100%
Washington	**35.3**	**1,513,843**	**25.7%**	**3,718,130**	**63.1%**	**662,148**	**11.2%**	**5,894,121**	**100%**

Source: U.S. Census Bureau, Census 2000 Summary File 1 Data; Thurston Regional Planning Council.

It is also informative to review how income is earned or received to understand poverty and wealth distribution in the county. Household income is a measure of household earnings and income from other sources such as social security, supplemental security income, income from public assistance, and income from retirement sources. At the national level, poverty thresholds are determined by the U.S. Census Bureau depending on household size, age of householders, and number of related children.

Taking a look at federal poverty statistics, Thurston County fared slightly better than the State for overall population below poverty, with 8.8 percent of its population falling below the poverty line in 2000. This better-than-State average holds true when poverty is examined in relation to the population under 18 and over 65, and parallels closely with trends from a decade ago. When comparing the cities and towns, the heaviest rates of poverty are concentrated in the small south county town of Bucoda, which has more than triple the county average. Other south county cities and towns have seen significant changes in the last decade and have lower numbers of households falling below the poverty level. Of the cities, Olympia has the highest rate of poverty, in part due to the concentration of social services in urban areas that are unavailable in rural settings.

Table 7
Individuals Below Poverty Level, 1999

Jurisdiction	Total Individuals		18+ Years		65+ Years		Related Children Under 18 Years	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Bucoda	162	25.1%	73	17.0%	1	2.7%	89	41.2%
Lacey	2,798	9.2%	1,865	8.2%	266	6.5%	892	11.5%
Olympia	4,982	12.1%	3,982	12.4%	319	6.3%	935	10.4%
Rainier	100	6.8%	63	6.4%	8	6.8%	33	6.8%
Tenino	132	9.1%	76	7.5%	20	9.9%	52	12.4%
Tumwater	1,060	8.5%	748	7.7%	88	5.2%	269	9.5%
Yelm	333	10.1%	204	8.8%	25	6.8%	111	11.3%
Thurston County	**17,992**	**8.8%**	**12,723**	**8.3%**	**1,135**	**5.0%**	**4,953**	**9.8%**
Chehalis Reservation	160	24.4%	81	21.3%	19	38.8%	78	28.5%
Nisqually Reservation	107	18.2%	62	16.3%	6	26.1%	37	18.4%
Washington State	**612,370**	**10.6%**	**409,479**	**9.6%**	**47,967**	**7.5%**	**193,569**	**13.2%**

Source: U.S. Bureau of the Census, 2000 Census.

Explanation: 1999 income used to calculate poverty statistics. Percent denotes percent of total population in specified age category. Refer to table II-18 for total population by age category.

Table 8
Household Income, 1999

1999 Income	Percentage of Households									
	Thurston County	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Yelm	Chehalis Reservation	Nisqually Reservation
Less than $10,000	6.60%	7.10%	7.60%	10.30%	5.90%	10.00%	5.70%	10.10%	14.50%	11.10%
$10,000 to $14,999	5.20%	7.70%	5.00%	7.20%	7.10%	7.20%	5.20%	8.30%	9.10%	5.00%
$15,000 to $24,999	11.10%	22.40%	12.60%	13.40%	7.50%	14.50%	13.40%	12.20%	16.70%	11.10%
$25,000 to $34,999	12.80%	13.80%	13.00%	13.50%	15.40%	19.30%	14.40%	12.40%	24.20%	22.80%
$35,000 to $49,999	17.80%	19.40%	19.70%	15.70%	23.50%	16.10%	19.60%	21.00%	18.80%	15.00%
$50,000 to $74,999	23.90%	19.90%	24.50%	20.50%	27.90%	23.50%	20.30%	24.90%	9.70%	17.20%
$75,000 to $99,999	11.80%	2.60%	10.10%	9.80%	9.30%	3.70%	11.50%	6.80%	4.80%	13.30%
$100,000 to $149,999	7.90%	3.60%	6.00%	7.30%	1.60%	4.60%	7.10%	3.30%	2.20%	4.40%
$150,000 to $199,999	1.40%	1.00%	0.90%	1.20%	1.40%	0.40%	1.10%	0.70%	0.00%	0.00%
$200,000 or more	1.50%	2.60%	0.60%	1.00%	0.40%	0.90%	1.60%	0.20%	0.00%	0.00%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
Median Income	$46,975	$34,286	$43,848	$40,846	$42,955	$34,526	$43,329	$39,453	$30,000	$35,000
# of Households	81,666	196	12,351	18,673	506	571	5,587	1,206	186	180

Source: U.S. Bureau of the Census, 2000 Census.
Explanation: Thurston County includes unincorporated and incorporated Thurston County. Income earned by all household members 15 years of age and older. 2000 Census
Note: Thurston County includes unincorporated and incorporated Thurston County. Numbers may not add due to rounding.

Economics

Median Household Income

Median household income measures the point at which half of all households earn more income and half of all households earn less. It measures money income only and does not include additional benefits such as employer contributions to pension plans and medical benefits.

Thurston County's median household income was measured at $46,975 during the 2000 Census. The county continues to have a higher median household income than adjacent counties, and moved above the state average during the last decade.

Between Census years, estimates of income are only available at the county-wide level. The most recent income statistics at the jurisdictional level are from the 2000 Census. Income from the 2000 Census reflects 1999 earnings. While the 2000 county-wide median household income was $46,975, income ranged widely between the local jurisdictions. Lacey continues to record the highest of the incorporated jurisdictions with a median of $43,848. In the past, the south county towns and cities have had a substantially lower median household income than the north county cities. Data from the 2000 Census, however, shows that for median household income, Rainier ranks third among the county's cities.

Table 8 provides information on household income in the county.

Employment and Jobs

The largest share of county jobs is in the government sector. State employment accounts for almost 23,000 jobs in Thurston County. On a per-capita basis, state employment has remained relatively steady at around 16 state employees per 1,000 people throughout the 1990s.

Thurston County has experienced a swell in the number of service industry jobs that increased its market share from 10 percent of the total county jobs in 1970, to 15 percent in 1980, and currently 23 percent in 2000. The services sector is a diverse grouping of industries. Not only does it include the hotel, recreation, and repair services that people traditionally associate with this sector, it also includes the health professions and professional services such as accounting, architecture, legal services, and engineering.

The following table shows employment categories and numbers of full-time and part-time employees from 1970 to 2000.

Table 9
Total Full-Time and Part-Time Employment, Thurston County
1970, 1980, 1990, 1999, 2000

Employment Category	1970	1980	1990	1999	2000
By Proprietor or Wage and Salary					
Wage and salary employment	30,366	46,141	69,192	88,829	90,584
Proprietors' employment	4,410	9,224	15,314	20,804	21,131
Farm proprietors' employment	448	814	921	1,012	1,006
Nonfarm proprietors' employment	3,962	8,410	14,393	19,792	20,125
By Industry					
Farm employment	1,640	1,865	1,525	1,810	1,639
Nonfarm employment	33,136	53,500	82,981	107,823	110,076
Private employment	18,878	33,779	54,567	73,958	75,418
Ag. Serv., Forestry, Fishing, and other	254	1,124	1,454	1,838	2,009
Mining	14	36	90	111	121
Construction	1,762	2,472	4,661	6,190	6,143
Manufacturing	2,779	3,633	4,354	5,003	4,777
Transportation and Public Utilities	1,223	1,606	2,123	2,959	3,099
Wholesale Trade	708	1,265	2,407	2,706	2,643
Retail Trade	4,778	9,253	14,079	18,347	18,572
Finance, Insurance, and Real Estate	2,385	4,075	4,755	7,042	7,067
Services	4,975	10,315	20,644	29,762	30,987
Government and Government enterprises	14,258	19,721	28,414	33,865	34,658
Federal, civilian	567	831	900	988	1,102
Military	433	590	948	792	803
State and local	13,258	18,300	26,566	32,085	32,753
State	N/A	13,722	19,385	22,283	22,746
Local	N/A	4,578	7,181	9,802	10,007
Total full- and part-time employment	**34,776**	**55,365**	**84,506**	**109,633**	**111,715**

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Measurement Division (Table CA25). 1969-1974 based on 1967 SIC. 1975-1987 based on 1972 SIC. 1988-1999 based on 1987 SIC. Available from http://fisher.lib.virginia.edu/reis or http://www.bea.doc.gov/bea/regional/data.htm.

Explanation: Employment is measured as the average annual number of jobs, full-time plus part-time; each job that a person holds is counted both by type (wage and salary employment and self-employment) and by industry. Excludes limited partners.

Agriculture

Agriculture remains an important component of Thurston County's economy. Activity on farms is varied, and ranges from tree farming to growing berries, to egg farms and organic farming. Much of the economic viability of farming is tied to access to local markets. This access needs to be addressed in natural hazard mitigation planning to minimize economic loss and loss of goods.

The 1997 Census of Agriculture revealed that there were 832 farms operating in Thurston County in 1997, designating over 56,000 acres of land to agriculture. While the number of

farms has increased since 1987, the average size of farms has decreased from 70 acres to 68 acres; more small farms (less than 9 acres) are being established in the County. The total value of all crops, including nursery crops, increased from over $19 million in 1992 to over $36 million in 1997. The total net cash from agriculture sales increased accordingly, from $8.6 million in 1992 to $22.5 million in 1997.

Transportation and Utilities

Transportation

Natural hazards have historically impacted the transportation system to a great degree. Roads and bridges have been rendered unusable during and following certain events. Transportation systems have been severely disrupted due to road or bridge closures. Transportation system failures during and after a disaster have caused significant economic losses.

Thurston County is bisected by Interstate 5, the major north-south highway on the United States west coast. U.S. Highway 101 begins in Olympia and is the major route to the Olympic Peninsula and Washington Coast. Local government maintains and operates a transportation system comprised of over 2,000 miles of roadway, dozens of transit routes and services, hundreds of miles of bike lanes and sidewalks, almost 90 miles of trail, a marine terminal, and a regional airport.

While population in the region has increased at an average annual rate of 4 percent from 1970 to 2000, vehicle registration during the same time period increased by 6 percent per year. This is compatible with trends in household vehicle ownership. In 1960, 53 percent of households in the region owned one or fewer vehicles, by 2000 only 36 percent of households owned one or fewer vehicles. The changes between 1960 and 2000 are most pronounced in the households with three or more cars. A mere 5 percent of households had three or more vehicles in 1960. By 2000, 24 percent, or about one in four households, owned three or more vehicles.

In working to meet the growing transportation needs of the region, local governments in Thurston County are guided by principles established in the Regional Transportation Plan. Individual jurisdictions have adopted comprehensive strategies to address the different aspects of the region's transportation system, including streets and roads, public transportation, rail, bicycle and pedestrian facilities, and marine and aviation facilities.

Intercity Transit (IT) provides public transportation services in Olympia, Lacey, Tumwater, and Yelm (see Map 2 – IT Service Area). It is estimated that residents ride IT buses and vans around 2.8 million times in a year. Intercity Transit's vehicle fleet consists of 33 full-size buses, 34 small buses and 65 vanpool groups. In addition to bus service in the greater Olympia area, IT operates a vanpool program, maintains a large ride-matching database and provides accessible services to residents and commuters.

The County is bisected by a major north-south railroad line serving Burlington Northern, Union Pacific, and Amtrak. Several spur-lines run throughout the County with a significant spur passing through the heart of downtown Olympia to serve the Port of Olympia.

The citizens of Thurston County created the Port of Olympia in 1922. The Port District's boundaries are countywide, and its primary holdings are located in Tumwater and Olympia with airport and marine terminals. The marine terminal is an international shipping point. It is located on the Port Peninsula in Budd Inlet, and can handle up to three vessels at one time. The terminal is served by truck and rail. Historically, primary cargoes have been logs, lumber, and food products.

The Port's air terminal is the Olympia Airport, south of Tumwater, which caters primarily to the private aviation community. Created in 1927, it is among the oldest public airports in the country. An industrial park at New Market Industrial Campus is adjacent to the Airport, and is home to a variety of industries, some of which are dependent on an Airport location. The Port is currently in the planning phase for the shift of the existing runway. The 5,000-foot strip will be shifted south 758 feet, because the north end is too close to Old Highway 99 to be in compliance with FAA regulations.

Utilities

Williams Pipeline has a high-pressure natural gas pipeline that crosses Thurston County, extending from near Yelm southwest into Lewis County. Feeder lines branch off to serve the north county and the Olympic Peninsula.

Olympic Pipeline Company has a liquid line that transports refined petroleum products from refineries in northwest Washington to Portland, Oregon. It generally parallels Williams Pipeline, extending from east of Yelm southwest into Lewis County.

Several electrical distribution and feeder lines cross the County. Bonneville Power Administration has a main line that enters the county east of Yelm which then branches off to two distribution stations: one to the southwest in Lewis County and one to the west in Olympia. The Olympia station feeds transmission lines serving Grays Harbor, Mason, and Thurston Counties.

Local Government Structure

In Washington State there are two different types of local governments: "general-purpose" and "limited-purpose." Counties, cities, and towns fall under the general-purpose government category by performing broad functions, providing a variety of public services, and representing local citizens. Limited-purpose governments, also referred to as special purpose districts, provide specific services to defined populations. Services that general-purpose and limited-purpose governments provide are not mutually exclusive. For example, water service can be supplied by a city, town, or special purpose district. The local

government structure in Washington State is relatively flexible by allowing citizens to decide which services would be better provided by general-purpose or limited-purpose governments.

In Thurston County, there are seven incorporated cities/towns: Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, and Yelm, which are independent municipalities. Bucoda, Rainier, Tenino, Tumwater, and Yelm all are represented by a Mayor and Council structure where the Council members and the Mayor are selected by public election. Olympia and Lacey have a Manager and Council administration where the Council members are selected by public election and the Council appoints the Manager. A Mayor may also be part of the administration in a Manager-Council structure. Thurston County government administers the remaining, unincorporated, part of the county which is represented by a three member Commission that is selected by public election.

Besides the eight general-purpose governments, Thurston County has several limited-purpose governments that provide a variety of functions, which include but are not limited to cemetery, parks and recreation, and fire districts. Also, within the county, the Nisqually Tribal Council and the Chehalis Tribal Council operate as semi-independent governing bodies.

Timberland Regional Library

The Timberland Regional Library (TRL) District has 27 branches in five counties, Grays Harbor, Lewis, Mason, Pacific, and Thurston, and serves over 400,000 people. In 2001, TRL circulated 4.1 million items. As of September 2002, TRL has 257,609 library cardholders. Thurston County libraries serve nearly half of Timberland Regional Library population base with five branches located in Lacey, Olympia, Tumwater, Yelm, and Tenino. The cities of Bucoda and Rainier have annexed to the library district for services.

Law Enforcement

There are a total of nine agencies responsible for law enforcement in Thurston County. The City of Olympia and Thurston County have the largest number of total full-time employees. Law enforcement employees do not include those employed by correctional facilities.

Adult Correctional Facilities

The Thurston County Corrections Facility has a total operational bed capacity of 408 inmates which consists of twelve general population housing units including intake, minimum, medium and maximum security, female unit, female work release and inmate worker unit, medical/protective custody unit; and disciplinary lockdown unit.

In addition to the general population units, the Corrections Facility provides direct supervision minimum-security beds in Post 6 and Chemical Dependency and internal inmate worker program beds in Post 5. Both are located in the basement part of the facility.

The Correctional Options annex houses up to 92 inmates serving sentences in work release and community betterment labor projects. The Annex also serves as the processing and monitoring center for up to 100 additional court-ordered offenders on Correctional Options Programs (i.e., Electronic Monitoring, Day Reporting, and Day Jail).

The average daily population for 2001 including General Population, Work Release, and Correctional Options Programs was 462.

Juvenile Correctional Facilities

Juvenile detention and correctional facilities in Thurston County include a county juvenile detention center and a state correctional facility. The Thurston County Juvenile Court is responsible for meeting the juvenile justice needs of the County for offenders under the age of 18, with extensions to age 21 for select juvenile offenders. The Juvenile Department provides legal processing of referrals, probation, detention, and rehabilitative programs for area youth and their families.

Fire Protection

Fifteen fire districts and three city fire departments in Olympia, Tumwater, and Bucoda serve residents of Thurston County. Fire protection for Lacey is provided by Fire District #3. Fire districts also provide Emergency Medical Services (Medic One), funded by a countywide special levy administered by the County (see Map - 3 Fire Districts).

Education

Thurston County has a variety of educational opportunities available to the students and adults of the community. These include both private and public primary, secondary, and higher education institutions. A number of these offer programs outside regular school hours, providing greater accessibility to working adults and students so that they may meet their educational goals.

Public Schools

Eight school districts provide primary and secondary education to most of Thurston County's students (see Map 4 - School Districts). School districts in Thurston County provide a wide variety of services and opportunities for students, including the Head Start program for preschoolers, advanced placement courses for high school students, and numerous community-based learning experiences for all ages.

School districts in the county range in size from rural Griffin, with a total of 595 students district-wide, to the more urban North Thurston Public Schools with 12,188 students during the 2001-2002 school year. Roughly 75 percent of public school attendance is in three of the north county school districts. North Thurston serves 34 percent of the students, Olympia serves 24 percent, and Tumwater serves 17 percent of the county's students.

Thurston County has 18 secondary schools. While most of these schools are comprehensive and offer a full range of academic and activity programs, there are several non-traditional secondary schools available.

Private Schools

In the 2001-02 academic year, there were 19 private State Board of Education approved schools in Thurston County serving 2,020 students. Many of the students enrolled in private schools are in elementary and middle schools.

Higher Education

South Puget Sound Community College has served the residents of Thurston County for 40 years. Each quarter, nearly 6,000 students attend the college, making it the largest institution of higher education in Thurston County. South Puget Sound offers a comprehensive program of day and evening classes and continuing education courses, as well as basic education, job skills training, and personal enrichment courses.

The Evergreen State College is a public college of arts and sciences that is considered a national leader in developing innovative approaches to teaching and learning. Founded in 1967, Evergreen opened its doors in 1971 and now enrolls more than 4,000 students.

Saint Martin's College is a four-year co-educational college with a strong liberal arts foundation. Located on a 360-acre campus in Lacey, more than 1,000 students attend Saint Martin's main campus. The college and Abbey employ about 450 people.

Native American Tribes with Traditional Lands within Thurston County

Chehalis

The Chehalis Indian people historically occupied a large area within the Chehalis River watershed stretching from the foothills of the Cascade Mountains to the Pacific Ocean in Southwest Washington. The Tribe has been located on a reservation within the Chehalis watershed since the 1850s, though important historic and archaeological sites are scattered throughout the Tribe's aboriginal area.

The reservation is situated approximately 26 miles southwest of Olympia. Thurston and Grays Harbor Counties bisect the reservation's 4,215-acre boundaries. About 800 acres of the reservation are within Thurston County boundaries.

Census 2000 figures show a Chehalis Reservation population of 691 persons, with 41 percent of the population under the age of 18 years. This is an increase in total population of 41

percent over the 1990 Census. The U.S. Bureau of Indian Affairs, U.S. Labor Force Report for 2001 reports an enrolled tribal population of 629 and a service population – enrolled and non-enrolled Indians living on and near the reservation and those non-Indians with familial ties to the reservation – of 2,143.

The Chehalis tribe employs about 80 people in its tribal government and provides extensive community services including the Chehalis Tribal Health Clinic, Head Start, day care, Tsapowum (drug and alcohol treatment), Youth Center, law enforcement, corrections, tribal court, child and family services, natural resources management, and the Chehalis Tribal Housing Authority. Tribal enterprises employ an additional 535 persons, making the Tribe a major regional employer.

The Chehalis tribal governing body is the General Council, which is comprised of all enrolled members 18 years of age and older. The Council meets twice annually, and may also convene special meetings. The Business Committee, a five-member body elected to the specific office by the General Council for two-year terms, oversees tribal administration and business. The Business Committee is composed of the Tribal Chairman, Vice Chairman, Secretary, Treasurer, and Fifth Council Member.

Nisqually

The Nisqually are a Coastal Salish tribe whose reservation includes 1,400 acres in Thurston County. The Nisqually were signatories of the Treaty of Medicine Creek, signed on December 26, 1854. The Indian War of 1855-56 and an Executive Order of January 20, 1857 reduced the tribal holdings. The 3,300 acres of reservation lands in Pierce County were condemned when Fort Lewis was established in 1918.

