

4th Edition

HAZARDS MITIGATION PLAN

for the Thurston Region

The Emergency Management Council
of Thurston County

Prepared by Thurston Regional Planning Council

November 2023

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Acknowledgments

Thurston County and the plan participants thank and acknowledge the Washington Military Department's Emergency Management Division and the Federal Emergency Management Agency (FEMA) for its financial support through the Pre-Disaster Mitigation Grant No. 97.047 for updating the *Fourth Edition Natural Hazards Mitigation Plan for the Thurston Region*.

Emergency Management Council of Thurston County

The Emergency Management Council (EMC) served as the Hazards Mitigation Plan Steering Committee. The EMC was created in 1993 via an interlocal agreement to coordinate emergency management activities with the county, cities, and tribes. The EMC is involved in a wide array of issues and leadership related to emergency preparedness, response, recovery, and mitigation.

Member	Representative, (Alternate)
City of Lacey	Ed Taylor, Chair, Emergency Management and Safety Coordinator
City of Olympia	Mike Buchanan, Assistant Fire Chief
City of Rainier	Tom Arnbrister, Council Member
City of Tenino	Robert Auderer, Police Chief
City of Tumwater	Brian Hurley, Vice Chair, Fire Chief
City of Yelm	Rob Carlson, Police Chief
Confederated Tribes of the Chehalis Reservation	Cal Bray, Emergency Manager
Nisqually Indian Tribe	Jeff Choke, Emergency Manager
Thurston County	Kyle Bustad, Emergency Manager
Town of Bucoda	Rob Gordon, Mayor

Hazard Mitigation Planning Workgroup

The Workgroup served as the working body for the Hazard Mitigation Plan update process. It served in an advisory role to inform the multijurisdictional planning process and to guide the plan's contents including the goals and policies, hazard risk assessment, the regional mitigation strategy, and the plan maintenance process.

County and City Members	Representatives
Thurston County	Cherie Carey, Emergency Management Coordinator Brandon Cheney, Emergency Management Coordinator Emily Schoendorf, Emergency Management Coordinator
Town of Bucoda	Mayor Steve Purcell (former) Mike Presswood, TCEM
City of Lacey	Ed Taylor, Emergency Management and Safety Coordinator
City of Olympia	Mike Buchanan, Assistant Fire Chief Susan Clark, Water Resources Engineering and Planning Supervisor
City of Rainier	Robert Shaw, Mayor Mike Presswood, TCEM
City of Tenino	Wayne Fournier, Mayor Mike Presswood, TCEM
City of Tumwater	Ericka Smith-Erickson, Housing and Land Use Planner Brad Medrud, Long Range Planning Manager
City of Yelm	Sara Williams, Assistant Planner Rob Carlson, Chief of Police
School District Members and Stakeholders	**Representatives**
Olympia School District	Wendy Couture, Custodial Supervisor & Safety/Risk Manager Frank Wilson, Director of Facilities
Tumwater School District	Mel Murray, Director of Facilities
Rochester School District	Ed Dowell, Director of Facilities
Educational Services District 113	Dan Beaudoin, Comprehensive School Safety Coordinator
Fire District Members and Stakeholders	**Representatives**
McLane-Black Lake Fire District 9	Leonard Johnson, Fire Chief
SE Thurston Fire Authority and Olympia Fire District #6	Brian Richardson, Captain
South Bay Fire District 8	Brian VanCamp, Fire Chief
West Thurston Regional Fire Authority	David Pethia, Commissioner Rob Smith, Fire Chief Robert Scott, Fire Chief (retired)
Special Purpose District Members and Stakeholders	**Representatives**
Intercity Transit	Jason Hanner, Safety Program Manager Emily Bergkamp, Interim General Manager
LOTT Clean Water Alliance	Julie Dufresne, Safety Manager
TCOMM 911	Wendy Hill, Director
Thurston PUD	Kim Gubbe, Director of Planning and Compliance
College Members and Stakeholders	**Representatives**
South Puget Sound Community College	Fred Creek, Director of Security
The Evergreen State College	Jackie LaVerne, Emergency Manager
Other Stakeholders	**Representatives**
Puget Sound Energy	Amy Tousley, Municipal Liaison Manager
Washington Department of Transportation	Lit Dudley, Emergency Manager

Thurston Regional Planning Council

TRPC was contracted by Thurston County to serve as the lead entity to coordinate the development of the Hazards Mitigation Plan.

Staff	Title
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Paul Brewster	Senior Planner, Project Manager
Scott Carte	GIS & Modeling Manager
Marc Daily	Executive Director
Tyson Justis	HR & Finance Manager
Burlina Lucas	Executive Assistant
Casey Mauck	Associate Planner
Dorinda Merrill	Office Specialist IV
Karen Parkhurst	Planning and Policy Director
Dave Read	IT Manager
Sarah Selstrom	Communications & Outreach Specialist II

Tetra Tech

Tetra Tech was contracted by TRPC to provide risk analysis services to the Hazards Mitigation Plan.

Staff	Title
Carol Baumann	Senior GIS Analyst
Marc Bragoli	GIS Analyst
Rob Flanner	Hazard Mitigation Program Manager

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Executive Summary

The Pacific Northwest is a beautiful place to live in. However, life in the Puget Sound Region comes with risk. Millions of people live in this geologically active corner of North America. It's not a matter of if, but when that earthquakes, tsunamis, landslides, and volcanic eruptions will impact Thurston County.

Climate science forecasts that winters in the Puget Sound Region will become warmer and wetter, altering our hydrological cycle. Changes in the timing, type, and quantity of precipitation will create adverse conditions for coastal, high groundwater, and riverine flooding. Summers will become longer, warmer, drier,

Residents highly value the natural and built environment that Thurston County offers. Photo courtesy of TRPC staff.

and exacerbate conditions for wildfire hazards and poor air quality. Extreme heat events will become more frequent resulting in more people becoming victims of heat-related injuries. Native flora, fauna, fish habitat, and agriculture will also be impacted.

The elderly, people with chronic disease or disabilities, youth, low-income households, and people who are unsheltered are most vulnerable. Hazard mitigation must provide equitable solutions and prioritize actions that protect socially vulnerable and underserved populations that typically suffer the greatest losses during natural disasters.

Hazard mitigation planning provides a framework for communities to alleviate the impacts of natural hazards. The Emergency Management Council of Thurston County has championed the region's multijurisdictional hazard mitigation plan update since the passage of the Disaster Mitigation Act of 2000. First adopted in 2003, the *Hazards Mitigation Plan for the Thurston Region* was among the first multijurisdictional hazard mitigation plans adopted in Washington. The region has updated the plan every five years to maintain an effective mitigation strategy. Revisiting the plan is a key step to make our communities more disaster resilient. The plan is divided into six chapters:

1. Introduction to Hazard Mitigation Planning
2. Mitigation Strategy – Goals, Policies, and Initiatives
3. Community Profile and Capability Assessment
4. Risk Assessment
5. Keeping the Plan Current
6. Plan Process and Development

1. Introduction

Chapter 1 provides a primer on hazard mitigation planning and its benefits. Thurston County has endured 25 Presidential Disaster Declarations since 1965. Hazard mitigation planning offers communities a useful framework to reduce future losses and minimize impacts. A federally approved hazard mitigation plan is a requirement for states, tribes, and local governments to apply for and receive federal mitigation assistance grant program funds. This chapter introduces these important grant programs.

2. Mitigation Strategy – Goals, Policies, and Initiatives

Chapter 2 presents the region's mitigation strategy. It consists of a vision, goals, policies, and actions. Working together, the Emergency Management Council and the Plan Participants have reaffirmed the plan's nine goals:

1. Protect Life
2. Protect Infrastructure
3. Protect Property
4. Protect the Environment
5. Sustain the Economy
6. Build Community Support
7. Expand Understanding of Hazards
8. Implement Effective Mitigation Strategies
9. Increase Public Awareness

Thirty-four policies will help guide communities with achieving the region's hazard mitigation vision and goals. Below is an example of the policies that support Goals 1, 2, and 3:

- Policy 1B: Prioritize mitigation actions that directly benefit underserved communities and special needs populations.
- Policy 2A: Maintain and upgrade roads, bridges, and other transportation infrastructure and services to withstand the effects of hazards without prolonged disruptions.
- Policy 3C: Safeguard objects or places that have cultural or historic significance.

VISION

All sectors of the community work together to create a disaster resilient region.

There are 12 regional mitigation initiatives, that if enacted will improve our communities' understanding of hazards and their risks, strengthen mitigation planning capabilities, and protect people, property, and community lifelines. In addition, each plan participant developed an annex that outlines their jurisdiction-specific actions. Each action was reviewed using a set of eight criteria to evaluate its benefits versus its costs and to prioritize the actions for implementation. The top five ranked regional mitigation initiatives are as follows:

1. **Regional Hazard Mitigation Public Outreach Strategy –** Continue countywide outreach and education activities to inform all sectors of the community about natural hazards and steps people and organizations can take to reduce their risks. Attention will be focused on socially vulnerable populations who are at greater risk.

2. **Community Wildfire Protection Plan** – Develop a countywide plan that identifies areas that are at risk for wildfire losses and prioritize strategies for reducing and controlling vegetative fuels, wildfire response, and community education and preparedness.
3. **Countywide Emergency Shelter Capacity and Operational Assessment** – Conduct a pre-disaster emergency shelter facilities assessment to look at staffing requirements, support services, material resources, funding, and agreements to support shelter operations for a range of capacities, durations, and needs.
4. **Extreme Heat Incident Response and Illness Prevention Plan** – Develop a countywide plan to improve the region's response during extreme heat incidents. The plan will identify capabilities and strategies needed to reduce heat-related injuries and deaths.
5. **Olympia Sea Level Rise Response Plan Implementation** – Implement the strategies in the Olympia SLR Response Plan, which aims to reduce risks from emerging sea level rise hazards. Downtown businesses, the Port of Olympia's Marine Terminal, and the LOTT Clean Water Alliance Budd Inlet Wastewater Treatment Plant are some of the valued assets and critical facilities that will require protection.

3. Community Profile and Capability Assessment

Chapter 3 presents a profile of Thurston County's geography, population, economy, development trends, special purpose local governments, and its transportation system. Located at the southern end of the Puget Sound, and the seat of Washington's State Capitol, Thurston County is one of fastest growing areas in the state. Thurston County's population of 300,500 people makes it the 7th most populous county in the state, but it is the 32nd in size at 737 square miles. Socially vulnerable individuals typically suffer the greatest in natural disasters because they lack the resources to protect themselves and their property from the impacts of hazards. 17 percent of Thurston County's residents have an income within 150 percent of the federal poverty level, 32 percent of households are cost-burdened, and five percent do not have health insurance.

The county's small size lends to the plan participants' willingness and ability to identify solutions to problems in a cooperative fashion. Chapter 3 describes the range of federal, state, local, and organizational institutions, laws, resources, funding programs, and capabilities that support Thurston County's multijurisdictional approach to hazard mitigation planning.

Community leadership is necessary to prioritize hazard mitigation planning to make our communities safer. Photo courtesy of Thurston County Emergency Management.

4. Risk Assessment

Chapter 4 introduces how risk is measured for the nine natural hazards that are most likely to impact Thurston County communities. Hazard risk scores and ratings are calculated for each community based on the probability of a hazard occurring combined with its level of impact on people, property, and the economy.

Understanding and documenting how community assets are vulnerable to the effects of natural hazards informs the development of a community's mitigation strategy. The risk assessment includes a subchapter or profile for each hazard. Each profile describes the hazard, area of impact, extent, effects of climate change, previous incidents, and probability of occurrence. In addition, descriptions, data, and maps are provided to document each hazard's impact on people, structures and systems, community lifelines, and natural, historic, and cultural resources. Accounting for all communities' combined total risks, the following countywide risk ratings were calculated for each hazard:

Hazard Profile	Probability	Impact on People	Impact on Property	Impact on Economy	Risk Rating
4.1 Dam Failure	Low	Low	Low	Low	Low
4.2 Earthquake	Medium	High	High	Medium	High
4.3 Flood	High	Low	Low	Low	Medium
4.4 Landslide	High	Low	Low	Low	Medium
4.5 Sea Level Rise	High	Low	Low	Low	Medium
4.6 Severe Weather	High	Low	Low	Low	Medium
4.7 Tsunami	Medium	Low	Low	Low	Low
4.8 Volcanic Lahar	Low	Low	Low	Low	Low
4.9 Wildfire	Medium	High	High	Medium	High

5. Keeping the Plan Current

Chapter 5 describes the regional process for how the plan participants will monitor, evaluate, and update the hazard mitigation plan, and afford the public the means to participate in the plan update process. Additionally, it outlines the Washington State and federal review and approval process that leads to plan adoption. The plan participants and stakeholders will help foster plan implementation through monitoring and maintenance including:

1. Performing an annual review of the regional and jurisdictional mitigation actions to document progress. Successes, obstacles, and course corrections will be reported and made available to the public.
2. Conducting a mid-cycle evaluation to summarize the plan's progress, note any changes in hazard risks, identify any changes in capabilities that will affect the plan's implementation, and identify recommendations for changes to the plan.
3. Convening a post-disaster after-action review within 45-60 days after a federal disaster declaration or major hazard event that activates the Thurston County Emergency Coordination Center.

6. Plan Process and Development

Chapter 6 describes who was involved and how the plan was prepared. Thurston County Emergency Management secured a federal Pre-Disaster Mitigation Grant from the Federal Emergency Management Agency to update the region's 4th edition hazard mitigation plan. Thurston Regional Planning Council (TRPC), the Metropolitan Planning Organization for the Thurston County served as the lead entity and convener to facilitate the development of the hazard mitigation plan. The plan was produced in partnership with the Emergency Management Council and the Hazard Mitigation Planning Workgroup (workgroup) with community input.

The workgroup consists of local government representatives and stakeholders with subject matter expertise in building, community planning, K-12 and higher education, emergency management, energy utility services, fire services, law enforcement, public works and utilities, transit, and others. The workgroup met 15 times over the course of 18 months to assemble the plan. Workgroup members provided feedback and data to support the development of the plan. Each workgroup representative from a participating jurisdiction was in turn responsible for convening their jurisdiction's planning team meetings to develop an annex to the plan.

A wildfire spreads in southwest Thurston County. Photo courtesy of West Thurston Regional Fire Authority.

TRPC convened two major public outreach campaigns to solicit community feedback and support for the plan. The details of the outreach activities are documented in Chapter 6. (the results of surveys are included in Appendix E).

1. **Summer 2022 Multijurisdictional Pre-Plan Development Natural Hazards and Resiliency Survey**
   From June through July, the plan partners solicited community feedback. The survey included 12 questions about perceived risks and solicited input on mitigation actions. The survey was offered in English, Korean, Spanish, and Vietnamese.
2. **Summer 2023 Multijurisdictional Hazard Risks and Action Plan Survey**
   From July through August community members could visit an online open house to learn about hazards, their impacts, and risks. The public was invited to take a short survey to prioritize the draft regional and jurisdictional mitigation actions and share ideas for other actions.

Chapter 1

Introduction to Hazard Mitigation

Mitigation Planning Strengthens Community Resiliency

Local governments are responsible for protecting the public health, safety, and welfare of their community. Hazard mitigation directly supports this essential function by providing communities the following benefits:

- Creating greater resilience for both population and infrastructure to existing and future disaster risks
- Lessening disruptions to daily life
- Strengthening businesses and the economy
- Protecting cultural, historic, and natural assets
- Reducing the costs of disaster response and recovery

Hazard mitigation and risk management preserves revenues that are needed for other essential public services and investments. According to the National Institute of Building Sciences' "Natural Hazard Mitigation Saves: 2019" report, every dollar in federal grants that is invested in mitigation can save up to six dollars.

A Multijurisdictional Mitigation Strategy

This is the Fourth Edition *Hazards Mitigation Plan for the Thurston Region*. First adopted in 2003, the plan describes the natural hazards that pose the greatest risks to people and the region's assets. The plan's goals, policies, and actions, if implemented, will minimize losses, and protect assets from future disasters. This is a multijurisdictional hazard mitigation plan (HMP). The plan's mitigation strategy includes regional actions to improve multi-agency coordination, build mitigation capabilities, and strengthen resiliency across Thurston County. In addition, each plan participant produces an annex that prioritizes actions to minimize losses within their jurisdiction.

Federal Disaster Declarations

Disasters frequently impact communities throughout the United States. Local and state governments share the responsibility for protecting communities and providing resources during and after disaster events. A local government's ability to respond during a disaster can quickly be overwhelmed by the magnitude of the crisis. The Stafford Disaster Relief and Emergency Assistance Act governs how the federal government provides resources to states and tribes that are impacted by disasters. A state governor or a leader of a federally recognized tribe is responsible for requesting federal disaster assistance through the regional Federal Emergency Management Agency (FEMA) office. If the President of the U.S. declares that a major disaster or emergency exists, the declaration activates an array of federal programs to assist affected states, tribes, and communities with response and recovery. The three general categories of federal assistance include:

- Individual Assistance – aid to individuals and households
- Public Assistance – aid to public (and certain private non-profit) entities for certain emergency services and the repair or replacement of disaster damaged public facilities
- Hazard Mitigation Assistance – funding for measures designed to reduce future losses to public and private property

Federal Disaster Declarations for Thurston County

Washington State has received 63 Presidential Disaster Declarations since 1956. Thurston County has been included in 25 of these major declarations, including one fire management assistance declaration in 2020. Table 1.1 lists the Federal Disaster Declarations affecting Thurston County.

Table 1.1 Thurston County Federal Disaster Declarations, 1956 to 2022

Disaster Number	Declaration Date	Incident Type	Title
196	May 1965	Earthquake	Earthquake
322	February 1972	Flood	Severe storms & flooding
328	March 1972	Flood	Heavy rains & flooding
414	January 1974	Flood	Severe storms, snowmelt & flooding
492	December 1975	Flood	Severe storms & flooding
545	December 1977	Flood	Severe storms, mudslides, & flooding
623	May 1980	Volcano	Volcanic eruption, Mt. St. Helens
852	January 1990	Flood	Severe storms & flooding
883	November 1990	Flood	Severe storms & flooding
981	March1993	Severe Storm	Severe storms & high wind
1079	January 1996	Severe Storm	Severe storms, high wind, and flooding
1100	February 1996	Flood	High winds, severe storms and flooding
1159	January 1997	Severe Storm	Severe winter storms, land & mudslides, flooding
1172	April 1997	Flood	Heavy rains, snow melt, flooding, land & mud slides
1361	March 2001	Earthquake	Earthquake
1499	November 2003	Severe Storm	Severe storms and flooding
1671	December 2006	Severe Storm	Severe storms, flooding, landslides, and mudslides
1682	February 2007	Severe Storm	Severe winter storm, landslides, and mudslides
1734	December 2007	Severe Storm	Severe storms, flooding, landslides, and mudslides
1817	January 2009	Flood	Severe winter storm, landslides, mudslides, and flooding
1825	March 2009	Severe Storm	Severe winter storm and record and near record snow
4056	March 2012	Severe Storm	Severe winter storm, flooding, landslides, and mudslides
4481	March 2022	Biological	COVID-19 Pandemic
4539	April 2020	Flood	Severe Storms, Flooding, landslides, and mudslides
5359[1]	September 2020	Fire	Bordeaux Road Fire
4650	March 2022	Flood	Severe Winter Storms, Snowstorms, Straight-line Winds, Flooding

[1]FM 5359 was Thurston County's first Fire Management Assistance emergency declaration.

Statewide, flooding, severe storms, and fires comprised 55 (87 percent) of Washington's disaster declarations. In fact, flood and severe weather disaster declarations affect more communities in the state than any other type of natural hazards. Thurston County is no different. Flooding and severe storms accounted for 21 (84 percent) of the county's declarations. Thurston County is ranked seventh in the state for total declarations (tied with Clallam and Jefferson counties). Lewis County has received 32 declarations, more than any other borough or county in all of Washington, Oregon, Idaho, and Alaska (the entirety of FEMA Region 10). The number and frequency of the federal disaster declarations affecting Thurston County emphasizes the importance of local governments developing and implementing an HMP.

The Disaster Mitigation Act of 2000

To manage risk, contain costs, and promote sustainable communities, the federal government has enacted hazard mitigation planning requirements for states, tribes, and local governments in the Disaster Mitigation Act of 2000. Local governments must adopt a federally approved HMP to apply for and to receive federal hazard mitigation assistance funding.

Hazard mitigation plans must demonstrate that a community's proposed mitigation measures are based on a sound planning process that accounts for the risk to and the capabilities of the individual jurisdiction. The Code of Federal Regulations (CFR), Title 44, Part 201.6 governs

how local government mitigation plans must be developed. Part 201.7 addresses tribal mitigation plans. Local governments must conduct a planning process that satisfies federal requirements to receive FEMA plan approval.

Communities must update their HMP every five years to remain eligible. The five-year update also provides communities the opportunity to:

- Assess hazards and update the risk assessment for the planning area
- Educate and promote awareness about mitigation planning
- Consider the diverse interests of the public and stakeholders to revisit community values and identify mitigation needs
- Evaluate and update the mitigation strategy
- Build consensus around mitigation strategy priorities

A multi-jurisdictional plan brings communities together to establish a common understanding of the hazards and to partner on developing a collective mitigation strategy. Each participating jurisdiction must also review and revise their plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.

Federal Hazard Mitigation Assistance

A federally approved HMP offers communities access to several FEMA grant programs. In general applicants submit proposals through the state. All grant programs fund 75 percent of a project's eligible costs. Applicants must provide a 25 percent non-federal match. There are three major grant programs that are issued at a national level and two programs that are only available to communities that are affected by a disaster declaration:

- Building Resilient Infrastructure and Communities (BRIC) – a nationally competitive annual grant program. It provides funding and direct technical support to states, local communities, tribes, and territories for a variety of hazard mitigation and climate resilience project types and programs. In Fiscal Year 2022, FEMA awarded $3 billion to 46 projects.
- Flood Mitigation Assistance – a competitive program that provides funding to states, local communities, federally recognized tribes, and territories. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the National Flood Insurance Program.
- Hazard Mitigation Grant Program (HMGP) – provides funding to state, local, tribal and territorial governments to develop hazard mitigation plans and rebuild in a way that reduces, or mitigates, future disaster losses in their communities. This grant funding is only available to affected states and communities after a presidentially declared disaster.
- HMGP-Post Fire – provides post fire assistance to help communities implement hazard mitigation measures after wildfire disasters.
- Pre-Disaster Mitigation Program – awards funds to state, local, tribal, and territorial governments to plan for and implement sustainable cost-effective measures to reduce the risk to individuals and property from future natural hazards, while also reducing reliance on federal funding from future disasters.

Plan Structure

This plan meets Federal Disaster Mitigation Act hazard mitigation planning requirements for both multijurisdictional and jurisdictional planning requirements. The core plan provides the multijurisdictional framework and is the centerpiece of every Thurston Region plan participant's HMP. The core plan is divided into six chapters plus appendices. Each plan participant seeking federal plan approval prepared a plan annex. Table 1.2 outline the plan's contents.

Table 1.2 Plan Contents

	Chapter		Contents
Core Regional Plan	1.	Introduction to Hazard Mitigation Planning	Overview of hazard mitigation planning Federal planning requirements Federal hazard mitigation assistance Plan structure
	2.	Mitigation Strategy	Vision, goals, and policies Regional mitigation initiatives
	3.	Community Profile and Capability Assessment	Profile of Thurston County population, demographics, and development trends Summary of the region's mitigation capabilities
	4.	Risk Assessment	Hazard profiles and risk assessments for dam failure, earthquake, flood, landslide, sea level rise, severe weather, tsunami, volcanic lahar, and wildland fire
	5.	Keeping the Plan Current	Description of the plan's monitoring, evaluation, and maintenance processes
	6.	Plan Process and Development	A description of how the plan was developed.
		Appendices	Supportive documentation
Annex		Jurisdiction's Plans	A subset of the plan that contains information specific to a single jurisdiction: process details, mitigation actions, risk assessment, and capability assessment

Endnotes

[i] https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report

[ii] FEMA. 2016. Disaster Declarations by State/Tribal Government. Data obtained online: https://www.fema.gov/disasters/grid/state-tribal-government.

Chapter 2

Mitigation Strategy: Goals, Objectives, and Initiatives

Vision:

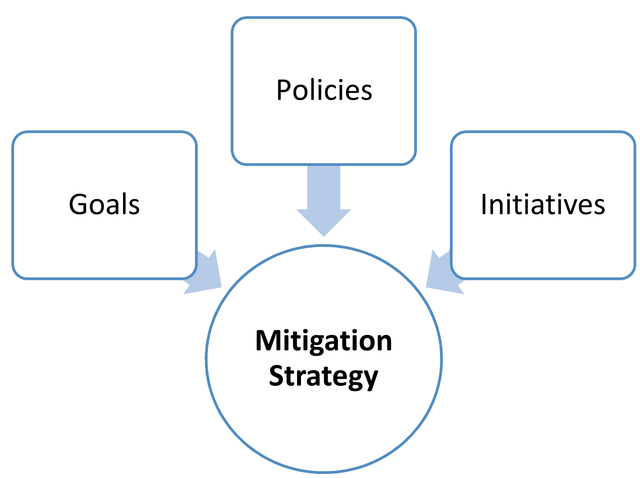
All sectors of the community work together to create a disaster resilient region.

Introduction

The mitigation strategy is a call to action. It is the Thurston Region's blueprint for reducing losses and impacts from the hazards that are identified in this plan's risk assessment. The plan's goals are the overarching principles that communities will base their mitigation planning and investment decision-making upon. The policies further support decision-making to fulfill the plan's goals. The initiatives are specific projects and activities that each jurisdiction identifies, prioritizes, and commits to implementing as a long-term investment to build and maintain disaster resilient communities. Together the plan's goals, policies, and initiatives form the Thurston Region's mitigation strategy.

As this is a multi-jurisdictional plan, the goals and policies are applicable to each plan participant. Moreover, each participant adheres to their jurisdiction's unique comprehensive or strategic plans, policies, and programs that promote and protect the safety and welfare of their community and their services. This plan's mitigation strategy provides a regional framework for local governments to work together with community members and stakeholders to expand the region's collective capacity to protect community assets from natural hazards.

Figure 2.1 Thurston Region Mitigation Strategy



Goals and Policies

The plan includes nine goals to achieve the plan's vision. The goals guide hazard mitigation decision making and investments. Achieving goals 1-5 will protect community assets including people, infrastructure, property, the environment, and the economy. Achieving goals 6-9 builds collective capacity to plan together to implement actions including building community support, expanding understanding of hazards, implementing mitigation strategies, and increasing public awareness.

Thirty-four policies support the plan's goals. Every regional mitigation initiative and each jurisdictional initiative is tied to one or more of the plan's policies.

1. **Protect Life**
    - A. Design, build, operate, and maintain disaster resistant communication systems that provide emergency notifications and instructions.
    - B. Prioritize mitigation actions that directly benefit underserved communities[1] and special needs populations[2].
    - C. Address emergency evacuation needs, prioritizing areas of the community where mitigation strategies are ineffective or cost prohibitive.
    - D. Train and equip emergency service providers to effectively respond to hazard events.
2. **Protect Infrastructure**
    - A. Maintain and upgrade roads, bridges, and other transportation infrastructure and services to withstand the effects of hazards without prolonged operational disruptions.
    - B. Maintain and upgrade utility systems and services to withstand the effects of hazards without prolonged operational disruptions.
    - C. Maintain or replace public buildings such as offices, schools, and other facilities to withstand the effects of hazards.
    - D. Strengthen or relocate critical facilities or create protective spaces or infrastructure around them so they are not significantly affected by the effects of hazards.
3. **Protect Property**
    - A. Minimize the number of properties that are situated in hazard prone locations.
    - B. Protect and preserve vital records, data, information technology systems, and facility contents.
    - C. Safeguard objects or places that have cultural or historic significance.

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[1] Executive Order 13985 On Advancing Racial Equity and Support for Underserved Communities Through the Federal Government defines "underserved communities" as "populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life…"

[2] Special Needs Populations: Populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to: maintaining independence, communication, transportation, supervision, and medical care. Individuals in need of additional response assistance may include those who have disabilities; who live in institutionalized settings; who are elderly; who are children; who are from diverse cultures; who have limited English proficiency or are non-English speaking; or who are transportation disadvantaged. Glossary, National Response Framework

4. **Protect the Environment**
    A. When possible, use mitigation strategies that preserve ecological functions of natural systems.
    B. Consider mitigation actions that restore natural systems that provide protective measures to surrounding properties.
    C. Continue evaluating the effectiveness of Critical Areas Ordinances and development regulations and revise as necessary to ensure development does not occur in areas prone to hazards or changing environmental conditions that threaten public safety.
    D. Support efforts to increase local jurisdictions' abilities to appropriately respond to hazardous material releases.
5. **Sustain the Economy**
    A. Develop and maintain efforts to prepare recovery plans.
    B. Focus on mitigation strategies that protect medical treatment centers, employment centers, commercial districts, and schools.
    C. Coordinate with regional, state, and federal agencies to identify and prioritize continuity of operations on lifeline transportation corridors and systems.
    D. Strengthen public-private partnerships to reinforce or establish redundancy for critical supply systems.
    E. Develop and maintain continuity of operations plans for essential public safety services.
6. **Build Community Support**
    A. Coordinate and provide leadership in the hazard mitigation planning process among local, tribal, state, and federal government entities.
    B. Engage residents, businesses, employers, medical centers, utility companies, subject matter experts, community, and faith-based organizations as partners to help identify opportunities to strengthen the region's hazard resilience.
    C. Update the region's Hazards Mitigation Plan every five years, or sooner if necessary to respond to emerging threats.
7. **Expand Understanding of Hazards**
    A. Monitor and evaluate precipitation, groundwater, and stream flow levels, and survey flood high water marks.
    B. Partner with state and federal agencies, colleges, universities, and nongovernmental organizations to participate in modeling programs to map areas at risk from hazards.
    C. Participate in regional or statewide disaster scenario exercises to assess mitigation, preparedness, response, and recovery capacities, and apply lessons learned to mitigation activities.

   D. Incorporate best available climate change science and data into hazard mitigation planning.

   E. Develop a better understanding of the location and mitigation needs of underserved communities and special needs populations.

   F. Document, share, and act on lessons learned following disaster events.

8. **Implement Effective Mitigation Strategies**

   A. Focus mitigation efforts on the region's greatest risks and vulnerabilities.

   B. Integrate adopted mitigation strategies into other planning documents such as response plans, comprehensive plans, strategic plans, Critical Areas Ordinances, Capital Facility Plans, zoning code, and development regulations.

   C. Apply for federal mitigation assistance grants and leverage other funding sources to finance mitigation projects.

9. **Increase Public Awareness**

   A. Develop and sustain communication campaigns with residents, customers, businesses, and other stakeholders about the known risks of hazard events and the actions that community members or organizations can take to prevent or minimize losses.

   B. Conduct broad outreach activities to engage all sectors of the community in the hazards mitigation planning process.

Revisions to Goals and Policies

The Hazard Mitigation Workgroup reviewed the plan's goals and policies during the plan update process. The goals remain the same. Five policies were revised and one new policy was added. Revisions were performed to clarify policy intent or to establish consistency between the plan's policies and new FEMA Local Mitigation Planning Policy guidance that became effective in April 2023. The following revisions were incorporated into this plan:

- Policy 1B was updated to emphasize the region's need to prioritize mitigation actions that benefit underserved communities and special needs populations.
- Policy 2B was revised to clarify that utilities should be protected from hazards to additionally withstand prolonged operational disruptions.