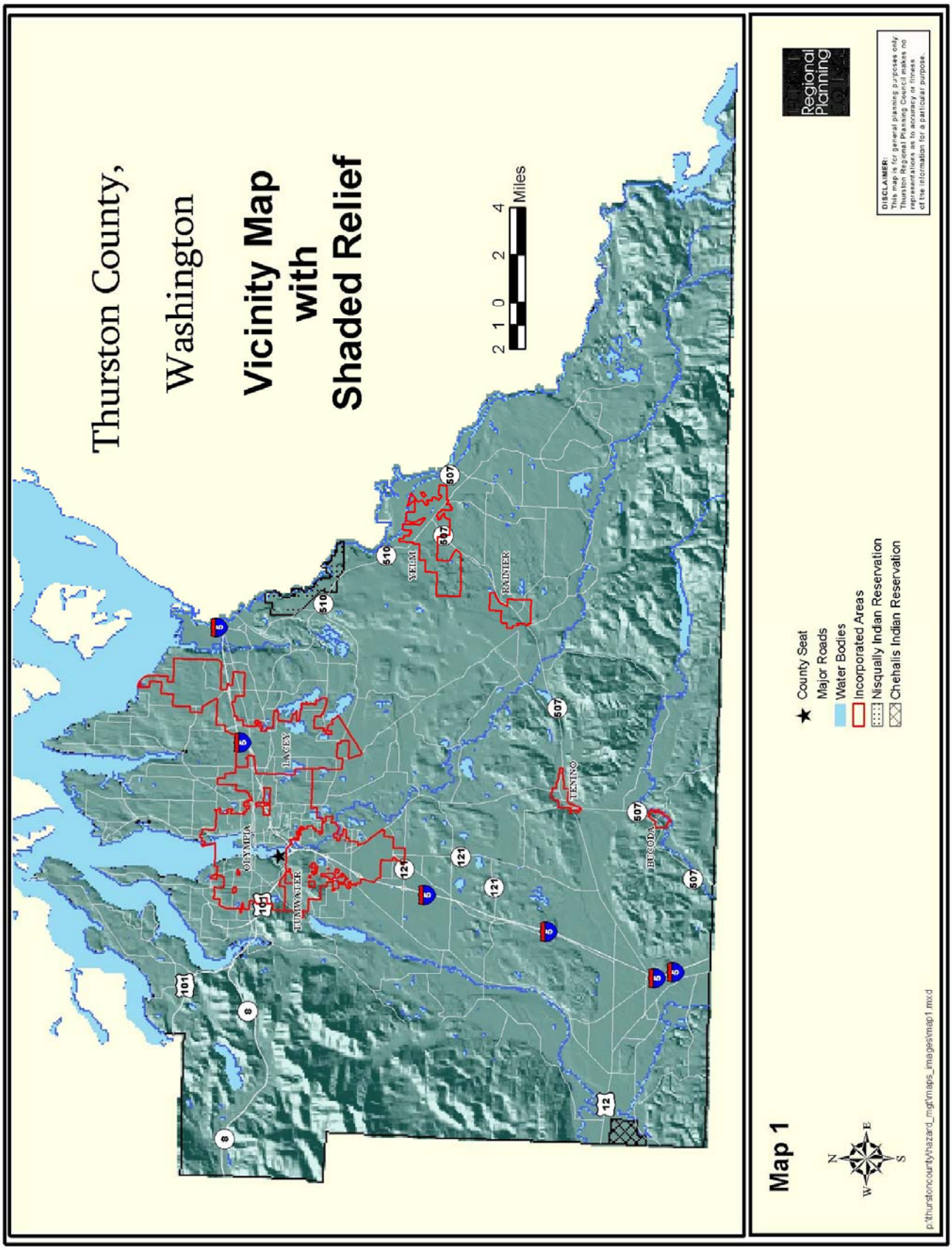
The Nisqually are and were a river people who gathered and preserved food from a vast land area and whose economy was based upon the land, the river, and the salmon of their traditional homelands.

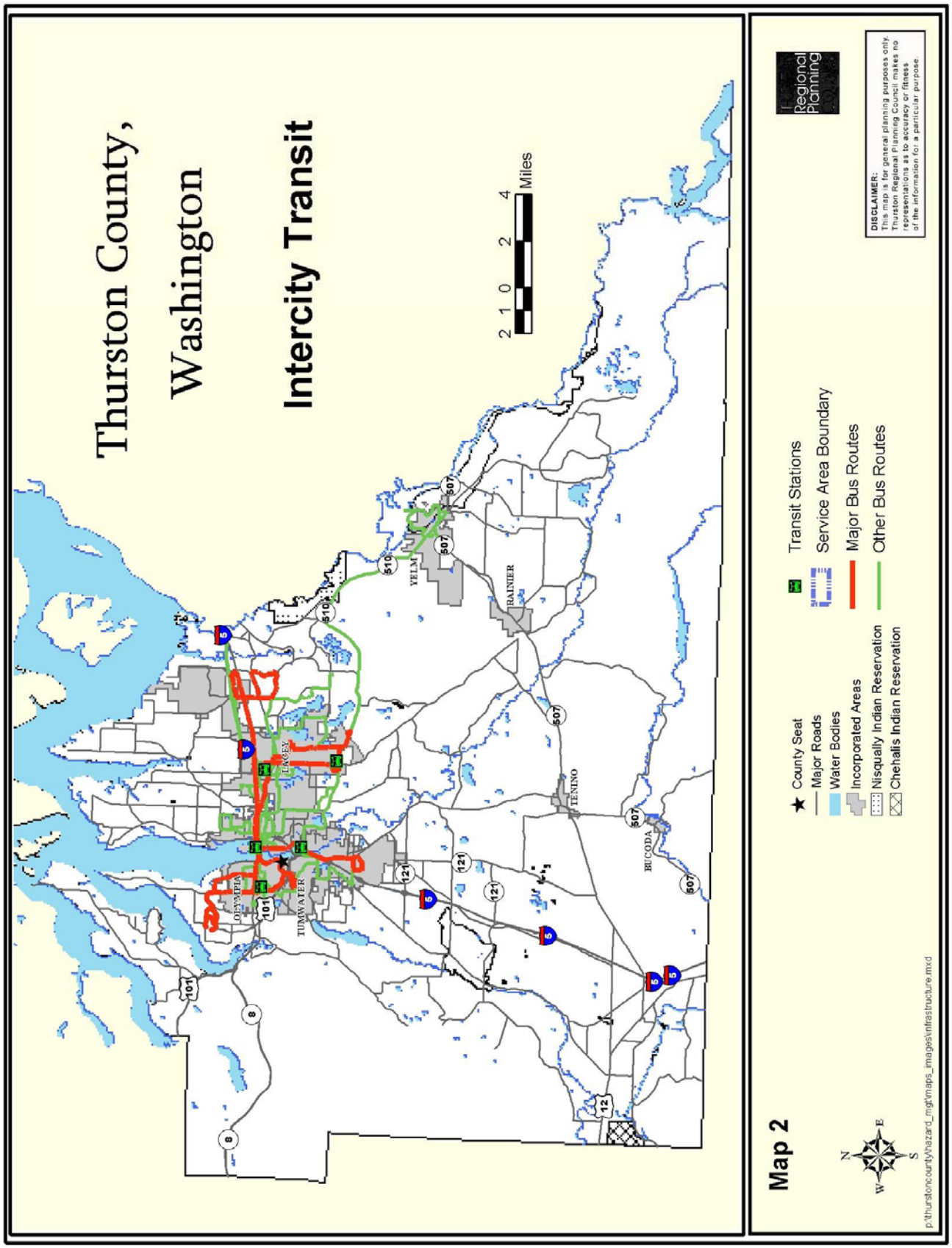
The Nisqually adopted their constitution in 1946 and tribal enrollment is now 507 members.

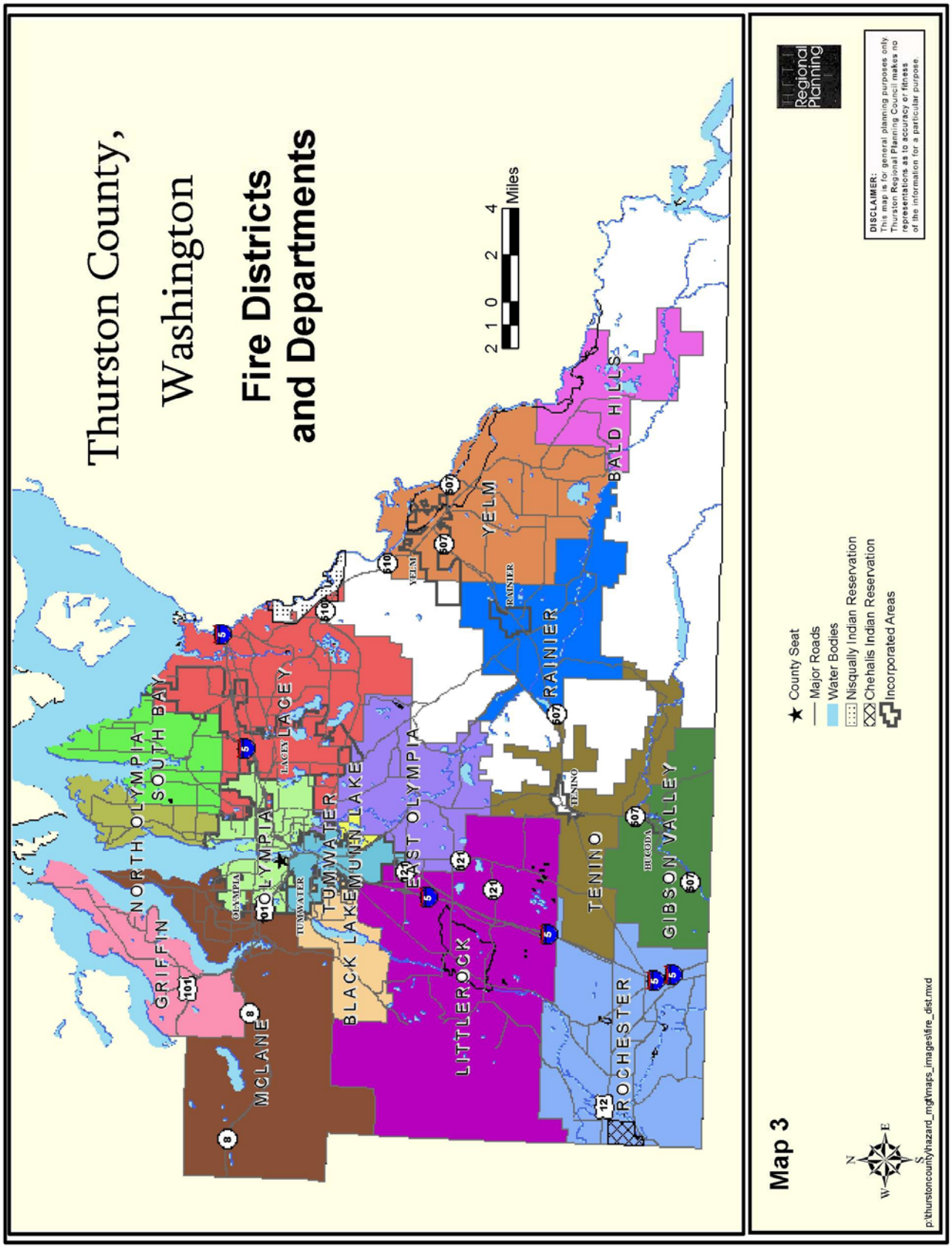
Squaxin Island

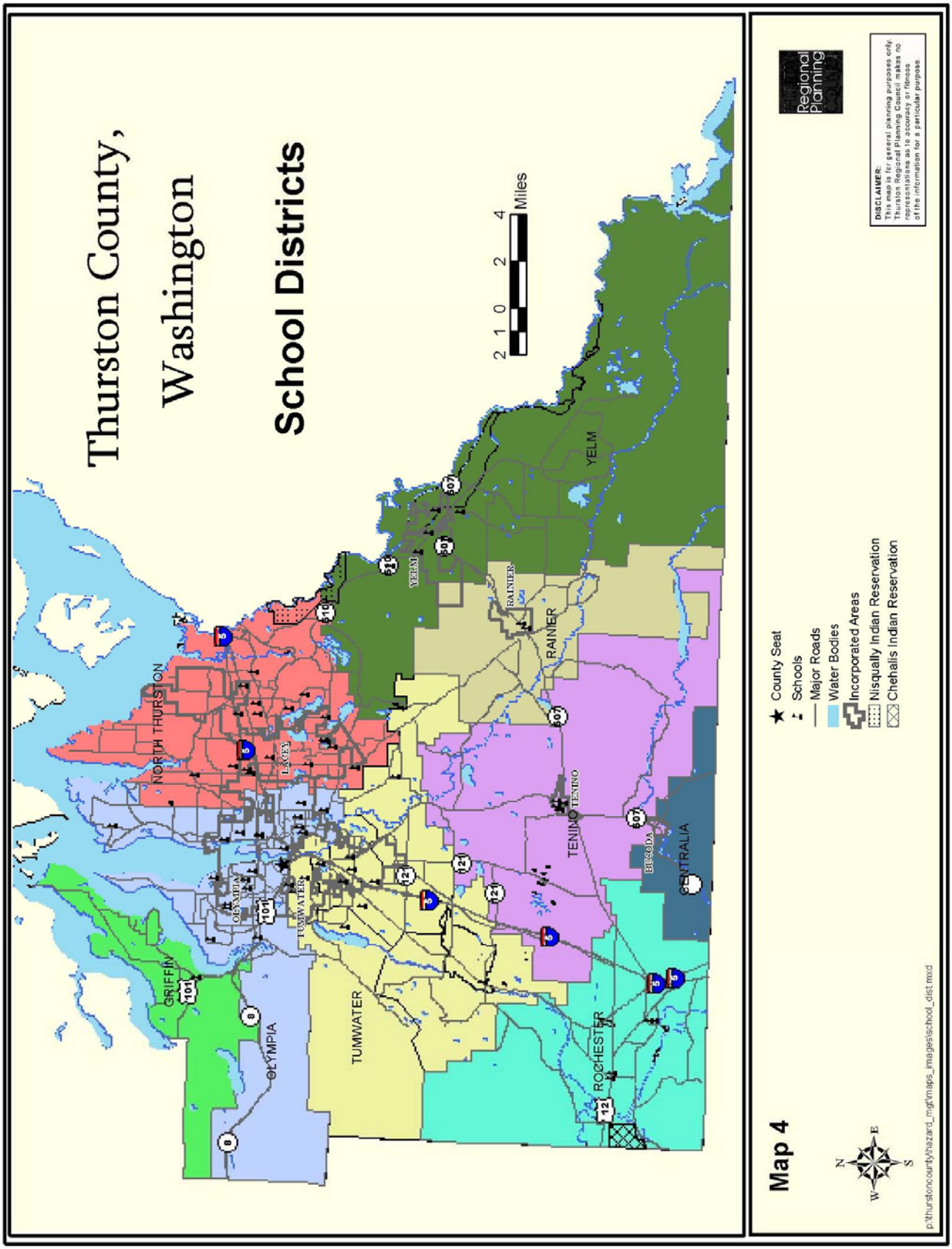
The Squaxin people are a southern coast Salish group who traditionally lived in the forests and along the waters of southern Puget Sound, depending upon the fish, shellfish, animals, and plants of that area for their economy. The Squaxin Island Reservation was established under the Treaty of Medicine Creek in 1854. The Squaxin ancestors were confined to the Island during the Indian War of 1855-56 and dispersed after the war.

Today the tribe numbers 719 enrolled members who utilize the Island for fishing, hunting, shellfish gathering, camping and other activities. The tribe was organized in 1934 and adopted its Constitution in 1965. The traditional lands of the Squaxin include parts of Thurston County.


Thurston County,
Washington
Vicinity Map
with
Shaded Relief
2 1 0 2 4 Miles
OLYMPIA
LACEY
TUMWATER
YELM
RAINER
TENINO
BUCODA
County Seat
Major Roads
Water Bodies
Incorporated Areas
Nisqually Indian Reservation
Chehalis Indian Reservation
Regional Planning
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Map 1
N
W
E
S
p:\thurstoncounty\hazard_mgt\maps_images\map1.mxd


Thurston County,
Washington
Intercity Transit
2 1 0 2 4 Miles
Regional Planning
Transit Stations
Service Area Boundary
Major Bus Routes
Other Bus Routes
County Seat
Major Roads
Water Bodies
Incorporated Areas
Nisqually Indian Reservation
Chehalis Indian Reservation
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Map 2
N
E
S
W
p:\thurstoncountyhazard_mgt\maps_images\infrastructure.mxd
OLYMPIA
TUMWATER
LACEY
YELM
RAINIER
TENINO
BUCODA


Thurston County,
Washington
Fire Districts
and Departments
2 1 0 2 4
Miles
NORTH OLYMPIA
SOUTH BAY
GRIFFIN
OLYMPIA
LACEY
TUMWATER
BLACK LAKE
MCLANE
EAST OLYMPIA
LITTLEROCK
TENINO
ROCHESTER
GIBSON VALLEY
YELM
RAINIER
BALD HILLS
Regional Planning
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
County Seat
Major Roads
Water Bodies
Nisqually Indian Reservation
Chehalis Indian Reservation
Incorporated Areas
Map 3
N
E
S
W
p:\thurstoncounty\hazard_mgt\maps_images\fire_dist.mxd


Thurston County,
Washington
School Districts
2 1 0 2 4 Miles
NORTH THURSTON
LACEY
OLYMPIA
TUMWATER
GRIFFIN
YELM
RAINIER
TENINO
BUCODA
CENTRALIA
ROCHESTER
County Seat
Schools
Major Roads
Water Bodies
Incorporated Areas
Nisqually Indian Reservation
Chehalis Indian Reservation
Regional Planning
DISCLAIMER:
This map is for general planning purposes only.
Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Map 4
N
E
S
W
p:\thurstoncounty\hazard_mgt\maps_images\school_dist.mxd

HAZARDS ANALYSIS

(This page left blank intentionally.)

EARTHQUAKE

Hazard Description

Earthquakes are one of nature's most damaging hazards. The earth's surface is constantly moving. Giant plates, called tectonic plates, make up the earth's crust and move very slowly over the surface of the globe. In areas where the plates are in contact, stresses build up. An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of tectonic plates.

Where tectonic plates overlap, as one plate slides under another, subduction zones are created. Washington State is situated near a tectonic collision boundary where the oceanic Juan de Fuca plate dives beneath the continental North American plate. The plate boundary is the Cascadia Subduction Zone which lies about 50 miles offshore, extending from near Vancouver Island to northern California. These plates are converging at a rate of 1-1 ½ inches per year.

As the Juan de Fuca plate slides beneath the North American plate, cracks, or faults, develop at their boundary and at the surface in response to bending. The friction caused by this sliding movement tends to stick the two plates, or two sides of a fault, together. Over time, tremendous pressure builds up and friction is overcome. When this happens, one plate or one side of a fault moves relative to the other plate or side resulting in the sudden release of energy that is felt as an earthquake.

The epicenter of an earthquake is the point on the earth's surface directly above the earthquake's focus. The severity of an earthquake is dependent on the amount of energy released from the fault or epicenter. The effects of an earthquake can be felt far beyond the site of its occurrence. They usually occur without warning and after just a few seconds can cause massive damage and extensive casualties.

The variables that characterize earthquakes are ground motion, surface faulting, ground failures, and seismic activity. Ground motion is the vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions.

Surface faulting is the differential movement of two sides of a fracture - - in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.

Liquefaction is the phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop upon gentle slopes and entail the

sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil supporting the structures liquefies. This can cause structures to tip and topple.

There are several common measures of earthquakes. The Richter Magnitude Scale is a mathematical scale which measures the intensity of ground motion. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a ten-fold increase in measured amplitude, and 31 times more energy released. The Modified Mercalli Intensity Scale measures the earthquake intensity by the damage it causes. Peak ground acceleration (PGA) is a measure of the strength of ground movements. It expresses an earthquake's severity by comparing its acceleration to the normal acceleration due to gravity.

Three kinds of earthquakes are recognized in the Pacific Northwest: shallow earthquakes, subduction zone earthquakes, and deep earthquakes.

Shallow earthquakes occur along faults close to the surface of the North American plate. They have a maximum depth of about 19 miles though most occur much nearer to the surface. The majority of earthquakes in the Pacific Northwest are of the shallow type. They could potentially produce magnitudes as high as 7.5, though most are less than 3.0.

Subduction zone earthquakes occur when there is motion between the two plates rather than at localized faults. The movement can occur over hundreds of miles and last for several minutes. Subduction zone earthquakes are considered to be the most destructive with potential magnitudes of 9.0 or greater.

Deep earthquakes occur along faults in the Juan de Fuca plate as it sinks beneath the North American plate. Their depths generally range from 16-62 miles. Magnitudes of 7.5 have been recorded.

Earthquake - Historical Occurrences and Impacts

Thurston County is located in a seismically active region. Each year, since 1980, the Pacific Northwest Seismograph Network has recorded an average of more then two thousand earthquakes in Washington and Oregon.

Shallow earthquakes: The vast majority of earthquakes are shallow earthquakes (>98%) with a magnitude less than 3.0 (>99%). The shallow 1972 earthquake in the North Cascades was the largest in the history of Washington and Oregon. It had an estimated magnitude of 7.4 and was followed by many aftershocks. In 1993, a magnitude 5.6 earthquake in the Willamette Valley of Oregon caused $28 million in damages, and a pair of earthquakes near Klamath Falls, Oregon of magnitude 5.9 and 6.0 caused two fatalities and $7 million in damage. Large shallow earthquakes occur in the Pacific Northwest about once every 50 years.

Subduction zone earthquakes: A subduction zone earthquake has not occurred locally since modern record keeping began. However, similar subduction zones worldwide have produced earthquakes of magnitude 8 or larger. An example is the magnitude 9.2 Alaska earthquake of 1964. Geologic evidence indicates that the Cascadia Subduction Zone has generated great earthquakes at roughly 500 year intervals, most recently about 300 years ago. Researchers estimate there is a 10% chance of a local subduction zone earthquake within the next 200 years.

Deep earthquakes: On February 28, 2001, a 6.8 magnitude earthquake was centered in the Nisqually Reach northeast of Olympia. The Nisqually earthquake was a deep earthquake, occurring 30 miles below the Nisqually wetland. There was one significant aftershock on March 1, 2001. Causing damage across much of the state, the Nisqually earthquake was the second-worst earthquake in recent Washington history. On the day of the earthquake, the state declared a state of emergency. The next day, the Governor requested federal assistance and estimated the economic consequences at $2 billion. On March 1, 2001, a Presidential Disaster Declaration was issued state-wide.

According to scientists, other historical earthquakes that caused damage in western Washington bear similarities to the Nisqually earthquake. In 1965 a deep earthquake with a magnitude of 6.5, located between Seattle and Olympia, caused 3 fatalities. Scientists say the 1965 earthquake had a similar fault orientation as the 2001 Nisqually earthquake. Another deep earthquake, with a magnitude of 7.1, occurred in 1949 and caused eight fatalities. The epicenter of the Nisqually earthquake was near that of the 1949 earthquake. Both of these earlier earthquakes caused significant damage. Other deep earthquakes occurred in 1882, 1909, and 1939. Large deep earthquakes are estimated to occur about once every 25 years.

During the 1949 quake, eight capitol buildings in Olympia were damaged with a loss of two million dollars. Nearly all large buildings in Olympia were damaged through cracked or fallen walls and plaster. Two large smokestacks and many chimneys fell. Streets were damaged extensively. Water and gas mains were broken. A large portion of a sandy spit jutting into Puget Sound north of the city disappeared completely during the earthquake.

Damage from the 1965 quake was estimated to be $12,500,000 with much of the loss in King County. It isn't clear how much of this occurred in Thurston County. Some of the reported damage included: The Union Pacific Railroad reported a hillside fill slid away from beneath a 400-foot section of a branch line just outside Olympia. Several capitol campus buildings were damaged, including the inner dome of the rotunda. The 5-ton chandelier in the Capitol Building swung like a pendulum clock on its 110 foot chain in a 1-foot orbit for half an hour after the shock.

The 2001 Nisqually earthquake produced strong ground shaking over a wide area. However, the depth of the earthquake minimized the intensity of the shaking and limited the impact to the built environment. In addition, drought conditions in the Puget Sound region reduced the number of landslides and amount of liquefaction that would have otherwise been caused by a quake of that magnitude. Nevertheless, according to geotechnical researchers, observations of liquefaction were widespread in parts of Olympia and South Seattle, and several

significant lateral spreads, embankment slides, and landslides occurred. The relatively long duration of the event and the relatively low cyclic resistances of some of the fills in the area are likely causes for the significant liquefaction and ground failure which occurred.

The Nisqually earthquake resulted in 400 injuries (a dozen of them serious) and one confirmed death (a trauma-induced heart attack). FEMA reported that 41,414 people registered for federal disaster aid, more than three times the number of a previous disaster in Washington.

One year after the earthquake, news reports put reported property damage at approximately $500 million. However, when factoring in unreported damage, actual losses may run significantly higher. A University of Washington study of damage to households only, estimates that the earthquake caused $1.5 billion in damage to nearly 300,000 residences, or almost one in four households in the Puget Sound area. This estimate does not include public and business sector losses. Other estimates of the combined losses to public, business, and household property have ranged from $2 billion to $3.9 billion.

Building damage varied throughout the region. In particular, Downtown Olympia, including many historic structures, and Seattle's historic Pioneer Square area were hit hard. Unreinforced brick masonry buildings with un-braced parapets and without wall anchors were particularly vulnerable, resulting in several collapses. In many cases, fallen brick resulted in damage to objects, such as cars and canopies, outside the building.

Most buildings performed well from a life-safety standpoint, in that the limited structural damage that occurred caused no loss of life or collapse. However, the economic cost of nonstructural damage, i.e., damage to nonessential building elements, such as architectural features, ceiling failures, shifting of equipment, fallen furniture/shelving, desktop computer damage, fallen light fixtures, and losses due to lost productivity, was high. In general, new buildings and buildings that had recently been seismically upgraded typically displayed good structural performance, but many still sustained non-structural damage.

In the Puget Sound region, over a thousand buildings were either red-tagged or yellow-tagged for inspection. Many of these businesses were declared unsafe and were closed for weeks. Other businesses, most with non-structural, cosmetic damage, closed temporarily for detailed inspections. While severe structural damage to businesses was relatively limited, non-structural damage, and the associated business disruption, caused significant economic loss.

In the City of Olympia, 300 buildings were inspected, two buildings red-tagged, and 43 buildings yellow-tagged. On the Capitol Campus, 31 buildings were inspected, three buildings red-tagged, and two buildings yellow-tagged. In Unincorporated Thurston County, 120 buildings were inspected, two buildings red tagged, and six buildings yellow-tagged.

Several of the government buildings in Olympia, including the capitol, were significantly damaged. Other state agency buildings were closed for inspection and repair. The 74 year-old capitol dome sustained a deep crack in its limestone exterior and damage to supporting

columns. There were a number of other non-structural damage areas throughout the Legislative Building. Previously scheduled renovation of the building was started early to accommodate $20 - $22 million in earthquake repairs and seismic upgrades. The building is expected to reopen to lawmakers and the public in January 2005.

Damage to residences came in a variety of forms, from severe mudslide destruction of entire houses to breakage of replaceable personal property. The most common damage was to chimneys. FEMA records indicate that one-third of the 30,000 homes inspected by FEMA sustained chimney damage. In the City of Olympia, chimney damage in the South Capitol neighborhood was the most concentrated of anywhere in Puget Sound. The 40-80-foot depth of loosely consolidated soils and gravel found in the South Capitol neighborhood of Olympia serves as a conduit for earthquake energy that is particularly hard on single-family homes.

Other residential areas hit hard include road and foundation failures in a Nisqually area mobile home park and the Tumwater Mobile Estates in Tumwater. Residents of 50 mobile homes in Tumwater Mobile Estates were evacuated when a gas line ruptured during the earthquake. Part of a street located within the mobile home park, a block of Pine Street, collapsed into a neighboring pond, taking two unoccupied cars into the water.

Transportation systems suffered extensive damage. There was serious damage to the region's largest airport, the Seattle-Tacoma International Airport. While the area's overall road network remained functional, numerous parts of highways, roads, and bridges were damaged. Several state routes and local roadways were closed due to slumping and pavement fractures.

The 4th Avenue Bridge in Olympia was one of four bridges in the state to suffer substantial damage from the quake. Constructed in 1920 and retrofitted after the 1949 earthquake, the bridge had been scheduled for replacement even before the 2001 earthquake. The closure of the bridge severely restricted access to downtown Olympia. Replacing the bridge has been estimated to cost almost $20 million and is the largest public works endeavor in the city's history. The new bridge opened to vehicles in December 2003. Removal of a temporary bridge used during construction of the new bridge, along with other related improvements, is expected to be completed by June 2004.

According to the State, the Deschutes Parkway in Olympia suffered the most damage of any road in the state. Waterlogged soil under the road liquefied during the shaking. Huge voids were created beneath portions of the concrete road surface. Sections of road and sidewalk buckled from the force of the earthquake. A vital link between downtown Olympia, the city's west side and Tumwater, the road was closed to traffic for 20 months. Preliminary estimates to fix the road were put at $7 million.

A number of landslides occurred. Most of these slides occurred in natural materials, including a 400 foot slide on the northeast side of Capitol Lake. Other slides occurred in engineered fills, particularly at locations where they spanned low-lying areas of natural soils. A flow slide removed part of Highway 101 just west of Olympia, closing both northbound lanes of traffic, as well as Madrona Beach Road. Some damage to earth structures occurred. The failure of a large retaining wall (a mechanically stabilized earth wall, or MSE)

supporting the parking lot of the Extended StayAmerica hotel on Mottman Road was caused by the earthquake.

With the exception of transportation systems, lifeline systems generally performed well during the earthquake. Lifeline systems include water, wastewater, electrical power, communications, natural gas and liquid fuels, and transportation systems. The impact of lifeline damage was in most cases minimal. Puget Sound Energy reported 200,000 customer power outages, and Seattle City Light reported 17,000 outages, but power was restored to most within a day. Landline and wireless communication systems were extremely overloaded immediately following the earthquake.

Only five of the state's 290 dams were found to have earthquake-related damage. One of these was the McAllister Springs Reservoir Dam in Thurston County.

Earthquake - Assessing Vulnerability

Summary Assessment

History suggests a **high probability of occurrence** of another damaging earthquake sometime in the next 25 years. With the 2001 Nisqually earthquake still fresh in the region's memory, it is important to note that it was not the largest earthquake event possible in the Puget Sound region. Damage from the 1949, 1965, and 2001 earthquakes indicate that a large earthquake could have a catastrophic impact on Thurston County suggesting **high vulnerability.** Accordingly, the **high risk rating** is assigned.

Delineation of Earthquake Liquefaction Hazard Area

Map 5, North Urban Area Liquefaction Susceptibility Map.

Ground motion data is not currently available for Thurston County. Liquefaction susceptibility data is currently available for only the north urban area of Thurston County. Although, the entire county is vulnerable to damage from a major earthquake, for the purposes of the data tables in this report, the Earthquake Liquefaction Hazard area has necessarily been limited to the area for which data is available. In the map legend, the Liquefaction Risk Levels which define the hazard area are the "High" and "Low to Moderate" categories. The location of damage from the 2001 Nisqually earthquake was part of the assessment in determining which risk levels to use in defining the Liquefaction Hazard area.

The "Total" columns in the data tables provided for the flood and landslide hazards provide useful information in assessing the population and assets at risk from a countywide hazard.

Population in Hazard Area

Table 10, Earthquake Liquefaction Hazard Area Population, 2000 and 2025.

This table assesses an aspect of current and future vulnerability by providing data on the number of people living within the hazard area as compared to total population, by jurisdiction, in the years 2000 and 2025. Please note that the data in these tables is limited to the area for which liquefaction susceptibility data is available. For example, the "Total" column for the Unincorporated County does not refer to the entire Unincorporated County, but only to that portion included in the liquefaction susceptibility assessment, as shown on Map 5. This applies similarly to all the jurisdictions for which data is provided in these tables, as well as to the other data tables provided in the earthquake hazard section.

Inventory of Assets and Dollar Value in Hazard Area

Tables 11 through 14, Earthquake Liquefaction Hazard Area, Vulnerability Assessment, 2000 and 2025.

These tables provide an estimate of the number of existing and future structures which are potentially impacted by the hazard, as well as an estimate of structure and building contents value, in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the year 2000 and 2025. Please note that the data in these tables is limited to the area for which liquefaction susceptibility data is available.

Critical Facilities and Infrastructure in Hazard Area

Based on the community impact which historical occurrences of natural hazards caused, it is clear that natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

Specific information on the location of critical facilities and infrastructure is housed with the Emergency Management Council of Thurston County. However, Table 15 shows the number of Priority I and II Critical Facilities located in the hazard area. Please note that the data in this table is limited to the area for which liquefaction susceptibility data is available.

Priority I facilities included in this table fall into the following categories: Medical, Fire Districts & Departments, Law Enforcement Correctional Facilities, Emergency Services Centers, Radio & TV Stations, Humanitarian & Volunteer Services, Electrical Distribution & Components, and Telephone Service & Components. Although State and County Transportation Lifelines are Priority I Critical Facilities, it is not currently possible to include an analysis of them in the data table. Priority II facilities consist of Clinics, Facilities Pre-Designated as Shelters by the Red Cross, Animal Shelters, Newspapers, Sewage Treatment, and Water Distribution Systems & Components.

Critical facilities include both public and private facilities. Table 15 indicates the number of facilities which are located in the jurisdiction, not their ownership. For example, hospitals are critical facilities but are privately owned. Likewise a facility owned by one jurisdiction may be located within the boundaries of another; such as the County Courthouse complex which is located in the City of Olympia.

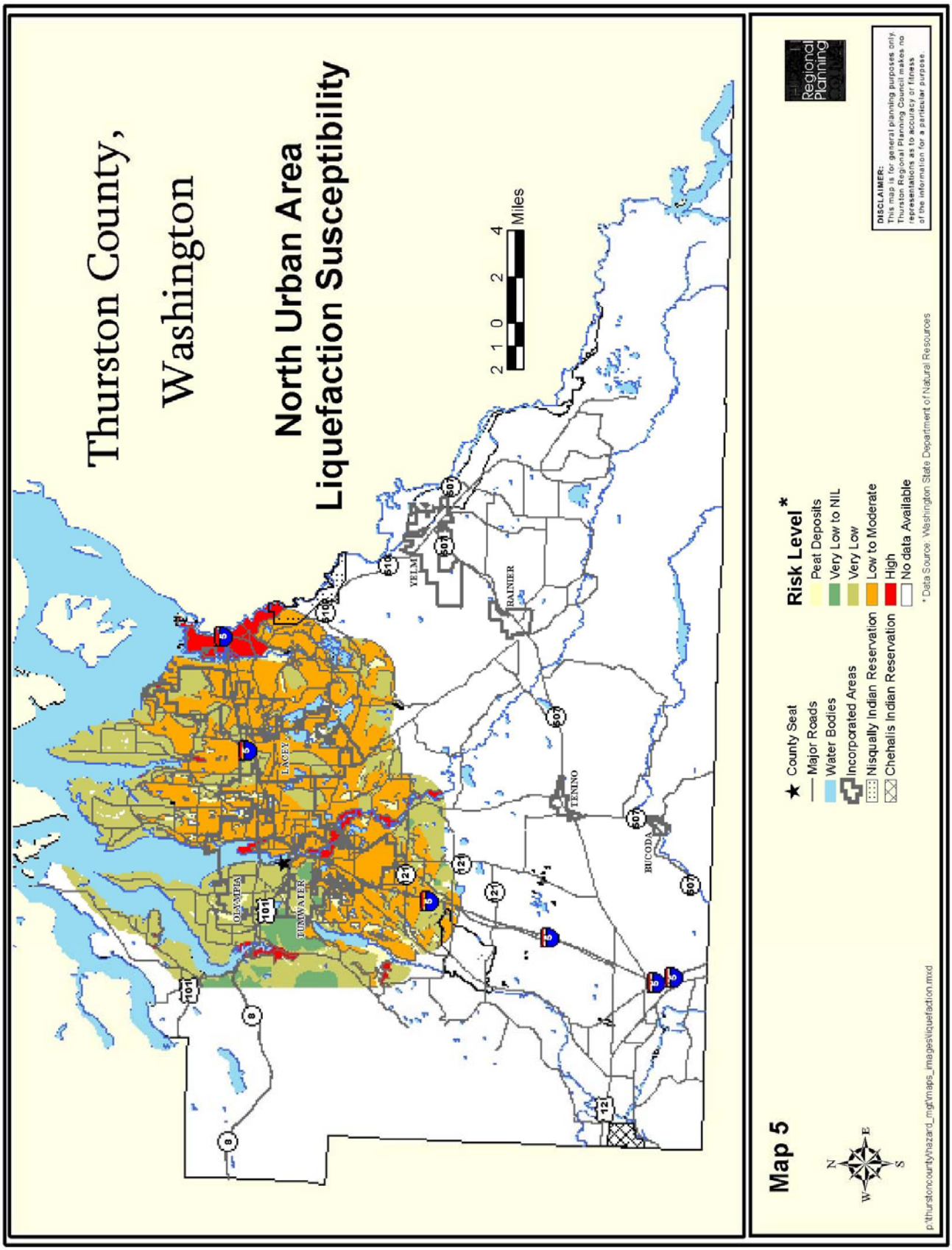

Thurston County,
Washington
North Urban Area
Liquefaction Susceptibility
2 1 0 2 4 Miles
Map 5
Risk Level*
Peat Deposits
Very Low to NIL
Very Low
Low to Moderate
High
No data Available
County Seat
Major Roads
Water Bodies
Incorporated Areas
Nisqually Indian Reservation
Chehalis Indian Reservation
* Data Source: Washington State Department of Natural Resources
Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
p:\thurstoncounty\hazard_mgt\maps_images\liquefaction.mxd
OLYMPIA
TUMWATER
LACEY
YELM
RAINIER
TENINO
BUCODA

Table 10
Earthquake Liquefaction Hazard Area, Population, 2000 and 2025

Jurisdiction		2000 Population Estimate Total	2000 In Hazard Area	2000 %	2025 Population Forecast Total	2025 In Hazard Area	2025 %
Lacey							
	City	30,958	26,605	85.9%	48,049	42,092	87.6%
	UGA	28,029	26,736	95.4%	46,648	44,185	94.7%
	Total	**58,986**	**53,341**	**90.4%**	**94,697**	**86,278**	**91.1%**
Olympia							
	City	42,519	24,148	56.8%	56,969	32,440	56.9%
	UGA	8,911	6,290	70.6%	22,057	15,164	68.7%
	Total	**51,429**	**30,438**	**59.2%**	**79,025**	**47,604**	**60.2%**
Tumwater							
	City	12,939	9,676	74.8%	19,423	13,823	71.2%
	UGA	7,068	6,230	88.1%	18,742	16,740	89.3%
	Total	**20,007**	**15,906**	**79.5%**	**38,165**	**30,563**	**80.1%**
Nisqually Reservation		**599**	**530**	**88.6%**	**1,056**	**667**	**63.1%**
Total Cities		**86,415**	**60,429**	**69.9%**	**124,440**	**88,356**	**71.0%**
Total UGAs		**44,007**	**39,256**	**89.2%**	**87,447**	**76,089**	**87.0%**
Total Urban Areas		**130,422**	**99,685**	**76.4%**	**211,888**	**164,445**	**77.6%**
Rural Unincorporated County		**67,709**	**14,569**	**21.5%**	**102,852**	**21,413**	**20.8%**
Thurston County Total		**198,730**	**114,785**	**57.8%**	**315,797**	**186,525**	**59.1%**

Source: Thurston Regional Planning Council.

Table 11
Earthquake Liquefaction Hazard Area, Vulnerability Assessment, Lacey
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	12,601	10,895	86.5%	1	1	100.0%	$1,148,978	$951,280	82.8%
Commercial/Industrial	431	430	99.8%	5,178	4,655	89.9%	$398,500	$359,349	90.2%
Religious Institutions & Private Schools	17	16	94.1%	479	330	68.7%	$42,235	$38,634	91.5%
Local Government	7	5	71.4%	1,066	665	62.3%	$98,505	$62,645	63.6%
State Government	8	8	100.0%	458	458	100.0%	$93,344	$93,344	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$26	$0	0.0%
Natural Resources (Public and Private)	8	7	87.5%	16	12	77.7%	$1,009	$783	77.6%
Parks, Preserves, Water, & Open Space	6	6	100.0%	3	2	85.3%	$1,537	$1,035	67.4%
Total	**13,078**	**11,367**		**7,201**	**6,122**		**$1,784,134**	**$1,507,071**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	13,547	11,790	87.0%	191	182	95.3%	$1,251,598	$1,048,485	83.8%
Commercial/Industrial	1,961	1,960	99.9%	5,310	4,784	90.1%	$548,436	$509,034	92.8%
Religious Institutions & Private Schools	17	16	94.1%	492	342	69.5%	$43,375	$39,774	91.7%
Local Government	7	5	71.4%	1,148	768	66.9%	$106,011	$72,122	68.0%
State Government	8	8	100.0%	463	463	100.0%	$93,857	$93,857	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$7	$0	0.0%
Natural Resources (Public and Private)	524	505	96.4%	337	256	76.0%	$76,933	$67,995	88.4%
Parks, Preserves, Water, & Open Space	6	6	100.0%	0	0	0.0%	$1,287	$822	63.9%
Undeveloped land	4,297	3,552	82.7%	2,804	2,631	93.8%	$644,099	$561,137	87.1%
Total	**20,366**	**17,842**		**10,746**	**9,427**		**$2,765,603**	**$2,393,227**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.
Source: Thurston Regional Planning Council.

Table 12
Earthquake Liquefaction Hazard Area, Vulnerability Assessment, Olympia
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	19,018	10,427	54.8%	1	1	100.0%	$1,729,120	$960,988	55.6%
Commercial/Industrial	610	594	97.4%	10,664	6,181	58.0%	$982,536	$572,357	58.3%
Religious Institutions & Private Schools	12	7	58.3%	1,117	881	78.9%	$131,766	$97,674	74.1%
Local Government	49	48	98.0%	2,149	1,584	73.7%	$376,202	$291,117	77.4%
State Government	2	2	100.0%	3,484	3,137	90.0%	$768,694	$750,120	97.6%
Federal Government	0	0	0.0%	37	37	100.0%	$1,898	$1,898	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	7	7	100.0%	83	83	100.0%	$2,843	$2,843	100.0%
Parks, Preserves, Water, & Open Space	4	2	50.0%	6	6	100.0%	$9,326	$7,591	81.4%
Total	**19,702**	**11,087**		**17,540**	**11,908**		**$4,002,384**	**$2,684,588**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	22,048	12,273	55.7%	625	556	89.0%	$2,104,448	$1,213,459	57.7%
Commercial/Industrial	773	691	89.4%	11,675	6,786	58.1%	$1,135,516	$663,981	58.5%
Religious Institutions & Private Schools	12	7	58.3%	1,209	958	79.2%	$144,385	$108,149	74.9%
Local Government	49	48	98.0%	3,216	2,362	73.4%	$521,303	$396,884	76.1%
State Government	2	2	100.0%	3,651	3,268	89.5%	$791,415	$767,973	97.0%
Federal Government	0	0	0.0%	61	61	100.0%	$5,206	$5,206	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	851	832	97.8%	449	449	100.0%	$133,566	$131,763	98.6%
Parks, Preserves, Water, & Open Space	8	6	75.5%	6	6	100.0%	$9,726	$7,992	82.2%
Undeveloped land	4,858	2,427	50.0%	4,232	2,035	48.1%	$1,041,167	$509,389	48.9%
Total	**28,601**	**16,287**		**25,124**	**16,480**		**$5,886,733**	**$3,804,796**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.
Source: Thurston Regional Planning Council.

Table 13
Earthquake Liquefaction Hazard Area, Vulnerability Assessment, Tumwater
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	5,891	4,303	73.0%	0	0	0.0%	$486,926	$346,728	71.2%
Commercial/Industrial	55	51	92.7%	3,764	1,985	52.7%	$250,677	$162,013	64.6%
Religious Institutions & Private Schools	3	3	100.0%	181	173	95.3%	$15,605	$14,913	95.6%
Local Government	1	0	0.0%	1,756	1,545	88.0%	$126,153	$103,849	82.3%
State Government	0	0	0.0%	575	562	97.8%	$97,624	$96,827	99.2%
Federal Government	0	0	0.0%	14	14	100.0%	$1,040	$1,040	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	0	0	0.0%	1	0	10.4%	$137	$24	17.8%
Parks, Preserves, Water, & Open Space	1	1	100.0%	5	5	100.0%	$7,125	$6,902	96.9%
Total	**5,951**	**4,358**		**6,297**	**4,285**		**$985,287**	**$732,295**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	7,579	5,502	72.6%	86	85	99.0%	$640,175	$457,564	71.5%
Commercial/Industrial	236	70	29.6%	4,034	2,138	53.0%	$288,263	$176,113	61.1%
Religious Institutions & Private Schools	3	3	100.0%	187	178	95.4%	$16,021	$15,329	95.7%
Local Government	1	0	0.0%	3,099	2,874	92.7%	$235,280	$211,865	90.0%
State Government	0	0	0.0%	609	567	93.2%	$100,410	$97,261	96.9%
Federal Government	0	0	0.0%	14	14	100.0%	$1,040	$1,040	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	222	222	100.0%	220	107	48.4%	$37,243	$27,953	75.1%
Parks, Preserves, Water, & Open Space	1	1	100.0%	5	5	100.0%	$7,125	$6,902	96.9%
Undeveloped land	1,427	941	65.9%	1,352	1,106	81.8%	$233,549	$171,422	73.4%
Total	**9,470**	**6,740**		**9,607**	**7,076**		**$1,559,106**	**$1,165,447**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.
Source: Thurston Regional Planning Council.