- Policy 7B was revised to address all areas at risk from hazards, not just high-risk areas.
- Policy 7D, a new initiative, was added to incorporate best available science and data about climate change into hazard mitigation planning.
- Policy 7E (formerly 7D) was revised to replace "vulnerable" with "underserved communities."
- Policy 9A, the word "ongoing" was removed.

Consistency with Washington State Hazard Mitigation Goals

The Washington State Enhanced Hazard Mitigation Plan, last updated in 2023, establishes the statewide hazard mitigation strategy and provides guidance to local governments. The Thurston region's goals and policies are unique to the needs of our communities, but there is consistency between the state's and the Thurston Region's policies.

Table 2.1 Washington State and Thurston Region Hazard Mitigation Planning Policy Relationships

Washington State Enhanced Hazard Mitigation Plan Goals		Thurston Region Hazard Mitigation Policies
1	Reduce the impacts of natural hazards on our community lifeline infrastructure and other critical assets.	2A, 2B, 2C, 2D
2	Prioritize effective long-term partnerships across all levels of government.	6A
3	Allow the risk and vulnerability assessments to drive the State's Mitigation Strategy and prioritization of mitigation actions.	8A
4	Improve our understanding of multi-hazard environments.	7A, 7B, 7C, 7D, 7E, 7F
5	Embed cultural understanding into our mitigation work.	3B, 3C
6	Ensure improved and equitable access to hazards information.	9A, 9B
7	Champion and prioritize people-centered mitigation actions in addition to property-centered ones.	6B, 7E, 3A
8	Emphasize the role of sustainable development and climate adaptation in hazard mitigation.	7D, 8B
9	Strategically reduce the number of repetitive loss and severe repetitive loss properties.	3A
10	Ensure all counties and sub-county jurisdictions in Washington understand their hazard risks and are eligible for mitigation funding opportunities.	6C

Progress Toward Goals and Policies

The region's mitigation partners have made steady progress toward fulfilling the plan's goals and policies. The plan's mitigation strategy is ongoing and will require ongoing coordination and continuous efforts from all communities, special purpose districts, and other public and private sector partners. Successful progress toward the plan's goals will be measured by the implementation, monitoring, and evaluation of the regional and the jurisdictional adopted mitigation initiatives. The following accomplishments highlight just a few of the successes that Thurston County communities are achieving to become more disaster resilient:

Plan partners – please insert your mitigation success stories in this section. It is acceptable to include a paragraph about mitigation grants you have applied to or funding awards that are pending based on this plan's approval.

1. **Protect Life** – The Thurston County Hazardous Weather Task Force led by Thurston County Public Health and Social Services developed a Hazardous Weather Response Plan. This life saving response plan mitigates extreme winter and summer weather impacts experienced by community members who are unsheltered. The plan coordinates response with local government partners, shelter operators, and other organizations to minimize the risks of hazardous weather on the life safety of vulnerable populations.
2. **Protect Infrastructure** – In June 2022, the Local Emergency Planning Committee, Thurston County Emergency Management, and TRPC invited local agency and Washington State Department of Transportation staff to participate in a one-day Cascadia Rising 2022 Transportation Recovery tabletop training exercise. The event assessed the participants' recovery and interagency coordination transportation planning capabilities for a Cascadia Subduction Zone earthquake scenario. The exercise revealed a strong interest among public works transportation staff to continue building interagency relationships and working together on transportation recovery and mitigation planning.

3. **Protect Property** – In March 2019, the Olympia Sea Level Rise Response Plan was approved by the City of Olympia, the Port of Olympia, and the LOTT Clean Water Alliance. The plan contains a range of potential adaptation strategies including physical, governance, informational, and operational strategies to protect Downtown Olympia and the Port Peninsula from the impacts of sea level rise. Implementation of the plan is occurring through the Olympia Sea Level Rise Collaborative.
4. **Protect the Environment** – In 2023, the City of Olympia submitted a Building Resilient Infrastructure and Communities (BRIC) grant application for a project to underground a sewer line located on a utility bridge in Percival Canyon which, if damage by an earthquake, landslide or severe weather could result in untreated sewage being discharged into Percival Creek and Budd inlet as occurred in 2020 during a severe winter storm. The project was selected for funding pending FEMA approval of the Hazard Mitigation Plan update.
5. **Sustain the Economy** – At the onset of COVID-19, Thurston County, Lacey, Olympia, Tumwater, the Economic Development Council, and several other community-based organizations formed the Thurston Strong coalition. The coalition took immediate action to help businesses and workers weather the emergency (a hotline, protective gear, childcare support, $9 million in grants) and implemented a 24-month plan to accelerate regional economic recovery and support workers seeking new job opportunities.
6. **Build Community Support** – In February 2019, over 100 local government elected officials, department leaders, staff, and community stakeholders participated in a four-day FEMA sponsored Integrated Emergency Management Course on disaster recovery and mitigation. The outcome of this exercise increased leadership awareness of disaster recovery and mitigation. A Disaster Recovery Council was formed in January 2022 to update the Thurston Region's Disaster Recovery Framework.
7. **Expand Understanding of Hazards** – Since February 2017, FEMA has worked with the City of Olympia and Thurston County on a Risk MAP process to conduct a flood study for 26 lakes in the City of Olympia and 40 lakes in Thurston County. Analyses included survey, hydrology, and flood risk products that will ultimately be used to support Flood Insurance Rate Map (FIRM) development, risk communications, and mitigation actions for the City of Olympia and Thurston County. A public outreach process was convened in Fall 2022 to inform affected property owners about the potential changes to FIRMs. A Final Letter of Determination is expected in November 2023.

   In 2021, Thurston County secured a grant from the Washington Department of Natural Resources and US Geological

Survey through the 3D Elevation Program to acquire QL1 LiDAR data for the entire county. This data will greatly improve the county's ability to update its wetland inventory, landslide hazard areas, and river channel migration zones more accurately.

8. **Implement Effective Mitigation Strategies** – In 2020, Thurston County and the cities of Lacey, Olympia, and Tumwater in partnership with TRPC produced the region's first Climate Mitigation Plan. The plan recognizes the increasing risks of natural hazards the region will experience due to the effects of climate change. The plan presents a comprehensive strategy for the plan partners to reduce carbon emissions. In 2023, the Sea Level Rise Collaborative, including the Squaxin Island Tribe and the Washington State Department of Enterprise Services, submitted a letter of intent for the National Oceanic and Atmospheric Administration's Resilience Challenge. The project request includes building sea level rise flood protection measures, Deschutes Estuary restoration, project staffing, and analyzing the City of Olympia's combined sewer and storm system for retrofits.

   In October 2017, Thurston County updated its Flood Hazard Mitigation Plan. Thurston County's flood mitigation investments in public information, flood mapping and regulations, flood damage reduction, and warning and response activities has earned it enough credit to earn a Class 2 Rating for the National Flood Insurance (NFIP) Program's Community Rating System (CRS). Only eight communities in the U.S. have earned a Class 1 or 2 CRS rating. The Class 2 rating affords NFIP policy holders a 40% discount on their flood insurance premiums.

9. **Increase Public Awareness** – In 2023, West Thurston Regional Fire Authority in partnership with the Thurston Conservation District and Washington State Department of Natural Resources launched a Wildfire Ready Neighbors Program in southwest Thurston County. The program provides direct contact with Thurston County residents to identify actions that property owners can take to reduce their risks for wildfire.

Also in 2023, Thurston County Emergency Management hosted a series of two-day Assessing Structure Ignition Potential from Wildfire workshops. The training was delivered by wildland fire specialists to instruct participants on the physical and behavioral sciences behind wildfire mitigation. These workshops were made available through FEMA Hazard Mitigation Grant Program Post Fire funding.

Mitigation Initiatives

Central to the hazard mitigation plan are the proposed projects, programs, and activities the plan participants will implement to provide long-term and sustained benefits that will reduce losses from the impacts of the hazards that are identified in this plan's risk assessment. Each action or initiative was evaluated and scored by benefit-cost review criteria. Each initiative will require significant investments in planning, design, and construction or coordination, and may take years to complete or be sustained as an ongoing activity. The desired outcomes of this plan's mitigation strategy are that communities:

- Build the necessary capacity to improve their knowledge of hazards and their risks.
- Identify and implement actions that will effectively reduce their jurisdiction's vulnerabilities to the hazard identified in the risk assessment; and
- Implement strategies that will fulfill the plan's goals and policies.

The plan defines two sets of mitigation initiatives. Through the adoption of both the Regional Mitigation Initiatives from the core plan and the jurisdiction-specific annex initiatives, each community formulates a comprehensive mitigation strategy tailored to its specific needs.

1. **Regional Mitigation Initiatives:** These are countywide actions that were identified by members of the Hazards Mitigation Workgroup and stakeholders and approved by the Emergency Management Council. Many of these actions have carried over from previous plans. The initiatives, if implemented, will benefit multiple jurisdictions and improve interagency hazard mitigation planning capabilities. The regional initiatives will be overseen by the Emergency Management Council, the Hazard Mitigation Planning Workgroup, and other leads. Thurston County Emergency Management staff will play a role in convening and coordinating stakeholders, and for some actions, managing the actions' implementation.
2. **Jurisdictional Initiatives:** Each plan partner identifies actions that address specific vulnerabilities in their community. The plan partners are responsible for implementing their actions. Each plan partners' initiatives are presented in their respective annex.

Types of Mitigation Activities

There are seven types of mitigation activities that jurisdictions can perform to reduce or eliminate current and future vulnerabilities. Each initiative primarily falls into one of the following categories, although the scope of some initiatives may incorporate activities from more than one category:

1. **Public Outreach and Information:** Information and outreach activities that improve the public's understanding of hazards, their impacts, and steps that people and organizations can take to reduce their risks.
2. **Plan Coordination and Implementation:** Developing emergency plans, coordinating their implementation across multiple agencies, training, and communications to improve community response and resiliency to hazards.
3. **Data Collection and Mapping:** Studies, data collection, monitoring programs, and mapping to improve a community's understanding of hazards to better inform decisions and investments to reduce risks.
4. **Development Regulations:** Developing or reviewing and updating strategic plans, codes, policies, and programs to incorporate best practices in hazard mitigation. Such activities influence the way land is developed and buildings are constructed.
5. **Hazard Preparedness:** Investments in emergency warning and alert notification systems, specialized training to enhancing emergency response, and stockpiling emergency supplies and materials.
6. **Hazard Damage Reduction:** Acquisition, elevation, relocation, seismic retrofits, modernization, and other modifications to or surrounding existing buildings and structures to protect them from hazards.
7. **Critical Facilities Replacement/ Retrofit:** Hazard damage reduction activities for key lifeline facilities such as medical facilities, police and fire stations, water treatment systems, bridges, communications, and other critical community assets.

Identification and Preparation of Mitigation Initiatives

Thurston Regional Planning Council provided guidance to the Hazard Mitigation Workgroup members who in turn coordinated with their jurisdiction planning team to prepare their mitigation strategies. Thurston Regional Planning Council provided numerous resources to assist the plan participants with their initiative development process, including:

- Updated Risk Assessment with hazard risk ratings
- Level 2 Hazus model critical facilities vulnerability analysis results

- Hazard maps
- Demographic data
- An online GIS map with hazard layers and critical facilities
- Updated Goals and Policies
- A copy of previous annexes with the initiatives
- Capability assessment worksheets
- An updated mitigation initiative template with instructions
- FEMA's "Local Mitigation Planning Handbook"
- FEMA's "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards"
- A catalogue of risk reduction measures
- Benefit-Cost Review Criteria and worksheet
- Public Engagement Activities including two community surveys and an online open house

The process for evaluating vulnerabilities and identifying a range of alternative mitigation actions to reduce actual and potential hazard exposure varies among jurisdictions depending on their capabilities and resources. In general, workgroup members collaborated with staff and/or committees within their jurisdictions that were most familiar with their infrastructure, facilities, key assets, services, and their incorporated boundaries or service areas. Local planning partners referenced a variety of jurisdiction-specific resources such as their comprehensive plans, strategic plans, emergency management plans, capital facility plans, after action review reports, other planning documents, and local knowledge to compile existing mitigation activities. Jurisdictions also considered existing initiatives from the previous plan and identified new and original initiatives identified as part of this plan's update process.

Benefit-Cost Review Criteria

A benefit-cost review is an assessment tool for weighing the various probable benefits that a mitigation action is expected to produce versus the cost to implement the action. This tool is useful for:

- Comparing a limited number of alternative actions to select a preferred action that will best serve the needs of a community to minimize or eliminate a vulnerability.
- Ranking the order of a set of actions based on their scores to sort the actions' order of implementation (higher scoring actions result in a higher priority implementation status).

During the development of the mitigation strategy, each action was screened using eight point-based criteria. Five points were awarded for high benefit, three points for medium benefit, and one point for low benefit. Each initiative could score a potential maximum of 40 points. Four additional but optional criteria were available to jurisdictions that required a more comprehensive review or a greater differentiation in point-based outcomes. The criteria and the scoring matrix are presented in Figure 2.2.

Regional Mitigation Initiative Scoring

A volunteer panel of the Hazard Mitigation Workgroup performed the benefit-cost review for the regional initiatives. The panel discussed all eight criteria including their definitions, how each criterion would be applied to each initiative, and the process for scoring the actions. A round robin approach was used to score each initiative for each criterion. For each action and every criterion, every panel member shared their perspectives and their score. Each action's point assignment was achieved through consensus. The Regional Mitigation Initiative Benefit-Cost Review Worksheet results are shown in Figure 2.3 at the end of this chapter.

Jurisdictional Mitigation Initiative Scoring

Each jurisdiction's planning team performed a benefit cost review process for their actions. The details of jurisdictional benefit-cost review scoring processes are documented in the annexes.

Figure 2.2 Mitigation Actions Benefit-Cost Review Criteria and Scoring Matrix

HIGH BENEFIT Description	Pts	MEDIUM BENEFIT Description	Pts	LOW BENEFIT Description	Pts	NO BENEFIT Description	Pts
1. Project Cost: The total cost to implement an action or project over its lifecycle. The action's outcomes should provide a protective benefit, be sustained, and exceed the cost to implement the action Lower cost initiatives with higher benefits should be a priority.							
Low cost, less than $100K	5	Medium cost, $100K-$500K	3	High cost, more than $500K	1	Cost far exceeds the anticipated benefits	0
2. Hazard Risk Rating: Actions that address high risk hazards or hazards that produce greater community vulnerabilities should be a community priority.							
Action addresses a jurisdiction's High-Risk Hazard	5	Action addresses a Medium-Risk Hazard	3	Action addresses a Low-Risk Hazard	1	Action Addresses a no-risk hazard	0
3. Goal and Policy Fulfillment: Actions that will achieve plan goals and policies should be a community priority.							
Action strongly supports at least four policies	5	Action supports at least two policies	3	Action supports one policy	1	Action does not support plan policies	0
4. Life Safety: An actions ability to protect the safety of residents, businesses, property, and community lifelines.							
Action will produce significant and lasting public safety benefits for residents, businesses, and property	5	Action will produce public safety benefits…	3	Action will produce minimal public safety benefits…	1	Action has no public safety benefits	0
5. Social Vulnerability[1]**:** Does the action directly benefit underserved communities or individuals or groups that are socially vulnerable?							
Action will produce a significant and direct benefit for socially vulnerable or underserved communities	5	Action will produce a benefit…	3	Action will have minimal benefit…	1	Action does not benefit socially vulnerable or underserved communities	0
5. Changes in Development: Does the action directly account for changes in development due to recently completed or planned construction or changes in policies, standards, codes, or regulations that influence development patterns?							
Action includes measures that strongly account for changes in development	5	Action includes measures that account for changes in development	3	Action includes minimal measures that account for changes in development	1	Action does not account for changes in development…	0
7. Climate Change: Does the action address a hazard that will present greater risks in the future due to the effects of climate change?							
Action strongly accounts for the effects of climate change on the hazard it addresses	5	Action accounts for the effects of climate change…	3	Action minimally accounts for the effects of climate change…	1	Action does not account for the effects of climate change…	0
8. Geographic Impact: Does the action address a hazard for the entire geographic area that is affected or at risk?							
Action addresses hazard risks for the entire affected area of the community	5	Action address risks across at least half of the affected area	3	Action address risk for a very limited portion of the affected area	1	Action does not address risks within the affected area	0

[1]Local governments have a responsibility to ensure that the plan's mitigation strategy complies with all applicable legal requirements related to civil rights, to ensure nondiscrimination. Compliance can help achieve equitable outcomes through the mitigation planning process for all communities, including underserved communities and socially vulnerable populations.

Mitigation Initiative Format

Every action in the plan follows a consistent format. Each initiative has a unique identification number, a title, a background and needs description, its benefit-cost review score, the hazard addressed, mitigation category, relationship to goals and policies, department or project lead, cost estimate, timeline for implementation, potential funding sources, relationship to other community planning documents – if applicable, and implementation status. Refer to Figure 2.3 for the layout of the mitigation initiative content.

Figure 2.3 Sample Mitigation Initiative

Initiative identification number and title

New, existing, modified, ongoing, or removed during the plan update process

Benefit-cost review score. Higher score is a higher priority

Hazard addressed and action category

Background and Need description

Relationship to plan goals

Implementation details

Source for the initiative.

Progress toward the initiative's implementation

CW-WH-2: Countywide Multijurisdictional Community Wildfire Protection Plan

Benefit-Cost Review Score: 36 **Status:** New

Hazard Addressed: Wildland Fire

Category: Plan Coordination and Implementation

Background and Need: Thurston County wildfire frequency and size have trended upward over the last 15 years. On September 8, 2020, a 268-acre fire in southwest Thurston County, intensified by sustained high speed winds, destroyed two homes and two outbuildings near Mima and Bordeaux Roads SW. The fire forced area residents to evacuate. The incident resulted in Thurston County receiving immediate federal fire management assistance, an uncommon wildfire declaration for communities in Western Washington lowlands.

The effects of climate change will make summers warmer, drier, and longer. Climate change combined with the region's growing population will increase the likelihood of more frequent, larger, and perhaps more severe wildfires. Planning is necessary to understand the wildfire risks for current and future households and businesses located in wildland urban interface and intermix areas. In addition, wildfire smoke will adversely impact people who suffer from chronic respiratory diseases or people who are exposed and unable to seek indoor refuge.

Building on the momentum of the 2023 Wildfire Ready Neighbors Program partnership and the 2023 Assessing Structural Ignition Potential courses hosted by Thurston County Emergency Management, the region will pursue the development of a multijurisdictional countywide Community Wildfire Protection Plan. The planning process will involve a whole community approach to engage a variety of stakeholders to identify areas of the community, especially underserved communities, that are at greatest risk for wildfire losses and establish a collaborative framework for communities to identify strategies for hazardous fuels management, wildfire response, hazard mitigation, and community education and preparedness.

Relates to Plan Goal(s) and Objectives: SC, 5c, 6a, 6b, 7b, 7d, 7e, 9a, 9b

Lead: The Association of Thurston County Fire Chiefs in partnership with the tribes, county, cities, special purpose districts, Wash. Dept. of Natural Resources, the US Forest Service, TRPC, the public, and other stakeholders.

Estimated Cost: Medium, $100,000 to $300,000

Time Period: 2024-2028

Funding Source: Wash. Dept. of Natural Resources Community Wildfire Defense Grant

Source and Date: 2023 Natural Hazards Mitigation Plan

Initiative and Implementation Status: This is a new initiative. Information about this initiative's status will be reported during the next plan update.

Regional Mitigation Strategy

The Regional Mitigation Strategy consists of 12 multijurisdictional initiatives that, if implemented, will improve the region's ability to coordinate hazard mitigation planning, assess risks, respond to natural hazards, and protect community assets. Seven initiatives are carried over from the previous plan. Five new initiatives were added through the plan update process.

Priority Actions

Table 2.2 presents the regional mitigation actions. The actions are sorted by their mitigation category and ranked by their benefit-cost review score. Five actions have benefit-cost review scores that are 32 points or higher, representing the top five highest-ranking actions in the plan (see title annotations in Table 2.2).

Regional Mitigation Strategy Action Survey Results

In Summer 2023, TRPC hosted an online open house and community survey to solicit feedback on the Regional Mitigation Strategy actions. The survey asked respondents "Based on your understanding of hazards and how they might impact you or your community, select the three actions that you would like to see prioritized highest." Only 70 people answered this question. Although the responses are not statistically meaningful, the survey respondents' top three actions align with three of the five highest benefit-cost review scored actions. Table 2.2 shows the percentage of survey participants that selected each initiative as one of their top three choices.

Table 2.2 Regional Mitigation Strategy Initiatives

Mitigation Categories and Initiative Description	Status	Benefit-Cost Review Score	Action Survey Results
Public Outreach and Information			
CW-MH-6 Regional Hazard Mitigation Public Outreach Strategy (Top 5) Continue countywide outreach and education activities to inform all sectors of the community about natural hazards and steps people and organizations can take to reduce their risks. Attention will focus on socially vulnerable populations who are at higher risk.	Ongoing	36	23%
Plan Coordination and Implementation			
CW-WH-2 Community Wildfire Protection Plan (Top 5) Develop a countywide plan that identifies areas that are at risk for wildfire losses and prioritize strategies for reducing and controlling vegetative fuels, wildfire response, and community education and preparedness.	New	36	37%
CW-SH-2 Extreme Heat Incident Response and Illness Prevention Plan (Top 5) Develop a countywide plan to improve the region's response during extreme heat incidents. The plan will identify capabilities and strategies needed to reduce heat-related injuries and deaths.	New	32	41%
CW-MH-13 Ongoing Hazard Mitigation Planning Workgroup Coordination Establish regular meetings among local government partners to implement, monitor, evaluate and maintain the Hazard Mitigation Plan's actions and risk assessment.	New	30	23%
CW-DH-1 Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar Develop an evacuation plan for potential dam failure and lahar hazards in coordination with residents, businesses, and other stakeholders. The plan will include routes, alert notification protocols, signs, staging areas, public education, emergency sheltering needs, operational plans, and training for organizations and personnel who would be involved in evacuation operations.	Modified	26	4%
Data Collection and Mapping			
CW-MH-11 Countywide Emergency Shelter Capacity and Operational Assessment (Top 5) Conduct a pre-disaster emergency shelter facilities assessment to look at staffing requirements, support services, material resources, funding, and agreements to support shelter operations for a range of capacities, durations, and needs.	Modified	34	40%
CW-MH-4 Develop a Regional Transportation Resiliency Plan Identify and map "lifeline" transportation routes that are critical for regional mobility, public safety, and economic resiliency. A plan will guide long-term transportation infrastructure strengthening projects.	Existing	28	31%
CW-MH-12 Hazard Modeling and Loss Estimation Capacity Building Build local knowledge and technical skills to develop, operate, and maintain community-specific GIS-based hazard modeling tools that include local data. Local modeling tools can inform planning and decision making for hazard mitigation, emergency management, and disaster recovery, and training.	Modified	28	6%

Mitigation Categories and Initiative Description	Status	Benefit-Cost Review Score	Action Survey Results
CW-MH-1 Critical Infrastructure Inventory Maintain an accurate and complete database of critical infrastructure such as bridges, water systems, medical facilities, energy utilities, etc. to improve communities' ability to look at risks, identify vulnerabilities, maintain situational awareness, and prioritize the restoration of essential lifeline services during post-disaster recovery.	Ongoing	24	26%
CW-LH-1 Countywide Landslide Hazards Mapping Enroll in the Washington Geological Survey Landslide Hazards Program to accurately inventory and map the county and cities' landslide hazards.	New	22	3%
Hazard Preparedness			
CW-MH-7 Critical Asset Management System Critical assets include subject matter expert personnel, specialized teams, and specialized equipment that supports emergency response and recovery needs. Developing and maintaining an inventory of these resources and a system for tracking requests can help reduce losses and speed recovery activities for both pre- and post-disaster emergency situations.	Existing	23	21%
Critical Facilities Strengthening			
CW-SL-1 Olympia Sea Level Rise Response Plan Implementation (Top 5) Implement the strategies in the Olympia SLR Response Plan, which aims to reduce risks from emerging sea level rise hazards. Downtown businesses, the Port of Olympia's Marine Terminal, and the LOTT Clean Water Alliance Budd Inlet Wastewater Treatment Plant are some of the valued assets and critical facilities that will require protection.	New	32	13%

CW-MH-6: Regional Hazard Mitigation Public Outreach Strategy

Benefit-Cost Review Score: 36 **Status:** Ongoing

Hazard Addressed: Multi Hazard

Category: Public Information

Background and Need: Ongoing public outreach and education for hazard mitigation is necessary to engage and inform all sectors of the community to become more disaster resilient. This action should ensure that useful information is tailored to socially vulnerable and underserved populations. This comprehensive hazard mitigation public outreach strategy entails crafting clear and accessible messages that educate the public on potential threats from dam failures, earthquakes, flooding, landslides, sea level rise, severe weather, tsunamis, volcanic lahars, and wildfires. This multihazard approach will foster awareness, preparedness, and resilience within the community.

A Summer 2022 Community Hazards Resiliency Survey revealed that a majority of Thurston County residents currently receive or prefer to receive information about natural hazards from their local governments, in addition to local or regional news media. Regular messaging and outreach activities should provide useful information for social service providers, households, businesses, and major employers to improve their understanding of natural hazards and the effects of climate change to help people and organizations minimize losses. Information should be regularly disseminated through a variety of modes:

1. Sharing information with social service providers and housing shelters
2. Convening an annual fall season in-person Emergency Preparedness Expo
3. Hosting annual summer and winter weather hazard seminars
4. Facilitating hazard mitigation and emergency planning seminars for elected officials and staff
5. Staffing and information sharing at a variety of regularly occurring community events
6. Publishing information on social media and websites
7. Distributing the Thurston County Flood Bulletin and other local agency e-newsletters
8. Cross-promotion partnerships with other area agencies

Relates to Plan Goal(s) and Policies: 1B, 5B, 6A, 6B, 9A, 9B

Lead: Thurston County Emergency Management Council in partnership with the tribes, state and federal agencies, county, cities, fire districts, and other special purpose districts.

Estimated Cost: Low on an annual basis.

Time Period: Ongoing

Funding Source: General funds, grant program funds for specific projects

Source and Date: 2009 Natural Hazards Mitigation Plan

Initiative and Implementation Status: In 2023, this existing initiative was revised to become an ongoing action. Emergency Preparedness Expos were held in 2018 and 2019, but paused in 2020-2022 as a safety precaution during the COVID Pandemic. The expo will resume in-person in Fall 2023. In 2022, staff attended over a dozen community events to perform outreach on hazard mitigation. The Emergency Management Council convened its annual Executive Seminars every year through the pandemic (online meetings) and resumed in-person meetings in 2022. Thurston County Emergency Management hosted online summer and winter weather hazard seminars. The plan partners conducted a countywide resiliency survey in Summer 2022 as part of the Hazard Mitigation Plan update process.

CW-WH-2: Community Wildfire Protection Plan

Benefit-Cost Review Score: 36 **Status:** New

Hazard Addressed: Wildland Fire

Category: Plan Coordination and Implementation

Background and Need: Thurston County wildfire frequency and size have trended upward over the last 15 years. On September 8, 2020, a 268-acre fire in southwest Thurston County, intensified by sustained high speed winds, destroyed two homes and two outbuildings near Mima and Bordeaux Roads SW. The fire forced area residents to evacuate. The incident resulted in Thurston County receiving immediate federal fire management assistance, an uncommon wildfire declaration for communities in Western Washington lowlands.

The effects of climate change will make summers warmer, drier, and longer. Climate change combined with the region's growing population will increase the likelihood of more frequent, larger, and perhaps more severe wildfires. Planning is necessary to understand the wildfire risks for current and future households and businesses located in wildland urban interface and intermix areas. In addition, wildfire smoke will adversely impact people who suffer from chronic respiratory diseases or people who are exposed and unable to seek indoor refuge.

Building on the momentum of the 2023 Wildfire Ready Neighbors Program partnership and the 2023 Assessing Structural Ignition Potential courses hosted by Thurston County Emergency Management, the region will pursue the development of a multijurisdictional countywide Community Wildfire Protection Plan. The planning process will involve a whole community approach to engage a variety of stakeholders to identify areas of the community, especially underserved communities, that are at greatest risk for wildfire losses and establish a collaborative framework for communities to identify strategies for hazardous fuels management, wildfire response, hazard mitigation, and community education and preparedness.

Relates to Plan Goal(s) and Policies: 3C, 5C, 6A, 6B, 7B, 7D, 7E, 9A, 9B

Lead: The Association of Thurston County Fire Chiefs in partnership with the tribes, county, cities, special purpose districts, Wash. Dept. of Natural Resources, the US Forest Service, TRPC, the public, and other stakeholders.

Estimated Cost: Medium, $100,000 to $300,000

Time Period: 2024-2028

Funding Source: Wash. Dept. of Natural Resources Community Wildfire Defense Grant

Source and Date: 2023 Natural Hazards Mitigation Plan

Initiative and Implementation Status: This is a new initiative. Information about this initiative's status will be reported during the next plan update.

CW-SH-2: Extreme Heat Incident Response and Illness Prevention Plan

Benefit-Cost Review Score: 32 **Status:** New

Hazard Addressed: Storm/Weather

Category: Plan Coordination and Implementation

Background and Need: Long-term climate science and forecasts reveal that by mid-century, warming will be outside of the range of historical variation. The June 2021 Heat Dome event portends future extreme heat impacts on Thurston County communities. Six residents died from heat related injuries, 74 Thurston County residents visited local Emergency Departments, and 272 individuals were sheltered by the Hazardous Weather Task Force. People in the maritime Pacific Northwest are unaccustomed to extreme heat and most households lack air conditioning. Outdoor workers, older adults, the very young, people experiencing homelessness, people with limited English proficiency, people who are uninsured/ underinsured, and people with mental illness and chronic disease are at highest risk for heat related illnesses and injuries (HRIs).

The region's Emergency Medical System (EMS), emergency rooms, intensive care units, urgent care clinics, and social service agencies are potentially unprepared to respond to a prolonged heat event that would produce surge in people who will suffer heat related illnesses and injuries (HRIs). The development and implementation of a whole community Extreme Heat Incident Response and Illness Prevention Plan can prepare public and private health care systems and social service providers to respond in future events more effectively.

This initiative will convene a general interagency planning workgroup consisting of representatives from public and private health institutions, Medic One, fire service, TCOMM 911, Emergency Management, social service providers, public information officers, utilities, community climate-focused nonprofit organizations, and others. There will be two sub-working groups, one focused on emergency services response and planning, and the other on community education and pre-incident mitigation interventions. The scope of the general workgroup will be as follows:

1. Identify areas and populations within the community that are most vulnerable to HRIs.
2. Identify mechanisms and thresholds for plan activation.
3. Identify interventions for emergency coordination, public communications, health care preparedness, and social services.
4. Evaluate and propose changes for existing interagency agreements for heat related emergency response interventions, if necessary.
5. Develop a pre-heat event education and heat illness prevention strategy.
6. Develop an operational plan with leads, roles, responsibilities, and partners. Plans will proceed along two separate but parallel and coordinated tracks: emergency response and pre-event mitigation along with education.
7. Identify the funding to implement the plan's components.
8. Identify the means to exercise, evaluate, and maintain the plan.