Table 14
Earthquake Liquefaction Hazard Area, Vulnerability Assessment, Unincorporated Thurston County
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	29,188	20,799	71.3%	0	0	100.0%	$3,377,218	$2,224,573	65.9%
Commercial/Industrial	120	97	80.8%	2,935	2,400	81.8%	$158,874	$125,637	79.1%
Religious Institutions & Private Schools	68	66	97.1%	276	216	78.5%	$36,876	$27,867	75.6%
Local Government	22	19	86.4%	1,189	894	75.2%	$198,631	$142,204	71.6%
State Government	17	15	88.2%	1,299	109	8.4%	$176,318	$10,749	6.1%
Federal Government	0	0	0.0%	53	53	100.0%	$6,750	$6,750	100.0%
Tribal	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$159	$159	100.0%
Natural Resources (Public and Private)	266	200	75.2%	481	479	99.6%	$50,388	$40,373	80.1%
Parks, Preserves, Water, & Open Space	16	12	75.0%	26	19	73.6%	$10,018	$8,783	87.7%
Total	**29,697**	**21,208**		**6,259**	**4,170**		**$4,015,231**	**$2,587,094**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	38,141	28,244	74.1%	284	213	75.0%	$4,304,809	$2,993,608	69.5%
Commercial/Industrial	299	243	81.4%	3,165	2,605	82.3%	$199,892	$160,876	80.5%
Religious Institutions & Private Schools	68	66	97.1%	286	225	78.8%	$37,912	$28,778	75.9%
Local Government	22	19	86.4%	1,689	1,324	78.4%	$248,701	$185,222	74.5%
State Government	17	15	88.2%	1,553	363	23.3%	$201,731	$36,163	17.9%
Federal Government	0	0	0.0%	64	64	100.0%	$7,862	$7,862	100.0%
Tribal	0	0	100.0%	0	0	0.0%	$43	$43	100.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$159	$159	100.0%
Natural Resources (Public and Private)	4,871	4,099	84.2%	772	736	95.3%	$542,033	$457,712	84.4%
Parks, Preserves, Water, & Open Space	16	12	75.0%	15	8	55.3%	$8,896	$7,684	86.4%
Undeveloped land	10,057	7,427	73.8%	1,473	1,059	71.9%	$1,157,529	$851,877	73.6%
Total	**53,492**	**40,126**		**9,302**	**6,597**		**$6,709,567**	**$4,729,982**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Plannning Council.

*Explanation: Please note that this table indicates the number of critical facilities which are located in the jurisdiction, not their ownership. For example, the County Courthouse is owned by the County but is located in the City of Olympia. Similarly, hospitals are privately owned facilities located within jurisdicitonal boundaries.
Source: Thurston Regional Planning Council.

FLOOD

Hazard Description

Of all natural hazards that affect Thurston County, floods are the most common and, on an annual average basis, the most costly. They can occur at any time of the year, and at any time of day or night. Most injuries and deaths occur when people are swept away by flood currents, and most property damage results from inundation by sediment-filled water.

Several factors determine the severity of floods, including rainfall intensity (or other water source) and duration. A large amount of rainfall over a short time span can result in flash flood conditions. A small amount of rain can also result in floods in locations where the soil is saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas. Topography and ground cover are also contributing factors for floods. Water run-off is greater in areas with steep slopes and little or no vegetative ground cover. Frequency of inundation is affected by the climate, soil, and channel slope.

Four types of flooding occur in Thurston County: river or stream building floods, flash floods, tidal floods, and groundwater flooding.

River and stream building floods occur because of prolonged heavy rainfall, a rapidly melting snow pack or a combination of these. Historically, Thurston County must experience two or three days of rainfall averaging 2-5 inches per day for this type of flooding to occur. Actual duration and rainfall amounts needed to cause flooding depend on the initial condition of the river or stream, groundwater conditions, and run-off conditions. The county is also vulnerable to events beyond our borders. Both the Nisqually River and the Chehalis River have flooded in Thurston County because of events in their watersheds outside the county. River and stream building floods are the most common in Thurston County because of our many rivers and streams, and development patterns along them.

Thurston County defines three levels of river flooding:

- Nuisance flooding: The river exceeds bank-full conditions at one or more locations, generally flooding fields and forests. Some roads may be covered but passable. There may be enhanced erosion of some river banks.
- Moderate flooding: Individual residential structures are threatened and evacuation is recommended for selected properties. Some roads may be closed. Moderate damage may be experienced.
- Major flooding: Neighborhoods and communities are threatened and evacuation is recommended for residents living on specified streets, in specified communities or neighborhoods, or along specified stretches of river. Major thoroughfares may be closed and major damage is expected.

A type of stream building flood characterized by a quick rise and fall of water level is the flash flood. Flash floods generally result from intense storms dropping large amounts of rain within a short period of time onto watersheds that cannot absorb or slow the flow. The natural terrain and vegetation in Thurston County helps to reduce the potential for flash floods. However, the Deschutes River and many smaller streams react in a "flashy" manner, making them more difficult to forecast. As development continues, increasing the distribution and proportion of impervious surfaces, the threat from flash floods will increase.

Extremely high tides combined with low atmospheric pressure, excessive run-off, or strong northerly winds, can lead to either localized or general tidal flooding in coastal areas. Spring tides, the highest tides during any month, occur with each full and new moon. When these coincide with a northerly wind piling water in south Puget Sound, tidal flooding can occur. The tides can also enhance flooding in delta areas when rivers or creeks are at or near flood stage. The area at greatest risk to tidal flooding is the Olympia waterfront, but it is also a threat to the low lying farm lands in the Nisqually Valley and McLane Creek near Mud Bay. In the county, tidal impact is of most concern in delta areas when rivers are at flood stage and high tide exacerbates the situation.

Groundwater flooding occurs whenever there is a high water table and persistent heavy rains. The situation is caused in areas where an upper, thin layer of permeable soils overlays an impermeable layer of hard pan. As the ground absorbs more and more rain water, the groundwater table rises and shows itself as flooding in areas where the land surface is below the water table. The condition has historically been most severe in the second and subsequent years of consecutive wet years. According to the U.S. Army Corps of Engineers, the frequency of a groundwater flooding disaster is probably on the order of every 25 years.

Most of the known floodplains in the United States have been mapped by FEMA. The 100-year flood designation applies to the area that has a 1 percent chance, on average, of flooding in any given year. Based upon existing mapping, countywide there are 41.7 square miles within the 100-year floodplain, and an additional 5.1 square miles within the 500-year floodplain. Floodplains cover about 7.5 percent of the county.

The high groundwater areas in the county were mapped from January 1997 aerial photographs, showing the severe impact of winter storms that year. Preliminary calculations indicated that 71 percent of the flooding occurred outside the mapped 100-year floodplain. However, 66 percent of the high groundwater area occurred within mapped wetlands, and 55 percent of this flooding occurred on Hydric Soils (one of the three wetland parameters) which are often wet during the winter.

There are 33 dams in or adjacent to Thurston County. See Dam Failure Hazard for further discussion.

Flood - Historical Occurrences and Impacts

Since 1964, only 185 counties in the country have had more than 10 Federal Disaster Declarations. Thurston County is part of this top 6 percent of counties. Since October 1962, Thurston County has been declared a federal disaster area 17 times, 13 of them for flooding.

Flooding history of the Nisqually River: The Nisqually River watershed drains the area along the eastern boundary of the county. Much of the land along the Nisqually River, from the Nisqually Delta at Puget Sound to McKenna (on the Pierce County side), is occupied by the Nisqually Indian Reservation and Fort Lewis Military Reservation. Historically, nuisance flooding occurs when the flow rate exceeds about 8,000 cubic feet per second (cfs). Since 1972, the river exceeded this flow rate 12 times. Moderate flooding occurs when the flow rate exceeds 15,000 cfs. Since 1972, this occurred seven times. Major flooding occurs when the flow rate exceeds about 22,000 cfs. This has been exceeded twice since 1972, in November 1995 and February 1996. The February 1996 flow rate, which exceeded 45,000 cfs, established the flood of record. Creeks within the Nisqually can be affected by localized rainfall events but in general they flood whenever the river is flooding. Also, it can take much less rainfall for creeks to rise to threatening levels without the nearby river flooding.

Flooding history of the Deschutes River: The Deschutes River flows diagonally across the central portion of the county and enters into Budd Inlet via Capitol Lake. Historically, nuisance flooding occurs when the flow rate exceeds about 3,000 cfs. Since 1972, the river has exceeded this flow rate 27 times. Moderate flooding occurs when the flow rate exceeds about 4,000 cfs. Since 1972, this has occurred 14 times. Major flooding occurs when the flow rate exceeds about 6,000 cfs. This has happened six times since 1972, in January 1972, January 1974, January 1990, April 1991, February 1996, and December 1996. The flood of record was in January 1990 when the flow rate reached 9,600 cfs. Creeks within the Deschutes Watershed can be affected by localized rainfall events but in general they flood whenever the river is flooding. Also, it can take much less rainfall for creeks to rise to threatening levels without the nearby river flooding.

Flooding history of the Skookumchuck River: The Skookumchuck River extends for approximately 24.7 miles in south-central Thurston County and has a wide floodplain from the county line upstream for 15 miles. Land use on the floodplain is mostly agricultural, and though flooded often, little damage is done. Historically, nuisance flooding occurs when the flow rate exceeds about 4,000 cfs. Since 1972, the river has exceeded the flow rate 22 times. Moderate flooding occurs when the flow rate exceeds 4,900 cfs. Since 1972, this has occurred 16 times. Major flooding occurs when the flow rate exceeds 6,500 cfs. This has happened 7 times since 1972: March 1977, December 1977, January 1990, February 1990, November 1990, April 1991, and February 1996. The flood of record was established in February 1996 when the flow rate reached nearly 7,200 cfs.

Flooding history of the Chehalis River: The Chehalis River extends for only 8.6 miles in Thurston County, but has an extensive floodplain, covering over eight square miles. Land use is primarily agricultural, houses are scattered sparsely over the area. Some flooding occurs nearly every year, but damage is usually light. Historically, nuisance flooding occurs when the flow rate exceeds about 14,000 cfs. Since 1972, the river has exceeded the flow rate 49 times. The typical year will have a flood in November or December and a second flood in January or February. Moderate flooding occurs when the flow rate exceeds about 26,000 cfs. Since 1972, this has occurred 21 times. Major flooding occurs when the rate exceeds about 45,000 cfs. This has happened six times since 1972: January 1972, December

1975, November 1986, January 1990, November 1990, and February 1996. The flood of record was established in February 1996 when the flow rate reached nearly 75,000 cfs.

Flooding history of the Black River: The Black River is a slow, meandering stream that flows through Thurston County for approximately 19 miles. Extending south from Black Lake, the river is lined by marshland, and the water table is perennially at or above the ground surface. Little development has occurred near the river for this reason. The preponderance of flooding along the Black River is caused by back-flow from the Chehalis River and similar recurrence intervals can be expected.

History of Groundwater Flooding: Nearly all residents of Thurston County rely on groundwater for their drinking water supplies. Various parts of the county have very different groundwater aquifers. Groundwater in the county is of generally high quality and adequate supply, with some exceptions. Groundwater flooding has historically been most severe in the second and subsequent years of consecutive wet years. According to the U.S. Army Corps of Engineers post event report on the winter storm of 1996-1997, the frequency of a groundwater flooding disaster is probably on the order of every 25 years. This was the first widespread groundwater flooding since 1972 and the worst on record until the winter of 1998-1999, which is now the "event of record." Statistically, the Corps estimates there is approximately a 70 percent chance that the 1996-1997 flooding will be equaled or exceeded at least once during a 30-year mortgage cycle. According to FEMA records of the March 1997 high groundwater flood event, only 15 of 237 damage sites (6 percent) occurred within the mapped 100-year floodplain. This was only increased to 9 percent when the 100- and 500- year floodplains coverages were added together.

Although relatively low percentages of land area and population are exposed to the threat of flooding, they are important segments. Both the north and south extensions of major thoroughfares and railroad lines cross a floodplain at the county border. This is also true of the eastern extensions. Petroleum pipelines, natural gas pipelines, and the major electricity feeder lines enter the county over a floodplain. The potential consequences are enormous as the following summaries of damages from flooding in 1996 and 1997 demonstrate:

The February 1996 flood:

- Destroyed over two dozen homes and caused major damage to more than 200 others;
- Caused nearly 1,000 people to evacuate their homes;
- Required more than 300 people to be rescued;
- Damaged more than 300 sections of the county road system;
- Destroyed a Native American school;
- Caused the closure of I-5 at the Lewis County line and the closure of the main north-south railroad line at the Pierce County line;
- Cost Thurston County government in excess of $2 million;
- Cost other government entities and utilities in excess of $20 million; and
- Cost uninsured private property losses in excess of $22 million.

The December 1996 and March 1997 winter storm and ground flooding:

- Inundated approximately 200 homes countywide;
- Contaminated approximately 200 drinking water wells;
- Caused wide spread failures of on-site septic systems;
- Severely impacted a number of business operations;
- Cost Thurston County government in excess of $340,000;
- Cost other government entities & utilities in excess of $750,000; and
- Cost uninsured private property losses in excess of $1.75 million.

Repetitive Loss Properties

According to county records, there are 13 identified repetitive loss properties in Thurston County. Map 6, Flood Hazards map, shows the general location of these properties.

General Location – Street, Zip Code	Dates of Flooding
11600 block of 6th Ave SE, 98513	December 1995 February 1996
17800 block of Corbin Dr SE, 98597	January 1990 February 1996
8900 block of Armstrong Rd SW, 98512	April 1990 March 1997
8800 block of Littlerock Rd SW, 98512	March 1997 (twice) January 1999
18500 block of Cedar Park Ln SE, 98597	January 1990 February 1996 December 1996
19400 block of Goebel Rd SE, 98589	January 1990 November 1990
17800 block of Deschutes Dr SE, 98597	January 1990 December 1996
14900 block of Turner Rd SE, 98576	January 1990 February 1996
18700 block of Dynamite Dr SE, 98597	January 1990 February 1996 January 1997
22600 block of Paul Bunyon Rd SE, 98597	January 1990 February 1996
400 block of Riverbend Ln SE, 98513	December 1995 February 1996
400 block of Riverbend Ln, SE, 98513	December 1995 February 1996
11400 block of 6th Ave, SE, 98513	November 1995 February 1996

Flood - Assessing Vulnerability

Summary Assessment

Historically, flooding occurs along one or more of the county's waterways every year, suggesting a **high probability of occurrence**. Because of the relative land area and population affected, the county is exposed to **moderate vulnerability**. On a jurisdictional basis, an exception is the Town of Bucoda, which has a **high vulnerability** to flooding due to its location within a 100-year floodplain. Although the vulnerability is moderate, the frequency of flooding, the potential for simultaneous flooding events, plus the historical record of recurrent flooding and cumulative costs, all suggest the assignment of a **high risk rating.**

Delineation of Flood Hazard Area

Map 6, Flood Hazards Map.

The Flood Hazard Area consists of those parcels in the county in 100- and 500-year floodplains, and areas of High Groundwater Flooding.

Population in Hazard Area

Table 16, Flood Hazard Area Population, 2000 and 2025.

This table assesses an aspect of current and future vulnerability by providing data on the number of people living within the hazard area as compared to total population, by jurisdiction, in the years 2000 and 2025.

Inventory of Assets and Dollar Value in Hazard Area

Tables 17 through Table 25, Flood Hazard Area Vulnerability Assessment, 2000 and 2025.

These tables provide an estimate of the number of existing and future structures which are potentially impacted by the hazard, as well as an estimate of structure and building contents value in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the years 2000 and 2025.

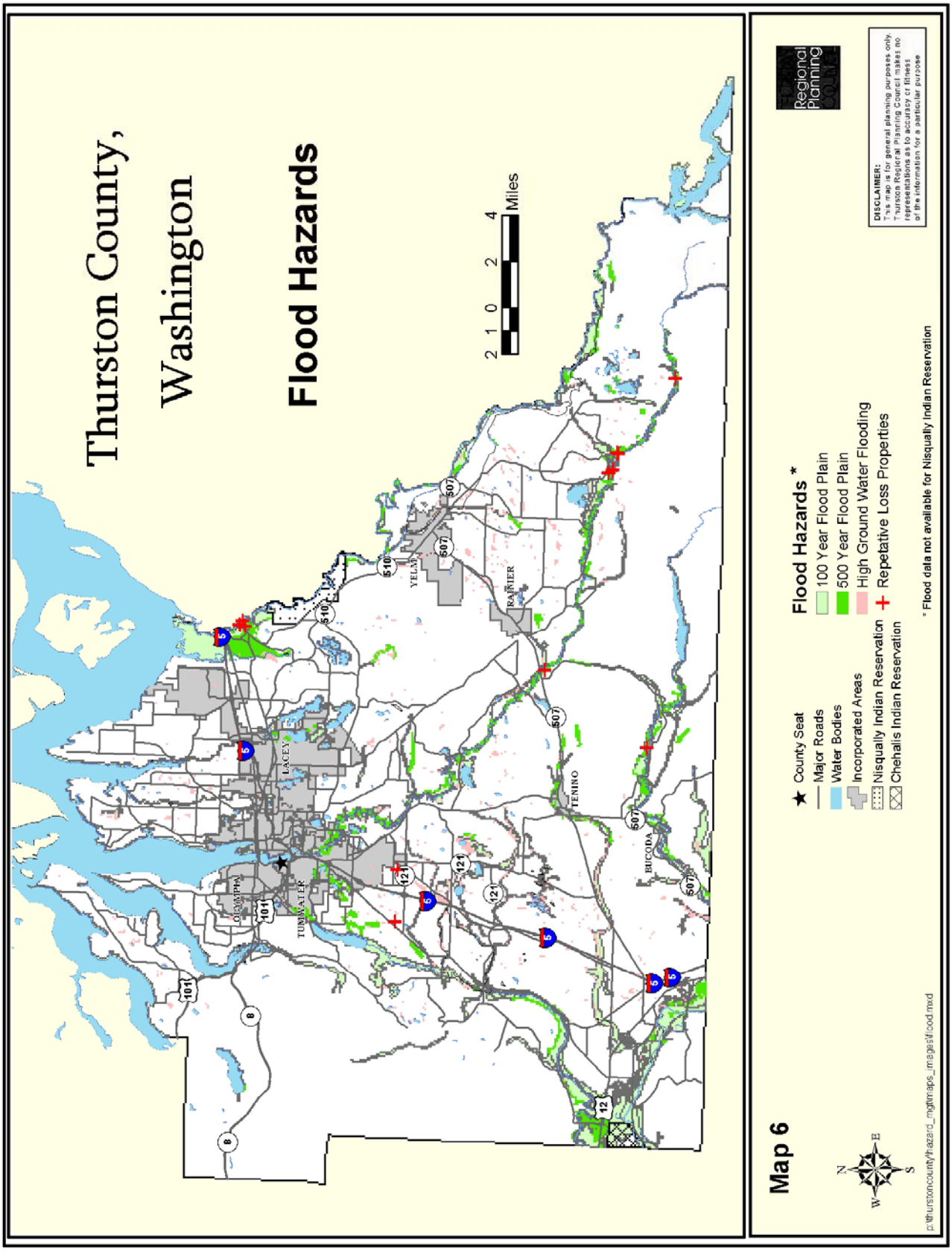
Critical Facilities and Infrastructure in Hazard Area

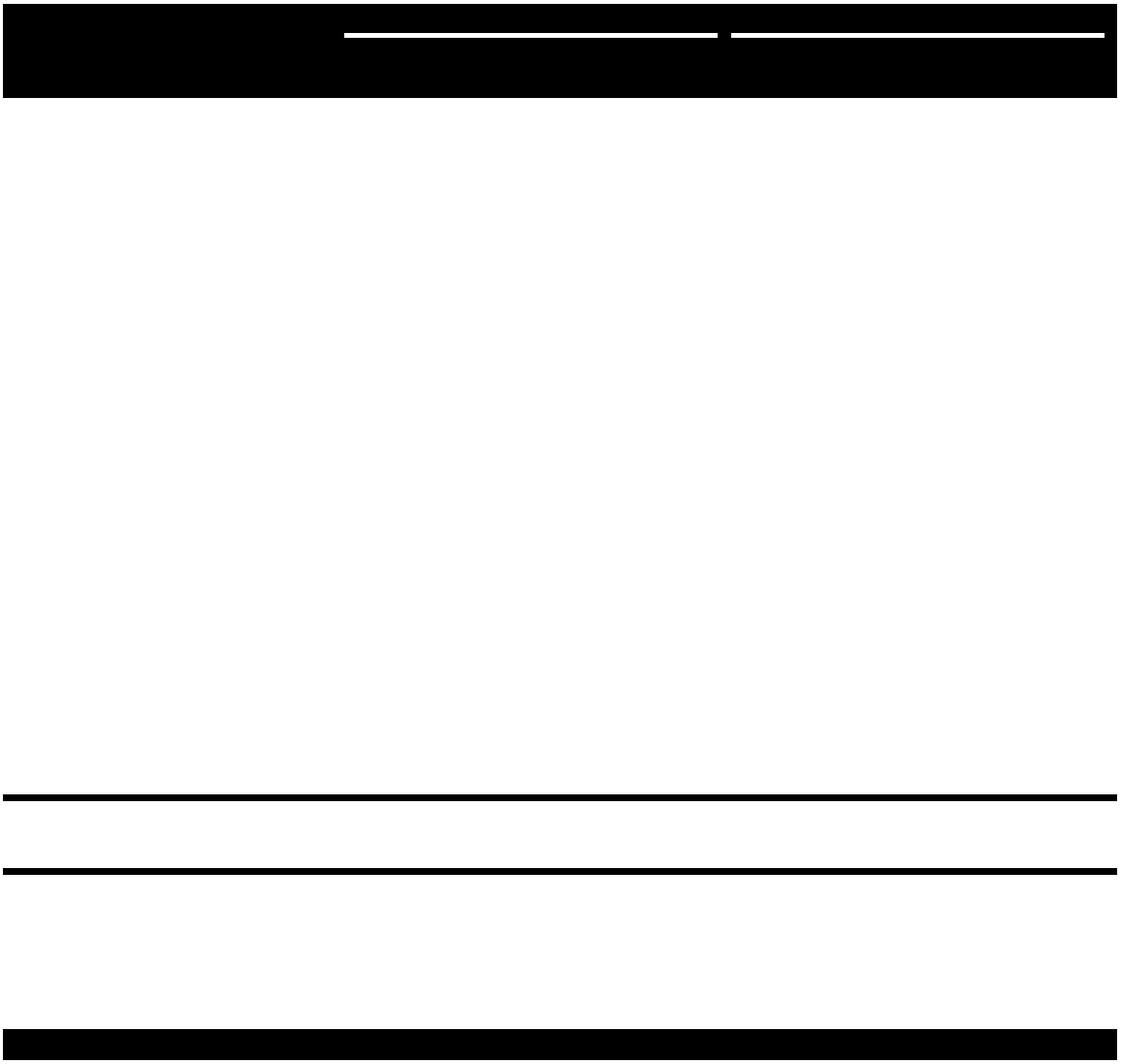
Based on the community impact which historical occurrences of natural hazards caused, it is clear that natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further

isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

Specific information on the location of critical facilities and infrastructure is housed with the Emergency Management Council of Thurston County. However, Table 26 shows the number of Priority I and II Critical Facilities located in the hazard area. Priority I facilities included in this table fall into the following categories: Medical, Fire Districts & Departments, Law Enforcement Correctional Facilities, Emergency Services Centers, Radio & TV Stations, Humanitarian & Volunteer Services, Electrical Distribution & Components, and Telephone Service & Components. Although State and County Transportation Lifelines are Priority I Critical Facilities, it is not currently possible to include an analysis of them in the data table. Priority II facilities consist of Clinics, Facilities Pre-Designated as Shelters by the Red Cross, Animal Shelters, Newspapers, Sewage Treatment, and Water Distribution Systems & Components.

Critical facilities include both public and private facilities. Table 26 indicates the number of facilities which are located in the jurisdiction, not their ownership. For example, hospitals are critical facilities but are privately owned. Likewise a facility owned by one jurisdiction may be located within the boundaries of another; such as the County Courthouse complex which is located in the City of Olympia.


Thurston County,
Washington
Flood Hazards
2 1 0 2 4
Miles
Map 6
Flood Hazards *
100 Year Flood Plain
500 Year Flood Plain
High Ground Water Flooding
Repetative Loss Properties
County Seat
Major Roads
Water Bodies
Incorporated Areas
Nisqually Indian Reservation
Chehalis Indian Reservation
* Flood data not available for Nisqually Indian Reservation
Regional Planning
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness for the information for a particular purpose
p:\thurstoncounty\hazard_mgt\maps_images\flood.mxd
LACEY
TUMWATER
OLYMPIA
YELM
RAINIER
TENINO
BUCODA



Source: Thurston Regional Planning Council.

Table17
Flood Hazard Area, Vulnerability Assessment, Bucoda
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	225	171	76.0%	1	0	0.0%	$11,225	$8,245	73.5%
Commercial/Industrial	1	1	100.0%	20	19	99.0%	$642	$642	100.0%
Religious Institutions & Private Schools	0	0	0.0%	2	2	100.0%	$228	$228	100.0%
Local Government	0	0	0.0%	11	11	95.4%	$671	$547	81.4%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	3	3	100.0%	0	0	0.0%	$5	$5	100.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$17	$17	100.0%
Total	**229**	**175**		**34**	**32**		**$12,787**	**$9,683**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	227	173	76.1%	1	0	0.0%	$11,326	$8,333	73.6%
Commercial/Industrial	1	1	100.0%	20	19	98.4%	$646	$642	99.3%
Religious Institutions & Private Schools	0	0	0.0%	2	2	100.0%	$228	$228	100.0%
Local Government	0	0	0.0%	14	13	93.2%	$772	$631	81.7%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	11	11	100.0%	0	0	0.0%	$367	$367	100.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$17	$17	100.0%
Undeveloped land	19	14	73.4%	4	1	19.1%	$1,051	$679	64.6%
Total	**258**	**198**		**41**	**35**		**$14,406**	**$10,896**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 18
Flood Hazard Area, Vulnerability Assessment, Chehalis Reservation*

2000 Dwelling Units Estimate		
Total	**In Hazard Area**	**% in Hazard Area**
13	11	84.6%

2000 Commercial, Industrial, and Tribal Assets - Floor Space Estimate		
Total [1,000 sq. ft.]	**In Hazard Area [1,000 sq. ft.]**	**% in Hazard Area**
97	96	99.9%

2000 Value of Structures and Building Contents Estimate		
Total [1,000 $]	**In Hazard Area [1,000 $]**	**% in Hazard Area**
$27,443	$27,394	99.8%

New Tribal Assets Planned for 2004		
Total [1,000 sq. ft.]	**Construction Cost Estimate [1,000 $]**	**% in Hazard Area**
10	$1,300	0.0%

*Thurston County portion only.

Source: Thurston Regional Planning Council.

Table 19
Flood Hazard Area, Vulnerability Assessment, Lacey
For Years 2000 and 2025

Land Use by Ownership in 2000	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	12,601	710	5.6%	1	0	25.4%	$1,148,978	$48,483	4.2%
Commercial/Industrial	431	0	0.0%	5,178	607	11.7%	$398,500	$28,403	7.1%
Religious Institutions & Private Schools	17	2	11.8%	479	85	17.8%	$42,235	$7,909	18.7%
Local Government	7	0	0.0%	1,066	128	12.0%	$98,505	$16,049	16.3%
State Government	8	0	0.0%	458	334	73.1%	$93,344	$88,425	94.7%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$26	$0	0.0%
Natural Resources (Public and Private)	8	4	50.0%	16	12	77.7%	$1,009	$652	64.6%
Parks, Preserves, Water, & Open Space	6	6	100.0%	3	1	24.2%	$1,537	$302	19.7%
Total	**13,078**	**722**		**7,201**	**1,167**		**$1,784,134**	**$190,223**	

Land Use by Ownership in 2000*	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	13,547	891	6.6%	191	58	30.6%	$1,251,598	$70,151	5.6%
Commercial/Industrial	1,961	195	9.9%	5,310	659	12.4%	$548,436	$50,758	9.3%
Religious Institutions & Private Schools	17	2	11.8%	492	85	17.3%	$43,375	$7,909	18.2%
Local Government	7	0	0.0%	1,148	178	15.5%	$106,011	$20,646	19.5%
State Government	8	0	0.0%	463	334	72.2%	$93,857	$88,425	94.2%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$7	$0	0.0%
Natural Resources (Public and Private)	524	216	41.2%	337	234	69.4%	$76,933	$40,058	52.1%
Parks, Preserves, Water, & Open Space	6	6	100.0%	0	0	0.0%	$1,287	$242	18.8%
Undeveloped land	4,297	471	11.0%	2,804	849	30.3%	$644,099	$120,268	18.7%
Total	**20,366**	**1,781**		**10,746**	**2,398**		**$2,765,603**	**$398,457**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 20
Flood Hazard Area, Vulnerability Assessment, Olympia
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	19,018	1,685	8.9%	1	0	0.0%	$1,729,120	$137,018	7.9%
Commercial/Industrial	610	9	1.5%	10,664	1,059	9.9%	$982,536	$73,785	7.5%
Religious Institutions & Private Schools	12	0	0.0%	1,117	2	0.2%	$131,766	$1,816	1.4%
Local Government	49	48	98.0%	2,149	1,105	51.4%	$376,202	$116,756	31.0%
State Government	2	1	50.0%	3,484	1,845	52.9%	$768,694	$202,920	26.4%
Federal Government	0	0	0.0%	37	0	0.0%	$1,898	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	7	4	57.1%	83	58	69.9%	$2,843	$1,559	54.8%
Parks, Preserves, Water, & Open Space	4	0	0.0%	6	6	100.0%	$9,326	$4,098	43.9%
Total	**19,702**	**1,747**		**17,540**	**4,074**		**$4,002,384**	**$537,952**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	22,048	2,130	9.7%	625	105	16.8%	$2,104,448	$193,945	9.2%
Commercial/Industrial	773	125	16.1%	11,675	1,454	12.5%	$1,135,516	$138,564	12.2%
Religious Institutions & Private Schools	12	0	0.0%	1,209	2	0.2%	$144,385	$1,816	1.3%
Local Government	49	48	98.0%	3,216	1,562	48.6%	$521,303	$178,832	34.3%
State Government	2	1	50.0%	3,651	1,845	50.5%	$791,415	$202,957	25.6%
Federal Government	0	0	0.0%	61	0	0.0%	$5,206	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	851	529	62.1%	449	401	89.3%	$133,566	$98,498	73.7%
Parks, Preserves, Water, & Open Space	8	0	0.0%	6	6	100.0%	$9,726	$4,098	42.1%
Undeveloped land	4,858	1,231	25.3%	4,232	939	22.2%	$1,041,167	$245,697	23.6%
Total	**28,601**	**4,063**		**25,124**	**6,313**		**$5,886,733**	**$1,064,408**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 21
Flood Hazard Area, Vulnerability Assessment, Rainier
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	547	16	2.9%	0	0	0.0%	$41,288	$964	2.3%
Commercial/Industrial	10	0	0.0%	83	0	0.0%	$4,031	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	5	0	0.0%	$251	$0	0.0%
Local Government	0	0	0.0%	164	0	0.0%	$16,371	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	2	0	0.0%	0	0	0.0%	$134	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Total	**559**	**16**		**253**	**0**		**$62,074**	**$964**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	625	29	4.7%	13	0	0.0%	$48,393	$1,966	4.1%
Commercial/Industrial	10	0	0.0%	84	0	0.0%	$4,134	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	5	0	0.0%	$251	$0	0.0%
Local Government	0	0	0.0%	173	0	0.0%	$17,099	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	153	0	0.0%	0	0	0.0%	$11,660	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Undeveloped land	57	6	10.5%	37	0	0.0%	$7,484	$463	6.2%
Total	**845**	**35**		**313**	**0**		**$89,021**	**$2,429**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 22
Flood Hazard Area, Vulnerability Assessment, Tenino
For Years 2000 and 2025

Land Use by Ownership in 2000	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	600	34	5.7%	0	0	0.0%	$41,885	$1,404	3.4%
Commercial/Industrial	19	0	0.0%	206	22	10.7%	$9,555	$1,889	19.8%
Religious Institutions & Private Schools	0	0	0.0%	13	0	0.0%	$1,603	$0	0.0%
Local Government	0	0	0.0%	235	165	70.3%	$31,459	$23,574	74.9%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$42	$0	0.0%
Natural Resources (Public and Private)	1	1	100.0%	0	0	0.0%		$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	8	0	0.0%	$908	$0	0.0%
Total	**620**	**35**		**463**	**187**		**$85,452**	**$26,867**	

Land Use by Ownership in 2000*	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	604	35	5.8%	16	14	87.2%	$43,641	$2,747	6.3%
Commercial/Industrial	19	0	0.0%	220	22	10.1%	$10,834	$1,889	17.4%
Religious Institutions & Private Schools	0	0	0.0%	13	0	0.0%	$1,603	$0	0.0%
Local Government	0	0	0.0%	280	188	67.2%	$35,654	$25,716	72.1%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$42	$0	0.0%
Natural Resources (Public and Private)	27	6	21.8%	0	0	0.0%	$1,618	$304	18.8%
Parks, Preserves, Water, & Open Space	0	0	0.0%	2	0	0.0%	$383	$0	0.0%
Undeveloped land	18	6	32.4%	31	0	0.0%	$3,993	$368	9.2%
Total	**669**	**47**		**562**	**224**		**$97,767**	**$31,024**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 23
Flood Hazard Area, Vulnerability Assessment, Tumwater
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	5,891	479	8.1%	0	0	0.0%	$486,926	$20,858	4.3%
Commercial/Industrial	55	4	7.3%	3,764	678	18.0%	$250,677	$32,333	12.9%
Religious Institutions & Private Schools	3	0	0.0%	181	93	51.1%	$15,605	$8,784	56.3%
Local Government	1	0	0.0%	1,756	711	40.5%	$126,153	$56,797	45.0%
State Government	0	0	0.0%	575	493	85.9%	$97,624	$92,637	94.9%
Federal Government	0	0	0.0%	14	0	0.0%	$1,040	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	0	0	0.0%	1	0	0.0%	$137	$0	0.0%
Parks, Preserves, Water, & Open Space	1	1	100.0%	5	5	100.0%	$7,125	$6,531	91.7%
Total	**5,951**	**484**		**6,297**	**1,981**		**$985,287**	**$217,939**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	7,579	783	10.3%	86	2	2.6%	$640,175	$47,338	7.4%
Commercial/Industrial	236	20	8.3%	4,034	774	19.2%	$288,263	$41,410	14.4%
Religious Institutions & Private Schools	3	0	0.0%	187	98	52.5%	$16,021	$9,200	57.4%
Local Government	1	0	0.0%	3,099	1,033	33.3%	$235,280	$82,957	35.3%
State Government	0	0	0.0%	609	520	85.4%	$100,410	$94,794	94.4%
Federal Government	0	0	0.0%	14	0	0.0%	$1,040	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	222	0	0.0%	220	0	0.0%	$37,243	$0	0.0%
Parks, Preserves, Water, & Open Space	1	1	100.0%	5	5	100.0%	$7,125	$6,531	91.7%
Undeveloped land	1,427	118	8.2%	1,352	221	16.4%	$233,549	$28,176	12.1%
Total	**9,470**	**921**		**9,607**	**2,653**		**$1,559,106**	**$310,406**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 24
Flood Hazard Area, Vulnerability Assessment, Unincorported Thurston County
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	43,845	7,283	16.6%	0	0	0.0%	$4,607,949	$814,816	17.7%
Commercial/Industrial	191	47	24.6%	4,080	589	14.4%	$211,870	$34,725	16.4%
Religious Institutions & Private Schools	115	102	88.7%	361	54	14.9%	$50,421	$8,237	16.3%
Local Government	30	4	13.3%	1,608	367	22.8%	$248,850	$55,453	22.3%
State Government	20	18	90.0%	1,655	1,452	87.8%	$208,986	$192,123	91.9%
Federal Government	0	0	0.0%	53	1	1.9%	$6,750	$512	7.6%
Tribal	0	0	0.0%	0	0	100.0%	$0	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$398	$323	81.2%
Natural Resources (Public and Private)	729	404	55.4%	1,100	291	26.5%	$137,013	$72,461	52.9%
Parks, Preserves, Water, & Open Space	41	32	78.0%	32	21	64.3%	$14,272	$8,443	59.2%
Total	**44,971**	**7,890**		**8,890**	**2,775**		**$5,486,508**	**$1,187,094**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	54,705	9,459	17.3%	503	55	11.0%	$5,748,920	$1,038,897	18.1%
Commercial/Industrial	488	188	38.4%	4,520	740	16.4%	$285,775	$63,980	22.4%
Religious Institutions & Private Schools	125	112	89.6%	377	54	14.2%	$53,003	$9,229	17.4%
Local Government	30	4	13.3%	2,304	822	35.7%	$318,579	$100,956	31.7%
State Government	20	18	90.0%	1,928	1,641	85.2%	$236,358	$211,071	89.3%
Federal Government	0	0	0.0%	71	1	1.4%	$8,511	$512	6.0%
Tribal	1	0	50.0%	0	0	100.0%	$86	$43	50.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$398	$323	81.2%
Natural Resources (Public and Private)	10,913	5,347	49.0%	1,630	582	35.7%	$1,212,741	$598,020	49.3%
Parks, Preserves, Water, & Open Space	41	32	78.0%	21	11	53.9%	$13,150	$7,502	57.0%
Undeveloped land	15,479	3,871	25.0%	2,056	418	20.3%	$1,760,373	$430,552	24.5%
Total	**81,802**	**19,031**		**13,410**	**4,324**		**$9,637,895**	**$2,461,085**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 25
Flood Hazard Area, Vulnerability Assessment, Yelm
For Years 2000 and 2025

Land Use by Ownership in 2000	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	1,273	113	8.9%	0	0	0.0%	$91,116	$6,597	7.2%
Commercial/Industrial	25	2	8.0%	1,093	126	11.5%	$66,679	$3,204	4.8%
Religious Institutions & Private Schools	4	0	0.0%	48	8	15.5%	$6,333	$0	0.0%
Local Government	1	0	0.0%	324	75	23.2%	$55,255	$11,453	20.7%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	14	5	35.7%	1	1	100.0%	$763	$248	32.5%
Parks, Preserves, Water, & Open Space	0	0	0.0%	2	0	0.0%	$27	$0	0.0%
Total	**1,317**	**120**		**1,467**	**209**		**$220,172**	**$21,501**	

Land Use by Ownership in 2000*	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	1,599	205	12.8%	189	87	46.2%	$132,627	$21,297	16.1%
Commercial/Industrial	32	2	7.1%	1,206	141	11.7%	$77,199	$4,551	5.9%
Religious Institutions & Private Schools	4	0	0.0%	48	8	15.5%	$6,333	$0	0.0%
Local Government	1	0	0.0%	358	75	21.0%	$58,283	$11,453	19.6%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	414	195	47.1%	83	9	11.4%	$38,481	$15,468	40.2%
Parks, Preserves, Water, & Open Space	0	0	0.0%	2	0	0.0%	$27	$0	0.0%
Undeveloped land	1,636	676	41.4%	324	22	6.7%	$153,429	$53,541	34.9%
Total	**3,684**	**1,078**		**2,210**	**342**		**$466,379**	**$106,309**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 26
Flood Hazard Area, Critical Facilities

Jurisdiction*		Priority I Facilities			Priority II Facilities		
		Total	In Hazard Area	% in Hazard Area	Total	In Hazard Area	% in Hazard Area
Bucoda							
	Total	**1**	**1**	**100.0%**	**0**	**0**	**0.0%**
Lacey							
	City	4	0	0.0%	13	0	0.0%
	UGA	1	0	0.0%	8	0	0.0%
	Total	**5**	**0**	**0.0%**	**21**	**0**	**0.0%**
Olympia							
	City	19	0	0.0%	20	0	0.0%
	UGA	1	0	0.0%	1	0	0.0%
	Total	**20**	**0**	**0.0%**	**21**	**0**	**0.0%**
Rainier							
	City	2	0	0.0%	1	0	0.0%
	UGA	0	0	0.0%	0	0	0.0%
	Total	**2**	**0**	**0.0%**	**1**	**0**	**0.0%**
Tenino							
	City	3	0	0.0%	4	0	0.0%
	UGA	0	0	0.0%	0	0	0.0%
	Total	**3**	**0**	**0.0%**	**4**	**0**	**0.0%**
Tumwater							
	City	5	0	0.0%	6	0	0.0%
	UGA	2	0	0.0%	1	0	0.0%
	Total	**7**	**0**	**0.0%**	**7**	**0**	**0.0%**
Yelm							
	City	3	0	0.0%	5	0	0.0%
	UGA	0	0	0.0%	1	0	0.0%
	Total	**3**	**0**	**0.0%**	**6**	**0**	**0.0%**
Grand Mound UGA							
	Total	**2**	**0**	**0.0%**	**0**	**0**	**0.0%**
Total Cities		**37**	**1**	**2.7%**	**49**	**0**	**0.0%**
Total UGAs		**6**	**0**	**0.0%**	**11**	**0**	**0.0%**
Total Urban Areas		**43**	**1**	**2.3%**	**60**	**0**	**0.0%**
Rural Unincorporated County		**32**	**1**	**3.1%**	**11**	**0**	**0.0%**
Thurston County Total		**75**	**2**	**2.7%**	**71**	**0**	**0.0%**

*Explanation: Please note that this table indicates the number of critical facilities which are located in the jurisdiction, not their ownership. For example, the County Courthouse is owned by the County but is located in the City of Olympia. Similarly, hospitals are privately owned facilities located within jurisdicitonal boundaries.

Source: Thurston Regional Plannning Council.

LANDSLIDE

Hazard Description

Landslides are the movement of rock, soil, or other debris, down a slope. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Gravity acting on an overly steep slope is the primary cause of a landslide. However, they are influenced by both natural factors (geology, topography, weather, and hydrology) and human activity (mining and construction of buildings, railroads, and highways). Landslides are activated by storms, fires, earthquakes, volcanoes, and various human activities.

Landslides vary greatly in size and composition: from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud or "slurry" which can travel at avalanche speeds, growing in size as it picks up trees, cars, and other materials along the way. Other types of landslides include: rock slides, slumps, mudslides, and earthflows. All of these differ in terms of content and flow. The travel rate of a landslide can range from a few inches per month to many feet per second depending on the slope, type of material, and moisture content.

The following factors will affect the severity of a landslide:

- Erosion – Erosion caused by rivers, glaciers, or ocean waves created by overly steep slopes.
- Unstable slopes – Rock and soil slopes are weakened through saturation by snowmelt or heavy rain.
- Earthquakes – The shaking from earthquakes creates stress that makes weak slopes fail.
- Volcanic eruptions – Eruptions produce loose ash deposits and debris flows.
- Vibrations – Machinery, traffic, blasting, and even thunder may cause vibrations that trigger failure of weak slopes.
- Increase of load – Weight of rain/snow, fills, vegetation, stockpiling of rock or ore from waste piles or from man-made structures may cause weak slopes to fail.
- Hydrologic factors – Rain, high water tables, little or no ground cover, and numerous freeze/thaw cycles may cause weak slopes to fail.
- Human activity – These include development activities such as cutting and filling along roads and removal of forest vegetation. Such activities are capable of greatly altering slope form and groundwater conditions which can cause weak slopes to fail.
- Removal of lateral and underlying support – Erosion, previous slides, road cuts and quarries can trigger failure of weak slopes.
- Increase of lateral pressures – Hydraulic pressures, tree roots, crystallization, swelling of clay soil may cause weak slopes to fail.
- Regional tilting – Geological movements can trigger weak slopes to fail.

Landslide - Historical Occurrences and Impacts

The State of Washington rates landslide losses second to flood losses for the state as a whole with the Puget Sound basin having the greatest vulnerability. This is because of increased population density and development on and below bluffs and slopes. In Thurston County, as development continues in high risk areas, vulnerability will increase. The greatest risk is to individual residential structures on or below bluffs or slopes, roads, pipelines, and electrical and communications distribution lines.