Relates to Plan Goal(s) and Policies: 1A,1B, 6B, 7D, 7E, 9A

Lead: Thurston County Public Health and Social Services and Thurston County Emergency Services

Estimated Cost: Low to Medium; $100,000 to $250,000

Time Period: 2024-2028

Funding Source: CDC Climate-Ready States & Cities Initiative and other grants and local agency funds

Source and Date: 2023 Natural Hazards Mitigation Plan Update

Initiative and Implementation Status: This is a new initiative. Progress will be reported during the next plan update.

CW-MH-13: Ongoing Hazard Mitigation Planning Workgroup Coordination

Benefit-Cost Review Score: 30 **Status:** New

Hazard Addressed: Multi Hazard

Category: Plan Coordination and Implementation

Background and Need: FEMA requires local governments update their Hazard Mitigation Plans every five years to maintain eligibility for federal mitigation assistance funding. Periodic monitoring and maintenance of multijurisdictional mitigation strategies and risk assessments, performed by the plan partners, increases opportunities for plan implementation and evaluation.

This action will initiate ongoing and regular coordination of the Hazard Mitigation Workgroup and other stakeholders. The workgroup will meet at least once a year to report on the status of mitigation strategies, review potential changes in threats, and consider revisions to mitigation strategies, if necessary, to address socially vulnerable and underserved communities, changes in development, and the effects of climate change to strengthen the planning partners' resiliency from hazard impacts.

The meetings will facilitate peer discussions between plan update cycles and enhance the region's hazard mitigation capabilities. Jurisdictions will benefit by staying informed about federal and state mitigation guidance, grant opportunities, and orient new staff representatives to the region's hazard mitigation planning process.

A mid-cycle evaluation report will be prepared halfway through the five-year timeline to summarize the progress on the countywide mitigation actions and all other changes or major issues identified by the Workgroup. The report and all meeting notes will be published on the project webpage. In addition, findings or updates identified by the Workgroup can inform the Emergency Management Council's Executive Seminars and public outreach activities related to CW-MH-6, Hazard Mitigation Public Outreach Strategy.

Relates to Plan Goal(s) and Policies: 6A, 6B, 6C, 7F, 8A, 8C, 9A

Lead: Thurston County Emergency Management Council in partnership with the Hazard Mitigation Plan partners, WAEMD, FEMA Region X, and other stakeholders.

Estimated Cost: Low

Time Period: A minimum of one meeting per year or additionally as needed, from 2024-2028

Funding Source: In-kind local agency staff time

Source and Date: 2023 Natural Hazards Mitigation Plan for the Thurston Region

Initiative and Implementation Status: This is a new initiative.

CW-DH 1: Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar

Benefit-Cost Review Score: 26 **Status:** Modified

Hazard Addressed: Dam Failure

Category: Plan Coordination and Implementation

Background and Need: Emergency Action Plans are available for the Skookumchuck and the Nisqually hydroelectric projects. Communication protocols between the operators, Tacoma Public Utilities and TransAlta, and essential emergency management and public safety personnel exist. However, there are no established operational plans for evacuations and protocols for notifying affected residents and property owners for the inundation areas in Thurston County should a dam failure incident or volcanic lahar occur. The combined Nisqually Hydroelectric Project and the TransAlta Project inundation areas and lahar areas affect populations with a medium high to high overall social vulnerability1. Evacuation routes must be planned in coordination with affected residents and businesses and other key local, state, and federal stakeholders. Work is needed to plan for effective alert notification protocols, evacuation plans, signs, staging areas, public education, emergency sheltering needs for people who may become displaced, and training for organizations and personnel who would be involved in executing the evacuation operations. The action will also identify a timeline to review the routes and plans.

Relates to Plan Goal(s) and Policies: 1A, 1B, 1C, 1D, 5C, 6A, 6B, 7C

Lead: Thurston County Emergency Management in partnership with dam operators, Nisqually Tribe, WAEMD, WSDOT, City of Yelm, and other stakeholders.

Estimated Cost: Medium, $500,000 to $1,000,000

Time Period: 2024-2028

Funding Source: Building Resilient Infrastructure and Communities grant program

Source and Date: 2003 Natural Hazards Mitigation Plan for the Thurston Region.

Initiative and Implementation Status: This initiative, previously identified as CW-FH 1 (flood hazard), is recoded as CW-DH-1 as it addresses a dam failure hazard. The action category is updated from “Data Collection and Mapping” to “Plan Coordination and Implementation” to reflect some revision to the proposed action’s scope of work. Thurston County Emergency Management performed some preliminary planning and mapping of affected routes. In 2022 Thurston County participated in both Tacoma Public Utilities and Trans Alta in their Federal Energy Regulatory Commission Emergency Action Plan exercises.

[1] 2020. Centers for Disease Control Agency for Toxic Substances and Disease Registry Social Vulnerability Index. Overall SVI Washington: Statewide Comparison by Census Tract. https://www.atsdr.cdc.gov/placeandhealth/svi/interactive_map.html

CW-MH-11: Countywide Emergency Shelter Capacity and Operational Assessment

Benefit-Cost Review Score: 34 **Status:** Modified

Hazard Addressed: Multi Hazard

Category: Data Collection and Mapping

Background and Need: Thurston County communities have identified faith-based community facilities, schools, and other public facilities that can serve as short- or long-term emergency shelters. However, no comprehensive assessment of the shelters' suitability and capacity for multi-hazard events (cooling, warming, housing for disaster displaced households) and special needs (companion pets, people experiencing homelessness, people suffering mental health or drug addiction) has been performed and documented. A pre-disaster assessment to evaluate staffing requirements, support services, material resources, funding, and agreements to sustain shelter operations for a range of capacities, durations, and needs will position communities to coordinate and fulfill emergency sheltering demands more effectively. In addition, operations planning to communicate shelter availability, coordinate transportation, and other logistics should be considered.

Relates to Plan Goal(s) and Policies: 1B, 6B, 9B

Lead: Thurston County Emergency Management and Public Health and Social Services, in partnership with cities, school districts, faith-based organizations, and social service providers, shelter operators, and other stakeholders

Estimated Cost: Low to Medium; $100,000 to $500,000

Time Period: 2024-2028

Funding Source: Grants and local agency general funds

Source and Date: 2017 Natural Hazards Mitigation Plan

Initiative and Implementation Status: The American Red Cross performed a baseline inventory of sheltering facilities in Thurston County

CW-MH-4: Develop a Regional Transportation Resiliency Plan

Benefit-Cost Review Score: 28 **Status:** Existing

Hazard Addressed: Multi Hazard

Category: Data Collection and Mapping

Background and Need: A Regional Transportation Resiliency Plan will assist communities with a variety of hazard mitigation, post-disaster route restoration and recovery, and long-term infrastructure resiliency investments. The plan will assess future population and demand on the region's most critical routes. The process will identify surface transportation system vulnerabilities and prioritize projects to strengthen resiliency and mitigate system disruptions. The vulnerability assessment will evaluate potential flood, earthquake, landslide, tsunami, wildfire, and other hazards. Routes, conditions, and other attributes will be mapped in a GIS. GIS database development will more readily enable state and local transportation partners to access, share, and communicate transportation lifeline priority needs. The plan will identify a process for plan monitoring and maintenance.

Relates to Plan Goal(s) and Policies: 1C, 2A, 2B, 5C

Lead: Thurston County Emergency Management. Partners include tribes, WSDOT and city and county public works transportation divisions, fire districts, Intercity Transit, school districts, TRPC and public and private utilities.

Estimated Cost: Medium, $100,000 to $500,000

Time Period: 2023-2028

Funding Source: FHWA Surface Transportation Block Grant or PROTECT Grant

Source and Date: 2023 Natural Hazards Mitigation Plan for the Thurston Region

Initiative and Implementation Status: Thurston County and the cities have identified their primary snow routes. In June 2022, Thurston County, WSDOT, and the cities participated in a Cascadia Rising transportation recovery exercise. The exercise tested the participants ability to identify, assess, and restore critical transportation corridors for disaster recovery. The participants recognized the need to continue coordination and collaboration on lifeline transportation route planning.

CW-MH-12: Hazard Modeling and Loss Estimation Capacity Building

Benefit-Cost Review Score: 28 **Status:** Modified

Hazard Addressed: Multi Hazard

Category: Data Collection and Mapping

Background and Need: Having ready access to tools to estimate potential losses from hazard scenarios can significantly increase communities' understanding of their hazard risks and impacts. Relying on outside expertise to develop and run models for resiliency planning is costly. Thurston County communities would benefit from building intraregional capacity and technical skills to develop, run, and maintain community-specific GIS-based hazard modeling tools that can incorporate local and regional data on existing conditions and forecast data on the region's population, employment, and land use. Best practices in model development for flood, earthquake, landslide, lahar, tsunami, and wildfire hazards will be evaluated. Models developed using local data with local expertise produce the most effective results to inform planning and decision making for hazard mitigation, emergency management, and disaster training.

Relates to Plan Goal(s) and Policies: 7A,B,C,D,E

Lead: Thurston County Emergency Management in partnership with Thurston GeoData, the tribes, cities, special purpose districts, and TRPC

Estimated Cost: Medium for initial development costs, \$100,000 to \$500,000. Low for long-term annual maintenance costs, less than \$100,000 per year.

Time Period: 2024-2028

Funding Source: Hazard Mitigation Grant Program and local agency general funds

Source and Date: 2023 Natural Hazards Mitigation Plan Update

Initiative and Implementation Status: During the 2023 Hazard Mitigation Plan update, this initiative was recoded from CW-EH-1 to CW-MH-12. It is modified to expand modeling capacity from earthquake to multiple hazards. Several Hazus model scenarios for earthquake, flood, dam failure, and sea level rise were developed by a contractor to inform the updated plan's risk assessment. The 2022-2023 data and model scenarios will be housed with Thurston County Emergency Management for future application and future model development.

CW-MH-1: Critical Infrastructure Inventory

Benefit-Cost Review Score: 28 **Status:** Ongoing

Hazard Addressed: Multi Hazard

Category: Data Collection and Mapping

Background and Need: Tracking critical infrastructure and facilities information is essential for hazard mitigation, emergency management, and resiliency planning activities. Maintaining an accurate and comprehensive critical infrastructure database will improve communities' ability to conduct risk assessments, identify vulnerabilities, maintain situational awareness, and prioritize the restoration of essential lifeline services in a post-disaster recovery situation. This action will coordinate data collection and inventory with the tribes, state, county, cities, special purpose districts, and private utilities. Planning partners will identify data definitions and storage, mapping, reporting, permissions, and database maintenance needs.

Relates to Plan Goal(s) and Policies: 2D, 6C, 7B, 8A

Lead: Emergency Management Council of Thurston County in partnership with tribes, state, county, cities, special purpose districts, and private utilities

Estimated Cost: Low, $100,000 to $500,000

Time Period: 2024-2028

Funding Source: To be determined

Source and Date: 2003 Natural Hazards Mitigation Plan for the Thurston Region

Initiative and Implementation Status: In 2023 this action's status was updated to "Ongoing." Essential facilities and critical assets data collection and database development was performed as part of the 2023 Hazard Mitigation Plan Update. Future data collection efforts need to strive for a more consistent accounting of similar assets among all the critical facility owners.

CW-LH-1: Countywide Landslide Hazards Mapping

Benefit-Cost Review Score: 22 **Status:** New

Hazard Addressed: Landslide

Category: Data Collection and Mapping

Background and Need: Enroll in the Washington Geological Survey Landslide Hazards Program to accurately inventory and map the county and cities' landslide hazards. Thurston County communities will seek technical assistance from the Washington Geological Survey Landslide Hazards Program to accurately inventory and map landslide hazards throughout the Thurston Region. The data will be used to assist communities with assessing landslide hazard areas, mitigating potential future losses, and updating comprehensive plans, zoning codes, development regulations, and policies.

Relates to Plan Goal(s) and Policies: 7B, 8B

Lead: Thurston County, cities, tribes, special purpose districts, Washington Department of Natural Resources Washington Geological Survey, US Geological Survey, and other stakeholders.

Estimated Cost: $100,000

Time Period: 2024-2028

Funding Source: Washington Geological Survey Landslide Hazards Mapping Program and local agency general fund and in-kind staff participation

Source and Date: 2023 Natural Hazards Mitigation Plan Update.

Initiative and Implementation Status: This initiative was identified during the 2023 Hazard Mitigation Plan update process. Progress on this initiative will be reported during the next plan update.

CW-MH-7: Critical Asset Management System

Benefit-Cost Review Score: 23 **Status:** Existing

Hazard Addressed: Multi Hazard

Category: Hazard Preparedness

Background and Need: During disasters, supplemental and/or specialized resources are in demand by affected communities. Examples of shared assets include personnel, specialized teams, and equipment. Ready access to a system of available critical resources and a means to request them can minimize losses or expedite recovery. This initiative proposes a coordinated phased approach to: 1) Convene partners to identify appropriate locally owned assets and resources that can be shared; 2) Evaluate the need for pre-executed interlocal agreements for resource sharing; 3) Develop or acquire an online tool to support requests and procurement; and 4) Maintain the system. This tool will streamline resource requests, tracking, and allocation.

Relates to Plan Goal(s) and Policies: 1D, 5D

Lead: Thurston County Emergency Management in partnership with tribes, cities, fire districts, school districts, utilities, and other regional stakeholders

Estimated Cost: Low, up to $100,000

Time Period: 2024-2028

Funding Source: Grants and local agency general funds

Source and Date: 2009 Natural Hazards Mitigation Plan for the Thurston Region

Initiative and Implementation Status: Some critical assets are inventoried in WebEOC. Implementing this project has been challenged by budget constraints, personnel changes, and COVID 19 response.

CW-SL-1: Olympia Sea Level Rise Response Plan Implementation

Benefit-Cost Review Score: 32 **Status:** New

Hazard Addressed: Sea Level Rise

Category: Hazard Damage Reduction

Background and Need: Downtown Olympia is a regional social, cultural, historic, and economic center in Thurston County. The Port of Olympia's Marine Terminal, the LOTT Clean Water Alliance Budd Inlet Wastewater Treatment Plant, state agencies, the Intercity Transit Downtown Station, and other regional critical facilities are located downtown.

Downtown Olympia is vulnerable to flood hazards from sea level rise (SLR). With only a 12-inch increase in SLR, a 100-year flood event could occur every other year. The recognition of this increased flood risk created a need for the City of Olympia, the Port of Olympia and the LOTT Clean Water Alliance to form a collaborative partnership and produce the 2019 "Olympia Sea Level Rise Response Plan."

The Olympia SLR Response Plan's vulnerability and risk assessment identified the key assets and services that would be adversely impacted during king tide and storm surge flooding events for several SLR scenarios ranging from zero to 68 inches.

During high flow events in the Deschutes River watershed, as observed in January 2022, assets along the Capitol Lake shoreline are exposed to flooding. An extreme coastal storm surge event could also cause flooding along the Percival Landing and Isthmus shorelines, as occurred in December 2022. In addition, flooding of the combined sewer system could convey floodwaters to the Budd Inlet Wastewater Treatment Plant and overwhelm the plant, resulting in an increased likelihood of untreated or partially treated wastewater being discharged directly to Budd Inlet.

This initiative would address the physical, operational, governance and information strategies outlined in the Olympia SLR Response Plan. Examples of capital projects, operational, governance and information strategies include, but are not limited to:

- Construct a berm at Heritage Park
- Install raised planters along Columbia Street and 4th Avenue
- Raise vulnerable Budd Inlet Treatment Plan components
- Raise Billy Frank Jr. Trail
- Consolidate stormwater outfalls and construct a stormwater discharge pump station
- Protect Percival Drinking Water Pump station
- Conduct emergency response activities during flooding events
- Develop and implement a sea level rise community and stakeholder strategy

Relates to Plan Goal(s) and Policies: 1B, 2A, 2B, 2D, 5B, 6A, 6B, 7D, 8A, 9A, 9B

Lead: The Sea Level Rise Collaborative: The City of Olympia, LOTT Clean Water Alliance and the Port of Olympia in partnership with downtown businesses, residents, and a variety of stakeholders.

Estimated Cost: Full implementation of all capital projects and recommendations is estimated at $190M to $350M (2018 planning estimate)

Time Period: 2023 – 2100

Funding Source: General funds, grant program funds for specific projects

Source and Date: Olympia Sea Level Rise Response Plan, March 2019

Initiative and Implementation Status: To implement the Olympia SLR Response Plan and inform its evolution, the partnership formed the Olympia Sea Level Rise Response Collaborative (Collaborative) through an Interlocal Agreement. The Collaborative has adopted an annual budget and work plan and its short-term focus is on conducting a groundwater study, a land subsidence survey and investigating funding mechanisms.

Mitigation Initiatives Removed from the Regional Mitigation Strategy

The plan update process removed five initiatives (Table 2.3) from the Countywide Mitigation Strategy:

- Two initiatives were completed
- One initiative was replaced
- Three initiatives were removed because they are no longer relevant

Additional details about why the initiatives were removed are shown in each initiative's implementation status in the pages that follow.

Table 2.3 Former Mitigation Initiatives Removed from the Countywide Mitigation Strategy

Initiative	Status	Former Ranking
Data Collection and Mapping		
CW-HW-1 Map the Region's High Risk Wildland Urban Interface Communities	Completed	6 of 12
CW-MH-9 Map Transportation Infrastructure subject to flooding and landslide hazards	Replaced	10 of 12
CW-MH-10 Develop and Adopt a Climate Adaptation Plan	Completed	11 of 12
Hazard Preparedness		
CW-SH-1 Develop a Debris Management Strategy	Completed	5 of 12
CW-MH-8 Strengthen Capabilities and Situational Awareness of Health and	Removed	12 of 12

CW-SH-1: Develop a disaster debris management strategy

Hazard Addressed: Storm/Weather **Status:** Completed

Category: Hazard Preparedness

Background and Need: Storms such as the January 2012 Winter Storm, the 1996 Ice Storm, and the 1993 Inaugural Day Windstorm each generated significant vegetative and building damage debris. HAZUS estimates of earthquake and flood debris generation also highlight the need for a coordinated debris management plan. This plan will improve coordination between local agencies, utility providers, and affected individuals and organizations to manage clean-up efforts.

Relates to Plan Goal(s) and Policies: 5C, 5D, 6B, 7C

Lead: Thurston County, cities, Port of Olympia, Washington State Department of Ecology, Olympic Region Clean Air Authority, Puget Sound Energy, and private contractors

Estimated Cost: Low

Time Period: 2017-2021

Funding Source: Grants and local match

Source and Date: 2003 Hazard Mitigation Plan

Initiative and Implementation Status: This initiative was the 5th ranked priority in the previous plan. In 2016, Thurston County initiated the development of a debris management strategy. This initiative was removed from the plan as it was completed. Future monitoring and maintenance of this strategy will be performed independent of the regional hazard mitigation planning process.

CW-WH-1: Map the region's high risk wildland urban interface communities

Hazard Addressed: Wildland Fire **Status:** Completed

Category: Data Collection and Mapping

Background and Need: The methodology for determining risk for wildfire relies on outdated analysis performed by the Washington State Department of Natural Resources (DNR) and forms the basis of the wildland urban interface fire risk assessment in this plan. Local protection fire districts need updated data and maps that reflect areas of the community that are at risk for wildland fires. This information would assist communities in developing wildfire protection plans, community education, and mitigation activities.

Relates to Plan Goal(s) and Policies: 1B, 3A, 7B

Lead: Thurston County Association of Fire Chiefs, DNR, Emergency Management Council, and TRPC

Estimated Cost: Low

Time Period: 2017-2021

Funding Source: Grants and in-kind staff resources from local fire districts and community development and planning departments

Source and Date: 2009 Natural Hazards Mitigation Plan

Initiative and Implementation Status: This initiative was the 6th ranked priority in the previous plan. In 2019, the Washington State Department of Natural Resources prepared a statewide map of Wildland Urban Interface and Intermix areas. This data was used for updating the region's wildland fire risk assessment as part of the plan update. This initiative was removed and will be replaced by a new initiative, CW-WH-2 Community Wildfire Protection Plan.

CW-MH-9: Map transportation infrastructure that is subject to frequent flooding or is prone to landslide hazards

Hazard Addressed: Multi Hazard **Status:** Replaced

Category: Data Collection and Mapping

Background and Need: There are numerous road segments and culverts that experience flooding or the effects of landslides during periods of above normal rainfall. These facilities are routinely closed for public safety, resulting in temporary or prolonged detours that delay travelers and the delivery of emergency services. Public Works maintenance crews have first-hand knowledge of these locations, but they are not systematically mapped. Developing a GIS database of these facilities would assist with planning transportation projects and mitigating potential hazardous situations. This data would also be used for assessing vulnerability and increased risks to transportation infrastructure from the effects of climate change. This initiative's activities will consist of data collection, mapping, and vulnerability analysis.

Relates to Plan Goal(s) and Policies: 2A, 2B, 8B

Lead: TRPC and regional stakeholders.

Estimated Cost: Low

Time Period: 2017-2021

Funding Source: National Estuary Program and Watershed Protection and Restoration Grant and TRPC Regional Transportation Program Funding

Source and Date: 2017 Natural Hazards Mitigation Plan

Initiative and Implementation Status: This was the 10th ranked initiative in the previous plan. This task was completed under the development of a Thurston Climate Adaptation Plan. Additional work is necessary to develop a longer-term multi-hazard assessment of the region's critical transportation infrastructure. This initiative will continue under the revised CW-MH-4 Lifeline Transportation Resiliency Route Planning and Mapping.

CW-MH-10: Develop and adopt a Climate Adaptation Plan

Hazard Addressed: Multi Hazard **Status:** Completed

Category: Plan Coordination and Implementaion

Background and Need: Preparing for and adjusting to the effects of a warming world — is now "unavoidable," the Intergovernmental Panel on Climate Change (IPCC) — the United Nations' climate research arm — concluded in its 2007 climate assessment. Even the most stringent efforts to reduce greenhouse gases "cannot avoid further impacts of climate change in the next few decades," the report explained. TRPC received a U.S. EPA National Estuary Program (NEP) grant administered by the Washington Department of Commerce to draft a watershed-based climate adaptation plan that will recommend actions Thurston County stakeholders could take to prepare for and cope with floods, droughts, wildfires, and other climate change-exacerbated hazards in the decades ahead. The planning work — which began in late 2015 and will conclude in late 2017 — includes: researching and analyzing climate change projections; assessing regional climate change vulnerabilities and risks; developing adaptation strategies and conducting benefit-cost analyses; and, presenting TRPC policymakers a draft plan with adaptation recommendations.

Relates to Plan Goal(s) and Policies: 4A, 4B, 4C, 5B, 7D, 8B

Lead: TRPC and regional stakeholders.

Estimated Cost: $270,000

Time Period: 2015-2018

Funding Source: National Estuary Program grant and TRPC Regional Transportation Program funding (funding secured)

Source and Date: Creating Places Preserving Spaces, a Sustainable Development Plan for the Thurston Region and the 2017 Natural Hazards Mitigation Plan

Initiative and Implementation Status: This was the 11th ranked initiative in the previous plan. TRPC adopted the Climate Adaptation Plan in 2018. In addition, Thurston County and the cities of Lacey, Olympia, and Tumwater adopted a Climate Mitigation Plan in 2020. In 2023 the Washington Legislature passed HB 1181 which requires communities planning under the Growth Management Act to incorporate climate resiliency into comprehensive plans.

CW-MH-8: Strengthen the capabilities to establish and to maintain situational awareness of health and medical system and resource coordination during an emergency

Hazard Addressed: Multi Hazard **Status:** Removed

Category: Hazard Preparedness

Background and Need: Prior to an emergency, the public health and health care system in Thurston County must work together to meet the needs of residents. The accurate coordination of information supports decision making processes of local, state, tribal, and private sector partners to carry out effective response measures to reduce harm and exposure to residents. Partner's use of an information system will provide multi-agency coordination and better assessment of risk, so effective mitigation and response strategies can be implemented. Resources available include patient movement tools such as Region 3 Healthcare Preparedness Coalition Disaster Medical Coordination Center, National Disaster Medical System, and Washington State Disaster Medical Control Center.

Relates to Plan Goal(s) and Policies: 1D, 5B, 5D

Lead: Thurston County Health and Social Services Department of Health 7 Region 3 Healthcare Preparedness Coalition

Estimated Cost: Low

Time Period: 2017-2021

Funding Source: Grants and local match

Source and Date: 2009 Natural Hazards Mitigation Plan

Initiative and Implementation Status: This was the 12th ranked initiative in the previous plan. The COVID 19 pandemic resulted in substantial changes to the processes and capabilities of Thurston County Public Health and Social Services and the Region 3 Healthcare Preparedness Coalitions ability to track disease metrics and response activities. This initiative was removed from the plan update. It is included in Thurston County's Comprehensive Emergency Management Plan in Emergency Support Function 8.

Figure 2.3 Regional Hazad Mitigation Initiatives Benefit-Cost Review Score Results

Mitigation Initiative	Hazard Risk Rating	Project Cost	HMP Goals and Objectives	Life/Safety	Social Vulnerability	Changes in Development	Climate Change	Geographic Impact	Total Score
Public Outreach and Information									
CW-MH-6 Regional Hazard Mitigation Public Outreach Strategy	5	5	5	3	5	3	5	5	36
Plan Coordination and Implementation									
CW-WH-2 Countywide Multijurisdictional Community Wildfire Protection Plan	5	3	5	3	5	5	5	5	36
CW-SH-2 Extreme Heat Incident Response and Illness Prevention Plan	3	3	5	5	5	1	5	5	32
CW-MH-13 Ongoing Hazard Mitigation Planning Workgroup Coordination	5	5	5	1	1	5	3	5	30
CW-DH-1 Develop Emergency Evacuation Routes for Potential Catastrophic Dam Failure	1	1	5	5	5	1	3	5	26
Data Collection and Mapping									
CW-MH-11 Countywide Emergency Shelter Capacity and Operational Assessment	5	3	3	5	5	3	5	5	34
CW-MH-4 Develop a Regional Transportation Resiliency Plan	5	3	5	1	3	3	3	5	28
CW-MH-12 Hazard Modeling and Loss Estimation Capacity Building	5	3	5	1	1	5	3	5	28
CW-MH-1 Critical Infrastructure Inventory and Data Development	5	3	5	1	1	3	1	5	24
CW-LH-1 Countywide Landslide Hazards Mapping	3	5	1	1	1	5	1	5	22
Hazard Preparedness									
CW-MH-7 Interjurisdictional Critical Asset Management System Development	5	5	3	1	3	0	1	5	23
Hazard Damage Reduction									
CW-SL-1 Olympia Sea Level Rise Response Plan Implementation	3	3	5	3	3	5	5	5	32

Benefit Review Criteria Points Explanation: High: 5 points; Medium: 3 points; Low: 1 point; No benefit: 0 points.

Chapter 3
Community Profile & Capability Assessment

Introduction

Chapter 3 is divided into two sections:

1. **Community Profile:** Presents a general overview of Thurston County's geography, population, economy, development trends, special purpose districts, and its multimodal transportation system.
2. **Capability Assessment:** Describes the evaluation tools that are available to plan participants to assess their mitigation planning capabilities. This section also summarizes the resources that communities can leverage to carry out this plan and implement risk reduction measures.

Find additional data about the Thurston Region online at www.trpc.org/theprofile.

1. Community Profile

Maps A1-A10 and Tables A1-A13 for Chapter 3.0 can be found in Appendix A: Community Profile Maps and Tables.

Location, Geography, and Climate

Thurston County, located in Western Washington at the terminus of Puget Sound, is home to three tribal areas and seven incorporated towns and cities. Thurston County is known for scenic waterways, native prairieland, and dense protected forests. The county is home to Washington State's Capitol, and government agencies and enterprises are the region's largest employer.

It is the 32nd largest county in the state with a total land area of 737 square miles. It is bordered by Mason, Grays Harbor, Lewis, and Pierce counites. The county's three tribal areas include the Nisqually Indian Reservation in the east, the Confederated Tribes of the Chehalis Reservation in the southwest, and the Squaxin Indian Reservation which borders the county in the northwest. Joint Base Lewis-McChord, the fourth most populous US military base, occupies a large tract of land from Pierce County into central eastern Thurston County. In the west, Capitol State Forest includes nearly 100,000 acres. While approximately 87 percent of the county's land area is unincorporated, it includes seven cities and towns and two unincorporated communities listed below (See Map A1 and Table A1):

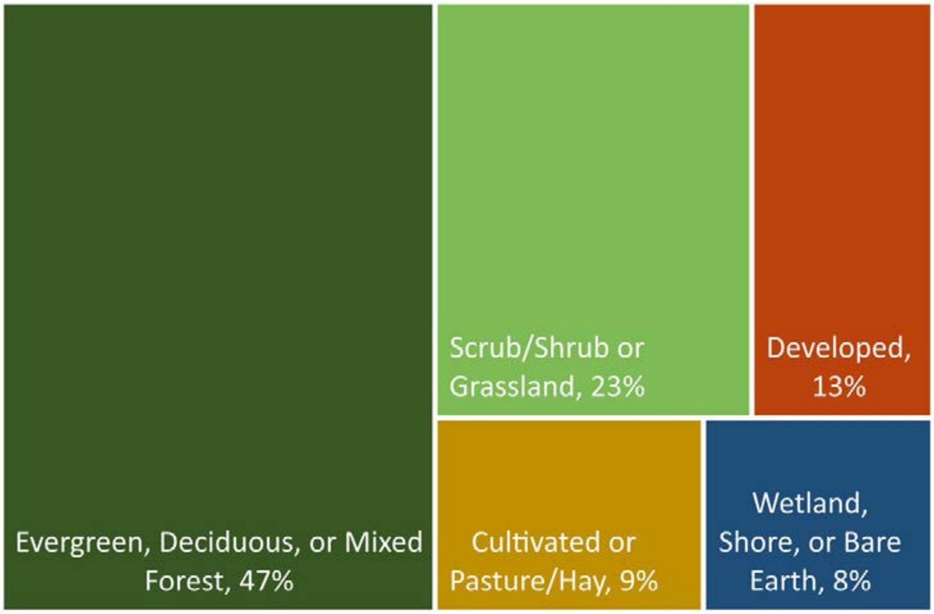


Figure 3.1 Thurston County Land Coverage.

See Table A2 in Appendix A for more detail. Source: NOAA C-CAP

- Town of Bucoda
- City of Lacey
- City of Olympia
- City of Rainier
- City of Tenino
- City of Tumwater
- City of Yelm
- Grand Mound Urban Growth Area (unincorporated)
- Rochester Community (unincorporated)

The county's landcover ranges from coastal lowlands to prairie flatlands to the foothills of the Cascades (Map A2). The land is dotted with lakes, and the northernmost boundary of the county is lined with the shoreline of Puget Sound. Four local watersheds flow to the Pacific Ocean basin and five flow to the Puget Sound basin. Approximately 43 percent of the county's waters flow into the Pacific Ocean and 57 percent drains to the Puget Sound. The northwest and southeast corners of the county are marked by peaks ranging from 1,700 to 3,000-foot elevations. Steep slopes, miles of shoreline, and forested areas leave the county vulnerable to a range of natural hazards.

Thurston County has a marine climate with mild temperatures year-round. In the warmest months, the average high temperature ranges between 70 and 80 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. Averaging 52 clear days a year, 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.