In September 1990, a major landslide occurred on the Nisqually River approximately five miles downstream from La Grande Dam. Over a quarter-million cubic yards of material blocked the River causing the channel to shift several hundred yards to the north.

During the floods of February 1996, large sections of conglomerate bluff slid into the Nisqually River in the vicinity of Thuja Lane near Yelm when groundwater, under heavy pressure from near record rains, spewed out of the hillside eroding and weakening the bluff. Several residences were subsequently declared unsafe to occupy.

Also in February 1996, a landslide broke the two main sewer lines that carried the majority of Tumwater's and the brewery's wastewater to the LOTT treatment plant near downtown Olympia. The pipelines were on a hillside under the Union Pacific Railroad tracks at the south end of Capitol Lake.

During and following most major rain events, there are several slides along county roads in the hill areas of south county. These slides are usually of the nuisance variety, causing roads to be closed for a few hours or days. However, in February 1996, a landslide removed a section of Flumerfelt Road, southwest of Bucoda, which could not be reopened for several months.

Following the December 1996 and March 1997 rain storms, sections of the coastal bluff near Hunter Point across from Squaxin Island slid a few feet resulting in two residences being declared unsafe to occupy. These storms also caused a slide south of Rainier which threatened a section of the Williams Pipeline and the disruption of natural gas supplies.

In the winter of 1998-99, three years of above average winter rainfall contributed to a massive slide in the Hunter Point, Carlyon Beach area. The community impact was significant. The 66-acre landslide ultimately left 40 homes uninhabitable. Homeowners were requested to evacuate and most of the affected homes were demolished. In a press release, the Governor noted that "many landslide victims face catastrophic financial losses because there is no insurance to cover landslide damage to homes and personal property."

Landslide - Assessing Vulnerability

Summary Assessment

Thurston County has a history of landslides and their numbers seem to be increasing, suggesting a **high probability of occurrence**. Although there are exceptions, such as the Carlyon Beach landslide, landslides tend to occur in isolated, sparsely developed areas threatening individual structures and remote sections of the transportation, energy, and communications infrastructure, suggesting **low vulnerability**. Because of the high probability of occurrence and the trend to more frequent landslides a **moderate risk rating** is assigned.

Delineation of Landslide Hazard Area

Map 7 - Slope Map.

For the purposes of the data tables in this report, the Landslide Hazard Area has been defined as those parcels in the county on which slopes of 40 percent or more occur.

Population in Hazard Area

Table 27, Landslide Hazard Area Population, 2000 and 2025.

This table assesses an aspect of current and future vulnerability by providing data on the number of people living within the hazard area as compared to total population, by jurisdiction, in the years 2000 and 2025.

Inventory of Assets and Dollar Value in Hazard Area

Tables 28 – 36, Landslide Hazard Area Vulnerability Assessment, 2000 and 2025.

These tables provide an estimate of the number of existing and future structures which are potentially impacted by the hazard, as well as an estimate of structure and building contents value, in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the years 2000 and 2025.

Critical Facilities and Infrastructure in Hazard Area

Based on the community impact which historical occurrences of natural hazards caused, it is clear that natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further

isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

Specific information on the location of critical facilities and infrastructure is housed with the Emergency Management Council of Thurston County. However, Table 27 shows the number of Priority I and II Critical Facilities located in the hazard area. Priority I facilities included in this table fall into the following categories: Medical, Fire Districts & Departments, Law Enforcement Correctional Facilities, Emergency Services Centers, Radio & TV Stations, Humanitarian & Volunteer Services, Electrical Distribution & Components, and Telephone Service & Components. Although State and County Transportation Lifelines are Priority I Critical Facilities, it is not currently possible to include an analysis of them in the data table. Priority II facilities consist of Clinics, Facilities Pre-Designated as Shelters by the Red Cross, Animal Shelters, Newspapers, Sewage Treatment, and Water Distribution Systems & Components.

Critical facilities include both public and private facilities. Table 37 indicates the number of facilities which are located in the jurisdiction, not their ownership. For example, hospitals are critical facilities but are privately owned. Likewise a facility owned by one jurisdiction may be located within the boundaries of another; such as the County Courthouse complex which is located in the City of Olympia.

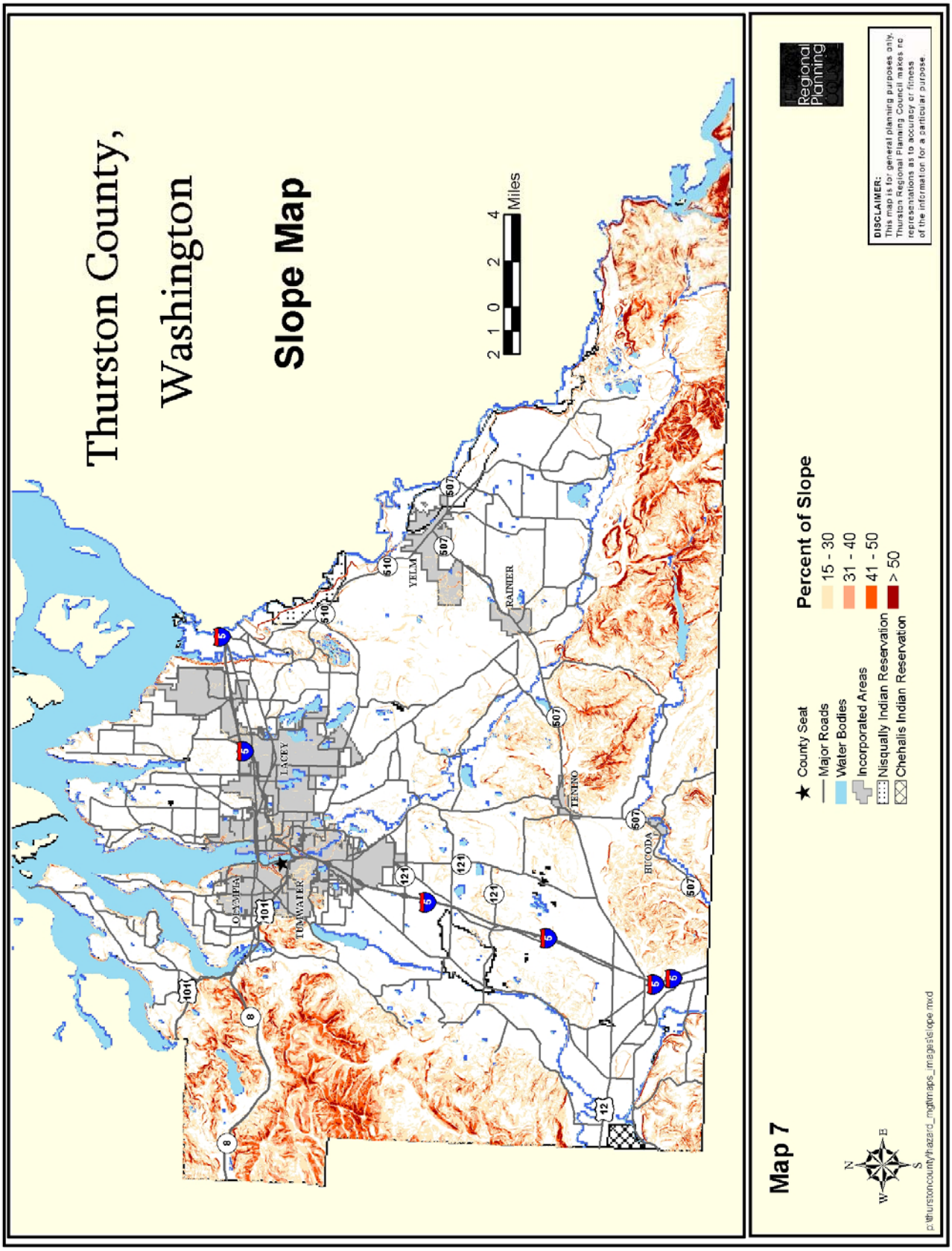

Thurston County,
Washington
Slope Map
2 1 0 2 4
Miles
OLYMPIA
LACEY
TUMWATER
YELM
RAINIER
TENINO
HICODA
Map 7
County Seat
Major Roads
Water Bodies
Incorporated Areas
Nisqually Indian Reservation
Chehalis Indian Reservation
Percent of Slope
15 - 30
31 - 40
41 - 50
> 50
Regional Planning
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
N
E
S
W
p:\thurstoncounty\hazard_mgt\maps_images\slope.mxd

Table 27
Landslide Hazard Area, Population, 2000 and 2025

Jurisdiction		2000 Population Estimate Total	2000 Population Estimate In Hazard Area	2000 Population Estimate %	2025 Population Forecast Total	2025 Population Forecast In Hazard Area	2025 Population Forecast %
Bucoda							
	Total	**584**	**3**	**0.5%**	**641**	**27**	**4.2%**
Lacey							
	City	30,958	5	0.0%	48,049	768	1.6%
	UGA	28,029	45	0.2%	46,648	646	1.4%
	Total	**58,986**	**50**	**0.1%**	**94,697**	**1,414**	**1.5%**
Olympia							
	City	42,519	1,326	3.1%	56,969	1,874	3.3%
	UGA	8,911	131	1.5%	22,057	887	4.0%
	Total	**51,429**	**1,457**	**2.8%**	**79,025**	**2,761**	**3.5%**
Rainier							
	City	1,356	10	0.7%	2,127	15	0.7%
	UGA	34		0.0%	186		0.0%
	Total	**1,390**	**10**	**0.7%**	**2,314**	**15**	**0.7%**
Tenino							
	City	1,521	15	1.0%	1,566	43	2.8%
	UGA	120		0.0%	365		0.0%
	Total	**1,641**	**15**	**0.9%**	**1,931**	**43**	**2.2%**
Tumwater							
	City	12,939	154	1.2%	19,423	824	4.2%
	UGA	7,068	21	0.3%	18,742	506	2.7%
	Total	**20,007**	**176**	**0.9%**	**38,165**	**1,330**	**3.5%**
Yelm							
	City	3,174	0	0.0%	8,559	2,298	26.9%
	UGA	1,071	5	0.5%	2,827	29	1.0%
	Total	**4,245**	**5**	**0.1%**	**11,386**	**2,328**	**20.4%**
Grand Mound UGA							
	Total	**720**	**0**	**0.0%**	**2,064**	**0**	**0.0%**
Chehalis Reservation		**34**	**0**	**0.0%**	**126**	**0**	**0.0%**
Nisqually Reservation		**599**	**227**	**37.9%**	**1,056**	**396**	**37.5%**
Total Cities		**93,050**	**1,513**	**1.6%**	**137,334**	**5,849**	**4.3%**
Total UGAs		**45,952**	**203**	**0.4%**	**92,890**	**2,068**	**2.2%**
Total Urban Areas		**139,002**	**1,716**	**1.2%**	**230,223**	**7,917**	**3.4%**
Rural Unincorporated County		**67,709**	**2,981**	**4.4%**	**102,852**	**10,738**	**10.4%**
Thurston County Total		**207,344**	**4,924**	**2.4%**	**334,258**	**19,051**	**5.7%**

Source: Thurston Regional Planning Council.

Table 28
Landslide Hazard Area, Vulnerability Assessment, Bucoda
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	225	1	0.4%	1	0	0.0%	$11,225	$0	0.0%
Commercial/Industrial	1	0	0.0%	20	0	0.0%	$642	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	2	0	0.0%	$228	$0	0.0%
Local Government	0	0	0.0%	11	0	0.0%	$671	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	3	0	0.0%	0	0	0.0%	$5	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$17	$0	0.0%
Total	**229**	**1**		**34**	**0**		**$12,787**	**$0**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	227	1	0.4%	1	0	0.0%	$11,326	$0	0.0%
Commercial/Industrial	1	0	0.0%	20	0	0.0%	$646	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	2	0	0.0%	$228	$0	0.0%
Local Government	0	0	0.0%	14	0	0.0%	$772	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	11	5	46.7%	0	0	0.0%	$367	$235	64.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$17	$0	0.0%
Undeveloped land	19	5	25.2%	4	0	0.0%	$1,051	$222	21.1%
Total	**258**	**11**		**41**	**0**		**$14,406**	**$456**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 29
Landslide Hazard Area, Vulnerability Assessment, Chehalis Reservation*

2000 Dwelling Units Estimate		
Total	**In Hazard Area**	**% in Hazard Area**
13	0	0.0%

2000 Commercial, Industrial, and Tribal Assets - Floor Space Estimate		
Total [1,000 sq. ft.]	**In Hazard Area [1,000 sq. ft.]**	**% in Hazard Area**
97	0	0.0%

2000 Value of Structures and Building Contents Estimate		
Total [1,000 $]	**In Hazard Area [1,000 $]**	**% in Hazard Area**
$27,443	$0	0.0%

New Tribal Assets Planned for 2004		
Total [1,000 sq. ft.]	**Construction Cost Estimate [1,000 $]**	**% in Hazard Area**
10	$1,300	0.0%

*Thurston County portion only.

Source: Thurston Regional Planning Council.

Table 30
Landslide Hazard Area, Vulnerability Assessment, Lacey
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	12,601	2	0.0%	1	0	0.0%	$1,148,978	$0	0.0%
Commercial/Industrial	431		0.0%	5,178	0	0.0%	$398,500	$0	0.0%
Religious Institutions & Private Schools	17	0	0.0%	479	0	0.0%	$42,235	$0	0.0%
Local Government	7	0	0.0%	1,066	0	0.0%	$98,505	$0	0.0%
State Government	8	0	0.0%	458	0	0.0%	$93,344	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$26	$0	0.0%
Natural Resources (Public and Private)	8	0	0.0%	16	2	11.6%	$1,009	$116	11.5%
Parks, Preserves, Water, & Open Space	6	0	0.0%	3	0	0.0%	$1,537	$0	0.0%
Total	**13,078**	**2**		**7,201**	**2**		**$1,784,134**	**$116**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	13,547	2	0.0%	191	0	0.0%	$1,251,598	$0	0.0%
Commercial/Industrial	1,961	0	0.0%	5,310	0	0.0%	$548,436	$0	0.0%
Religious Institutions & Private Schools	17	0	0.0%	492	0	0.0%	$43,375	$0	0.0%
Local Government	7	0	0.0%	1,148	0	0.0%	$106,011	$0	0.0%
State Government	8	0	0.0%	463	0	0.0%	$93,857	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$7	$0	0.0%
Natural Resources (Public and Private)	524	0	0.0%	337	103	30.4%	$76,933	$9,353	12.2%
Parks, Preserves, Water, & Open Space	6	0	0.0%	0	0	0.0%	$1,287	$0	0.0%
Undeveloped land	4,297	323	7.5%	2,804	0	0.0%	$644,099	$29,127	4.5%
Total	**20,366**	**325**		**10,746**	**103**		**$2,765,603**	**$38,480**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 31
Landslide Hazard Area, Vulnerability Assessment, Olympia
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	19,018	503	2.6%	1	0	0.0%	$1,729,120	$48,410	2.8%
Commercial/Industrial	610	2	0.3%	10,664	123	1.2%	$982,536	$7,543	0.8%
Religious Institutions & Private Schools	12	0	0.0%	1,117	0	0.0%	$131,766	$0	0.0%
Local Government	49	0	0.0%	2,149	209	9.7%	$376,202	$33,252	8.8%
State Government	2	1	50.0%	3,484	1,634	46.9%	$768,694	$249,209	32.4%
Federal Government	0	0	0.0%	37	0	0.0%	$1,898	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	7	0	0.0%	83	0	0.0%	$2,843	$0	0.0%
Parks, Preserves, Water, & Open Space	4	0	0.0%	6	6	100.0%	$9,326	$1,087	11.7%
Total	**19,702**	**506**		**17,540**	**1,971**		**$4,002,384**	**$339,500**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	22,048	659	3.0%	625	9	1.5%	$2,104,448	$64,602	3.1%
Commercial/Industrial	773	27	3.5%	11,675	144	1.2%	$1,135,516	$12,878	1.1%
Religious Institutions & Private Schools	12	0	0.0%	1,209	0	0.0%	$144,385	$0	0.0%
Local Government	49	0	0.0%	3,216	215	6.7%	$521,303	$34,179	6.6%
State Government	2	1	50.0%	3,651	1,634	44.8%	$791,415	$249,209	31.5%
Federal Government	0	0	0.0%	61	0	0.0%	$5,206	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	851	0	0.0%	449	0	0.0%	$133,566	$0	0.0%
Parks, Preserves, Water, & Open Space	8	0	0.0%	6	6	100.0%	$9,726	$1,087	11.2%
Undeveloped land	4,858	254	5.2%	4,232	385	9.1%	$1,041,167	$76,710	7.4%
Total	**28,601**	**941**		**25,124**	**2,394**		**$5,886,733**	**$438,665**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 32
Landslide Hazard Area, Vulnerability Assessment, Rainier
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	547	4	0.7%	0	0	0.0%	$41,288	$477	1.2%
Commercial/Industrial	10	0	0.0%	83	0	0.0%	$4,031	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	5	0	0.0%	$251	$0	0.0%
Local Government	0	0	0.0%	164	0	0.0%	$16,371	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	2	0	0.0%	0	0	0.0%	$134	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Total	**559**	**4**		**253**	**0**		**$62,074**	**$477**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	625	6	1.0%	13	0	0.0%	$48,393	$631	1.3%
Commercial/Industrial	10	0	0.0%	84	0	0.0%	$4,134	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	5	0	0.0%	$251	$0	0.0%
Local Government	0	0	0.0%	173	0	0.0%	$17,099	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	153	0	0.0%	0	0	0.0%	$11,660	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Undeveloped land	57	0	0.0%	37	0	0.0%	$7,484	$0	0.0%
Total	**845**	**6**		**313**	**0**		**$89,021**	**$631**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 33
Landslide Hazard Area, Vulnerability Assessment, Tenino
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	600	5	0.8%	0	0	0.0%	$41,885	$0	0.0%
Commercial/Industrial	19	0	0.0%	206	0	0.0%	$9,555	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	13	0	0.0%	$1,603	$0	0.0%
Local Government	0	0	0.0%	235	0	0.0%	$31,459	$607	1.9%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$42	$0	0.0%
Natural Resources (Public and Private)	1	1	100.0%		0	0.0%	$0	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	8	0	0.0%	$908	$52	5.7%
Total	**620**	**6**		**463**	**0**		**$85,452**	**$658**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	604	6	0.9%	16	0	0.0%	$43,641	$32	0.1%
Commercial/Industrial	19	0	0.0%	220	0	0.0%	$10,834	$0	0.0%
Religious Institutions & Private Schools	0	0	0.0%	13	0	0.0%	$1,603	$0	0.0%
Local Government	0	0	0.0%	280	0	0.0%	$35,654	$607	1.7%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$42	$0	0.0%
Natural Resources (Public and Private)	27	12	44.7%	0	0	0.0%	$1,618	$689	42.6%
Parks, Preserves, Water, & Open Space	0	0	0.0%	2	0	0.0%	$383	$52	13.5%
Undeveloped land	18	1	4.9%	31	0	0.0%	$3,993	$56	1.4%
Total	**669**	**19**		**562**	**0**		**$97,767**	**$1,435**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 34
Landslide Hazard Area, Vulnerability Assessment, Tumwater
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	5,891	56	1.0%	0	0	0.0%	$486,926	$11,535	2.4%
Commercial/Industrial	55	3	5.5%	3,764	59	1.6%	$250,677	$746	0.3%
Religious Institutions & Private Schools	3	0	0.0%	181	0	0.0%	$15,605	$0	0.0%
Local Government	1	0	0.0%	1,756	38	2.2%	$126,153	$1,335	1.1%
State Government	0	0	0.0%	575	0	0.0%	$97,624	$0	0.0%
Federal Government	0	0	0.0%	14	0	0.0%	$1,040	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	0	0	0.0%	1	1	100.0%	$137	$119	86.5%
Parks, Preserves, Water, & Open Space	1	0	0.0%	5	2	34.8%	$7,125	$317	4.4%
Total	**5,951**	**59**		**6,297**	**101**		**$985,287**	**$14,051**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	7,579	285	3.8%	86	1	1.3%	$640,175	$31,419	4.9%
Commercial/Industrial	236	3	1.3%	4,034	117	2.9%	$288,263	$5,439	1.9%
Religious Institutions & Private Schools	3	0	0.0%	187	0	0.0%	$16,021	$0	0.0%
Local Government	1	0	0.0%	3,099	38	1.2%	$235,280	$1,335	0.6%
State Government	0	0	0.0%	609	0	0.0%	$100,410	$0	0.0%
Federal Government	0	0	0.0%	14	0	0.0%	$1,040	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	222	0	0.0%	220	220	100.0%	$37,243	$17,956	48.2%
Parks, Preserves, Water, & Open Space	1	0	0.0%	5	2	34.8%	$7,125	$317	4.4%
Undeveloped land	1,427	114	8.0%	1,352	30	2.3%	$233,549	$12,373	5.3%
Total	**9,470**	**402**		**9,607**	**410**		**$1,559,106**	**$68,838**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 35
Landslide Hazard Area, Vulnerability Assessment, Unincorporated Thurston County
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	43,845	1,213	2.8%	0	0	0.0%	$4,607,949	$185,290	4.0%
Commercial/Industrial	191	2	1.0%	4,080	57	1.4%	$211,870	$3,621	1.7%
Religious Institutions & Private Schools	115	44	38.3%	361	11	3.1%	$50,421	$5,496	10.9%
Local Government	30	2	6.7%	1,608	9	0.6%	$248,850	$4,573	1.8%
State Government	20	1	5.0%	1,655	1	0.1%	$208,986	$1,811	0.9%
Federal Government	0	0	0.0%	53	0	0.0%	$6,750	$0	0.0%
Tribal	0	0	0.0%	0	0	0.0%	$0		0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$398	$0	0.0%
Natural Resources (Public and Private)	729	67	9.2%	1,100	19	1.8%	$137,013	$7,228	5.3%
Parks, Preserves, Water, & Open Space	41	5	12.2%	32	0	0.0%	$14,272	$866	6.1%
Total	**44,971**	**1,334**		**8,890**	**97**		**$5,486,508**	**$208,885**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	54,705	1,648	3.0%	503	8	1.7%	$5,748,920	$229,791	4.0%
Commercial/Industrial	488	37	7.6%	4,520	76	1.7%	$285,775	$9,036	3.2%
Religious Institutions & Private Schools	125	54	43.1%	377	15	3.9%	$53,003	$6,844	12.9%
Local Government	30	2	6.7%	2,304	211	9.2%	$318,579	$24,851	7.8%
State Government	20	1	5.0%	1,928	15	0.8%	$236,358	$3,272	1.4%
Federal Government	0	0	0.0%	71	0	0.0%	$8,511	$0	0.0%
Tribal	1	0	0.0%	0	0	0.0%	$86	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$398	$0	0.0%
Natural Resources (Public and Private)	10,913	2,840	26.0%	1,630	34	2.1%	$1,212,741	$287,191	23.7%
Parks, Preserves, Water, & Open Space	41	5	12.2%	21	0	0.0%	$13,150	$866	6.6%
Undeveloped land	15,479	866	5.6%	2,056	99	4.8%	$1,760,373	$96,917	5.5%
Total	**81,802**	**5,453**		**13,410**	**459**		**$9,637,895**	**$658,768**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 36
Landslide Hazard Area, Vulnerability Assessment, Yelm
For Years 2000 and 2025

	2000 Dwelling Units Estimate			2000 Commercial and Industrial Floor Space Estimate			2000 Value of Structures and Building Contents Estimate		
Land Use by Ownership in 2000	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	1,273	0	0.0%	0	0	0.0%	$91,116	$0	0.0%
Commercial/Industrial	25	0	0.0%	1,093	0	0.0%	$66,679	$0	0.0%
Religious Institutions & Private Schools	4	0	0.0%	48	0	0.0%	$6,333	$0	0.0%
Local Government	1	0	0.0%	324	0	0.0%	$55,255		0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0		0.0%
Natural Resources (Public and Private)	14	0	0.0%	1	0	0.0%	$763		0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	2	0	0.0%	$27		0.0%
Total	**1,317**	**0**		**1,467**	**0**		**$220,172**	**$0**	

	2025 Dwelling Units Forecast			2025 Commercial and Industrial Floor Space Forecast			2025 Value of Structures and Building Contents Forecast		
Land Use by Ownership in 2000*	Total	In Hazard Area	% in Hazard Area	Total [1,000 sq. ft.]	In Hazard Area [1,000 sq. ft.]	% in Hazard Area	Total [1,000 $]	In Hazard Area [1,000 $]	% in Hazard Area
Residential	1,599	0	0.0%	189	0	0.0%	$132,627	$0	0.0%
Commercial/Industrial	32	0	0.0%	1,206	0	0.0%	$77,199	$0	0.0%
Religious Institutions & Private Schools	4	0	0.0%	48	0	0.0%	$6,333	$0	0.0%
Local Government	1	0	0.0%	358	0	0.0%	$58,283	$0	0.0%
Roads, Railroads, & Rights of Way	0	0	0.0%	0	0	0.0%	$0	$0	0.0%
Natural Resources (Public and Private)	414	0	0.0%	83	0	0.0%	$38,481	$0	0.0%
Parks, Preserves, Water, & Open Space	0	0	0.0%	2	0	0.0%	$27	$0	0.0%
Undeveloped land	1,636	989	60.5%	324	0	0.0%	$153,429	$75,523	49.2%
Total	**3,684**	**989**		**2,210**	**0**		**$466,379**	**$75,523**	

*Explanation: Please note that 2025 estimates are shown according to 2000 land use ownership, since land ownership for 2025 is unknown.

Source: Thurston Regional Planning Council.

Table 37
Landslide Hazard Area, Critical Facilities

Jurisdiction*		Priority I Facilities			Priority II Facilities		
		Total	In Hazard Area	% in Hazard Area	Total	In Hazard Area	% in Hazard Area
Bucoda							
	Total	**1**	**0**	**0.0%**	**0**	**0**	**0.0%**
Lacey							
	City	4	0	0.0%	13	0	0.0%
	UGA	1	0	0.0%	8	0	0.0%
	Total	**5**	**0**	**0.0%**	**21**	**0**	**0.0%**
Olympia							
	City	19	0	0.0%	20	0	0.0%
	UGA	1	0	0.0%	1	0	0.0%
	Total	**20**	**0**	**0.0%**	**21**	**0**	**0.0%**
Rainier							
	City	2	0	0.0%	1	0	0.0%
	UGA	0	0	0.0%	0	0	0.0%
	Total	**2**	**0**	**0.0%**	**1**	**0**	**0.0%**
Tenino							
	City	3	0	0.0%	4	0	0.0%
	UGA	0	0	0.0%	0	0	0.0%
	Total	**3**	**0**	**0.0%**	**4**	**0**	**0.0%**
Tumwater							
	City	5	0	0.0%	6	0	0.0%
	UGA	2	0	0.0%	1	0	0.0%
	Total	**7**	**0**	**0.0%**	**7**	**0**	**0.0%**
Yelm							
	City	3	0	0.0%	5	0	0.0%
	UGA	0	0	0.0%	1	0	0.0%
	Total	**3**	**0**	**0.0%**	**6**	**0**	**0.0%**
Grand Mound UGA							
	Total	**2**	**0**	**0.0%**	**0**	**0**	**0.0%**
Total Cities		**37**	**0**	**0.0%**	**49**	**0**	**0.0%**
Total UGAs		**6**	**0**	**0.0%**	**11**	**0**	**0.0%**
Total Urban Areas		**43**	**0**	**0.0%**	**60**	**0**	**0.0%**
Rural Unincorporated County		**32**	**0**	**0.0%**	**11**	**0**	**0.0%**
Thurston County Total		**75**	**0**	**0.0%**	**71**	**0**	**0.0%**

*Explanation: Please note that this table indicates the number of critical facilities which are located in the jurisdiction, not their ownership. For example, the County Courthouse is owned by the County but is located in the City of Olympia. Similarly, hospitals are privately owned facilities located within jurisdicitonal boundaries.

Source: Thurston Regional Planning Council.

STORM

Hazard Description

Destructive storms come in several varieties: wind, rain, ice, snow, and combination. Nearly all destructive local storms occur from November through April when the jet stream is over the U.S. west coast and Pacific low-pressure systems are more frequent. The trajectory of these lows determines their effect locally. The more southerly ones bring heavy rains while the more northerly ones bring cold air and the potential for snow and ice. Any winter storm, regardless of its trajectory, can pack high winds. Generally, winds above about 30 miles per hour can cause widespread damage and those above about 50 miles per hour can be disastrous. High winds of short duration, such as tornados and strong gusts from thunderstorms, can also be destructive though generally not as widespread.

Storm - Historical Occurrences and Impacts

Storms are frequent in Thurston County. Between 1972 and 1997 Thurston County dealt with the impact of 15 severe storms, 12 of them leading to federal disaster declarations. The majority of these were combination events with high winds, heavy rain, snow or ice, and subsequent flooding. The following are examples of the type of impact from recent storms.

A weather front in November of 1981 brought strong winds and rain to the area. Thurston County Commissioners declared the county a disaster area as a result of the storm, estimating $3.4 million damage to private property throughout the county. Governor Spellman signed an order declaring a state of emergency as a result of the storm losses throughout Western Washington. The winds left over 60,000 people in Thurston County without electricity. In the City of Olympia, high winds sent debris from boats moored at the West Bay Marina out into Budd Inlet. About 150 boats broke loose and were strewn for miles.

Winds up to 70 miles per hour struck the county in January 1986. During a 24-hour period that January, the area was hit with 3.4 inches of rain, accompanied by winds up to 55 miles per hour. About 20,000 Puget Sound Power and Light customers were without electricity one night that month. Recurring winds and rain caused mud slides and an estimated $186,000 damage to storm drains and roads. City storm drains were unable to handle the run-off. The City of Olympia Fire Department received 30-40 calls every half hour during one day. The majority of callers were city residents with flooding in their homes.

In January 1993, the Inaugural Day Storm affected all of Western Washington. Virtually the entire South Sound area was left without power for 36 hours. Across Western Washington citizens were ill-prepared for such an event. There were five fatalities area-wide, 870,000 persons without power and 60 dwellings destroyed. Recent studies show that severe windstorms are expected to occur approximately every five years.

Other recent storms of major impact, other than flooding, were the windstorm of December 1995, and the ice and windstorm of December 1996. Costs associated with destructive

storms can be significant. The ice and windstorms of December 1996 cost the county nearly $1 million in non-flood related costs, primarily due to large amounts of debris and damage to the road system; caused power outages to nearly one-half of the county population for several days; required the expenditure of nearly $10 million by Puget Sound Energy to make repairs to the power distribution system; and resulted in an estimated $3 million in uninsured losses to private property. Similar costs were incurred as a result of the Inaugural Day Storm in 1993.

The entire county is vulnerable to the effects of a storm.

High winds can bring down trees, down telephone and electrical lines, and interrupt transportation, communications and power distribution, leaving large areas without electric power.

Prolonged heavy rains can cause the ground to be saturated, rivers and streams to rise, and result in local flooding and landslides in rural areas. In the urban area, city storm drains may be unable to handle the run-off. In the cities served by LOTT, there can be a loss of LOTT communications links, damage to LOTT plant functions, flooding of streets and intersections, mudslides off steep slopes and costly street damage from these mudslides.

Ice storms occur when rain falls out of a warm atmospheric layer into a cold one near the ground. The rain freezes on contact with cold objects including the ground, trees, structures, and power lines, causing buildings to collapse and power lines to break.

Snow storms primarily impact the transportation system and the availability or timing of public safety services. Snow accumulations can also cause roofs to collapse. Snow accompanied by high winds is a blizzard which can affect visibility, cause large drifts and strand residents for up to several days. Melting snow adds to river loading and can turn an otherwise benign situation into a local disaster.

Each of these when in combination with any other or if accompanied by freezing temperatures can exacerbate a storm's impact. Isolated residents without power are more likely to use wood fires to stay warm or to cook, possibly resulting in an increase in the number of structural fires. Residents without food or water may attempt to use impassable roads and thereby increase the potential rescues. Since stress can bring on medical problems, there tends to be an increase in calls for medical assistance. High winds, heavy snows, and heavy rains often result in increased automobile accidents as well.

Storm - Assessing Vulnerability

Summary Assessment

Storm history suggests a **high probability of occurrence**. Historical damage and cumulative costs of destructive storms suggest **high vulnerability**. Accordingly, a **high risk rating** is assigned.

Delineation of Storm Hazard Area, Population and Assets Data

The entire county is vulnerable to the effects of a storm. As a result, a separate Storm Hazard Area has not been delineated. The "Total" columns in the Population and Assets tables provided for the flood and landslide hazards provide useful information in assessing the population and assets at risk from a countywide hazard.

Critical Facilities and Infrastructure in Hazard Area

Based on the community impact which historical occurrences of natural hazards caused, it is clear that natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

Specific information on the location of critical facilities and infrastructure is housed with the Emergency Management Council of Thurston County. However, the "Total" columns in the Critical Facilities tables provided for the flood and landslide hazards provide useful information in assessing the risk for these assets from a countywide hazard.

CIVIL DISTURBANCE

Hazard Description

Civil unrest or disturbance is a result of individuals or groups within the population feeling their needs or rights are not being met by society, a segment of it, or the current political system. Civil unrest spans a variety of actions including labor unrest, strikes, civil disobedience, demonstrations, riots and rebellion. Events that could trigger these actions include racial tension, unemployment, unpopular political actions, and a decrease in the supply of essential goods or services.

Historical Occurrences and Impacts

There have been no major incidents of local civil disorder in Thurston County.

There have been, and will continue to be, civil demonstrations during the Washington State Legislative session (mid-January through mid-March or April each year) as special interest groups attempt to influence the legislative process. These events, however, have historically been peaceful, well organized and coordinated with law enforcement officials.

Any large disturbance would most likely affect the Capital Campus in Olympia and immediate surroundings. Under an extreme scenario, there may be some looting, arson, and rioting that could approach the Olympia downtown area. There is little likelihood of significant impact elsewhere in the County.

In recent years, within the City of Olympia, up to several hundred protesters have staged "Take Back the Streets" marches on May Day, May 1. These activities have been staged without law enforcement coordination, hindering planning efforts to minimize the local impacts. These events have resulted in traffic congestion on local roads and freeways, and affected commercial areas in Olympia.

Vulnerability – Summary Assessment

History suggests a **low probability of occurrence** and **low vulnerability**. A **low risk rating** is assigned.

CRITICAL SHORTAGE

Hazard Description

Critical shortages are the lack or reduction of essential goods or services due to a disruption in their supply. They are distinguished from short-term shortages due to local emergencies by being caused by events that occur elsewhere. These events could include embargoes, strikes, natural disasters, epidemics, crop failures, over exploitation of a natural resource, terrorist activities and political unrest.

Historical Occurrences and Impacts

Thurston County has never suffered a critical shortage but there have been events that could have led to significant local impact. Similar events may in the future.

Petroleum shortages occurred during the 1973-74 Arab oil embargo and following Iran=s embargo of 1979. During those periods, a state 'set-aside' program allowed state government to allocate part of the fuel in the state to areas of greatest need. This program was abolished under deregulation rules in 1981.

Electrical shortages occurred in 1973-74 and 1977-78 due to drought conditions that resulted in insufficient amounts of water to operate hydroelectric plants.

The collapse of the salmon fishery in 1993 led to the declaration of a federal economic disaster as did the collapse of the timber industry in 1995. Each of these events had significant local impact because of their effect on unemployment and the need to retrain workers to be competitive in new fields.

A critical shortage of any important commodity would affect the entire County, either directly or indirectly. Depending on the commodity and the season, the impact could range from broad inconvenience (oil embargo leading to reduced vehicle use), to widespread economic disruption (major bank failure), or a major public health emergency (fuel oil shortage during winter). Specific shortages might include electricity, natural gas, heating oil, gasoline, medical supplies, foodstuffs, natural resources and jobs.

Vulnerability – Summary Assessment

Previous energy shortages and recent economic impacts due to the collapse of the salmon and timber industries suggest a **moderate probability of occurrence**. The impact of a critical shortage would affect the entire county, either directly or through higher costs of services suggesting a **moderate to high vulnerability**. A **moderate risk rating** is assigned.

DAM FAILURE

Hazard Description

There are 33 dams in or adjacent to Thurston County. Many of them serve more than one purpose such as hydroelectric power generation, irrigation, and recreation. Washington State uses a Downstream Hazard Classification system for dams which assigns a Low, Significant or High rating for populations at risk of economic loss and environmental damage should the dam fail (see table below). In Thurston County, most dams are rated low, a few significant and three high.

The three potential high hazard dams are Alder and La Grande Dams on the Nisqually River and the Skookumchuck Dam on the Skookumchuck River. Each of these dams could affect a population of 300 or more, inundate major transportation routes and industries, and have long term effects on water quality and wildlife. Alder Reservoir has a storage capacity of 232,000 acre-feet, and the smaller La Grande Reservoir, 2,700 acre-feet. Firm flood control storage is not provided for either reservoir, although the operation at Alder Dam can be adjusted when a flood is expected. This can reduce flood peaks on the Nisqually River. The Skookumchuck Dam, located approximately eight miles upstream of Bucoda, has a storage capacity of 42,000 acre-feet. Its major function is water supply for the Steam-Electric Project and it provides little protection from large floods. Of the three dams, the Skookumchuck is an earthen dam, whereas La Grande and Alder are both concrete structures.

Although not classified a dam, a failure of the Centralia Power Canal off the Nisqually River in Yelm could cause inundation of a number of residential properties.

Historical Occurrences and Impacts

Many dam failures have occurred in Washington State over the last 40 years. Some of them have been catastrophic but none have been in or affected Thurston County. The high hazard dams in Thurston County are primarily for electricity generation and are licensed by the Federal Energy Regulatory Commission. Accordingly, they are inspected regularly and staffed 24 hours a day. Dam failures can be caused by nature, such as flooding or an earthquake, but mostly they are caused by human error such as poor construction, operation, maintenance or repair.

The effects of a dam failure are highly variable depending on the dam, the amount of water stored behind the dam, the current stream flow, and the size and proximity of the downstream population. Some of the effects of a major dam failure are: loss of life, destruction of homes and property, damage to roads, bridges, power lines, and other infrastructure, loss of power generation and flood control capabilities, disruption of fish stock and spawning beds, and the erosion of stream and river banks.

Vulnerability – Summary Assessment

History suggests a **low probability of occurrence**. The failure of a high hazard dam would threaten a small but important segment of the County suggesting **moderate vulnerability**. Because there has not been a major dam failure in Thurston County, and the three high hazard dams are well maintained and operated providing no reason to suspect a compromise in structural integrity barring a natural disaster or terrorist action, a **low risk rating** is assigned.

Thurston County Dams

Name of Dam	River or Stream	Storage (Acre-Feet)	Hazard Class
Adams Dam	Woodland Creek	10	3
Alder Dam	Nisqually River (Alder Lake)	231,936	1A
Beaver Dam	Nisqually River	34	3
Berger Dam	Scatter Creek	50	3
Cougar Mtn. Farm Dam	Deschutes River (Nelda Lake)	30	3
Deschutes Dam	Deschutes River (Capitol Lake)	3,700	3
Dunlap Pond Dam	Prairie Creek (Dunlap Pond)	6	3
Grass Lake Dam	Puget Sound (Grass Lake)	60	3
Havvaski Waterski Pond	Black River	83	3
Kaufman Dam	Puget Sound (Kaufman Pond)	65	3
Kyte Dam	Skookumchuck River	17	2
La Grande Dam	Nisqually River (La Grande Reservoir)	2,676	1B
Lawrence Lake Dam	Deschutes River (Lake Lawrence)	4,379	2
Lucinda Lake Dam	Deschutes River (Lucinda Lake)	35	3
Mackie Dam	Woodland Creek	5	3
Maytown Ski Pond Dam	Scatter Creek (Maytown Lake)	81	3
McAllister Spring Lake Dam	McAllister Creek	17	3
Medicine Creek Dam	Medicine Creek (Medicine Creek Reservoir)	20	3
Monte Vista Pond	Off stream - Poultry Detention Pond	17	3
Mottman Road Pond	Percival Creek (Stormwater Detention Pond)	4	3
Muskrat Dam	Nisqually River	10	3
Nisqually Trout Farm Dam	McAllister Creek	6	3
PEO Dam No. 32	Hanaford Creek (PEO Pond No. 32)	22	3
PEO Dam No. 32B	North Hanaford Creek(PEO Pond No. 32B)	124	3
Schoenbachler Dam	Silver Springs Creek	21	3
Seeley Ski Lake	Black River	40	3
Skookumchuck Dam	Skookumchuck River (Skookumchuck Reservoir)	35,000	1A
Summit Lake Dam	Kennedy Creek (Summit Lake)	1,570	3
Sunwood Lake Dam	Off stream - Sunwood Lake	60	3
Tempo Lake Dam	Deschutes River (Tempo Lake)	400	3
Tumwater Falls Dam	Deschutes River	15	3
Walentiny Dam	Black River	35	3
Winsor Waterski Pond	Nisqually River	125	2

"Downstream Hazard Class" is a measurement of the risks associated with large dam releases or destruction. A rating of 3 indicates damage would be minimal, posing a risk to from 1 to 6 downstream residents. A rating of 2 indicates damage would be moderate, posing risk to between 6 and 30 residents. A rating of 1 indicates damage would be great, posing risk to 30 or more residents (1B) or more than 300 (1A). Source: Washington State Department of Ecology (Inventory of Dams in the State of Washington, 1/94).

DROUGHT

Hazard Description

Drought is a condition of climatic dryness that is severe enough to reduce soil moisture levels and water levels below the minimum necessary for sustaining plant, animal, human life and economic systems.

Historical Occurrences and Impacts

The State of Washington Hazard Identification and Vulnerability Analysis specifically mentions western Washington as being affected during 11 droughts or near drought events since 1902. Three of these were during extended dry periods: April 1934-March 1937, October 1976-September 1977, and October 1991-September 1994. This history suggests a recurrence interval of less than 10 years.

During previous dry events, both municipal systems and private wells experienced reduced water availability for consumption, sanitation, manufacturing, agriculture and landscaping. This was mostly the result of declining aquifer levels, however, surface water levels also experienced noticeable declines. Residents of most cities and towns in Thurston County were under either recommended or mandatory water conservation measures.

Other potential impacts include: decreased ability to generate hydroelectric power; reduced spawning of salmon due to both warmer water and low water levels; increased threats of forest and prairie fires; greater difficulty in fighting fires; salt water intrusion into fresh water aquifers; increased unemployment due to reductions in agricultural activity and manufacturing; reduced recreational opportunities; and reductions in, or restrictions on, growth.

Vulnerability – Summary Assessment

History suggests a **high 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 greater, suggesting **moderate vulnerability**. A **moderate risk rating** is assigned.

EPIDEMIC

Hazard Description

Epidemics are outbreaks of disease that affect, or threaten to affect, a significant portion of a population in a relatively short period of time. Although usually referring to human contagious disease, epidemics can also affect domestic and wild animals and crops. Epidemic diseases are usually introduced into an area from remote regions and inflict devastation because there is no natural or induced immunity.

Historical Occurrences and Impacts

Thurston County has not suffered an epidemic. This is due to our northern locale (a hostile environment to many of the world's most contagious diseases), low population density, clean water and food supplies, effective sewage and waste disposal, a high incidence of inoculations, and aggressive monitoring and treatment of potential disease outbreaks by public health officials. We are not immune, however, and events in other parts of the country or world could affect us.

During a worldwide influenza outbreak in 1918 and 1919, an estimated 20 million people died. A 1946 polio epidemic in the United States killed approximately 25,000 people. The 1976 outbreak of Legionnaire=s Disease in Philadelphia, PA claimed 30 lives. Additionally, there is growing concern that tropical diseases are moving northward in response to a warming climate and an increasingly mobile world population.

The virus that causes influenza is constantly changing its identity slightly (this is called "genetic drift"). In some years, the influenza virus "shifts," changing its genetic structure dramatically and unexpectedly, forming a new strain to which few people will be immune. The mobility of the population could cause such a virus to spread world-wide rapidly and could potentially cause serious illness and death for millions of people.