Population

As of 2022, Thurston County's is home to a population of 300,500, cementing it as the seventh most-populous county in the state (Map A3). Thurston County has been one of the fastest-growing counties in Washington State since the 1960s, consistently exceeding the state's overall rate of growth. Two factors drive population growth: net migration (people moving in minus people moving out) and natural increases (births minus deaths). Since 1960, in-migration has caused most of the growth, and since 2010 the rate of natural increase has continuously dropped. Between 2016 and 2021, Thurston County's population increased by an average of 4,357 people annually and 84 percent of growth was the result of in-migration. The increased cost of living in the Seattle metropolitan area has helped drive individuals to the region.

Thurston Regional Planning Council's 2045 population forecast is 383,500, meaning 83,000 more people will live in the region than in 2022 (Map A4, Table A3). Most future residents will live in the cities and urban growth areas while approximately a quarter of the population will reside in rural unincorporated areas.

Figure 3.2 Social Vulnerability Index Characteristics for Thurston County

Household Characteristics

- 4% of residents over age 5 speak English less than "very well"
- 14% of residents have a disability
- 9% of households have children and a single parent
- 21% of residents are under the age of 18
- 17% of residents are over the age of 64

Housing and Transportation

- 5% of households do not have a vehicle
- 10% of households are in structures with 10 or more units
- 11% of households are in manufactured homes
- 2% of residents are in group quarters
- 2% of households have more occupants than bedrooms
- 33% of households are renter-occupied

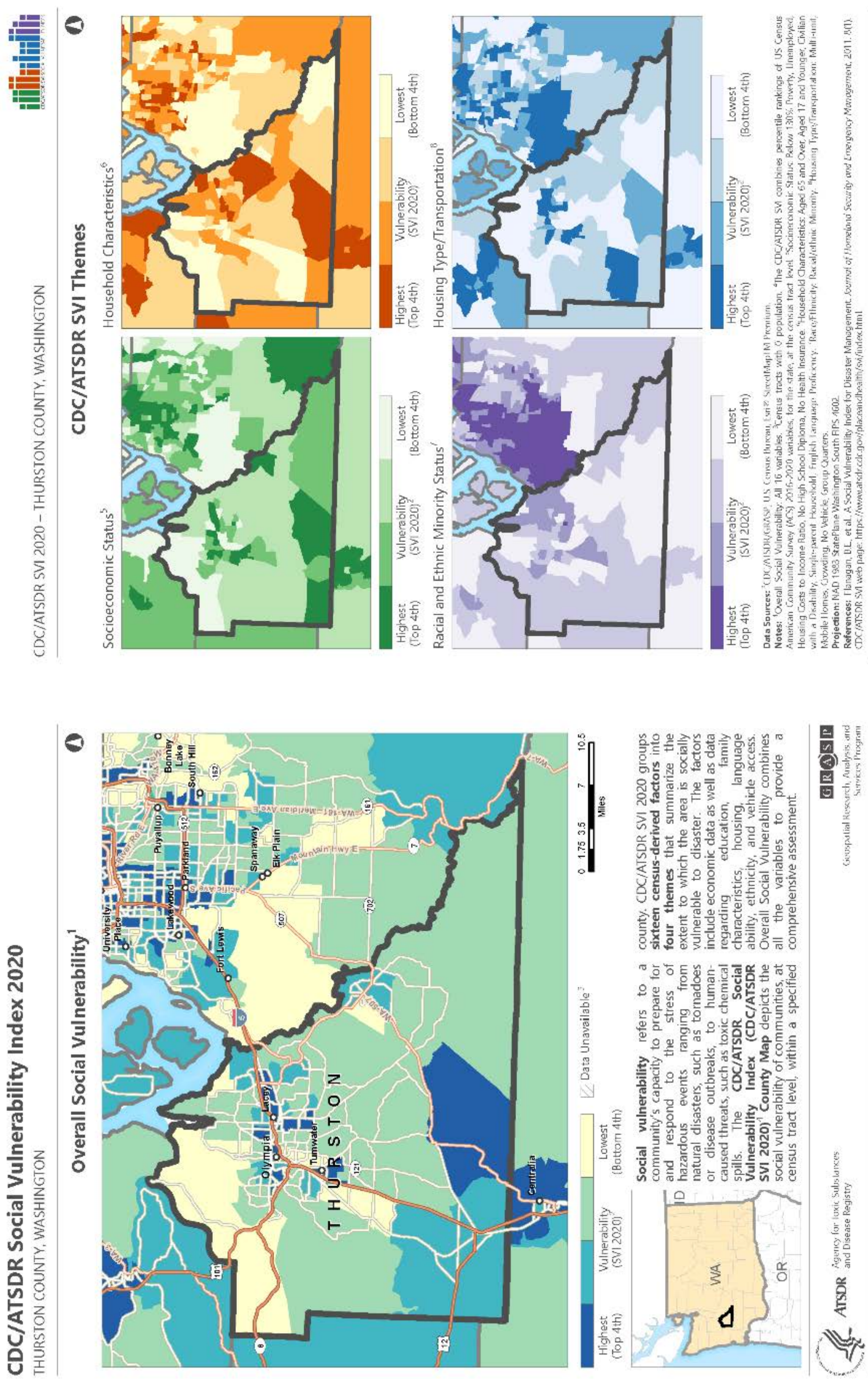
Socioeconomic Status

- 3% of residents 16 years of age or older are in the labor force and unemployed
- 6% of residents 25 years of age or older do not have a high school diploma or GED
- 32% of households are cost-burdened
- 14% of households are severely cost-burdened
- 5% of residents do not have health insurance
- 17% of residents have an income within 150% of the federal poverty level

Race and Ethnicity

- 29% of residents identify as a person of color

Figure 3.3 Social Vulnerability Index for Thurston County



Social Vulnerable Populations

Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events. There are several factors that may make individuals or families more vulnerable to natural hazards, or socially vulnerable. It is important to recognize and acknowledge these factors to ensure that the hazard mitigation planning process engages individuals with higher vulnerability and produces a mitigation strategy that is beneficial to them. There are many factors that may contribute to a group or individual's social vulnerability, including but not limited to:

- Income
- Housing type
- Health characteristics
- Age
- Race
- English proficiency

Social Vulnerability Index for Thurston County

The Centers for Disease Control/Agency for Toxic Substances and Disease Registry Social Vulnerability Index (CDC/ATSDR SVI) uses 16 U.S. census variables to help local officials identify communities that may need support before, during, or after disasters. Variables are organized into four topics areas: Socioeconomic Status, Households Characteristics, Racial & Ethnic Minority Status, and Housing Type & Transportation. Census tracts are ranked against other tracts in the state to show overall vulnerability and vulnerability in each topic area. The variables used to determine Social Vulnerability, such as population with a disability, population with no health insurance, or housing units without a vehicle, are reported below for Thurston County (See Figures 3.2 and 3.3). Table A4 in Appendix A includes the variables broken out by each Thurston County jurisdiction.

Homelessness

Individuals experiencing homelessness often face the highest barriers to prepare for and respond to natural hazards and receive timely information about expected hazards. The Thurston County Point-in-Time homeless count in 2022 recorded a total of 661 individuals living in transitional housing, emergency shelter, vehicles, or outside. Approximately 52% of individuals in the count were unsheltered or living in places not meant for human habitation such as cars, tents, or sidewalks (Table A5). It is estimated that the total count underestimates the number of residents experiencing homelessness, as people who did not consent to being surveyed are not included. During the 2022-2023 school year, approximately

1,265 students in Thurston School Districts experienced homelessness (Table A6). This is a point-in-time count and does not include all students who may have experienced homelessness at any point during the year. The districts with the highest number of students experiencing homelessness were North Thurston (684 students) and Yelm (173 students). The districts with the highest proportion of students experiencing homelessness were North Thurston (5%) and Rochester (4%).

Economy

Home to Washington State's Capitol, Thurston County's local economy is dependent on government employment. Government and government services employ 26% of all workers in the county. While the City of Lacey is now the most populous Thurston County community, the City of Olympia and its Urban Growth Area has the highest concentration of jobs, approximately 47% of jobs countywide in 2017. Healthcare and social assistance are the second largest industry in the county, employing approximately 12% of workers. While not located in Thurston County, Joint Base Lewis-McChord employs a significant number of Thurston residents in military and civilian positions.

For most of the 2010s, Thurston County's unemployment rate slightly exceeded that of Washington state and stayed higher than the national rate. In 2020, when the COVID-19 pandemic significantly halted economic activity, state and national unemployment rates increased to over 8% and exceeded the county rate. After a sharp incline from COVID-19, Thurston County's unemployment rate as of 2021 still exceeds pre-pandemic levels yet shows the community is returning to normal. Refer to Table A7 for median household income by Thurston County jurisdictions.

Development Trends

Over the past two decades, the proportion of development occurring in urban areas has increased. Density within urban centers and corridors has increased dramatically, allowing residents to readily access goods and services, and preserving rural lands from seeing the brunt of development. As development occurs, the total area of impervious surfaces increases, and natural features such as trees and streams are removed or altered.

Between 2017 and 2021, 8,592 residential building permits were issued countywide (Table A10). Approximately 65% of the permits were issued in incorporated cities, and 18% were issued in areas of the rural unincorporated county. The City of Lacey had the highest proportion of total permits issued at 28%, with Olympia and Tumwater following behind at 17% and 14% respectively. As housing has become less affordable, the amount of multifamily housing permitted has increased. Approximately 52% of residential building permits during this period were for multifamily units. Maps A5 and A6 show housing density for 2022 and 2045 respectively.

Tables A8 and A9 show total house estimates by jurisdiction and housing estimates by type.

Special Districts

Thurston County has many special districts that provide a wide variety of public services including cemetery, conservation, drainage, fire protection, library, parks, port, school, utility, and transportation benefit districts. Maps A7 and A8 show the school and fire district boundaries. Tables A10 and A11 show population by school districts and fire districts. These districts and other regional organizations are important partners in hazard mitigation planning, as they provide focused input and can carry out their own mitigation initiatives. Figure 3.4 lists the special districts and regional agencies that operate in Thurston County.

Multimodal Transportation System

Road Network

Thurston County, as a whole, has a well-connected road network to move people, freight, goods, and services. There are over 2,540 centerline miles of roads countywide. Over 1,660 miles are owned and managed by local governments, 293 miles by the state, and the rest are privately owned or located on Joint Base Lewis-McChord.

In general, most rural roadways operate with minimal congestion. Arterials and collectors

Figure 3.4 Special Purpose Districts in Thurston County

Cemetery Districts
Thurston County Cemetery District No. 1
Thurston County Cemetery District No. 2

Conservation Districts
Thurston Conservation District

Drainage Districts
Chambers Lake Drainage District No. 3
Hopkins Drainage District No. 2
Scott Lake Drainage District No. 11

Emergency Dispatch
TCOMM 9-1-1 Fire Protection Districts

Fire Protection Districts
1 & 11 - West Thurston Regional Fire Authority
2 & 4 - SE Thurston Regional Fire Authority
3 - Lacey
6 - East Olympia
8 - South Bay
9 - McLane Black Lake
12 & 16 - South Thurston Fire & EMS
13 - Griffin
17 - Bald Hills

Park Districts
Tanglewilde Park and Recreation District No. 1

Port Districts
Port of Olympia

Public Transportation Benefit Area
Intercity Transit

Regional Agencies
Capitol Region Educational Services District 113
Housing Authority of Thurston County
Lewis - Mason - Thurston Area Agency On Aging
Olympic Region Clean Air Agency
Timberland Regional Library
Thurston Regional Planning Council: Metropolitan Planning Organization

School Districts
Griffin School District No. 324
North Thurston Public Schools
Olympia School District No. 111
Rainier School District No. 307
Rochester School District No. 401
Tenino School District No. 402
Tumwater School District No. 33
Yelm Community School District

Special Districts
Black Lake Special District

Transportation and Utility District
Lacey Transportation Benefit District
Olympia Transportation Benefit District
Tumwater Transportation Benefit District
LOTT Clean Water Alliance
Thurston Pubic Utility District

within and near the urban growth areas and the larger cities experience varying degrees of congestion during peak commute periods. Most congestion occurs on Interstate 5 (I-5) from the Nisqually Valley to the City of Tumwater. Congestion on State Routes 510 and 507 through Yelm is problematic when I-5 experiences major traffic disruptions with lane closures.

Highway of statewide significance include:

- Interstate 5
- U.S. Highway 101
- State Route 8
- State Route 12
- State Route 510

Ports

The Port of Olympia operates a 66-acre seaport, the southernmost port on the Puget Sound. The port's marine terminal includes three deepwater berths with a total of 1,750 lineal feat, a mobile harbor crane, and an on-dock 76,000 square foot warehouse, and on-dock rail service. The marine terminal located at the north end of the Port Peninsula in Olympia can provide bulk, breakbulk, heavy-lift, and other freight operations.

The Olympia Regional Airport is located in the City of Tumwater. The airport offers general aviation with aircraft services and maintenance operations, flight instruction, hangars and tie down space, state and corporate aviation facilities, and land and buildings available for aviation related uses.

Public Transportation

Intercity Transit provides public transportation for people who live and work in Olympia, Lacey, Tumwater, and Yelm with a service area of approximately 101 square miles. The agency operates 18 zero-fare fixed bus routes within the Lacey/Olympia/Tumwater/Yelm area and express services to Pierce County. Intercity Transit offers Dial-A-Lift door-to-door service for people with disabilities. In addition, Intercity Transit operates a vanpool program, specialized van program services, and several community services to enhance public transportation.

Rural Transit operates three weekday zero-fare routes for transit customers who live outside of Intercity Transit's Public Transportation Benefit Area. Morning, mid-day, and early evening trips provide basic transit services between Yelm, Rainier, Tenino, Bucoda, Grand Mound, Rochester, the Confederated Tribes of the Chehalis Reservation, Centralia, and Tumwater.

Refer to Maps A9 and A10 for intermodal and multimodal transportation facilities in Thurston County.

are important partners in hazard mitigation planning, as they provide focused input and can carry out their own mitigation initiatives. Figure 3.4 lists the special districts and regional agencies that operate in Thurston County.

Photo courtesy of Intercity Transit.

2. Capability Assessment

Why Conduct a Capability Assessment?

To effectively develop and implement a mitigation strategy, a community must assess the range of tools and capabilities that are available to support the process of planning for and implementing their mitigation strategy. Does a community have the authorities, regulations, plans, financing, and technical capabilities to understand their risks, vulnerabilities, and capabilities to become more disaster resilient? This section describes the regional capability assessment processes performed by the plan participants to assess their capabilities, obstacles, and areas that may need more capacity building. This chapter identifies various federal, state, local, and non-governmental resources that can assist Thurston County communities with hazard mitigation planning.

Hazard Mitigation Capability Self-Assessment

The plan participants performed an initial Hazard Mitigation Capability Self-Assessment Questionnaire in April 2022 to help their jurisdictions identify the capabilities they have available to support their mitigation plan. Fifteen planning partners responded to 20 questions about their organization's political support, familiarity, outreach programs, staff capabilities, National Flood Insurance Program (NFIP) status, and obstacles as they relate to hazard mitigation planning and activities.

Key findings from the self-assessment show that most respondents indicated moderate or strong support for participation in the Hazard Mitigation Plan (HMP) update process, and a moderate or high familiarity with hazard mitigation planning. The top obstacles to implementing HMP projects and programs include lack of staff time, lack of funding, and lack of familiarity and expertise.

Strengths, Weaknessess, Obstacles, and Opportunities (SWOO) Assessment

TRPC had introduced hazard mitigation principles and concepts to the plan participants during their first 10 meetings over the first year of the plan update process. In March 2023, nearly one year into the process, the Hazard Mitigation Planning Workgroup members participated in a self-paced online SWOO Assessment. Fifteen agencies and stakeholders rated their familiarity with twenty-five emergency management and hazard mitigation planning activities/program statements in both a regional and jurisdictional context as an area of "strength", "weakness", "not applicable", or "don't know."

Key findings related to regional hazard mitigation capabilities are that natural hazards are adequately mapped, and planning partners believe they are knowledgeable about hazards and their risks. However, respondents report that more effort is needed to improve community members' understanding of natural hazards, their risks, and how to access useful information. The SWOO respondents believe there is an effective regional planning framework, but more effort is needed to include relevant stakeholders in hazard mitigation planning.

Key findings related to jurisdictional hazard mitigation capabilities follow. Most respondents indicated they feel capable of assessing and mitigating their hazard risks, accounting for changes in population and land use patterns when assessing risk and developing effective mitigation strategies and seeking funding and resources to implement priority actions. Areas identified for improvement include:

- Having a strong policy framework to prioritize actions that benefit socially vulnerable populations.
- Accounting for the impacts of climate change in hazard risk assessments.
- Providing information to residents around flood insurance.
- Maintaining ongoing efforts to coordinate and implement the plan to reduce risks after the HMP is adopted.

A 27-page detailed assessment of the SWOO results is included in Appendix B.

Jurisdictional Capability Assessment

Each plan participant completed a series of detailed capability assessment worksheets to highlight their jurisdiction's capabilities, strengths, and gaps in their ability to implement their mitigation strategies. Jurisdiction-specific capabilities are documented in their annex to this plan. Copies of the assessment worksheets are included in the plan participants' annexes.

Regional Capability Assessment

FEMA identifies four types of mitigation capabilities:

1. **Planning and Regulatory** – Includes laws, ordinances, and plans that guide growth and development. These capabilities can either support risk reduction or create potential vulnerabilities.
2. **Administrative and Technical** – Includes staff, programs, or projects that can be leveraged for mitigation planning or having the means to implement mitigation actions.
3. **Financial** – The range of resources to fund mitigation actions.
4. **Public Outreach** – Includes organizations, programs, and activities that can be leveraged to communicate and encourage risk reduction among community members, businesses, and affected entities.

The remainder of this section identifies capabilities within the Thurston Region that are supportive of or could be leveraged to some degree to support mitigation planning. Each capability is accompanied by a general description and discussion of how it influenced the development of this plan and/or can be used for hazard mitigation.

Planning and Regulatory

There are a wide variety of laws, ordinances, and plans that provide authority for agencies to pursue hazard mitigation actions, though hazard mitigation is not necessarily the core focus of each item. Many of the plans that are detailed below are updated regularly. These regulatory tools provide local governments an opportunity to leverage their amendment and development processes to better incorporate hazard mitigation into their regulatory frameworks through existing plans, goals, policies, and lines of business.

ACRONYMS USED

COM – Washington Department of Commerce

DNR – Washington Department of Natural Resources

ECY – Washington Department of Ecology

EMC – Emergency Management Council of Thurston County

EMD – Washington Emergency Management Division

EPA – Environmental Protection Agency

FEMA – Federal Emergency Management Agency

FHWA - U.S Department of Transportation Federal Highway Administration

FWS – U.S. Fish and Wildlife Service

HUD – U.S. Department of Housing and Urban Development

NOAA – National Oceanic and Atmospheric Administration

SBCC – Washington State Building Code Council

USBR – U.S. Bureau of Reclamation

USDOT – U.S. Department of Transportation

National Mitigation Planning and Regulary Mechanisms

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
Clean Water Act (CWA)	EPA	Employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage pollutant runoff.	Permitting requirements can affect mitigation projects. CWA requirements can apply to wetlands, which can be used to mitigate risks from several hazards. Requirements strongly influence stormwater management, a critical mitigation tool.
Disaster Mitigation Act of 2000 (DMA)	FEMA	Directs hazard mitigation planning and puts an emphasis on pre-disaster planning. Requires communities to have hazard mitigation plans to access Hazard Mitigation Assistance grant funds.	This hazard mitigation plan has been developed to meet the requirements of DMA and ensure planning partners can access grant funds.
Endangered Species Act (ESA)	NOAA, FWS	Works to conserve species facing depletion or extinction and their habitats. Determines which species are threatened or endangered.	The planning area includes habitat of several species covered under ESA. Habitat Conservation Plans can be used to mitigate risks from several hazards.
FEMA Risk MAP	FEMA	Provides data and supports long-term hazard mitigation planning, specifically to mitigate flood risks. Program through which Flood Insurance Rate Maps (FIRMs) and Base Flood Elevations (BFEs) are updated.	The flood risk assessment chapter used Risk MAP products to define the floodplain. As products are updated, staff should use these and work to protect new areas at risk of flooding.
National Flood Insurance Program (NFIP) & Community Rating System (CRS)	FEMA	NFIP: Provides federally backed flood insurance to communities that enact floodplain regulations. Unlocks grant funding. CRS: Voluntary program within NFIP that encourages floodplain regulations exceeding the minimum NFIP requirements. Provides lower flood insurance premiums.	Several communities in the planning area participate and are in good standing with NFIP. Thurston County participates in CRS. NFIP programs enable communities to reduce flood risk and provide flood protection benefits to residents. Communities will address NFIP compliance in their plan annexes.

State Mitigation Planning and Regulary Mechanisms

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
Growth Management Act (GMA)	COM	Directs local planning and sets requirements for comprehensive plans. HB 1181 became law in 2023, which incorporated resiliency into comprehensive planning.	The goals, policies, and guiding principles of this plan should be consistent with the GMA. Under the climate change and resiliency goal, comprehensive plans, development regulations, and regional plans must prepare for climate impact scenarios, foster resiliency to climate impacts and natural hazards, protect and enhance environmental, economic, and human health and safety, and advance environmental justice.
Shoreline Management Act	ECY	Manages and protects shorelines and associated wetlands by regulating development. Authorizes local governments to administer regulations through Shoreline Master Programs (SMPs).	Planning partners with SMPs should ensure their annexes are consistent with their SMP goals, policies, and regulations. SMP goals, policies, and regulations should work to mitigate risks from hazards.
State Environmental Policy Act (SEPA)	ECY	Requires environmental issues to be addressed in land use decisions. The review process involves identifying probable environmental impacts and mitigation measures to reduce adverse impacts.	Agencies can use SEPA to regulate development in and around sensitive areas and areas of known hazards. SEPA can help fill gaps that local development regulations may not cover. Mitigation actions may be subject to SEPA review.
Washington State Enhanced Hazard Mitigation Plan (SEHMP)	EMD	Profiles hazards, identifies risks and vulnerabilities, and proposes strategies and actions to reduce risks to people, property, the economy, the environment, infrastructure and first responders. Unlocks higher funding from HMGP due to enhanced status.	The goals and policies of this plan are consistent with the SEHMP. The SEHMP is used to help identify best available data and methodologies to identify risks.
Washington State Floodplain Management Law	ECY	Gives ECY regulatory control over floodplain management. Authorizes county governments to levy taxes, condemn properties, and undertake flood control activities directed toward a public purpose.	Jurisdictions can use the authority created by the law to regulate development in and around floodplains.
Washington State Building Code	State Building Code Council	Most state building codes are modeled after national codes and amended at the state level. Some are state-specific codes. The codes cover commercial, residential, mechanical, fire, Wildland-Urban Interface, plumbing, ventilation, and historic codes.	Adoption, implementation, and enforcement of building codes is one of the most effective means to mitigate risks from hazards. Planning partners can also advocate for code changes that support resilience and hazard mitigation.

Regional Mitigation Planning and Regulary Mechanisms

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
Countywide Planning Policies	TRPC	Establishes a framework for developing and adopting county and city comprehensive plans. Provides coordination for regional issues or issues affecting common borders.	Hazard mitigation strategies can be included as policies, and the mitigation planning process should be guided by these policies.
Regional Transportation Plan (RTP)	TRPC	Serves as a strategic blueprint for the region's transportation system. Provides an overall analysis of how transportation will work in the region over a 20-25-year time frame and supports coordination among jurisdictions. Updated regularly.	Hazard mitigation can be incorporated into the guiding principles, goals, and policies of the plan, and these items should influence this plan's contents and initiatives. Mitigation can be incorporated into the projects listed in the plan.
Thurston Climate Adaption Plan (TCAP)	TRPC	Summarizes observed and projected impacts of climate change with risk and vulnerability assessments. Includes a list of adaptation actions for the public- and private-sectors.	Adaptation actions can be considered as countywide or individual agency mitigation initiatives. When adaption actions are carried out, mitigation from a variety of hazards can be incorporated in the final design and implementation.
Thurston Climate Mitigation Plan (TCMP)	TRPC	Presents a regional framework for how Thurston County, Lacey, Olympia, and Tumwater can work together to make measurable progress to reduce local contributions to climate change while building a stronger, healthier, and more resilient region.	Climate mitigation actions can be considered as countywide or individual agency mitigation initiatives. Climate mitigation is critical to reduce the effects of climate change on hazards such as storms and severe weather, flooding, wildfire, landslides, and loss of natural resources.
Thurston County Flood Hazards Mitigation Plan	Thurston County	Assesses countywide flood risks and establishes goals, objectives, and a mitigation strategy to reduce risks from flood events. Updated regularly.	Mitigation initiatives can be carried over between the flood plan and HMP. The risk assessments of each plan build on information presented in previous editions.
Thurston Region Disaster Recovery Framework	EMC	Outlines how local governments can leverage federal and state support and work with community partners to recover quickly and efficiently from disasters.	The framework supports coordinated, efficient recovery in the short- and long-term periods following a disaster. The recommendations from the framework planning process can be included as initiatives in the HMP.

Local Mitigation Planning and Regulary Mechanisms

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
Capital Facilities Plan	Various	Contains a list of capital projects with estimated costs and proposed financing methods. Updated regularly.	Mitigation initiatives can be included as projects to fund. The risk assessment can be used to identify hazard exposure areas, and hazard mitigation can be incorporated into the design of existing projects in these areas.
Comprehensive Plan	Various	Sets goals and objectives that guide decision-making in local governments. Establishes current and future land use designations. Updated regularly.	Land use designations/zoning can be leveraged to mitigate a variety of risks. Hazard mitigation strategies can be included as goals and objectives, and the mitigation planning process should be guided by Comprehensive Plan goals and objectives.
Continuity of Operations Plan (COOP)	Various	Sets objectives and policies to minimize disruptions to operations and services from a wide range of emergencies.	COOPs support hazard mitigation by ensuring that during a disaster, all emergency operations can be identified and conducted.
Critical Areas Ordinance	Various	Regulates development in and around critical areas, such as endangered species habitats, wetlands, and steep slopes.	Protecting natural areas can help mitigate a variety of risks, especially flooding and sea level rise.
Development Codes	Various	Regulates where different types of development can occur, and what features development projects are required to have.	Development codes can restrict development in hazard-prone areas or require certain elements such as seismic design principles that will mitigate risks from hazards.
Comprehensive Emergency Management Plan (CEMP)	Various	Guides an agency's actions before, during, and after a disaster. Defines roles, responsibilities, important locations, and other details that are critical during and after a disaster. Updated regularly. .	CEMPs should be informed by the hazard mitigation plan risk assessments. CEMPs are one of the most important tools to support hazard preparedness, and quick response following an incident.
Habitat Conservation Plan (HCP)	Various	Allows for and mitigates the effects of development in endangered species habitats. Offsets development in habitat areas by preserving land.	Hazard-prone areas can be preserved through the land conservation system established in an HCP. Habitat may overlap with hazard-prone areas, and this tool can be used to restrict development in areas at risk of hazards.
Housing Action Plan	Various	Examines current and future housing supply and needs. Identifies strategies an agency can take to support housing needs.	Agencies can support strategies that encourage housing outside of hazard-prone areas. The hazard mitigation plan risk assessment should be used to inform strategies and future housing locations.

Administrative and Technical

The Thurston region is home to many committees, organizations, and ongoing efforts that regularly bring together diverse stakeholders to tackle difficult issues. Local staff can work through these established groups and pathways to build support for hazard mitigation, resilience, and incorporate hazard mitigation into a wide range of projects and community programs.

Local and State Administrative and Technical Capabilities

NAME	PURPOSE	MEMBERSHIP OR ATTENDANCE	APPLICABILITY TO HAZARD MITIGATION
Disaster Assistance Council (DAC)	To establish policies and procedures to organize disaster assistance in the most economical and effective manner.	Membership of the DAC is administered by Thurston County Emergency Management in coordination with the EMC.	The DAC plays a vital role in disaster assistance which can expedite relief and recovery for disaster victims. It can serve in an advisory role to plan participants about the needs of underserved and socially vulnerable populations.
Emergency Management Council (EMC)	Coordinates local emergency management activities of the county, cities, and tribes.	Emergency managers of Thurston County, Lacey, Olympia, Tumwater, Bucoda, Rainier, Yelm, Nisqually Tribe, and Confederated Tribes of the Chehalis Reservation.	The EMC oversees the development of the HMP. The group meets regularly and can oversee the progress and implementation of mitigation initiatives.
Local Emergency Planning Committee (LEPC)	Works to develop and maintain emergency plans, conduct drills and exercises, and provide education and outreach to the community.	Representatives from local government agencies, first responders, emergency management personnel, private sector businesses, and community organizations.	The LEPC can serve as a forum to exchange information about funding opportunities, projects, and serve in an advisory role to the region on hazard mitigation planning activities.
Office of the Chehalis Basin (OCB)	Carries out the Chehalis Basin Strategy, a strategy to design and implement projects to restore aquatic habitats and protect residents from flood damage, moving forward.	Local governments, tribes, conservation districts, state agencies, and other community organizations.	The group focuses on protecting residents and communities from flood damage and preparing the region for more frequent and severe flood events. Mitigation initiatives may be carried out as OCB projects.
Puget Sound Partnership (PSP)	Leads the region's collective effort to restore and protect Puget Sound. Brings together hundreds of partners to mobilize action around a common agenda, advance Puget Sound investments, and advance priority actions by supporting partners.	Residents and representatives from federal agencies, state agencies, local jurisdictions, tribes, watersheds, businesses, and environmental groups.	Hazard mitigation can be incorporated into PSP projects.

NAME	PURPOSE	MEMBERSHIP OR ATTENDANCE	APPLICABILITY TO HAZARD MITIGATION
Stream Team	Provides environmental education programs, activities, and hands-on projects to Thurston County.	Storm and surface water utilities of the cities of Lacey, Olympia and Tumwater and Thurston County.	Stream Team can carry out hazard mitigation activities.
South Sound Military and Communities Partnership (SSMCP)	Takes on projects to advance infrastructure and regional improvements that support military readiness and the communities neighboring Joint Base Lewis-McChord.	Cities, counties, tribes, Joint Base Lewis-McChord (JBLM), and regional, corporate, and non-profit organizations.	Hazard mitigation can be incorporated into SSMCP projects. The SSMCP is conducting a JBLM community resiliency study to understand the risks to communities that provide community lifelines to JBLM.
Thurston Conservation District (TCD)	Educates and assists residents of Thurston County in the management of natural resources for the benefit of present and future generations, inspiring voluntary, incentive-based conservation practices.	Residents and representatives from federal agencies, state agencies, local jurisdictions, tribes, watersheds, businesses, and environmental groups.	TCD provides support to all county residents around soil health, conservation planning, habitat restoration, and more. Hazard mitigation can be incorporated into TCD's guidance, or planning partners could present information on hazard mitigation and risk reduction at public events hosted by TCD. TCD supports community Firewise programs.
Thurston County Emergency Management Council Executive Seminars	Discuss emergency management, build support, and provide a forum for coordination quarterly.	Emergency management staff and elected officials and executives from agencies in the Thurston Region.	These seminars were used throughout this planning process to educate elected officials and executives about the HMP update. Going forward, these seminars can be used to review mitigation initiative progress and build collaboration and support for mitigation.
Thurston County Summer and Winter Weather Hazards Seminars	Brings together subject matter experts to provide information about the upcoming summer or winter season and hazard risks. Biannual event.	Planners, state and regional department staff, first responders, and emergency management staff.	This event can connect staff at local agencies with resources and information around upcoming hazard risks and suggested actions.
Thurston County Fire Chiefs Association (TCFCA)	Fosters communications and sharing among chief fire officers within Thurston County. Leads, supports, and develops fire agency and Emergency Medical Service systems and policies.	Chief fire officers from Thurston County fire protection districts and municipal fire departments.	TCFCA serves in an advisory role to hazard mitigation planning. The fire chiefs have local knowledge of the community, natural hazards and their risks, and are partners in mitigation and resiliency strategies.

NAME	PURPOSE	MEMBERSHIP OR ATTENDANCE	APPLICABILITY TO HAZARD MITIGATION
Thurston Regional Planning Council (TRPC)	Develops regionally focused plans and studies on topics such as transportation, growth management, and environmental quality. Provides information regarding the region and its emerging planning issues.	Elected officials from jurisdictions and organizations in the Thurston region.	TRPC acts a regional convener for multijurisdictional plans and projects, and can support coordinated initiatives. TRPC provides regional data that has been used in this plan and has facilitated coordination and development of the regional core HMP.
University of Washington Climate Impacts Group	Builds climate resilience by advancing understanding of climate risks and enabling science-based action to manage those risks.	Interdisciplinary research group at the University of Washington composed of natural, physical and social scientists as well as communications and administrative professionals.	Resources from this group were used in the HMP's risk assessment. New resources can inform future plan updates and support incorporating climate mitigation and adaptation into hazard mitigation initiatives.
Deschutes WRIA 13 Salmon Habitat Recovery Committee	Identifies and prioritizes salmon habitat projects in the WRIA 13 watershed.	Tribes, federal and state agencies, local governments, citizens, non-profits, businesses, and technical experts.	Hazard mitigation can be incorporated into salmon habitat projects.

Financial

In addition to agencies' capital budgets, the following funding sources may be eligible to fund hazard mitigation initiatives, projects, or programs. Agencies in Thurston County are encouraged to engage in planning processes outside of hazard mitigation and incorporate hazard mitigation into the design and implementation of projects across disciplines and sectors.

Federal and State Funding Sources in Support of Hazard Mitigation Planning Activities

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
Building Resilient Infrastructure and Communities (BRIC)	FEMA	Supports states, local communities, tribes and territories undertake mitigation projects. Annual program.	BRIC can fund a wide variety of mitigation actions, from infrastructure projects to capability- and capacity-building including hazard mitigation planning.
Carbon Reduction Program (CRP)	FHWA	Funds projects designed to reduce transportation emissions, defined as carbon dioxide emissions from on-road highway sources. TRPC receives an allocation of these funds to award to eligible high priority local agency projects.	Transportation projects can be designed to incorporate hazard mitigation, or this program can fund mitigation initiatives on highways.
Community Development Block Grants (CDBG)	HUD	Provides annual grants on a formula basis to entitled cities and counties to develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low- and moderate-income persons.	CDBG eligible projects include design, renovation, or construction of public facilities, housing rehabilitation, relocation of individuals or businesses, and more. Initiatives that involve retrofitting public facilities or relocating businesses or individuals in floodplains may be eligible for funding.
Community Wildfire Defense Grant Program	USDA	Supports at-risk, local communities with planning for and mitigation against risks from wildfires.	This program can fund the development, revising, or implementation of Community Wildfire Protection Plans.
Emergency Management Performance Grant (EMPG)	FEMA	Provides state, local, and tribal emergency management agencies with the resources required for implementation of the National Preparedness System and works toward the National Preparedness Goal of a secure and resilient nation.	The EMPG's allowable costs support efforts to build and sustain core capabilities across the prevention, protection, mitigation, response and recovery mission areas.

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
Flood Control Assistance Account Program (FCAAP)	ECY	Assists local governments with comprehensive floodplain management planning and implementation of actions to mitigate flood risks.	FCAAP can fund flood hazard management plans, feasibility studies, and some infrastructure projects.
Flood Mitigation Assistance (FMA)	FEMA	Provides funding to local jurisdictions and states for projects and planning that reduce or eliminate long-term risk of flood damage to structures insured under the NFIP.	FMA funds can be used for a variety of projects benefiting NFIP structures, such as acquisition or retrofits.
Floodplains by Design	ECY	Funds collaborative and innovative projects that integrate flood hazard reduction with ecological preservation and preservation. Biannual program.	This program can fund ambitious flood mitigation projects that also work to provide other community co-benefits or mitigate other hazard risks.
Hazard Mitigation Grant Program (HMGP)	FEMA	Funds hazard mitigation measures and planning following a presidential disaster declaration.	HMGP can fund a wide variety of mitigation actions, and priority is given to initiatives listed in a community's HMP.
Increase Cost of Compliance (ICC) under NFIP	FEMA	Provides funding under the NFIP to homeowners with NFIP flood insurance whose structures have been substantially damaged.	Funding can be used to pay for or offset the costs of mitigation when the structure is rebuilt. It is often used to offsetthe non-federal share for hazard mitigation grants.
Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Program	WSDOT	Provides funding to help make surface transportation more resilient to climate change and natural disasters.	PROTECT projects can mitigate a wide variety of hazard risks through planning, resilience improvements, evacuation routes, and other projects that incorporate resilience.
Public Assistance Grant Program (PA)	FEMA	Provides funding to assist communities responding to and recovering from major disasters or emergencies declared by the president under the Stafford Act.	Mitigation can be incorporated into recovery projects to reduce long-term risk.
Reconnecting Communities Pilot Program	USDOT	Funds planning and capital construction of projects seeking to reconnect communities previously cut off from economic opportunities by transportation infrastructure.	Planning partners could incorporate hazard mitigation into existing project proposals in the area.
Safeguarding Tomorrow Revolving Loan Funding Program	FEMA	Supports capitalization grants to states and tribes to establish revolving loan funds that provide hazard mitigation assistance for local governments to reduce risks from natural hazards and disasters.	These low-interest loans allow jurisdictions to reduce vulnerability to natural disasters, foster greater community resilience and reduce disaster suffering.

NAME	LEAD AGENCY	DESCRIPTION	APPLICABILITY TO HAZARD MITIGATION
School District Bonds	School Districts	Can fund structural additions or renovations to schools and district-owned facilities.	School districts can use bonds to fund construction projects that mitigate risks from a variety of hazards.
Surface Transportation Block Grants (STBG)	TRPC	Provides flexible federal funding to local agencies for projects to preserve and improve the conditions and performance on transportation facilities.	STBG funds can support a wide variety of planning and construction projects to mitigate risks from hazards.
Transportation Alternatives STBG Set-Aside (TA)	TRPC	Provides funding for a variety of generally smaller-scale transportation projects such as pedestrian and bicycle facilities, construction of turnouts, overlooks, and viewing areas, community improvements, environmental mitigation related to stormwater and habitat connectivity, recreational trails, safe routes to school projects, and vulnerable road user safety assessments.	TA funds can support a wide variety of planning and construction projects to mitigate risks from hazards.
Urban and Community Forestry Grants	DNR	Offers grants to cities and towns, counties, tribal governments, non-profit organizations, and educational institutions to improve the health of community forests and develop local urban forestry programs.	This program can provide smaller awards ($10k-$40k) for projects that support the planning, growth, and maintenance of trees in urban areas. This could fund educational programs or other mitigation initiatives to mitigate the risks of wildfire, landslides, and other hazards.
WaterSMART Grants	USBR	Provides financial assistance to water managers for projects that seek to conserve and use water more efficiently, implement renewable energy, investigate, and develop water marketing strategies, mitigate conflict risk in areas at a high risk of future water conflict, and accomplish other benefits that contribute to sustainability in the western United States.	Planning partners could work to incorporate flood, drought, and mitigation of other hazard risks into existing project proposals in the area.
WRIA 13 Salmon Habitat Recovery Funding	WRIA 13 Lead Entity	Funds projects in the Deschutes Water Resource Inventory Area (WRIA) that improve conditions for salmon.	Local agencies can apply for grants or engage with other applicants to incorporate hazard mitigation into habitat restoration projects. Projects can mitigate landslides or flood risks.

Public Education and Outreach

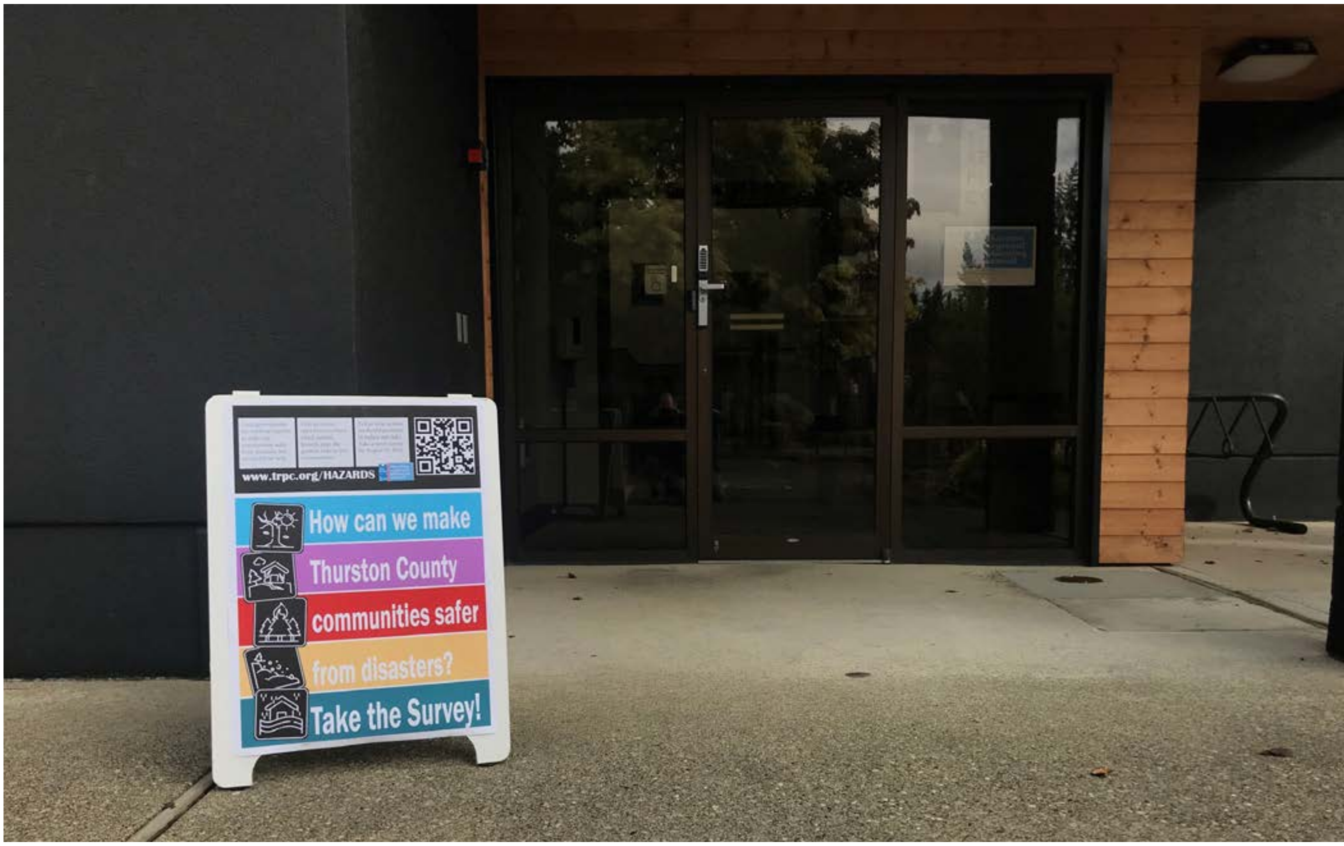
The following list includes committees, organizations, and events that already inform the public about hazard risks and mitigation actions or could be used to do so in the future. Planning partners are encouraged to collaborate and form partnerships on outreach efforts to ensure all residents and visitors to the Thurston Region are well informed about the risks to their communities and how to mitigate them.

Public Eduction and Outreach Resources in Thurston County

NAME	PURPOSE	MEMBERSHIP OR ATTENDANCE	APPLICABILITY TO HAZARD MITIGATION
Nisqually River Council (NRC)	Promotes the environmental, social, and economic integrity of the Nisqually Watershed.	The Council is a non-regulatory advocacy, coordination, and education organization represented by tribes, cities, counties, utilities, and other government agencies.	The NRC's Nisqually River Education Project inspires youth about environmental health and sustainability of the Nisqually Watershed. It provides outdoor environmental education with hands on learning opportunities to engage them in the stewardship of natural resources and problem solving.
Stream Team	Provides environmental education programs, activities, and hands-on projects to Thurston County.	Storm and surface water utilities of the cities of Lacey, Olympia and Tumwater and Thurston County.	Stream Team can carry out education and outreach activities.
Thurston Community Alert	Alerts residents of hazardous conditions in the area with several modes of notification: phone, email, and text message.	Local agencies are members to acquire the service; community members must subscribe for notifications.	This system is used to ensure residents receive timely, accurate information before, during, and after hazard events. Partners should continue to use this system and conduct outreach to register more community members.
Thurston Conservation District (TCD)	Educates and assists residents of Thurston County in the management of natural resources for the benefit of present and future generations, inspiring voluntary, incentive-based conservation practices.	Residents and representatives from federal agencies, state agencies, local jurisdictions, tribes, watersheds, businesses, and environmental groups.	TCD provides support to all county residents around soil health, conservation planning, habitat restoration, and more. Planning partners can present information on hazard mitigation and risk reduction at public events hosted by TCD. TCD supports community Firewise programs.

NAME	PURPOSE	MEMBERSHIP OR ATTENDANCE	APPLICABILITY TO HAZARD MITIGATION
Thurston County Emergency Management Council Executive Seminars	Discuss emergency management, build support, and provide a forum for coordination quarterly.	Emergency management staff and elected officials and executives from agencies throughout the Thurston Region.	These seminars were used throughout this planning process to educate elected officials and executives about hazard mitigation planning and this plan update. Going forward, these seminars can be used to educate elected officials and executives about hazard mitigation and pass along information to a wide range of agencies.
Puget Sound Partnership (PSP)	Leads the region's collective effort to restore and protect Puget Sound. Brings together hundreds of partners to mobilize action around a common agenda, advance Puget Sound investments, and advance priority actions by supporting partners.	Residents and representatives from federal agencies, state agencies, local jurisdictions, tribes, watersheds, businesses, and environmental groups.	Hazard mitigation can be incorporated into PSP projects.
Thurston County Flood Bulletin	An annual bulletin provides information to residents on alert systems, flood insurance, flood mitigation activities and programs, and more. Annual bulletin.	Mailed to all households in Special Flood Hazard Areas. Available to all Thurston County residents online and at community locations.	This tool goes directly to a large number of Thurston residents with concise, actionable information on flood risks and mitigation actions. This bulletin can be used to share information about personal preparedness, encourage residents to engage with emergency management staff, or build support for regional mitigation actions.
Thurston County Preparedness Expo	Provides education and awareness to the public about being prepared for disasters and emergencies. Offers an opportunity for vendors and participants to share their products and information. Annual event.	Emergency management staff, first responders, residents, and emergency products vendors	This is the largest regular event in the Thurston region to promote hazard preparedness and provide a range of emergency management, hazard mitigation, and other information and resources to the general public.

NAME	PURPOSE	MEMBERSHIP OR ATTENDANCE	APPLICABILITY TO HAZARD MITIGATION
Thurston County Summer and Winter Weather Hazards Seminars	Brings together subject matter experts to provide information about the upcoming summer or winter season and hazard risks. Biannual event.	Federal, state, local government, and private utility agencies. Meetings are attended by department directors, community panners, emergency management staff, first responders, transit, school districts, public works, and others.	This event connects staff across all levels of government with resources and information sharing. Recordings of the events are shared with stakeholders and the public. Presentations typically cover actions that agencies are taking to reduce risks from weather hazards.
Timberland Regional Library (TRL)	Provides library services to the residents of five counties in Southwest Washington State.	Residents in Grays Habor, Lewis, Mason, Pacific, and Thurston Counties	TRL supported public outreach efforts during development of this plan, and can support outreach efforts for mitigation actions going forward.
Wildfire Ready Neighbors Program	Provides residents with free consultations and tailored plans with suggested actions to reduce risks from wildfires.	Temporary program ongoing at the time of this planning process; open to all Thurston County residents.	This free program provides in-person consultations and forest health assessments that then lead to actionable suggestions for residents to reduce wildfire risks.



Sandwich board outside of Timberland Regional Library.

Chapter 4

Risk Assessment

Introduction

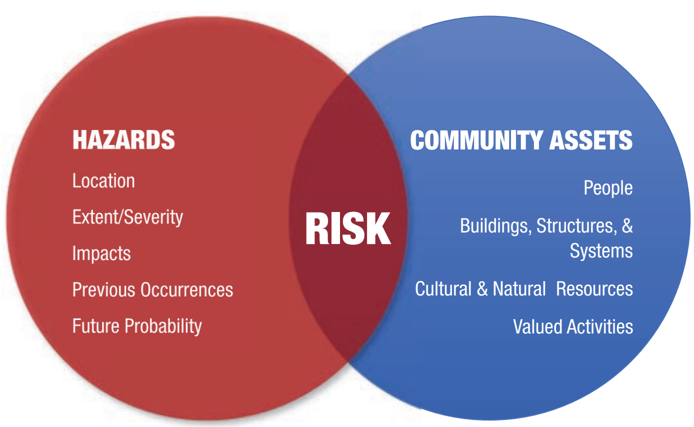
The risk assessment evaluates the threats posed by nine natural hazards that have occurred or are likely to occur in Thurston County in the future. Understanding and documenting how these hazards harm people, property, and the environment is the first step to developing a mitigation strategy. This chapter introduces how risk is measured and orients the reader to the content presented in each of the sections that follow. Chapters 4.1 through 4.9 profile the hazards that are assessed in this plan. Appendix C includes additional data that supports the hazard risk ratings for the overall planning area and each jurisdiction.

Chapter 4 Risk Assessment Contents

Assets, Vulnerabilities, Impacts, and Risks

Performing and documenting the risk assessment is the most technical process of hazard mitigation planning. A risk assessment describes the hazards that impact a community and summarizes which assets are vulnerable (Figure 4.1 – courtesy of FEMA). It is an important tool to inform a range of projects, programs, and services that communities can invest in to protect assets and make communities safer and more disaster resilient.

Figure 4.1 General Risk Concept, Hazards, and Community Assets



Risk Assessment Process, Format, and Content

This plan's risk assessment follows the guidance outlined in the Federal Emergency Management Agency (FEMA) Local Mitigation Planning Handbook.[1] Each hazard's risk assessment is documented through narratives, data, figures, images, and maps. Each subchapter of the risk assessment is referred to as a hazard profile. There are several key terms used in the hazard mitigation planning process that are used to describe the risk assessment process (Figure 4.2). These terms are used throughout Chapter 4 and its hazard profiles.

Figure 4.2 Key Hazard Mitigation Risk Assessment Terms

Natural Hazard: a harmful phenomenon produced by a meteorological, environmental, or geological event such as floods, earthquakes, storms, volcanic eruptions, and landslides.

Community Assets: people, homes, property, buildings, utilities, lifeline services, historic or cultural resources, natural resources, and activities that are valued by a community.

Vulnerability: a description of assets within locations identified to be hazard prone, that are at risk from the effects of a hazard.

Impacts: the consequences of the effects of each hazard on assets. Impacts can be anecdotal accounts as documented from previous disasters. Impacts can be an estimate of assets that are exposed to hazards or located in areas prone to hazards. The most detailed impacts can be derived from loss estimates produced by scenario-based data driven computer models.

Risk: the potential for damage or loss when natural hazards interact with people or assets.
Hazard Profile: The documentation of each hazard's risk assessment. It describes each identified hazard's location, extent, previous occurrences, and probability of future events.

Source: FEMA Local Mitigation Planning Handbook

Five Step Risk Assessment Process

FEMA describes the risk assessment process in five steps. This plan's risk assessment mirrors these steps. The hazard profiles in Chapters 4.1 through 4.9 document the risk assessment in accordance with FEMA's planning requirements. Each hazard profile is organized using the same format and description of contents that is described in the five steps that follow.

1. Hazard Identification

There are nine hazard profiles in the risk assessment. The Hazard Mitigation Planning Workgroup deliberated with TRPC and the consultant team, who was contracted to assist with the risk assessment process, to identify the hazards and a subset of hazard scenarios that are identified in this plan. Table 4.1 lists the changes in the hazard identification and profiling since the last plan update.

Hazard Profile Selection Criteria

Hazards were selected for risk assessment analysis based on the following criteria:

- **Common Threat** – a known hazard that was profiled in the previous Hazard Mitigation Plan and remains a threat to the region.
- **Emerging Threat** – a hazard that is included in Thurston County's Hazard Identification and Vulnerability Analysis (HIVA)[2] and was identified in the previous plan but was not profiled. The hazard has occurred in the community or is perceived as a more serious threat since the last plan update. The hazard is now profiled or described within an existing hazard profile.
- **New Evidence** – a hazard that was identified in the previous plan, but not profiled due to insufficient data or analysis to conduct a risk assessment. New evidence reveals there are areas in the Thurston Region that are vulnerable and the hazard warrants inclusion as a profiled hazard in the plan update.
- **FEMA Policy Change** – a new federal hazard mitigation planning requirements makes it advantageous to profile the hazard in the plan update.

Table 4.1 Changes in Hazard Identification and Profiling

Hazards	2017 Plan*	Plan Update	Reason for Change
Dam Failure	Identified	Profiled	FEMA Policy Change
Earthquake	Profiled	Profiled	Common Threat
Flood	Profiled	Profiled	Common Threat
Landslide	Profiled	Profiled	Common Threat
Sea Level Rise	Identified in Flood Profile	Profiled Independently	Emerging Threat
Severe Weather	Hazardous temperatures not included in profile	Hazardous temperatures added to Profile	Emerging Threat
Tsunami	Identified in Earthquake Profile	Profiled Independently	New Evidence
Volcanic Activity	Profiled	Profiled	Common Threat
Wildfire	Profiled	Profiled	Common Threat

*The last Natural Hazards Mitigation Plan for the Thurston Region was approved by FEMA in August 2017.

Hazards Not Profiled

Communities in Thurston County are subject to a wide variety of natural, technological, and human- caused hazards and threats that are documented in the Thurston County HIVA. The following threats and hazards have a likelihood of occurring in Thurston County communities but are not profiled in this plan. The plan participants may or may not include these hazards or other hazards in their annex to this plan.

1. **Critical Shortage** – Critical shortage is the lack of or a reduction in the supply of essential goods or services to a regional economy due to a disruption caused by events that occur elsewhere. These events may include embargoes, strikes, natural disasters, epidemics, crop failures, overexploitation of a natural resource, terrorist activities, or political unrest. Critical shortage is described as a potential impact to communities in several hazard profiles. It is not profiled as it is not a natural hazard.
2. **Cyberattack** – A cyberattack is an offensive maneuver against individuals, businesses, governments, or other organizations that targets computer information systems, infrastructure, networks, or personal devices. These attacks attempt to disable operations, steal information, or hold systems ransom. They may be launched by nation states, criminal organizations, or hackers acting with malicious intent. Local government infrastructure such as signal controllers, water systems, and other utilities that are controlled remotely by computers may be at risk to disruptions. A risk assessment was not performed for cyberattack. While attacks are common, it is one of the most mitigated threats in the technology industry. Local governments take great measures to train personnel about cybersecurity and invest in technologies and services to mitigate malicious attacks on their communications infrastructure.

3. **Drought** – Drought is a condition of climatic dryness severe enough to reduce soil moisture levels and water levels below the minimum necessary for sustaining plant, animal, and human life systems. Climate change projections for the Puget Sound Region indicate that longer, warmer, and drier summers will become the norm by mid-century. Drought can destroy or lower crop yields, impact fish habitat, and increase risk for wildland fires. A risk assessment was not performed for drought. However, the impacts of extreme heat are documented in the severe weather hazard profile. Drought may be profiled in a future plan update if the Hazard Mitigation Planning Workgroup decides it is an emerging threat or if new evidence warrants its inclusion. For this plan update, jurisdictions may include drought in their annex.
4. **Epidemic** – 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 a human contagious disease, epidemics can also affect domestic and wild animals and crops. Epidemic diseases such as COVID-19, Influenza, West Nile Virus, and the Zika Virus are usually introduced into an area from remote regions and inflict devastation because of a lack of natural or induced immunity. Epidemic mitigation measures are principally within the jurisdiction of the state and county public health departments. As such, a risk assessment for epidemic was not performed.
5. **Hazardous Material Incident** – 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 place public property and the environment at risk from their inadvertent or intentional release. Local communities have little to no knowledge of when and what types of hazardous materials are being transported by highways or railroads through Thurston County. A risk assessment for hazardous materials release was not performed as it is not a natural hazard. Hazardous materials release planning and oversight is coordinated by Thurston County Emergency Management through the Local Emergency Planning Committee.
6. **Space Weather/Solar Wind/ Geomagnetic Storm** – The energy output of the sun varies according to its 11-year cycle. A coronal mass ejection or other solar phenomena can release magnetic storms that can severely disrupt and damage electrical distribution systems and electric devices on Earth. In March 1989, a current surge induced by the changing magnetic fields at ground level affected transformers at power stations in Canada. The surge led to power blackouts throughout Quebec that lasted for several hours, and the

power company lost more than 21,500 megawatts of its production capacity. Space weather is not considered an emerging threat and there is little new evidence to conduct a risk assessment for the impacts of a geomagnetic storm for the planning area.

7. **Terrorist Attack** – Terrorism is the use of force or violence against persons or property violating the laws of the United States for purposes of intimidation, coercion, or ransom. Terrorists often use threats to create fear among the public; try to convince citizens that their government is powerless to prevent terrorism; and sometimes try to garner publicity for their causes. Bombings and mass shootings are the most frequently used terrorist method in the United States. Other possibilities include attacks upon transportation facilities, utilities, or other public services, or an incident involving chemical or biological agents. Terrorism is not a natural hazard. A terrorism risk assessment was not performed. Measures to mitigate or prevent terrorism is best addressed through interagency coordination of national security with federal, state, and local law enforcement agencies.

2. Hazard Description

Each hazard profile follows the same format. This section describes the contents that comprise the hazard profiles and how the hazard occurs within the planning area.

Definition

The profile introduces the hazard by defining its source of energy, origin, and the types of damaging effects the hazard produces. Profiles with multiple effects, like severe weather, have several unique effects or elements that are defined separately. For example, heavy snow, freezing rain, and hail are all forms of hazardous precipitation, but each is produced by different conditions and presents unique risks.

Area of Impact

The hazard profile describes the areas that are most affected by a hazard. In this plan, Thurston County is the overall planning area. Each participating jurisdiction, whether a local government, special purpose district government, or a public college is located in part or all of the planning area.

Affected areas are described using both narrative descriptions and maps. Some communities are more vulnerable to hazards due to their geography or other conditions. In such instances, the communities that are most vulnerable to a hazard are described. For example, sea level rise and tsunami directly affect communities and neighborhoods that are on the Puget Sound. On the other hand, severe weather impacts the entire planning area and so it is more challenging to characterize and rate risks that are unique to individual communities. The hazard delineation maps in Chapter 4 refer to the entire area. Hazard maps are located at the end of each profile. Agency-specific hazard area impact descriptions and maps are also shown in the participating jurisdictions' annexes.

Extent

For some of the profiled hazards, there are means to measure the strength or intensity of its effects. For example, temperature, windspeed, snow depth, flood water depth, number of acres burned, and Mercalli intensity index describe the degree to which a hazard could damage or disrupt community assets. Where measures are lacking, a general description of the types of factors that contribute to a hazard's level of severity are presented.

Effects of Climate Change

Climate change affects atmospheric and environmental conditions to the extent that it is changing the timing, frequency, intensity, and reach of natural hazards such as extreme heat, precipitation, and wildfire conditions. Documenting data-supported projections for climate impacts informs the risk assessment and considerations for mitigation actions. The effects of climate change are documented for flood, landslide, severe weather, and wildfire hazards.

Previous Incidents

Previous incidents offer communities insights about potential future impacts. Where available, historic disaster events, dates, disaster declaration numbers, and brief descriptions of the impacts to people, property, infrastructure, and the environment are presented.

Probability of Occurrence

The probability of occurrence is a description or measurement of how likely a hazard event will occur or reoccur in the future. Statistical probability values are shown, if available. In general, probability is described for each hazard using a qualitative description. The probability of a hazard is one of the main factors used to calculate each hazard's risk rating. Probability is described within a 25 to 100-year period as follows:

- **High** – Hazard event is likely to occur within 25 years
- **Medium** – Hazard event is likely to occur within 100 years
- **Low** – Hazard event is not likely to occur within 100 years
- **None** – If there is no exposure to a hazard, there is no probability of occurrence

3. Inventory of Community Assets

Tetra Tech Consulting was contracted by TRPC to assist the region with the risk assessment. For the regional risk assessment, a variety of data sources were used to assess assets exposure and vulnerability to the hazards. This section describes the assets and data sources that were used as inputs and to inform the plan's exposure analysis, hazard modeling, and risk assessment.

People

The people who live and work in Thurston County are the region's most valuable asset. Knowing where and how many people are potentially exposed to hazards is vital to identifying strategies to protect them. Thurston County Population data was obtained from the Washington State Office of Financial Management. Estimates of hazard population exposure were derived from residential units within affected hazard areas. For each hazard, the portion of a community's population exposed to the hazard was calculated. Population exposure is the highest weighted factor for calculating a community's hazard risk rating. A table summarizing the number of individuals, by jurisdiction that are located in areas that are prone or exposed to each hazard is documented in the Impacts and Vulnerability section.

Measuring the impact of hazards on socially vulnerable populations is difficult as there is little community-specific data available to evaluate risk for subareas within a community. This plan presents information from the FEMA National Risk Index and Center for Disease Control Social Vulnerability Index ratings. Social Vulnerability Index ratings are mapped by Census Tract for each hazard in the Risk Ratings section. More information about these indices can be found in section 5. Summarizing Vulnerability and in Chapter X. Community Profile.

Structures and Systems

Residential units, commercial buildings, public buildings, and other building types are exposed to some level of risk depending on their age, construction type, location, and how they are used. Buildings are also referred to as the region's general building stock. An inventory of general building stock and parcel data was obtained from the Thurston County Assessor's Office through Thurston GeoData.

Nearly 105,000 structure point locations were mapped in GIS to assess the structural assets' exposure to each hazard and to estimate potential replacement value losses. Replacement value is the cost to replace the entire structure with one of equal quality and utility. Replacement value is based on industry-standard cost-estimation models published in RS Means Square Foot Costs[1]. It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure from the tax assessor data. The construction class and number of stories for single-family residential structures also factor into determining the square-foot costs.

A table summarizing the number and type of structures in the hazard area (residential, commercial, industrial, agricultural, religion, government, and education) is shown in each hazard profile's Impacts and Vulnerability section.

[1]As referenced by Tetra Tech Consulting. RSMeans.com, 2022.

The total valuation of structures and their contents as a share of the total valuation is also shown. The structural and contents value is categorized as property in the risk rating model. The share of exposed property that suffers damage is measured as an economic impact. Property exposure is the second highest weighted factor to calculate a hazard's risk rating. Economic impacts are the third rated factor for calculating risk.