Additional diseases that have been of concern in recent years include severe acute respiratory syndrome (SARS) and West Nile virus.

The entire population is vulnerable to an epidemic. Depending on the disease, there could be short or long term debilitation and massive loss of life. Lost productivity and efficiency could have a devastating impact on the economy and on the provision of essential public safety and health services.

Vulnerability – Summary Assessment

History suggests a **low probability of occurrence**. However, because the potential impact is so great, there is **high vulnerability**. A **moderate risk rating** is assigned.

HAZARDOUS MATERIAL INCIDENT

Hazard Description

Hazardous materials include chemicals used in manufacturing, household chemicals, crude oil and petroleum products, pesticides, herbicides, fertilizers, paints, medical wastes, radioactive materials and a host of other substances. Their manufacture, transport, storage, use and disposal places the public, property, and environment at risk from their inadvertent or intentional release.

Historical Occurrences and Impacts

Hazardous material incidents are a regular occurrence in Thurston County. The numbers of industrial spill incidents have declined over the past few years due to increased corporate and public awareness, enhanced compliance with notification and reporting requirements, improved hazardous materials management practices, and the use of alternate technologies. However, the increase in the number of methamphetamine related arrests indicate an expansion of this activity and a concurrent increase in the threat posed by the chemicals used in their manufacture.

Thurston County is bisected by both a major north-south rail line and an interstate highway and also has an active sea port. Statistics show that nearly half of all hazardous materials incidents occur during transit. Although there has not been an official study of the transport of hazardous material in the County, rail, highway and waterborne accidents elsewhere, plus the frequent sighting of hazardous material placards on trucks and rail cars, suggest a substantial movement into and through the County and potentially substantial risk.

An incident involving hazardous materials can occur anytime and any place. Historically, seven out of eight hazardous material incidents in Thurston County occur within a quarter-mile of a residential area. Hazardous materials can be flammable, explosive, poisonous, caustic, acidic, suffocating, carcinogenic, radioactive or have a combination of these characteristics.

The potential impact depends on the nature of the material, conditions of the release, weather at the time of release and area involved. Releases may be small, easily handled and with negligible impact or catastrophic, with immediate impact and long-term public health, habitability and environmental consequences.

Vulnerability – Summary Assessment

History, plus the inferred transport into and through the County, suggest a **high probability of occurrence**. A hazardous material spill generally impacts a relatively small area, but if that area is a high density urban area or a critical wildlife habitat, the impact could be significant, suggesting **moderate vulnerability**. Because of the magnitude of the potential risk posed by the transport of hazardous materials, a **high risk rating** is assigned.

Hazardous Materials Spills in Washington State (1995-2003)

Year	Quantity
2003	1,727
2002	1,895
2001	1,975
2000	1,902
1999	3,988
1998	2,829
1997	2,546
1996	2,841
1995	1,206

HEAT WAVE

Hazard Description

A heat wave is generally characterized by five or more consecutive days of unusually hot weather. Locally, the National Weather Service considers hot weather to be 90 degrees or higher.

Historical Occurrences and Impacts

There has never been a heat wave in Thurston County. However, the unpredictable weather of recent history and the possibility of global warming suggest the possibility in the future.

Kansas City and St. Louis in 1980, Philadelphia in 1993, and most recently Chicago in 1995 each experienced unexpected heat waves that caused hundreds of deaths and thousands of heat related injuries.

The heat waves that hit Chicago during mid to late July of 1995 were responsible for more than 450 deaths and numerous heat-related injuries. Several extra refrigeration facilities had to be rented by area hospitals whose morgues had overfilled with fatalities. At one point, thermometers read 106 degrees, and the temperatures during the night stayed in the high 80's to low 90's.

Thurston County normally experiences temperatures in the upper-70's to mid-80's during the hottest months of June, July, and August. Because of our mild marine climate, most residents are not acclimated to hot weather and many do not have air conditioning in their homes or vehicles. Senior citizens, infants, and the infirm would be most susceptible to heat and its effects. Those living alone, without family or friends to help, would be even more susceptible.

A heat wave could have local impact similar to that experienced by Chicago in 1995. Heat fatigue, heat stroke, respiratory distress, dehydration, and other heat related conditions could cause many deaths and injuries.

Vulnerability – Summary Assessment

There is no historical evidence of a heat wave affecting Thurston County suggesting a **low probability of occurrence**. The susceptible population suggests **moderate vulnerability**. A **low risk rating** is assigned.

TERRORISM

Hazard Description

Terrorism is the unlawful use of force or violence against persons or property to intimidate or coerce a government or civilian population in furtherance of political or social objectives. Terrorists often use threats to create fear among the public; try to convince citizens that their government is powerless to prevent terrorism; and try to get publicity for their causes.

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 terrorists' targets. Bombings are the most frequently used terrorist method in the United States and world-wide. Other methods include chemical, biological, radiological, nuclear, incendiary, agricultural and cyber-attacks.

Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction.

International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States or whose activities transcend national boundaries.

Potential targets include government buildings and facilities, utilities and public services, transportation facilities, financial institutions, research facilities, sites of historic and symbolic significance, communications facilities, special event gatherings and other critical facilities.

Historical Occurrences and Impacts

Recent terrorist acts include the 1988 bombing of Pan Am flight 103 over Lockerbie, Scotland (international terrorism), the 1993 bombing of the World Trade Center in New York City (international terrorism), the 1995 bombing of the federal office building in Oklahoma City (domestic terrorism), and at the 1996 bombing at the Atlanta Olympics (domestic terrorism suspected) and the 2001 airline highjackings and attacks on the World Trade Center in New York City and the Pentagon (international terrorism).

In 1995, a militia group committed a series of domestic terrorist acts and bank robberies in Spokane to both bring attention to their cause and to finance their militia activities.

In 1972, a power substation was bombed in Olympia disrupting power to a large segment of the community. In 1974 a pipe bomb exploded in the Capital Lake Center Building in Olympia, which targeted the Washington State Parole Board, Records Division. As home to the state capital, it may only be a matter of time before some individual or group commits another terrorist act to gain attention to their cause or to protest government policy or actions. In addition to terrorism targets within the community, there is also a risk of weapons and

other terrorism-related materials being transported through the community on freeways, rails and other transportation modes.

The effects of terrorism can vary significantly from massive loss of life and property damage to nuisance service interruptions. Threatened services include electricity, water supply, public transportation, communications, and public safety.

The type of terrorist act would determine vulnerability. Vulnerability could include a large segment of the population or infrastructure with the destruction of a major power distribution line, a pipeline, or the contamination of a municipal well, or a relatively small segment with the telephoning of a bomb threat to a business or government agency.

Terrorism Vulnerability – Summary Assessment

As home to the state capital and because of the general increase in terrorist activity nation-wide and world-wide, a **moderate probability of occurrence** is suggested. Although terrorists tend to chose relatively easy targets and activities, their impact could affect a large segment of the community suggesting **moderate vulnerability**. Accordingly, a **moderate risk rating** is assigned.

TSUNAMI

Hazard Description

A tsunami is a sea wave of extremely long length generated by a seismic disturbance (earthquake, volcanic eruption or debris slide) below or on the ocean floor. Tsunamis have wave lengths of more than 60 miles and travel at speeds of 300-600 miles per hour. They can be of local origin or may originate from a considerable distance such as Alaska or Japan. Tsunamis can be very destructive to coastal areas and can occur anytime.

Historical Occurrences and Impacts

Although Washington's Pacific coast has been threatened by several tsunamis, there is no record of tsunami activity in South Puget Sound. A strong earthquake below Puget Sound could cause damaging waves to impact the County, however, because of the characteristics of the local shoreline and the relatively shallow nature of the south Sound, compared to the wavelength of the tsunami, most of the destructive energy would be dissipated before it reached us.

The greatest local impact would be to the land areas immediately adjacent to Puget Sound with effects similar to those experienced during abnormally high tides.

Vulnerability – Summary Assessment

History and geography suggest a **low probability of occurrence** and **low vulnerability**. A **low risk rating** is assigned.

VOLCANO

Hazard Description

A volcano is a mountain connected to a reservoir of molten rock below the surface of the earth. Volcanoes are built up by an accumulation of their own eruptive products, lava and ash. Though there are no volcanoes within Thurston County, active volcanoes in the Cascade Range, including Mt. Rainier to the east and Mt. St. Helens to the south, could affect Thurston County with mud and debris flow (lahar), flooding due to an upstream lahar, and ashfall.

Historical Occurrences and Impacts

Cascade Range volcanoes in the U.S. have erupted more than 200 times during the past 12,000 years for an average of nearly two eruptions per century. At least five eruptions have occurred during the past 150 years. The last major eruption of Mt. Rainier was more than 1,000 years ago.

The most recent eruptions in the Cascade Range are the well-documented 1980-1986 eruptions of Mount St. Helens which claimed 57 lives and caused nearly a billion dollars in damage and response costs. The effects were felt throughout the northwest. Thurston County was affected by extensive ash fall which damaged internal combustion engines, caused transportation problems due to reduced visibility, and was a general nuisance. There was also an economic impact resulting from the closure of I-5. Over the past 200 years, Mount St. Helens has erupted three times, suggesting a recurrence interval of about 70 years.

An eruption at Mt. Rainier could seriously impact Thurston County. The greatest local threat is from mud, debris, and pyroclastic flows which could inundate the Nisqually Valley in a worst case scenario. A devastating collateral effect is the potential destruction of Alder and LaGrande Dams which would add significantly to the destructive impact of the debris flows. A more likely potential is the displacement of water in the Alder reservoir, caused by upstream debris flow, with potential flooding effects in the Nisqually Valley.

Additional devastating impacts could result if winds move debris and ash toward Thurston County. This would disrupt transportation and other essential services, and cause buildings to collapse while particulates, toxic gases and acid rains could affect public health, water supplies, animal, aquatic and other plant life.

Another eruption of Mount St. Helens would likely have an impact similar to that experienced in 1980.

Vulnerability – Summary Assessment

History suggests a **low probability of occurrence**. There is a **moderate to high vulnerability**. Because Mt. Rainier has been quiet for the past 1,000 years with no indication of change, this hazard is assigned a **low risk rating**.

WILDFIRE/FOREST FIRE

Hazard Description

Any instance of uncontrolled burning in grasslands, brush, or woodlands is classified as a wildfire, whereas uncontrolled burning within a forested area is a forest fire.

Historical Occurrences and Impacts

Forest and wildfires are most likely to occur during the local dry season, mid-May through October, and anytime during prolonged dry periods causing drought or near-drought conditions. The probability of a destructive fire depends on weather, fuel conditions, topography and human activities such as debris burning, land clearing, camping, and construction. Greater than four out of five forest and wildfires are started by people, often due to negligent behavior such as failure to properly extinguish smoking materials or campfires.

There have been no major forest fires or wildfires in Thurston County. However, the existence of large tracts of public and private forest, increasing population, increasing recreational use of forested land, and possible changing climate patterns, all increase the likelihood of a major fire.

Although nearly half of the County is forest land, three general areas are vulnerable to a major forest fire. These are Capital Forest in the west, Fort Lewis Military Reservation in the east, and large commercial tracts in the southeast. In each of these areas, development is prohibited or restricted.

All areas of the county are vulnerable to a wildfire, especially those areas surrounded by brush and grass which tend to dry out in the hotter months. The threat of fire increases in years following those in which there is a large amount debris added to the forest floor and ground such as the summer of 1997 following the massive amounts of fuel added during the wind and ice storm of December 1996.

The impact of a major fire would be amplified by collateral effects such as loss of ground cover which could exacerbate runoff, flooding and landslides, loss of commercial and aesthetic value of the forest, destruction of wildlife habitat, and damage to power lines, pipelines and the communications and transportation infrastructure.

Vulnerability – Summary Assessment

Although not a historical problem, 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 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**. Accordingly, a **moderate risk rating** is assigned.

APPENDIX

(This page left blank intentionally.)

Earthquake, Flood, Landslide, and Storm Hazards - Methodology for Inventory, Forecast, and Dollar Value of Assets

Introduction

The Buildable Lands Program is a state Growth Management Act review and evaluation program.

For more information on the Buildable Lands Program, please refer to Buildable Lands Report for Thurston County, 2002, Thurston Regional Planning Council (TRPC), and Buildable Lands Report for Thurston County: Technical Documentation, 2002, Thurston Regional Planning Council.

Data generated by the Buildable Lands program included an extensive land use analysis for the cities and the county. A tax-parcel based inventory of residential dwelling units and commercial and industrial buildings was compiled for the program and is the basis for the inventory of assets in this hazard mitigation plan. However, tribal areas were not included in the Buildable Lands Program. This means there is a significant difference in the datasets available for the tribal areas as compared to the rest of the county. This is reflected in the more limited data available in the data tables in this plan. Data in the Vulnerability Assessment tables for the Chehalis Tribe is a combination of TRPC data and data provided by the Chehalis Tribe.

Inventory of Assets

Dwelling units were adjusted to 2000 Census counts by Census Block Group in the fall of 2002. An estimate of population was made by multiplying dwelling units by type (single-family, multifamily, and manufactured homes) by household size and vacancy rate at the Census Tract level. The estimate of population is consistent with 2000 Census population counts at the county and census tract level, but may differ at the jurisdiction level.

The value of individual structures was determined through a multi-tiered approach. First, data from the Thurston County Assessor's (Assessor) office for the year 2000 was obtained and used to determine a basic building value. Secondly, the value of the building's contents was assumed to be proportionate to the building value. Residential buildings were assumed to have contents worth 50 percent of the building value. Commercial and industrial buildings were assumed to have contents worth 100 percent of the building value. Adding these together gave a total value of buildings and contents.

Finally, individual jurisdictions provided additional sources of valuation for government owned or leased facilities as it was felt that the Assessor's records may not contain complete information for government-owned facilities. This supplemental information also provided valuation for structures other than buildings, including playground equipment, pump stations, and other government owned facilities. A list of supplemental information on government

assets that has been received from jurisdictions in Thurston County is found below. Only those assets that could be identified through a tax parcel number could be included in the assets tables.

Supplemental Information from Jurisdictions on Government Owned Assets

	General Facilities	Library	Fire	Waste Water Management Systems	Stormwater Ponds	Parks	Public Art	Water
Bucoda	-	-	-	N/A	-	-	-	-
Lacey	✔	✔	-	✔	-	✔	✔	✔
Olympia	✔	✔	✔	✔	*	✔	*	✔
Rainier	-	-	-	N/A	-	-	-	-
Tumwater	✔	✔	✔	-	✔	✔	-	*
Tenino	✔	✔	-	N/A	-	✔	-	✔
Yelm	-	-	-	N/A	-	-	-	-
Thurston County	✔	N/A	-	✔	-	✔	-	-
Chehalis Reservation	✔	-	-	✔	-	*	-	✔
Nisqually Reservation	-	-	-	-	-	-	-	-

Legend	
Data included in assets analysis	✔
Data not provided or not available	-
Data not included - partial data	*
Not applicable	N/A

Note: General Facilities include city halls, police stations, Lucky Eagle Casino, maintenance centers, and miscellaneous facilities.

The extent of each hazard was mapped using a geographic information system (GIS). The boundaries were overlain on tax-parcels to provide for an indication as to whether an asset lay within or outside of a specific hazard area. If the hazard area overlapped with all or part of a tax parcel, the structures on that tax parcel were determined to lie within a hazard area. In this manner, the extent of a particular hazard was overestimated rather than underestimated to err on the side of caution.

Forecast of Assets

The capacity for future development, described in terms of dwelling units and square feet for commercial and industrial floor space, was determined for each tax parcel. For future residential development, capacity was based on the availability of buildable land and the density of development by zoning district. For commercial and industrial development, capacity was determined based on the availability of buildable land for commercial or industrial uses, and an estimate of the floor space to area (FAR) ratio expected for a particular jurisdiction. Much of this methodology was developed under the Buildable Lands Program. Since development assumptions for the Confederated Tribes of the Chehalis Reservation and the Nisqually Indian Tribe were not included in the Buildable Lands program, it is not currently possible to produce an estimate of forecast assets for tribal areas.

Capacity provides a determination of the total amount of new development a tax parcel can potentially hold, given current zoning and development conditions. However, it is well understood that zoning and development patterns are subject to change in both the long and short term.

To support local planning efforts, TRPC provides periodic population and employment forecasts for Thurston County to the traffic analysis zone (TAZ), jurisdiction, and planning area level within Thurston County. The estimates of population are described in terms of dwelling units (with household size and vacancy rate adjustment factors) and employment. For more information on the forecast please refer to Population and Employment Forecast for Thurston County, Final Report, 1999, Thurston Regional Planning Council.

Population Forecast

The amount of new growth, as measured in new dwelling units, by jurisdiction was obtained from the forecast. This growth was then allocated to the parcels based on their capacity to hold new growth. An estimate of population was derived by multiplying dwellings by a household size and vacancy rate factor. Using this methodology, growth was distributed evenly throughout a jurisdiction without regard to planning areas. For this reason, this estimate provides only a rough approximation of where growth is forecast to occur.

Employment Forecast

The demand for new commercial and industrial building floor space was determined in the Buildable Lands work program. The new floor space was evenly allocated to the tax-parcel level based on available capacity for commercial or industrial growth. As with the dwelling unit allocation, the new growth was distributed evenly throughout each individual jurisdiction without regard to planning area growth trends. For this reason, this estimate provides only a rough approximation of where growth is forecast to occur.

Values

The future value of assets is an unknown; therefore, the dollar values for the future building assets were determined by projecting current day values into the future. As a result, all dollar values are shown in current dollars, making it possible to compare values across time.

(This page left blank intentionally.)

REFERENCES

General:

City of Lacey, Washington. City of Lacey Comprehensive Emergency Management Plan, Hazard Identification and Analysis. April 2002

City of Olympia, Washington. Olympia Fire Department, Emergency Management Division. City of Olympia Emergency Management Plan, Hazard Vulnerability Analysis. April 1995.

Emergency Management Council of Thurston County. Natural Hazards Mitigation Plan for the Thurston Region. October 2003.

Oregon Natural Hazards Workgroup. Local Natural Hazard Mitigation Plans. January 2002.

Thurston Regional Planning Council. Buildable Lands Report for Thurston County. September 2002.

Thurston Regional Planning Council. The Profile. 2002.

U.S. Federal Emergency Management Agency. Principal Threats Facing Communities and Local Emergency Management Coordinators. April 1990.

U.S. Federal Emergency Management Agency. Risks and Hazards: A State by State Guide (FEMA 196). Washington: GPO, 1990.

U.S. Federal Emergency Management Agency. State and Local Mitigation Planning. September 2002.

Washington State Military Department. Emergency Management Division. State of Washington Hazard Identification and Vulnerability Analysis. June 1996.

Washington State Military Department. Emergency Management Division. State of Washington Hazard Identification and Vulnerability Analysis. 2001.

Dam Failure:

U.S. Federal Emergency Management Agency. Emergency Action Planning Guidelines for Dams. FEMA 64, Denver: GPO, 1985.

Washington State Department of Ecology. Guidelines for Developing Dam Emergency Action Plans. Olympia: WSDOE, 1992.

Washington State Department of Ecology. Water Resources Program, Dam Safety Section. Inventory of Dams in the State of Washington. Olympia: WSDOE, 1994.

City of Tacoma Department of Public Utilities, Light Division. Emergency Action Plan for Nisqually Hydroelectric Project. FERC Project No. 1862, December 1996.

Pacific Power. Emergency Action Plan: Skookumchuck Hydroelectric Project. FERC Project No. 4441, March, 1997.

Drought:

Washington State. Executive Water Emergency Committee. Initial Drought Action Program for 1988, March 1988.

American Meteorological Society. Policy Statement. Meteorological Drought, 2 February 1997.

Earthquake:

Montersky, R. "Seismic Risk: When Less is More", Science News. Vol. 147, No.13, April 1, 1995.

U.S. Department of the Interior-U.S. Geological Survey. Cascades Volcano Observatory. Washington and Oregon Earthquake History and Hazards. 1994.

University of Washington. Nisqually Earthquake Clearinghouse Group. The Nisqually Earthquake of 28 February 2001, Preliminary Reconnaissance Report. March 2001.

Washington State Department of Natural Resources. Division of Geology and Earth Resources. The Puget Lowland Earthquakes of 1949 and 1965, Reproductions of selected articles describing damage. 1986.

Washington State Department of Natural Resources. Division of Geology and Earth Resources. Washington Geology. Vol.22 No.3. September 1994.

Washington State Department of Natural Resources. Division of Geology and Earth Resources. Washington State Earthquake Hazards. Information Circular 85, Section C. WSDNR, 1988.

Flood:

Thurston Regional Planning Council, Thurston Flood Hazard Management Plan. June 1999.

HAZMAT:

Thurston County Local Emergency Planning Committee. Appendix 1 to Annex O: Thurston County Hazardous Material Emergency Response Plan 1988.

Washington State Department of Health. Environmental Health Programs. Hazardous Substance Emergency Event Surveillance System. Final Report. Olympia: WSDOH, 1992.

Code of Federal Regulations. Hazardous Materials Table. 49 CFR Ch. 1. ə172.101 pp. 114-375. October, 1995.

Landslide:

Washington State Department of Natural Resources. Division of Geology and Earth Resources. Washington Geology. Vol.22 No.3. September 1994.

Storm:

American Red Cross, NOAA, FEMA. Winter Storms. . . the Deceptive Killers: A Guide to Survival. November 1991.

Tsunami:

Washington State Department of Natural Resources. Division of Geology and Earth Resources. Tsunamis on the Pacific Coast of Washington State and Adjacent Areas-An annotated Bibliography and Directory. March 1994.

Terrorism:

Southern Poverty Law Center. False Patriots: The Threat of Antigovernment Extremists. 1996.

Volcano:

U.S. Dept. of the Interior. U.S. Geological Survey. Cascades Volcano Observatory. Preparing for the Next Eruption in the Cascades. November 1995.

Washington State Department of Natural Resources. Division of Geology and Earth Resources. Washington Geology. Vol.22 No.3. September 1994.

U.S. Dept. of the Interior. U.S. Geological Survey. Debris Flow, Debris Avalanche, and Flood Hazards at and Downstream from Mt. Rainier, Washington. 1995.