Critical Facilities and Community Lifelines

Critical facilities and lifelines for police and fire, health care, energy, communication, transportation, water systems, and hazardous materials are fundamental to the safety, security, and health of a community. When these assets are disrupted, other sectors of the community can suffer impacts to services that are critical to a community's function and protection of public safety. FEMA emphasizes local governments pursue mitigation activities to protect such vital services and facilities through hazard mitigation planning.

TRPC coordinated with the plan participants to collect critical infrastructure data. This data was digitized in GIS and augmented with a variety of other data such as health care clinics, long-term care facilities, bridges, communications stations and infrastructure, FDIC insured banks, and electric substations (see Appendix C for a catalog of the data sources used in the risk assessment). In total, the critical facilities data consists of nearly 1,300 records. A table summarizing the number and type of critical facilities and lifelines is shown in the Impacts and Vulnerability section. Records of critical facilities need to be protected and are not published in this plan. General information about the types of critical facilities is described.

Natural, Historic, and Cultural Resources

Hazard mitigation should be all encompassing to protect the assets that the public values. This includes a range of natural, historic, and cultural resources. Natural resources such as wellhead protection areas, farmland, estuaries, wetlands, rivers, prairies, and forests are vital to the health and welfare of people, wildlife, and ecosystems. Historic buildings, homes, monuments, and other structures are valued for showcasing our communities' stories and educating residents and visitors about our region's past. Other cultural assets such as parks, performance halls, art, and museums contribute to a community's sense of place, quality of life, and economic development. A comprehensive analysis of natural, historic, and cultural resources was not performed during this plan update, however a general description of the types of assets that are potentially vulnerable is described in each profile's Impacts and Vulnerability section.

Activities

COVID-19 public health safety precautions profoundly disrupted a wide range of activities that people and communities across all sectors could access or experience. Physical disruptions and critical shortages from natural hazards will disrupt community lifeline services resulting in reduced levels of public and private sector services. Traditional and seasonal activities such as festivals, sporting events, and outdoor concerts and other performances could also be disrupted. These events add to a community's quality of life and support commerce and economic development. A general discussion of the types of activities that could potentially be affected by natural hazards is described in each hazard profile's Impacts and Vulnerability section.

Changes in Development

The county, cities, and special purpose district plan participants have authorities and responsibilities for planning and implementing capital projects for transportation, water and wastewater systems, residential subdivisions, apartment buildings, new school buildings, and commercial activities within their jurisdictions. Any changes in development since the plan was last updated are described and assessed to determine whether a community's vulnerability or risk for each hazard has increased, decreased, or not changed. Descriptions about the jurisdictions' changes in development are included in the annexes.

4. Analyzing Impacts

Two methods were used to analyze the hazards' impacts on communities. The risk assessment for this plan determined exposure and vulnerability for the nine profiled hazards for the overall planning area. The methods are described below.

Exposure Analysis

An exposure analysis examines what quantity or portion of a community's assets are located in areas prone to hazards. This type of exposure is useful when a hazard area is well defined, mapped, and available as a GIS database. Using GIS, an exposure analysis can readily summarize the number of people, homes, structures, and other assets that are exposed to a hazard. A map of the hazard areas used for analyzing impacts is shown in each hazard profile. Figure 4.3 shows the hazard map data sources that were used for the exposure analysis.

Modeled Scenario Analysis

FEMA has developed a GIS modeling tool to analyze hazards and forecast outputs at varying levels of detail based on the type and availability of data used to run the model. The tool can evaluate specific hazard scenarios to estimate losses to assist communities with evaluating potential losses and evaluate their risks. The Hazus model supports a limited number of hazard types, therefore only a subset of the hazards in this plan could have modeled scenario analyses performed.

TRPC contracted with Tetra Tech to run "what if" scenarios for varying levels of severity for earthquake and flood hazards. The impact analysis for these hazards used Hazus models to estimate losses and evaluate vulnerabilities in the planning area. A Level 2 analysis was performed for all the scenarios that were developed.

Figure 4.3 Hazard Impacts Analyzed by Exposure Analysis

Hazard	Digital GIS Hazard Data Source
High Groundwater Flooding	Thurston County GeoData High Groundwater Special Flood Hazard Areas
Landslide	Washington Department of Natural Resources (WADNR) Landslide Compilation Data and Slopes >40% (delineated by a 3-foot LiDAR Digital Elevation Model)
Tsunami	WADNR Cascadia Subduction Zone M9.3 Earthquake Tsunami Scenario Inundation Map
Volcanic Activity	United States Geological Survey Case I Lahar Inundation Map
Wildfire	WADNR Wildland-Urban Interface and Intermix Map

Level 2 analysis is supported by a combination of local data inputs and baseline national datasets, whereas a Level 1 analysis only provides a baseline assessment using national data (see Figure 4.4). The approach used for each hazard is described below.

- **Flood** — A Level 2 user-defined analysis was performed for general building stock in flood zones and for critical facilities. Current flood mapping for the planning area was used to delineate flood hazard areas and estimate potential losses from the two-percent-annual-chance (50-year), one-percent-annual-chance (100-year), and 0.2-percent-annual-chance flood events (500-year). To estimate damage that would result from a flood, Hazus uses pre-defined relationships between flood depth at a structure and resulting damage, with damage given as a percent of total replacement value. Curves defining these relationships have been developed for damage to structures and for damage to typical contents within a structure. By inputting flood depth data and known property replacement cost values, dollar-value estimates of damage were generated.
- **Dam Failure** — A Level 2 user-defined analysis was performed for general building stock and critical facilities located in the dam failure hazard areas for Probable Maximum Flood (PMF) for the Nisqually Hydroelectric Project (Tacoma Power Alder and LaGrande dams) and the TransAlta Skookumchuck Dam. Depth grids were generated using the dam failure inundation areas and uploaded into the Hazus riverine flood model. By inputting depth data and known property replacement cost values, dollar-value estimates of damage were generated.

Figure 4.4 Levels of Hazus Modeling Analysis

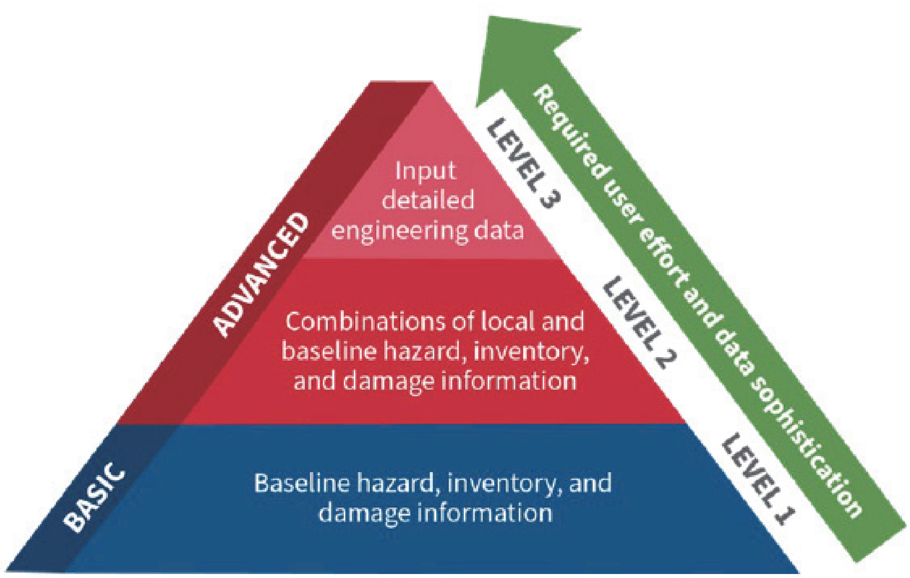


Image courtesy of FEMA

- **Earthquake** — A Level 2 analysis was performed to assess earthquake exposure and vulnerability for three scenario events:
  - A Magnitude 9.34 event on the Cascadia Fault Zone
  - A Magnitude 7.2 event on the Nisqually Fault
  - A Magnitude 7.2 event on the southern Seattle Fault Zone
- **Sea Level Rise** — A Level 2 user-defined analysis was performed for general building stock and critical facilities located in the sea level rise hazard area for a 6 inches of rise scenario. Depth grids were generated using the sea level rise hazard area and uploaded into the Hazus coastal flood model. By inputting depth data and known property replacement cost values, dollar-value estimates of damage were generated.

5. Summarizing Vulnerability

This plan provides risk ratings for both the overall area and each plan participant. As this plan is a multijurisdictional plan, each participant has differing degrees of risk exposure and vulnerability and provides additional information about existing or non-existing vulnerabilities that each hazard presents to its jurisdiction. Any differences between what is documented in Chapter 4 for impacts, vulnerabilities, and risk and an individual jurisdiction's vulnerabilities are documented in its annex.

Each hazard profile summarizes vulnerability in the Risk Rating section. The Risk Rating section presents:

- The FEMA National Risk Index; and
- The Community Hazard Risk Rating that follows the methodology prepared by Tetra Tech for this plan.

National Risk Index

The FEMA National Risk Index (NRI) provides three different types of results for risk for 18 hazard types. The plan only references the nine hazards or similar hazards that are included in the hazard profiles. The following descriptions of the NRI are borrowed from the FEMA NRI Technical Documentation.[3]

National Risk Index Composite Rating

In the National Risk Index (NRI), risk is defined as the potential for negative impacts as a result of a natural hazard. The risk equation behind the National Risk Index includes three components: a natural hazards risk component, a consequence enhancing component, and a consequence reduction component. EAL [Expected Annual Loss] is the natural hazards risk component, measuring the expected loss of building value, population, and/or agriculture value each year due to natural hazards. Social Vulnerability is the consequence enhancing component and analyzes demographic characteristics to measure the susceptibility of social groups to the adverse impacts of natural hazards. Community Resilience is the consequence reduction component and uses demographic characteristics to measure a community's ability to prepare for, adapt to, withstand, and recover from the effects of natural hazards. The Social Vulnerability and Community Resilience components are combined into one Community Risk Factor (CRF) which is multiplied by the EAL component to calculate a composite risk value.

Risk Index scores are calculated using an equation that combines scores for Expected Annual Loss due to natural hazards, Social Vulnerability and Community Resilience:

Expected Annual Loss
× Social Vulnerability
÷ Community Resilience
= Risk Index

Expected Annual Loss

Expected Annual Loss (EAL) represents the average economic loss in dollars resulting from natural hazards each year. It is calculated for each hazard type and quantifies loss for relevant consequence types: buildings, people, and agriculture. As the natural hazards component of the National Risk Index, an Expected Annual Loss score and rating represent a community's relative level of expected losses each year when compared to all other communities at the same level. An Expected Annual Loss score is positively associated to a community's risk; thus, a higher Expected Annual Loss score results in a higher Risk Index score.

Social Vulnerability

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the NRI, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score.

Community Resilience

Community resilience is the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. As a consequence reduction risk component of the NRI, a Community Resilience score and rating represent the relative level of a community's resilience compared to all other communities at the same level. A community's Community Resilience score measures its national rank and is inversely proportional to a community's risk. A higher Community Resilience score results in a lower Risk Index score.

NRI Ratings

The Risk Rating section in each hazard profile documents the county's relative hazard composite Risk Index, EAL, and Social Vulnerability scores and ratings at the countywide level. Table 4.2 shows Thurston County's EAL, Social Vulnerability, and Community Resilience scores for the profiled hazards.

- Values – EAL values are in units of dollars, representing the community's average economic loss from natural hazards each year. For Social Vulnerability and Community Resilience, values are the index values for the community provided by the source data sets.
- Scores - Scores represent the national percentile ranking of the community's component value compared to all other communities at the same level (county or Census tract).
- Ratings - Ratings are provided in one of five qualitative categories describing the community's component value in comparison to all other communities at the same level. Rating categories range from "Very Low" to "Very High."

Table 4.2 Thurston County National Risk Index Scores and Ratings (National Percentile)

Hazard	Expected Annual Loss	National Risk Index
Dam Failure	Not available	Not available
Earthquake	$96M	98.9, Relatively High
Flood	$53K	17.3, Very Low
Landslide	$0.22M	94.4, Relatively Moderate
Sea Level Rise	Not available	Not available
Winter Weather	$30K	35.3, Relatively Low
Tsunami	No Rating	No Rating
Volcanic Activity	$14M	95.5, Relatively High
Wildfire	$39K	50.3, Very Low
Composite	**$113K**	**96.2, Relatively High**
Countywide Social Vulnerability (applies to all hazards)		**37.2, Relatively Low**
Countywide Community Resiliency (applies to all hazards)		**71.9, Relatively High**

Community Risk Rating Methodology

For the plan update, a Community Hazard Risk Rating Model was developed to calculate an overall risk rating for each profiled hazard for the overall planning area and for each plan participant. The results from the exposure analysis and the modeled scenario analysis were used to calculate the risk scores. The hazard score provides the jurisdictions a data-based method for producing a generalized planning level risk rating. For each hazard the risk rating methodology its probability of occurrence multiplied by the sum of its potential impacts on community assets (people, property, and the economy, see Figure 4.5). The higher the probability and impacts, the higher the risk rating. Each variable is described below.

Probability Factors

A probability factor is assigned based on how often a hazard is likely to occur. The probability of occurrence of a hazard event is generally based on past hazard events in an area. For example, if a jurisdiction has experienced two damaging floods in the last 25 years, the probability of occurrence is high for flooding and is assigned a probability factor of 3. If a jurisdiction has experienced no damage from landslides in the last 100 years, the probability of occurrence for landslide is low, a probability factor of 1. For each hazard, a jurisdiction is assigned a probability factor as follows:

Occurrence Description	Probability	Factor
No exposure to a hazard = no probability of occurrence	None	0
Hazard event is not likely to occur within 100 years	Low	1
Hazard event is likely to occur within 100 years	Medium	2
Hazard event is likely to occur within 25 years	High	3

Figure 4.5 Thurston Region Hazard Mitigation Plan Community Hazard Risk Rating Calculation

Impact Weight Values

Weighting the value of the impacts on community assets allows a community to place emphasis on what they value most. The Community Hazard Risk Rating calculation includes three weight values that are assigned to assets that are impacted: 1) Impacts on people; 2) Impacts on property; and 3) Impacts on the economy. These weight values are multiplied by their respective impact factors:

Asset Value	Weight
People and their safety are a community's highest priority	3
Protection of property is the second priority	2
The economy is the third priority	1

People Impact Factors

The impact factors are assigned based on the percentage of the total population exposed to the hazard event. The degree of impact on individuals varies, however it is not measurable. The calculation assumes that the population exposed is equally impacted when a hazard event occurs. Impact factors are determined as follows:

% Population Exposed to Hazard	Impact	Factor
Population is not exposed to a hazard = no exposure	None	0
≤9 percent is exposed	Low	1
10 to 24 percent is exposed	Medium	2
≥25 percent is exposed	High	3

Property Impact Factors

The percent estimated exposure of property or replacement value (combined structure and contents value) is estimated from the impact analysis. Property impact factors are assigned based on the percentage of the total property value exposed to the hazard:

% Property Exposed to Hazard	Impact	Factor
Property is not exposed to a hazard = no exposure	None	0
≤9 percent is exposed	Low	1
10 to 24 percent is exposed	Medium	2
≥25 percent is exposed	High	3

Economy Impact Factors

Economic losses are estimates of the portion of exposed property (structures and their contents) that are damaged or destroyed by hazards. The economic loss impact factors are assigned the same for all hazards, however the process to estimate the economic loss values differs depending on the type of impact analysis performed for the hazard.

% Replacement Value Loss to Hazard	Impact	Factor
No losses are estimated	None	0
≤4 percent of total replacement value is lost	Low	1
5 o 9 percent loss of total replacement value is lost	Medium	2
≥10 percent of total replacement value is lost	High	3

Economic Loss Estimates based on Exposure Analysis

There are no model forecast loss estimation tools for assets that were evaluated using the exposure analysis process. For the high ground water flooding, landslide, tsunami, volcanic lahar, and wildfire hazards, economic loss estimates are calculated from the portion of the percent of total value exposed property estimates that are determined by the exposure analysis. For example, a large percentage of the building stock may be exposed to landslide or wildfire risk, but it is not expected that a single event would result in a total loss to all exposed structures. For these hazards, a loss factor is multiplied to the percent total value exposed to produce a planning level loss estimate or the total replacement value damage. A loss factor of 25 percent is applied to all the non-modeled hazards to determine which economic impact factor is assigned. The severe weather hazards do not have a defined extent and location; therefore the entire building stock is considered to be exposed, but impacts are generally considered to be "low."

Economic Loss Estimates based on Modeled Scenario Analysis

Hazus model loss data is used to calculate the loss estimates for the flood (excluding high groundwater), dam failure, earthquake, and sea level rise hazard scenarios. The percent estimated impacts on the economy are the percentage of the total property value (structure and contents) that the model estimates to be vulnerable to the hazard events. Values represent estimates of the loss from a major event of each hazard in comparison to the total replacement value of the property exposed to the hazard.

Variations in the Community Risk Rating Model for Special Purpose District Participants

Property Impacts

For special purpose district participants, property impact values are based on the percentage of a district's critical facilities exposed to the hazard area. This detail is shown for all the hazards except the earthquake scenarios (see Notes for special purpose districts on economic impacts). The property impact factor values are the same as shown above.

Flood Economic Losses

Special purpose districts' critical facilities loss estimates for the 50-, 100-, 500-year floods, dam failure, and the sea level rise scenarios calculate the flood losses based on Hazus model results. The model results forecast the percent flood damage to a structure. For a single facility in a district, this value would be multiplied by the value of the affected structure to yield the estimated percent economic loss. For a district with multiple affected structures, the mean percent damage to the structures would be used to calculate the percent economic loss. The economic ratings values are also the same as shown above.

Earthquake Functional Downtime as a Substitute for Economic Impact Factors

The Hazus earthquake model scenarios include estimates of functional downtime for the critical facilities – a facility's percent functionality after an event at days 1, 3, 7, 14, 30, and 90. For special purpose districts, functional down time is assessed for the number of days necessary for functionality to be restored to 50 percent. Functional downtime is assigned an impact factor as follows:

Days of Functional Downtime before 50% restoration	Impact	Impact Factor
0	None	0
≤14	Low	1
15-44	Medium	2
≥45	High	3

Community Risk Scores and Hazard Risk Ratings

A community's risk score and rating direct a community's hazard mitigation planning team to focus on mitigation actions for hazards and areas that are prone to hazard impacts. The higher the risk, the greater attention a community should give to evaluating actions to reduce asset vulnerabilities and impacts. Actions that mitigate higher risk hazards should be prioritized over low risk hazards as part of a jurisdiction's benefit cost review process. The Risk Scores translate to risk ratings as follows:

Risk Score	Risk Rating
0-15	Low
16-32	Medium
33-54	High

Example Community Hazard Risk Rating Calculation

Let's examine Hazard City, a foothills community that is nestled only 20 miles from the edifice of Mount Restlessness, a 14,000 foot volcano. We'll use the Community Hazard Risk Rating formula to calculate its risk. Refer to the information below to assign the probability impact factors and calculate the hazard risk rating for the city. The results are shown in Figure 4.6.

A portion of Hazard City is located in the lahar inundation zone. Mount Restlessness has been dormant for nearly 300 years, but there is geologic evidence that a lahar spread through the northeast edge of the city. The following information is known about the hazard:

a. Geologists believe there is an 80% probability that Mount Restlessness will erupt in the next 100 years. A Lahar would likely occur. This is considered a medium probability, as such a probability factor of 2 is assigned for Lahar for Hazard City.

b. Fourteen percent of the city's population is within a mapped historic lahar inundation zone – a medium population impact factor of 2 is assigned. The weighting value for impacts to people is 3, so the impact results for people are equal to 2x3 = 6.

c. $207.7 million or 10 percent of the city's $2 billion property valuation is exposed to the lahar zone. This is a medium property impact factor of 2. The weighting value for property is 2. The impact results to property are equal to 2x2=4.

d. Applying the 25% loss factor to the $207.7 million exposed value is $51.9 million or 2.5 percent of the total economic valuation of properties for Hazard City. This results in an estimated economic loss of 2.5 percent – an impact factor of 1 is assigned. The weighting value for the economy is 1, so the economic impact results are equal to 1x1=1.

e. The sum of impacts for people (6), property (4), and economy (1) is 11.

f. Multiplying the probability factor 2 to the sum of impacts (11) equals 22.

Hazard City has a lahar risk ranking score of 22 which is a "Medium" risk rating. Hazard City mitigation planners have identified the following lahar mitigation actions in their plan: 1) Develop a lahar hazard public awareness outreach, education, and preparedness campaign; 2) Create a volcano emergency alert system; and 3) Designate lahar evacuation routes with signs.

Figure 4.6 Hazard City Lahar Risk Rating

Probability Factor	Impact on People	Impact on Property	Impact on Economy	Risk Ranking Score	Risk Rating
2 x	(6 +	4 +	1)=	22	Medium

Community Hazard Risk Ratings for the Thurston Region

The hazard profiles present the Community Hazard Risk Ratings for each hazard and jurisdiction. Table 4.3 summarizes the overall planning area's risk rating for the major hazards assessed in the profiles. Specific information about the data used to inform the risk scores can be found in the hazard profiles and in Appendix C.

Addressing a Hazard's Risks in the Regional Mitigation Strategy

To provide a nexus between the plan's mitigation actions and the region's vulnerabilities, each hazard profile provides a brief description of the actions included in the Region's Mitigation Strategy that will reduce the hazard's impacts on the region. More information about the regional mitigation strategy can be found in Chapter 2, Recommendations. Information about jurisdictions' specific mitigation actions can be found in the annexes.

Table 4.3 Thurston Region Hazard Risk Ratings

		Dam Failure	Earthquake (CSZ 9.3)	Flood (100-year)	Landslide	Sea Level Rise (6 inches)	Severe Weather	Tsunami	Volcanic Lahar	Wildfire
Probability	Level	Low	Medium	High	High	High	High	Medium	Low	Medium
	Factor	1	2	3	3	3	3	2	1	2
People	%Exposed	1.47%	100.00%	0.97%	1.91%	0.16%	na	0.05%	0.76%	32.24%
	Impact	Low	High	Low	Low	Low	Low	Low	Low	High
	Factor	1	3	1	1	1	1	1	1	3
	Weighted Results	3	9	3	3	3	3	3	3	9
Property	%Exposed	0.71%	100.00%	0.93%	1.71%	0.85%	na	0.13%	0.35%	35.10%
	Impact	Low	High	Low	Low	Low	Low	Low	Low	High
	Factor	1	3	1	1	1	1	1	1	3
	Weighted Results	2	6	2	2	2	2	2	2	6
Economy	% Total Value Damaged	0.37%	6.74%	0.05%	0.43%	0.06%	na	0.03%	0.09%	8.78%
	Impact	Low	Medium	Low	Low	Low	Low	Low	Low	Medium
	Factor	1	2	1	1	1	1	1	1	2
	Weighted Results	1	2	1	1	1	1	1	1	2
Risk	**Risk Score**	**6**	**34**	**18**	**18**	**18**	**18**	**12**	**6**	**34**
	Risk Rating	**Low**	**High**	**Medium**	**Medium**	**Medium**	**Medium**	**Low**	**Low**	**High**

Endnotes

[1]Federal Emergency Management Agency. 2023. Local Mitigation Planning Handbook. https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-handbook_052023.pdf

[2]Thurston County Emergency Management. 2004. Hazard Inventory and Vulnerability Analysis. https://www.thurstoncountywa.gov/departments/emergency-management/threats-hazards

[3]Federal Emergency Management Agency. 2023. National Risk Index Technical Documentation. https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_technical-documentation.pdf

Chapter 4.1

Dam Failure Hazard Risk Assessment

Introduction

A catastrophic dam failure would principally impact residents, businesses, property owners, and assets in unincorporated Thurston County, the Nisqually Indian Reservation, and the Town of Bucoda. However, impacts would be experienced regionally because flood damage and impacts to roads, power, and critical facilities would indirectly impact a larger portion of the population that lives in dam failure inundation areas.

Previous versions of this plan identified the risks of dam failure. However, a dam failure was not profiled in detail in the risk assessment. This plan update includes a new dam failure hazard profile, and this chapter describes the potential risks from catastrophic dam failure to people and community assets.

Climate change will produce warmer and wetter winters for Western Washington. The total days and quantity of rainfall is modeled to surpass the normal range of variation (see Chapter 4.5 Severe Weather Hazards Risk Assessment). There is a high likelihood for a single extreme atmospheric river or a series of heavy rainfall events to occur. More extreme precipitation

will increase the risks for landslides, glacial outbursts, and flood events that could adversely impact normal dam operations. There is great uncertainty how future climate conditions could achieve or surpass probable maximum flood conditions that older dams were designed to withstand. Profiling dam failure and its risks provides affected communities information to identify mitigation strategies to safeguard people, property, and the environment.

Definition

In the context of hazard mitigation planning, dam failure is a catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water which creates life and property threatening impacts downstream from the dam.

For dam operations, there are lesser degrees of failure. Any malfunction or abnormality outside the design assumptions and parameters that adversely affect a dam's primary function of impounding water is properly considered a failure. Lesser degrees of failure can progressively lead to or heighten the risk of a catastrophic failure. However, lesser degrees of failure, when detected early can normally be mitigated with immediate corrective action.

Causes of Dam Failure

There are several mechanisms that could be the driving force to cause a catastrophic failure. A review of local dams' Emergency Action Plans and federal dam regulatory agency resources identify possible sources of dam failure that could affect dams in Thurston County. These causes are described below. The US Corps of Engineers Hydraulic Reference Manual summarizes several possible failure modes based on the type of dam construction (Figure 4.1.1).[1]

Deferred Maintenance – Like any infrastructure, dams need to be maintained so that minor problems don't become major issues. Vegetation in Western Washington grows prolifically and quickly. Trees and brush, and burrowing animals increase the chances for internal erosion and surface slides of earthen dams. Debris can block spillways. Dams must be routinely monitored and maintained to prevent potential failures.

Earthquake – Major seismic events with sufficient violent ground shaking could compromise the structural integrity of an earthen or concrete dam or the ability of dam operations personnel to safely operate the dam.

Overtopping – Severe storms with excess rain or heavy snowpack, volcanic lahars, or mudflows can swell rivers, increase runoff, and create flood conditions that can exceed a spillway's operational capacity to maintain safe water levels below the crest of a dam structure. Malfunctioning spillway gates can also lead to overtopping. Overtopping is also caused by the action of high-speed wind driven waves that wash across the crest of a dam. Earth embankments are not designed to be overtopped and are vulnerable to the erosive action of excess water spilling over the embankment. According to the US Army Corps of Engineers, 30 percent of dam failures in the United States are attributed to overtopping.

Overturning – horizontal and vertical forces such as water pressure, silt pressure, and uplift pressure can act against a gravity dam, creating overturning force or rotation of the structure. The structure resists this rotation by having adequate weight. If the sum of all the forces acting on a dam surpasses its design threshold, either through or outside of the downstream toe of the dam, the dam will rotate and overturn.[2]

Piping – Most all dams experience some level of seepage. Earthen dams are vulnerable to internal erosion, a process called piping. Soil erosion can occur by flowing water if there are cavities, cracks in rock, or other openings large enough so that soil particles can be transported away by seeping water. This type of underground erosion, when not detected and corrected, can create an open path for flow and grow to breach that causes a dam failure and an uncontrolled release of impounded water.

Sabotage – an act of terrorism such as an explosive device could cause structural damage resulting in a major breach.

Sliding – When the dam slides over its foundation or one part of the dam slides over a part of itself, it is called a sliding failure. It occurs when the net horizontal forces acting on the gravity dam exceed the frictional resistance produced between the body of the dam and the foundation.

Figure 4.1.1 Possible Modes of Failure by Dam Type

Failure Mode	Earth Fill/Embankment	Concrete Gravity	Concrete Arch
Cracking	X	X	X
Equipment Failure	X	X	X
Foundation Defects	X	X	X
Overtopping	X	X	X
Overturning		X	X
Piping	X	X	X
Sliding	X	X	

Area of Impact

Thirty-eight 38 dams are located in or immediately adjacent to Thurston County. Eight of these are categorized as high hazard potential dams. This category is assigned to dams that have a potential to threaten life safety and property downstream in the event of their catastrophic failure. Thurston Regional Planning Council obtained copies of Emergency Action Plans for each of the high hazard potential dams from the Washington State Department of Ecology (WADOE) and the dam owners.

The dam failure hazard risk assessment only characterizes the community risk ratings for two dam project failure scenarios.

1. The Nisqually Hydroelectric Project, consisting of the Alder and La Grande dams; and
2. The Skookumchuck Dam

These scenarios were selected for Hazus modeling analysis because failures of these dams present the greatest risk to the region's population and assets. Future updates of the mitigation plan will attempt to perform additional exposure analysis for the other high hazard potential dams. See Map 4.1.2 for the dam failure inundation areas for these two scenarios. The results of these scenarios are presented in the Vulnerabilities and Impacts section and the community risk ratings are shown in the Risk Characterization section.

Table 4.1.1 lists the high hazard potential dams located in or immediately adjacent to Thurston County.[3] Figure 4.1.2 lists the categories of downstream hazard categories if a structure were to fail with an uncontrolled release of its reservoir. Information about each dam was gathered from the operator's Emergency Action Plan (EAP). The EAP describes the dam structures, identifies conditions that may endanger the dam, identifies actions to mitigate dam failures, and specifies protocols for notifying emergency personnel of an impending or actual dam failure. A summary of each dam and its downstream impacts is presented below.

LaGrande Dam. Photo courtesty Washington State Department of Transportation

Table 4.1.1 High Hazard Potential Dams and Impoundment Structures in or Near Thurston County

Dam	Owner	Year Built	Type	Height (Ft)	Length (Ft)	Storage (Acre Ft)	Purpose	Primary[1] Regulatory Agency	Hazard Category
Alder	Tacoma Public Utilities	1945	Concrete Single Arch	330	1,150	241,950	Hydroelectric & Recreation	FERC	1A
LaGrande	Tacoma Public Utilities	1944	Concrete Gravity	217	710	3,015	Hydroelectric	FERC	1B
Berger	Robert & Michelle Strawn	1970	Earth	11	500	128	Recreation	WADOE	1C
Kyte	Southwest Resources LLC, Jorgensen Timber	1966	Earth	20	265	27	Irrigation/ Recreation	WADOE	2D
Skookumchuck	TransAlta Centralia Generation	1970	Earth	195	1320	35,000	Water supply for Centralia Steam Plant	FERC	1A
SPSCC Stormwater Pond F	SPSCC	2005	Earth	10	680	12	Stormwater Conveyance	WADOE	1C
Rainier Lake Dam (Formerly Windsor Waterski Pond)	Windsor Estates Homeowners Association	1992	Earth	11	350	175	Recreation	WADOE	1C
Yelm Hydroelectric Project	City of Centralia	1929	Concrete and Earth	20	48,050	350	Hydroelectric	FERC	High

[1]FERC = Federal Energy Regulatory Commission; WADOE=Washington State Department of Ecology

Figure 4.1.2 Downstream Hazard Classification

Hazard Classification	Lives at Risk	Risk Level
1A	Greater than 300	High
1B	31 to 300	High
1C	7 to 30	High
2D	1 to 6	Significant

Nisqually Hydroelectric Project – the Alder and La Grande Dams

The Alder and LaGrande dams are located on the Nisqually River. The City of Centralia's Yelm Hydroelectric Plant is located about 15 miles downstream from the Nisqually Project at approximately River Mile (RM) 26.2. There are no recreation areas, water retention facilities, or residences immediately downstream of the dams that require individual notification. The town of McKenna (in Pierce County), with a population of 716 is located about 32 miles downstream of Alder Dam. State Route 507, which is approximately RM 22, crosses the Nisqually River, cuts through the center of McKenna, and continues into Yelm. Portions of McKenna would be affected, including the facilities adjacent to the river. The City of Yelm is located at approximately RM 14. Access to Yelm may be restricted, but facilities would not be affected. Nisqually Tribal Lands lie approximately between RMs 11 and 4.5. Facilities within the area which could be impacted include the fish hatcheries, the aqueduct pumping station, a school, and some residences (See Map 4.1.1).

The Tacoma Power Nisqually Hydroelectric Project EAP was last updated in December 2022 and identifies procedures and responsibilities for notifying local, state, and federal agencies of all types of dam failure that are categorized by Tacoma Power. Tacoma Power reports that they are presently performing a new flood inundation study that will include additional reservoir variable discharge scenarios. This study is expected to be completed within one to two years.

Berger Dam

The Berger Dam is located on a tributary of Scatter Creek approximately 1.4 miles northeast of the City of Tenino near Strawn Lane. The dam's EAP was last updated in May 2020. The Berger Dam EAP consists of two inundation maps that show dam break water flowing within Scatter Creek. Floodwater will drain and flood properties as far west near Old Hwy 99 SE in Tenino. The EAP is unclear about the number of residences at risk for dam floodwater inundation. It identifies at least five residences that are located in the inundation area. However, the inundation maps are annotated that the inundation area could impact 37 to 61 homes with major flooding but requires verification. The EAP reports the first residence would be inundated by over seven feet of floodwater in six minutes after a dam failure. Floodwater would reach Old Hwy 99 SE in approximately 95 minutes and reach a maximum depth of nearly seven feet.

Two flood simulation scenarios and reports were prepared using Decision Support System for Water Infrastructure Security (DSS-WISE) GIS modeling software in 2021. This analysis generated updated inundation area maps for a Berger Dam failure that is not cited in the EAP. A visual examination of the updated inundation area over arial photos shows properties along Strawn Lane, Valentine Road SE, and Old Military Road SE will most likely be impacted. A more thorough analysis of potential flood risks should be examined prior to the next hazard mitigation plan update.

Kyte Dam

The Kyte Dam is located in a remote area of south Thurston County on an unnamed tributary of Coffee Creek that flows into the Skookumchuck River. The dam's EAP was last updated in June 2022.

One residence and several greenhouses are located in the dam's inundation area. Slape/Mcelfresh and Boyd roads are also in the inundation area and would be affected. Floodwaters would reach the residence approximately 12 minutes after the dam failure.

Skookumchuck Dam

The Skookumchuck Dam is located on the Skookumchuck River in south Thurston County approximately 12 miles upstream from the Town of Bucoda. The area immediately downstream from the dam is rural. A Washington Department of Fish and Wildlife hatchery is located 0.6 RM below the dam. Properties in the Skookumchuck River Valley along Skookumchuck Road and its connecting local roads, Johnson Creek Road, Tono Road, 184th Avenue SE are in the inundation area. SR 507 would be flooded from 180th Avenue SE to the Lewis County border. The entire Town of Bucoda is in the dam breach inundation area and would be isolated due to all connecting roads being flooded. The EAP was last updated in July 2023. The EAP includes an inundation study for a probable maximum flood dam failure scenario. This scenario models a 16-foot surface water elevation above the 100-year flood for the Town of Bucoda.

This plan's risk assessment modeling analysis reveals that nearly 230 buildings in Bucoda are exposed to dam failure risks and 94 percent of the town's population would be impacted.

The dam floodwaters would drain into the Scatter Creek basin south into Lewis County and drain into the Chehalis River before re-entering Thurston County. North of the Lewis County border, floodwater would impact areas around Prather Road SE, James Road SE, Independence Road SE, Moon Rd SE, and US Highway 12 north to the Black River near the unincorporated area of Gate. 615 residences in unincorporated Thurston County would be affected.

SPSCC Stormwater Pond F

The South Puget Sound Community College (SPSCC) Stormwater Pond F straddles the border of Olympia and Tumwater City Limits. It sits immediately below the F parking lot on the south edge of the campus. It is a below grade stormwater retention pond for nearby residences on 29th Avenue SW and the F parking lot. There are no residents living downstream from the structure. The impoundment is above grade to the south end of the SPSCC campus.

The stormwater pond spillway will convey rising water to a surface drainage swale below the impoundment. SPSCC staff stated they have never seen water in the pond reach the elevation of the spillway. Spillway water will drain to an adjacent wetland. During wet year conditions, the wetland is designed to overflow via an engineered swale to an inlet that drains an underground stormwater bypass near the college's Technology Building. This drains into a stormwater pond between buildings 32 and 34. This pond then drains via a culvert directly to Percival Creek.

Page 13 of the EAP indicates that 29th Ave SW (Tumwater) is listed as a road at risk. However, the stormwater pond is below grade from 29th Ave is not vulnerable. There are no residences in the path of the flood zone below grade from the stormwater pond. The Technology Building on campus is also listed as a vulnerable asset. If a catastrophic failure of the embankment occurred, impacts would likely be minimal due to the open space and wetland that lies immediately below the pond. The second stormwater pond between the Technology Building and the Percival Creek outflow culvert would effectively mitigate any major flood damage.

The EAP was last updated in September 2016. This stormwater pond deserves reevaluation as a high hazard potential classification at the time the EAP is updated. The EAP should be updated to accurately report on dam failure vulnerabilities and its emergency contact information. At present, the college's ongoing security patrols, routine structural inspections, and maintenance activities are sufficiently maintaining the safe operation of this facility.

Rainier Lake Dam (Formerly Windsor Waterski Pond)

The Rainier Lake Dam is located at Morris Road SE and 127th Lane SE. It is a recreational impoundment that is owned by the Windsor Estates Homeowners Association. It was originally developed as a waterski pond in 1992. The EAP appears to have been last updated in 2016. The flood path in the

EAP was identified by WADOE in 1991. A downstream breach hazards map shows flow paths for a northeast breach and a southeast breach. In general, the flow paths drain toward Yelm Creek. The EAP is not clear about the number of downstream residents and properties that are potentially impacted. The EAP states five residences are located in the dam break floodplain. However, the EAP lists seven residences, two barns, and a few outbuildings on eight parcels that are at greatest risk. In addition, breach hazard maps that are not included in the EAP appear to show at least 17 residences and structures as at risk in the dam failure flow path in the vicinity of Morris Road SE and 123rd Avenue SE. The maps also show properties east of Morris Road SE near Harris Road SE as potentially at risk.

Yelm Hydroelectric Project

The Yelm Hydroelectric Project is a "run of the river dam" located near the communities of Yelm and McKenna. A diversion dam and intake structure are located at Nisqually RM 26.2, about 4 miles southeast of McKenna. The project's major structures include a concrete diversion dam, an intake structure, a 9.1-mile-long earthen canal, three spillways, forebay, gatehouse, two penstocks, powerhouse, and transmission lines. The diversion dam, constructed in 1985, is a concrete gravity dam. The dam has a structural height of 20 feet, but a hydraulic height of only four feet at low stages. During high stages, the dam is nearly submerged with a difference of less than one foot between the headwater and tailwater. The EAP states that this low hydraulic differential combined with the large-channel-capacity of the Nisqually River diminishes the risk of overflooding consequences from a structural failure of the diversion dam.

The Centralia power canal was first constructed in 1929. It conveys water to the powerhouse downstream from the dam. It has a maximum flow rate of 800 cubic feet per second. The normal average depth is nearly 12 feet, and the average velocity is 2.2 feet per second. The canal runs parallel to the Nisqually River and north of the City of Yelm. The distances between the canal and the river vary from about 100 feet at the diversion dam, to 500 feet near the McKenna Bridge on SR507, and up to 1.2 miles near the Yelm Creek Flume. The slope of the land between the canal and the river varies at average rates between one and four percent. The land is mostly forested with some single homes, residential developments, mobile home parks, and farmland. If the canal failed, residences and businesses within some areas of the inundation zone could see flood depths of two or more feet.

The EAP is concerned with the possible failure of the canal embankment. A series of flow and level sensors are located in high hazard areas to monitor the canal. Yelm Hydroelectric Project staff also inspect the canal and the diversion dam daily. The project does not sustain high flows within the canal; any cause for high flows would be the result of the Nisqually

River overtopping the canal embankment. The Nisqually Hydroelectric Project has a major impact on the elevation and flow of the Nisqually River. Unlike the other dam structures in Thurston County, the canal could be adversely impacted by vehicle accidents with vehicles entering the canal and creating an obstruction that could lead to failure.

A canal failure would likely be a progressive failure than an imminent failure. However, the EAP includes hypothetical canal breach scenarios that are instantaneous events. Inundation maps with flood arrival times, maximum depths, and maximum velocities are included in the plan to provide general guidance to the timing of events. In general, a canal failure flow from the canal to the river is estimated to be between one and twenty minutes, depending on the location of the breach. A failure of the canal would likely produce localized flooding at the site of the breach and flooding would occur along the down gradient route to the Nisqually River. The City of Centralia mails an annual letter to residents who live within the inundation zone. The letter describes the hydroelectric project, what warning signs to watch for, and how to report a canal failure. The EAP lists the mailing address for 115 property owners and residents within the inundation zone.

Extent

Actual dam failure is more likely to be progressive in nature than a catastrophic uncontrolled release of impounded water. For high hazard potential dams in Thurston County, the Emergency Action Plans are focused on worst-case scenarios. Tacoma Public Utilities and TransAlta have conducted flood inundation studies to determine flood routing and severity based on hydrologic modeling for two commonly used catastrophic dam failure planning scenarios:

1. **Fair Weather or "Sunny Day" Failure** – a scenario in which a dam breach occurs under normal operating conditions. A failure occurs with a reservoir at normal full pool elevation and with a normal stream flow prevailing. This scenario is generally considered to have the most potential for loss of human life due to a failure occurring when it is not expected.
2. **Probable Maximum Flood (PMF)** – a scenario based upon a hypothetical breach occurring during the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin. PMF inundation reaches higher elevations resulting in more areas and additional populations being affected than the sunny day scenario.

The studies produce maps that show the modeled geographic extent of flooding for both Fair Weather and PMF scenarios. The maps areas are divided into sections. Each section is annotated with details for each scenario. This information includes the river mile, the flood wave or leading-edge arrival time, peak flow, and incremental rise or total rise in water surface. This information informs decisions about the types of warning systems that may be necessary to protect community members from incoming flooding due to a dam breach. For example, the dam operators and emergency managers need to inform the population downstream when to expect flooding, when to evacuate, and how long the flooding may last after the arrival time. The maps can also be used for identifying road closures, evacuation routes, and identifying critical infrastructure vulnerabilities.

Copies of the inundation maps are not included in this plan at the request of the dam operators to limit the availability and distribution of sensitive information. Interested parties may request copies of EAPS and inundation maps from the dam owners. In lieu of the maps, the dam breach flood inundation level information is provided in tabular form. Table 4.1.2 shows Nisqually Hydroelectric Project Dam failure flood inundation levels for locations in Thurston County. Table 4.1.3 shows Skookumchuck Hydroelectric Project Dam failure inundation levels.

Key Terms for Flood Inundation Levels

Flood Arrival Time: The time that dam breach floodwater arrives at a river or basin cross-section and increases the elevation of the normal water level.

Time to Peak: The time for floodwater to reach its maximum elevation at a river or basin cross-section.

Peak Water Surface Elevation: In general, the maximum height above mean sea level that water in a reservoir, river, or flood plain has reached.

Peak Discharge: The maximum rate of discharge in cubic feet per second (cfs) – 1 cfs equals 7.48 gallons per second.

Table 4.1.2 Nisqually Dam Failure Inundation Levels in Thurston County[2]

Scenario	Flood Arrival Time (hr:min)	Time to Peak (hr:min)	Peak Water Surface Elevation (feet)	Peak Discharge (cubic feet per second, cfs)
RM 30 Near Hobson Road SE				
Sunny Day	0:55	1:13	424	2,117,762
PMF	0:42	1:00	431	2,732,420
RM 26.2 Yelm Hydroelectric Project Diversion Dam				
Sunny Day	1:34	2:19	38	872,796
PMF	1:09	1:54	394	1,295,659
RM 24 Vicinity of Crook Road and Arlene Lane SE				
Sunny Day	1:55	2:43	356	820,941
PMF	1:24	2:12	366	1,233,354
RM 22 Vicinity of SR507 Bridge near McKenna				
Sunny Day	2:15	3:07	334	772,350
PMF	1:42	2:33	343	1,199,754
RM 17 Two Miles Downstream from vicinity of Briar St SE and Heather Ln SE				
Sunny Day	2:55	4:13	243	673,880
PMF	2:18	3:30	254	1,063,493
RM 13.5 Vicinity of Yelm Hydroelectric Plant				
Sunny Day	3:31	4:37	170	656,619
PMF	2:42	4:00	183	1,040,331
RM 11 Vicinity of Peter Kalama Road SE on the Nisqually Indian Reservation				
Sunny Day	4:07	5:01	104	648,715
PMF	3:06	4:42	115	1,046,665
RM 5 Vicinity of Sportsman Lane SE				
Sunny Day	5:18	6:55	77	439,799
PMF	3:48	5:36	97	786,443
RM 3.5 Vicinity of Conine Street SE				
Sunny Day	5:31	7:07	41	438,775
PMF	4:00	5:54	48	783,885
0.6 miles below the dam, Washington Fish and Wildlife Hatchery				
Sunny Day	0:10	0:43	383	704,000
PMF	0:13	0:48	380	869,000
3.9 miles below the dam, Skookumchuck Road SE Bridge				
Sunny Day	0:36	0:59	334	551,000
PMF	0:32	1:00	333	764,000

[2]Note: Because of the method, procedures, and assumptions used to develop the flooded areas, the limits of flooding shown and flood wave travel on the inundation maps are approximate and should be used only as a guideline for planning purposes. Actual areas inundated will depend on actual failure or flooding conditions and may differ from what is shown.

Scenario	Flood Arrival Time (hr:min)	Time to Peak (hr:min)	Peak Water Surface Elevation (feet)	Peak Discharge (cubic feet per second, cfs)
10.4 miles below the dam, 184th Avenue SE and SR507				
Sunny Day	1:40	2:32	276	185,000
PMF	1:17	1:55	281	376,000
11.8 miles below the dam, Town of Bucoda				
Sunny Day	1:56	2:50	266	175,000
PMF	1:26	2:08	270	353,000
16.7 miles below the dam, Vicinity of Troy Street SE at the SR 507 Bridge				
Sunny Day	2:51	3:48	233	145,000
PMF	1:59	2:36	237	309,000
30.8 miles below the dam, Prather Road SE Bridge at the Chehalis River				
Sunny Day	7:50	10:42	148	61,000
PMF	4:59	6:24	151	190,000
36.7 miles below the dam, Independence Road SW Bridge at the Chehalis River				
Sunny Day	10:19	13:59	120	58,000
PMF	n/a	7:56	122	180,000

Previous Incidents

There are no documented incidents of dam failure in Thurston County.

Probability of Occurrence

The EAPs for the Nisqually Hydroelectric Project and the Skookumchuck Hydroelectric Project do not present information about the probabilities of the included sunny day and Probable Maximum Flood dam failure scenarios. For the dam failure hazard profile, no analysis was conducted to estimate the probability of dam failure. The probability of experiencing catastrophic dam failure is typically very low. For the risk assessment dam failure is categorized as low – a catastrophic dam failure is unlikely to occur within 100 years.

Vulnerabilities and Impacts

This risk assessment is based on catastrophic dam failures for the Nisqually Hydroelectric and the Skookumchuck Hydroelectric project dams. TRPC obtained copies of the dam inundation digital files from Tacoma Power and TransAlta Centralia Generation. A GIS exposure analysis was used to estimate the population within the dam inundation areas. A Level 2 user-defined analysis was performed for general building stock and critical facilities located in the dam failure hazard areas for the Probable Maximum Flood (PMF) scenarios. Depth grids were generated using the dam failure inundation areas and uploaded into the Hazus riverine flood model. By inputting depth data and known property replacement cost values, dollar-value estimates of damage were generated.

For the data tables in the sections that follow, only the jurisdictions with estimated impacts and vulnerabilities are shown, unless otherwise noted. For the Nisqually Hydroelectric Project dams, only unincorporated Thurston is affected. For the Skookumchuck Hydroelectric Project dams, only the Town of Bucoda and unincorporated Thurston County are affected.

Refer to Chapter 4.3 Flood Hazard Risk Assessment for a description of the types of direct impacts floodwaters would have on people, structures and systems, natural and cultural resources, and activities.

Impacts to People

Estimates of People Exposed to Dam Failure Flood Inundation

An estimated 4,406 people in unincorporated Thurston County and the Town of Bucoda reside in the combined Alder, LaGrande, and Skookumchuck PMF dam failure inundation areas (Table 4.1.4)

Bucoda residents are most at risk from a catastrophic dam failure from the Skookumchuck Dam. An estimated 94 percent of the community's population would be threatened by floodwater (Table 4.1.5). The community would be inundated with peak flood floodwater elevation within two hours. Warning notification time and evacuation orders are time-critical for such a scenario.

An estimated 1,719 unincorporated Thurston County residents also face Skookumchuck dam failure hazards, especially those residents who live in the Skookumchuck River Valley near and along Skookumchuck Road SE.

Table 4.1.4 Thurston County Population Residing in the Dam Failure Inundation Areas

Jurisdiction	Population	Nisqually Dams		Skookumchuck Dam		Combined Inundation Areas
		Population Exposed	%Population Exposed	Population Exposed	%Population Exposed	Population Exposed
Bucoda	610	0	0	571	94.1%	571
Unincorporated Thurston County	143,760	2,116	1.5%	1,719	1.2%	3,835
Total Planning Area	**300,500**	**2,116**	**0.7%**	**2,291**	**0.8%**	**4,406**

Estimates of People Displaced or Requiring Shelter

Table 4.1.5 shows estimates of the number of individuals who could be displaced or require short-term sheltering for dam failure.

Table 4.1.5 Number of Individuals Displaced and Needing Shelter for the Dam Failure Scenarios

Jurisdiction	Nisqually Dam Failure		Skookumchuck Dam Failure	
	Displaced Individuals	Individuals Needing Shelter	Displaced Individuals	Individuals Needing Shelter
Bucoda	0	0	169	12
Unincorporated Thurston County	31	2	20	0
Total Planning Area	31	2	199	12

Impacts to Structures and Systems

Estimates of Structures in Dam Inundation Areas

An estimated 1,594 total residences are located in the region's combined dam failure inundation areas. There are an estimated total 1,662 structures countywide that are potentially vulnerable to dam failure flooding (Tables 4.1.6 and 4.1.7)

Table 4.1.6 Number of Structures in the Nisqually Dam Failure Inundation Area

Jurisdiction	Number of Structures in Nisqually Dam Failure Inundation Areas							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Unincorporated Thurston County	757	34	1	0	0	0	4	**796**
Tota Planning Areal	757	34	1	0	0	0	4	**796**

Table 4.1.7 Number of Structures in the Skookumchuck Dam Failure Inundation Area

Jurisdiction	Number of Structures in Skookumchuck Dam Failure Inundation Areas							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	222	6	0	0	0	2	0	**230**
Unincorporated Thurston County	615	15	3	0	1	2	0	**636**
Tota Planning Areal	837	21	3	0	1	4	0	**866**

Estimates of Structural and Content Damage in Dam Inundation Areas

Hazus modeling for dam failure scenarios estimates there would be an estimated 567 buildings impacted resulting in nearly $143 million in combined structural and content losses countywide for a catastrophic failure of the Nisqually Alder and LaGrande dams (Table 4.1.8). There would be an estimated 796 buildings impacted resulting in over $131 million in combined structural and content losses countywide for a catastrophic Skookumchuck Dam failure (Table 4.1.9)

Table 4.1.8 Estimated Value of Structural and Content Damage for the Nisqually Dam Failure Scenario

Jurisdiction	Buildings Impacted	Total Value of Structural and Content Damage	% of Total Value Damage
Unincorporated Thurston County	567	$142,932,250	0.6%
Total Planning Area	567	$142,932,250	$0.2%

Table 4.1.9 Estimated Value of Structural and Content Damage for the Skookumchuck Dam Failure Scenario

Jurisdiction	Buildings Impacted	Total Value of Structural and Content Damage	% of Total Value Damage
Bucoda	230	$46,409,627	72.8%
Unincorporated Thurston County	566	$84,646,048	0.3%
Total Planning Area	796	$131,055,675	0.2%

Estimates of Structural Damage Debris

Flood Hazus modeling estimates the tons of structural debris that will be generated by major flood events. Countywide, the Nisqually dam failure scenario would produce an estimated 33,155 tons of structural damage debris and the Skookumchuck Dam failure scenario would generate an estimated 21,610 tons of debris. Table 4.1.10 shows estimates of debris generation for each dam failure scenario.

Table 4.1.10 Estimates of Structural Debris for the Nisqually and Skookumchuck Dam Failure Scenarios

	Structure Debris (tons)	
Jurisdiction	Nisqually Dam Failure	Skookumchuck Dam Failure
Bucoda	0	7,248
Unincorporated Thurston County	33,115	14,362
Total Planning Area	33,115	21,610

Estimates of Lifeline Asset Exposure

There are an estimated 13 community lifeline assets located in the Nisqually dams' inundation area (Table 4.1.11). Exposed assets include an electric substation, a City of Lacey water treatment facility, three wells – two owned by Lacey and one by the Thurston PUD, the Wa He Lut Indian School, and seven state highway bridges. Table 4.1.13 shows the percent average value damage to structures by lifeline. While not included in the tabulations, the Yelm Hydroelectric Project owned by the City of Centralia would be adversely impacted by Nisqually River flooding.

There are an estimated 20 lifeline assets located in the Skookumchuck Dam inundation area (Table 4.1.12). Lifeline assets include an electric substation, a water pump station, three wells owned by Thurston PUD, two park shelter facilities, four fire stations owned by Bucoda and South Thurston Fire and EMS, four Bucoda government buildings, and five state highway bridges. Table 4.1.14 shows the percent average value damage to structures by lifeline.

Table 4.1.11 Community Lifelines located in the Nisqually Dam Failure Scenario

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Unincorporated Thurston County	0	1	4	0	0	1	7	13
Total Planning Area	0	1	4	0	0	1	7	13

Table 4.1.12 Community Lifelines located in the Skookumchuck Dam Failure Scenario

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	3	0	0	5	0	8
Unincorporated Thurston County	0	1	3	0	0	3	5	12
Total Planning Area	0	1	6	0	0	8	5	20

Table 4.1.13 Estimates of Damage to Community Lifelines in the Nisqually Dam Failure Scenario

Lifelines	Number of Facilities Affected	% Average of Total Value Damaged	
		Structure	Content
Safety and Security	1	86%	100%
Food, Water and Sheltering	4	65%	81%
Health and Medical	0	N/A	N/A
Energy	1	65%	81%
Communications	0	N/A	N/A
Transportation	7	1%	N/A
Hazardous Material	0	N/A	N/A
Total/Average	13	54%	87%

Table 4.1.14 Estimates of Damage to Community Lifelines in the Skookumchuck Dam Failure Scenario

Lifelines	Number of Facilities Affected	% Average of Total Value Damaged	
		Structure	Content
Safety and Security	7	62%	99
Food, Water and Sheltering	6	42%	91
Health and Medical	0	N/A	N/A
Energy	1	65%	81
Communications	0	N/A	N/A
Transportation	5	3%	N/A
Hazardous Material	0	N/A	N/A
Total/Average	19	43%	90%

Impacts to Natural, Cultural, and Historic Resources

A catastrophic dam failure would have major impacts on the environment due to contamination of water resources and agricultural lands from hazardous materials released during the flood event. The sudden release of impounded water would scour gravel from river and stream beds and destroy vital fish habitat including fish hatcheries on the Nisqually and Skookumchuck Rivers. Rising floodwaters would also destroy surrounding riparian and portions of upland habitat impacting terrestrial species. The loss of such habitat would adversely impact traditional fishing, hunting, and foraging areas for the Nisqually and Chehalis tribes.

Dam floodwater would destroy culturally significant structures such as the Wa He Lut Indian School, the Bucoda Gym, and the Bucoda City Hall historic Oddfellows Building.

Impacts to Activities

A dam failure disaster would disrupt travel for people, goods, and services to and from Thurston County due to impacts to bridges over the Nisqually and Skookumchuck Rivers.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.1.2 shows assets and structures in Thurston County that are located in the dam failure inundation areas by census tract social vulnerability ratings. Most areas affected by dam failure have a social vulnerability rating that ranges from relatively moderate to relatively high.

The Federal Emergency Management Agency does not include a dam failure hazard in its National Risk Index.

Community Hazard Risk Ratings for Dam Failure

The Town of Bucoda's dam failure risk rating is based solely on the Skookumchuck probable maximum flood dam failure scenario. Dam failure is a low probability high consequence event for Bucoda. As such, the risk rating model produces a risk ranking score of 18 or a medium risk rating, principally because the probability of a failure is low.

The unincorporated Thurston County and countywide dam failure risk rating process combines the dam failure scenarios for both the Nisqually and Skookumchuck dams. As such, the unincorporated county and countywide risk ranking scores are each 6, resulting in a low-risk rating.

Only four special purpose districts have critical facilities located in the dam failure inundation areas. All four have a low-risk rating. Table 4.1.16 shows special purpose district dam failure hazard risk ratings. The details of the dam failure hazard risk assessment calculations are shown in Appendix X.

Table 4.1.15 Community Dam Failure Hazard Risk Ratings

Municipal Plan Participants	Dam Failure Hazard	
	Risk Ranking Score	Risk Rating
Bucoda	18	Medium
Unincorporated Thurston County	6	Low
Total Planning Area	6	Low

Table 4.1.16 Special Purpose District Dam Failure Hazard Risk Ratings

Special Purpose District Plan Participants	Dam Failure Hazard	
	Risk Ranking Score	Risk Rating
Lacey Fire District	3	Low
SE Thurston Fire Authority	3	Low
Thurston PUD	6	Low
West Thurston Regional Fire Authority	3	Low

Changes in Dam Failure Hazard Risks Since Last Plan Update

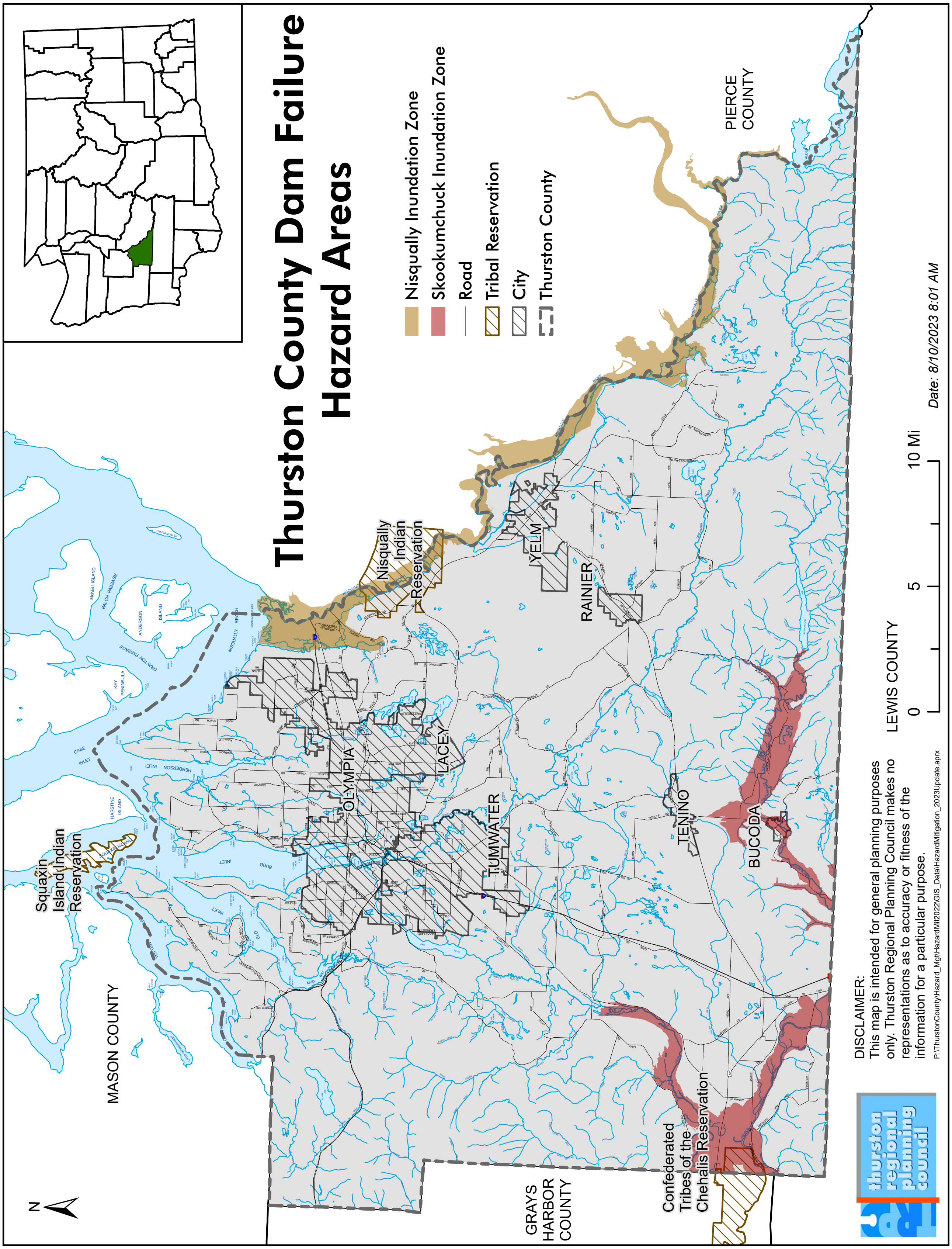
This plan presents the region's first ever countywide dam failure risk assessment. This hazard profile provides a baseline assessment for future evaluation of the region's dam failure hazard vulnerabilities and risks.

Connection to the Regional Mitigation Strategy

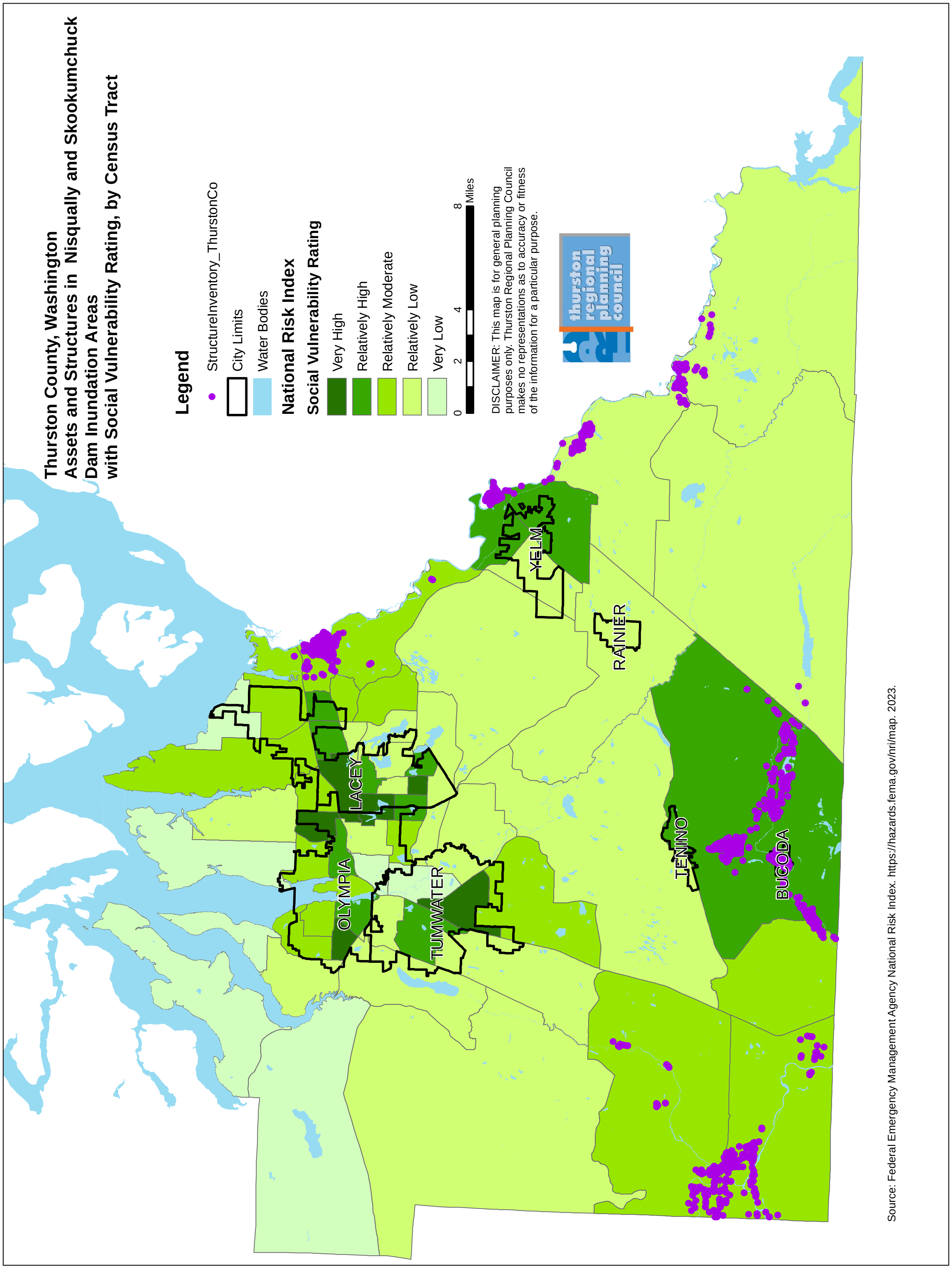
Dam Failure hazard information will be included through the Regional Hazard Mitigation Public Outreach Strategy initiative. The Hazard Modeling and Loss Estimation Capacity Building initiative will build local knowledge and technical skills to develop, operate, and maintain community-specific GIS-based hazard modeling tools that include local data such as data for other dam inundation areas not included in this hazard profile. Local modeling tools can inform planning and decision making for hazard mitigation, emergency management, disaster recovery, and training. The Lifeline Transportation Resiliency Plan will identify priority transportation projects to strengthen bridges, roads, and other multimodal transportation assets so they are less prone to floodwater inundation and closures.

The Hazard Mitigation Planning Workgroup identified a regional initiative, Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar. This initiative will develop an evacuation plan for potential dam failure and lahar hazards in coordination with residents, businesses, and other stakeholders. The plan will include routes, alert notification protocols, signs, staging areas, public education, emergency sheltering needs, operational plans, and training for organizations and personnel who would be involved in evacuation operations.

Map 4.1.1 Nisqually and Skookumchuck River Dam Failure Inundation Areas of Thurston County



Map 4.1.2 Exposed Assets and Structures in the Nisqually and Skookumchuck Dam Inundation Areas with Social Vulnerability Index Rating by Census Tract



Endnotes

[1]US Corps of Engineers. 2023. Hydrologic Engineering Center. Hydraulic Reference Manual: https://www.hec.usace.army.mil/confluence/rasdocs/ras1dtechref/6.3/performing-a-dam-break-study-with-hec-ras/estimating-dam-breach-parameters/causes-and-types-of-dam-failures.

[2]Association of State Dam Safety Officials. 2023. Gravity Dam Failure Modes:

https://damsafety.org/dam-owners/concrete-gravity-dam-failures.

[3]Inventory of Dams Report for Selected Washington Counties and Selected Dam Hazard Categories. 2020. Washington State Department of Ecology, Water Resources Program, Dam Safety Office. 200 pages.

Chapter 4.2

Earthquake Hazard Risk Assessment

Introduction

The Washington Department of Natural Resources (WADNR) Geological Survey reports that Washington has the second highest risk for large damaging earthquakes in the United States. This is due to the state's geological conditions and the proximity of large intensely developed population centers to known active faults. Large earthquakes have rattled Thurston County in 1949, 1965, and 2001 resulting in major damage and two federal disaster declarations. A University of Washington study following the 2001 Nisqually 6.8 magnitude earthquake found the event caused an estimated $1.5 billion in damage to approximately 300,000 residences. The study also revealed that the vast majority of the region's residents made little effort to adjust their earthquake preparedness following the incident.

Definition

An earthquake is the rapid movement and shaking of the ground caused by a sudden fracture, slipping, or movement in the Earth's crust. A fault is a fracture in the Earth where the two sides have been displaced relative to each other (see Figure 4.2.1 for the active faults in Washington State). A fault ruptures when the accumulation of stress overcomes friction. This rupture disperses energy in the form of seismic waves that move through the earth in all directions. With sufficient energy, it causes the ground to shake or tremor vigorously. This shaking motion and the subsequent behavior of the earth's surface – liquefaction, landslides, ruptures, or ground failure – damages and destroys roads, bridges, buildings, utilities, and other infrastructure. Earthquakes can also produce secondary destructive effects including fires, flooding, and tsunamis.

Effects of Earthquakes

Ground Motion

The intensity of ground shaking depends on a community's proximity to the fault or source that produced the earthquake: the closer to the rupture, the greater the ground shaking. The effects of ground shaking produce ground failures. The composition and structure of the underlying earth also affects intensity. Shaking is strongest in areas of soft soils, such as in river valleys or along the shorelines of bays and lakes. Softer soils amplify ground shaking. The greater the wave velocity difference, the greater the amplification of ground surface shaking. Consequently, ground shaking in areas of soft soils underlain by stiffer soils or rock is generally stronger than in areas where there is little or no variation between the surface and lower layer.[1] Observations of past earthquakes verify this phenomenon as evidenced by damage to buildings and infrastructure in downtown Olympia and Seattle in areas built on fill. Strong ground shaking can damage a variety of structures and utilities.

Ground Failures

Earthquakes can cause surface faulting, landslides, subsidence, and uplifting. Surface faulting occurs when the ground breaks apart. The length, width, and displacement of the ground characterize surface faults. During the 2001 Nisqually earthquake, surface faulting occurred along Deschutes Parkway and around Capitol Lake recreational trails near Interstate 5. Subsidence is the sinking of earth and uplifting is the elevation of earth. Unstable and unconsolidated soils are most vulnerable to ground failures and surface faulting.

Liquefaction

Liquefaction is a 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 on gentle slopes and involve the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil supporting a structure liquefies. This can cause structures to tip and topple. Liquefaction typically occurs in artificial fills and in areas of loose sandy soils that are saturated with water, such as low-lying coastal areas, lakeshores, and river valleys.

Area of Impact

The entire Pacific Northwest is seismically active, and all communities are at risk for earthquake hazards. Map 4.2.1 shows susceptibility level for liquefaction in Thurston County. For the risk assessment, three earthquake scenarios were modeled using the natural hazards GIS modeling tool Hazus to assess vulnerabilities, estimate losses, and characterize earthquake hazard risks for Thurston County:

- A Cascadia Subduction Zone Magnitude 9.3 (megathrust earthquake)
- A Nisqually 7.2 (deep intraplate earthquake)
- A Seattle Fault 7.2 (shallow or crustal faulting earthquake)

Earthquake ShakeMaps prepared by the United States Geological Survey were used in the modeling analysis. Data from the WADNR on National Earthquake Hazard Reduction Program (NEHRP) soil types and liquefaction susceptibility were also integrated into the Hazus model.

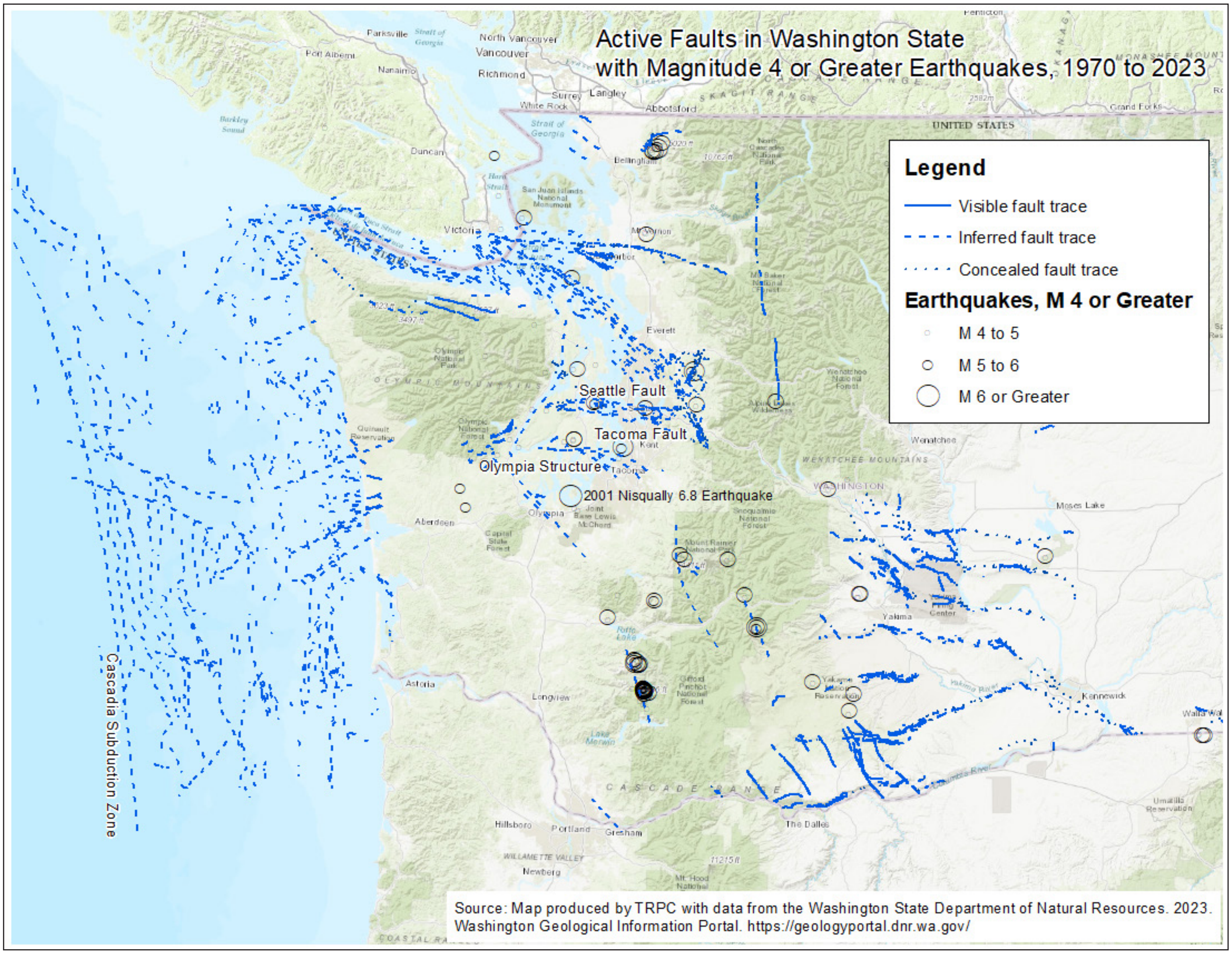
Communities Most Vulnerable to Earthquake Hazards

Maps 4.2.2, 4.2.3, and 4.2.4 are portions of ShakeMaps for Thurston County that show the level of ground shaking by the Mercalli Intensity (see Figure 4.2.4 for definitions) for the Cascadia Subduction Zone, Nisqually, and Seattle earthquake scenarios respectively. The Cascadia Subduction Zone scenario produces very strong to severe shaking across most of Thurston County with more severe shaking expected for the western half of the county. For the Nisqually scenario, moderate to very strong shaking will be felt across the entire county. For the Seattle scenario, strong shaking is expected for the northern third of the county and very light to moderate shaking will be felt further south.

Liquefaction hazards vary from very low to high throughout Thurston County. The following areas have moderate to high liquefaction susceptibility:

- **Town of Bucoda** – Most of Bucoda (63%) is categorized with a moderate to high risk for liquefaction due to the prevalence of sedimentary deposits left by historic surface waters.
- **City of Olympia** – The entire Port Peninsula approximately north of State Avenue, the entire margin of the north basin of Capitol Lake from Marathon Park to Budd Inlet, including Deschutes Parkway. The isthmus between Capitol Lake and West Bay, and the 4th and 5th Avenue corridors, and the filled portions of the western shore of West Bay including West Bay Park and the former Hardel Plywood property. The Henderson Boulevard/Moxlie Creek corridor from north of Watershed Park to East Bay.
- **City of Tumwater** – The entire Deschutes River Valley from Henderson Boulevard SE to the former Olympia Brewery. Percival Creek vicinity from Trosper Road SW to Sapp Road SW.
- **Thurston County** – The north and west ends of Young Cove on the Steamboat Island Peninsula near the Gravelly Beach Road NW and Gravelly Beach Loop NW intersections. Mud Bay at the southern end of Eld Inlet along Delphi Rd to 40th Avenue SW (U.S. Highway 101 runs through this vicinity). The Deschutes River Valley from Henderson Boulevard SE to north of Offut Lake. The entire Nisqually River Delta, including the portion of Interstate 5 that runs through it. The neighborhoods immediately straddling Mullen Road north of Pattison Lake.

Figure 4.2.1 Active Faults in Washington State and Source Locations of Magnitude 4 or Greater Earthquakes, 1970-2023

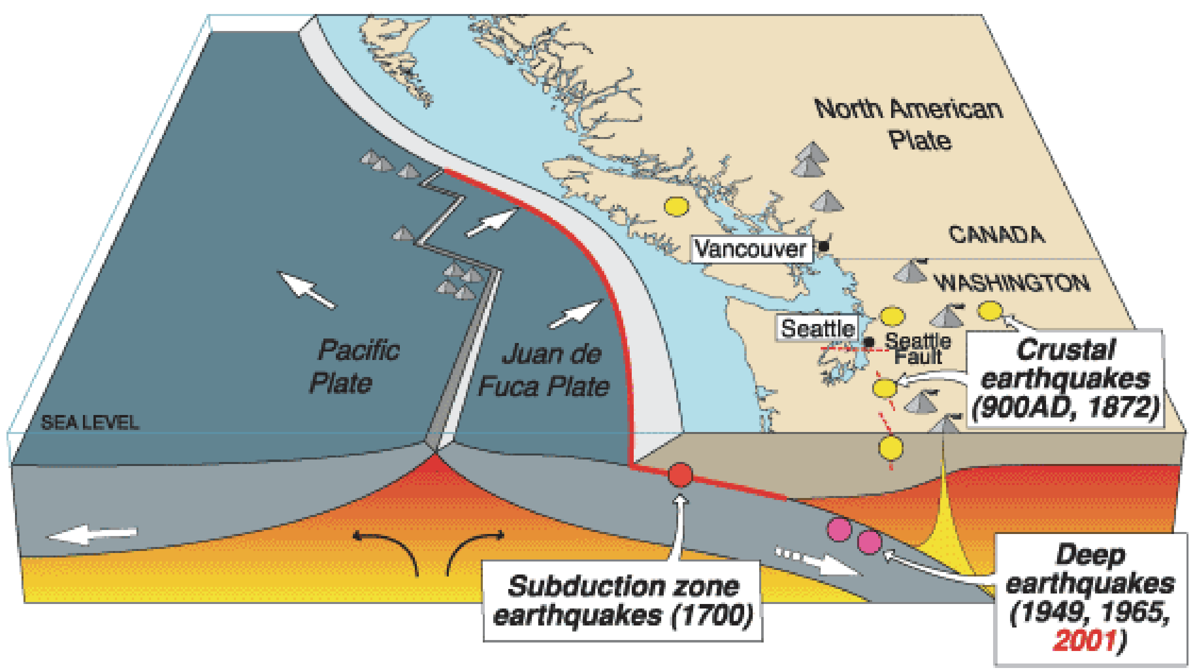


Extent

Sources of Earthquakes Affecting Pacific Northwest

Earthquakes predominantly occur due to the processes of plate tectonics. The Pacific Northwest is one of the most geologically active regions in North America. Seismologists categorize northwest earthquakes into three different source zones (Figure 4.2.2). The three source zones capable of causing major destruction are the Cascadia Megathrust (interplate), Deep Intraplate, and Crustal Faulting zones. The Thurston County region is vulnerable to earthquakes from all three zones. A fourth type, volcanic earthquakes, are generally smaller events and are in remote areas and therefore have less potential to cause damage directly to Thurston County communities.

Figure 4.2.2 Cascadia Earthquake Sources with Maximum Magnitudes and Recurrence Intervals[5]



Source	Affected area	Max. Size	Recurrence
Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

Cascadia Megathrust or Subduction Zone

Most of the world's most damaging earthquakes take place near the ocean boundary between two or more plates, known as interplate earthquakes. Washington State is located on a convergent continental margin, the boundary between three tectonic plates known as the Cascadia Subduction Zone. Located offshore, it stretches nearly 1,000 kilometers from northern California to Vancouver Island, British Columbia. The younger Juan de Fuca Plate is spreading away from the Pacific Plate and plunging beneath the continental North American Plate. The strain between these plates has slowly built-up energy over the last several hundred years, but the plates are locked by friction. When the fault's frictional strength is exceeded and the rocks slip past each other, a megathrust earthquake will occur. When this pressure eventually releases, it will result in "the big one," an estimated magnitude 8.0 to 9.2 earthquake. The edge of the North American Plate will lurch suddenly upward and southwest and the oceanic plates will slip under and northeast. The western edge of the North American Plate is expected to flex, causing the coastline to subside or drop as much as 2 meters in elevation. An earthquake of this strength will result in violent ground shaking that can travel hundreds of miles and last for four to six minutes. Such earthquakes generate massive tsunamis (see Chapter 4.7 Tsunami Hazard Risk Assessment).

Subduction zone earthquakes are the largest, most destructive earthquakes on Earth as recently experienced in 2011 in Tohoku, Japan, the 2004 Sumatra-Andaman earthquakes, the 2001 southern Peru earthquake, the 1965 Alaska earthquake, and the 1960 Great Chilean earthquake. The last subduction zone earthquake in the Pacific Northwest is believed to have occurred in January 1700. Seismologists estimate that such earthquakes have occurred at least seven times in the last 3,500 years with a recurrence interval of 300 to 600 years. The next megathrust earthquake could strike the Pacific Northwest at any time or still be hundreds of years away. In the next 50 years, scientists believe there is a 40 to 80 percent chance of a magnitude 8 to 9 earthquake striking somewhere along the Cascadia Subduction Zone.

Megathrust earthquakes are followed by strong, persistent, and frequent aftershocks in the following weeks, months, and years. Aftershocks gradually diminish, but they pose major hazards to life safety and infrastructure. Earthquakes of such magnitude can drastically alter tens of thousands of points of stress along the plates of a subduction zone, completely modifying the frictional stability of the faults and making them susceptible to ruptures. A megathrust quake can also disrupt both deep intraplate and shallow crustal faults inland. The Olympia Structure, a theoretical fault that transverses Thurston County (see Figure 4.2.1), is one such shallow crustal fault that could be triggered by a megathrust quake.

Two years after the Tohuku earthquake, Japan experienced more than 9,500 aftershocks. While most originated offshore, many registered in the upper and lower range of magnitude 6, strong enough to shake buildings and trigger landslides. The persistent aftershocks forced more than 250,000 people from their homes. In April 2016 a magnitude 7.3 aftershock killed over 40 people and injured more than 1,000 in the city of Kumamoto.[2] In the event of a megathrust earthquake, aftershocks are likely strike the Pacific Northwest with similar frequency and strength.

Deep Intraplate Earthquakes

The Pacific Northwest Seismic Network states that deep intraplate earthquakes are the most common source of damaging earthquakes in Washington and Oregon. They occur along faults in the subducting portions of the Juan de Fuca plate, originating beneath the North American plate. Earthquakes from this zone are common in the greater Puget Sound Basin. They emanate from depths of 30 to 50 miles and can reach a strength as high as magnitude 7.5. Because they rupture at such great depths, their seismic energy is distributed over a large area and the intensity is less than a shallow quake of the same strength. Ground shaking generally lasts less than a minute. Aftershocks from these events are not typical. While tsunamis are not expected, earthquake-induced landslides into the Puget Sound may produce a local tsunami. Due to their proximity to larger urban communities in western Washington, deep earthquakes can cause significant damage.

Historically, earthquakes have originated from this zone about every 30 years. The 1949 Olympia (M6.8), 1965 Seattle (M6.5), and 2001 Nisqually (6.8) earthquakes were all deep intraplate events (see Figure 4.1.1). The 2001 Nisqually earthquake's focus was located about 32 miles deep below its epicenter in the Nisqually River Delta. The United States Geological Survey (USGS) estimates there is an 84 percent chance of another deep earthquake of Magnitude 6.5 or greater occurring within the Puget Sound region in the next 50 years.

Crustal Faulting or Shallow Earthquakes

Crustal (shallow) earthquakes occur along faults close to the surface of the North American plate. They are produced in the upper 18 miles of the Earth's crust, though most occur much closer to the surface. The Seattle fault is perhaps the most infamous, as it lies under the most densely populated area of the state. Most earthquakes in the Pacific Northwest originate from the Crustal Faulting Zone. They could potentially reach magnitudes as high as 7.5, though most are less than 3.0. Ground shaking from earthquakes on shallow faults typically last from 20 to 60 seconds and is localized to the source.

Evidence suggests that an Olympia fault structure may exist across the north end of Thurston County.[3] A strong earthquake is estimated to have occurred nearly 1,100 years ago, which resulted in rapid one to three-meter subsidence in lowland forests near present day McAllister Creek, the Nisqually River, and at Little Skookum Inlet. A magnitude 6.0 or greater earthquake originating from a surface fault could render incredible destruction. More research is necessary to verify the existence of the Olympia fault structure and its probability of rupturing.[4]

Measures of Earthquake Strength

Magnitude

Several common measures are used to articulate earthquake strength. Magnitude (M) is a measurement of the total quantified energy released by an earthquake. “Moment magnitude” is calculated from the amount of movement on the fault causing the earthquake and the area of the fault surface that ruptures during the earthquake. It is a base-10 logarithmic scale, where each whole number increase in magnitude represents a ten-fold increase in measured amplitude, and about 32 times more ‘elastic’ energy released in the form of seismic waves than the magnitude that precedes it. For example, a M7.0 earthquake releases about 32 times more energy than a M6.0, while a M8.0 releases about 30 times more energy than an M7.0. A M9.0 earthquake thereby releases nearly 1,000 times more energy than a large M7.0 earthquake and nearly 33,000 times more energy than a M6.0 event. Figure 4.2.3 illustrates the scale of the magnitude of historic earthquakes.

Modified Mercalli Intensity

The Modified Mercalli Intensity (MMI) 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. The MMI value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at that place. The lower numbers of the intensity scale generally deal with how people feel the earthquake. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

The intensity of an earthquake is also dependent upon the magnitude, the epicenter, the depth, and the soil or rock conditions at the site. The intensity of ground shaking increases with the amount of energy released and decreases with distance from the causative fault or epicenter.

Figure 4.2.3 Comparison of Recent and Historic Earthquakes by Energy Release (Magnitude)[6]

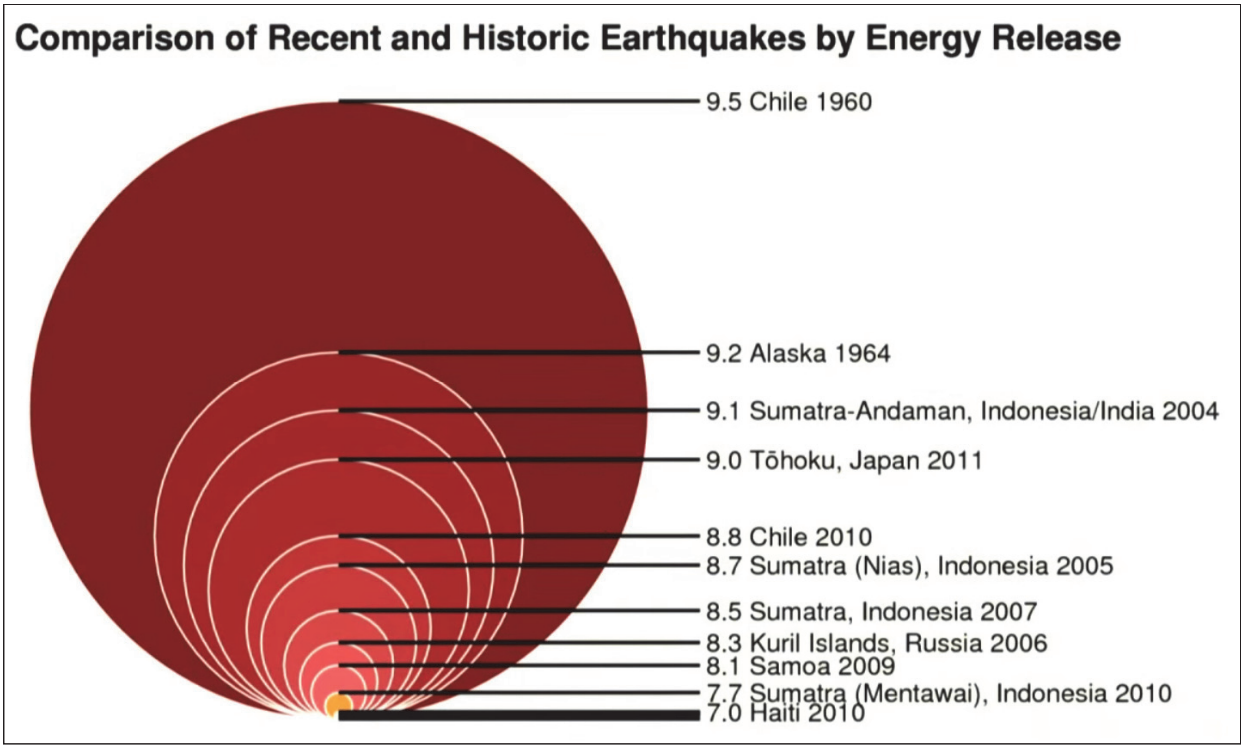


Figure 4.2.4 Modified Mercalli Intensity and Descriptions

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Previous Incidents

Earthquakes have impacted Washington State and the Thurston County region over the last several decades. Previous incidents offer insights into the types of losses that Thurston County communities could experience in future earthquakes.

February 28, 2001, Nisqually Earthquake. Federal Disaster 1361.

At 10:54 a.m. a magnitude 6.8 earthquake produced strong ground shaking across Washington State. The epicenter was located near Anderson Island, approximately 10 miles north of Olympia near the Nisqually River Delta. The observations of geotechnical engineers indicate that liquefaction was widespread in parts of Olympia and South Seattle. Several significant lateral spreads, embankment slides, and landslides also occurred.

Thurston County was among the hardest hit counties in Washington. Statewide, the Nisqually earthquake resulted in several hundred injuries (nearly a dozen considered 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 any previous disaster in Washington.

Unreinforced brick masonry buildings lacking braced parapets and wall anchors were particularly vulnerable, resulting in numerous collapses. In many cases, fallen brick caused damage to objects, such as cars and canopies, outside the building. 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 that neighborhood serves as a conduit for earthquake energy that is particularly hard on single-family homes. This type of damage mirrored that of the 1949 Olympia earthquake (described below).

In unincorporated Thurston County, 120 buildings were inspected, two buildings red-tagged, and six buildings yellow-tagged. In Olympia, 27 buildings were closed immediately following the earthquake. Most buildings performed well from a life-safety standpoint, in that the limited structural damage 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.

The 74-year-old capitol dome sustained a deep crack in its exterior and damage to supporting columns, and non-structural damage occurred throughout the Legislative Building. Previously scheduled renovation of the building was started early to accommodate $20 - $22 million in earthquake repairs and seismic upgrades. Other state agency buildings were closed for inspection and repair.

A gas line rupture during the earthquake resulted in the evacuation of residents of 50 mobile homes in Tumwater. Part of a private street located within the mobile home park, a block of Pine Street, collapsed into a neighboring pond, taking two unoccupied cars into the water.

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 and the City's west side. Replacing the bridge and connecting infrastructure cost $39 million; the largest public works endeavor in the city's history.

Deschutes Parkway in Olympia suffered the most damage of any road in the state. Waterlogged soil under the road liquefied during the shaking, creating huge voids beneath portions of the concrete road surface. Sections of road and sidewalk also buckled from the force of the quake. This road, a vital link between downtown Olympia, the City's west side, and Tumwater, was closed to traffic for 20 months.

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.

Except for transportation, lifeline systems generally performed well during the earthquake. Lifeline systems include water, wastewater, electrical power, communications, natural gas and liquid fuels, and transportation systems. In most cases, the impact of lifeline damage was minimal. Puget Sound Energy reported 200,000 customer power outages, and Seattle City Light reported 17,000 outages, but power was restored to most customers 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.

April 29, 1965, Seattle Tacoma Earthquake. DR 196.

A magnitude 6.5 earthquake struck the Puget Sound Region at 7:28 a.m. The epicenter was located about 12 miles north of Tacoma at a depth of about 40 miles. This quake killed seven people and damage was estimated to be $12.5 million (1965 dollars); with much of the loss in King County. The Union Pacific Railroad reported a hillside fill slid away from beneath a 400-foot section of a branch line just outside of Olympia. Damage to the Capitol Building – including a crack about 3 feet long on the inside of the inner dome of the rotunda – forced adjournment of the legislative session. A road around Capitol Lake, at the base of the Capitol complex, was damaged, allowing water to flow beneath the road. St. Peter Hospital reported treating four people for minor injuries.

April 13, 1949, Olympia Earthquake.

A magnitude 6.8 earthquake rattled the region at 11:55 a.m. The epicenter was located about eight miles north-northeast of Olympia. Property damage for the Puget Sound Region likely exceeded $25 million (1949 dollars). Eight state government buildings in Olympia were damaged at a loss of two million dollars. Two people died. The quake damaged nearly all large buildings in Olympia – with cracked or fallen walls and plaster. Two large smokestacks and many chimneys fell. Streets were damaged extensively. Water and gas mains broke. A large portion of a sandy spit jutting into Puget Sound north of the city disappeared completely during the earthquake.

Probability of Occurrence

There is a 40 to 80 percent chance of a large earthquake occurring in Washington State in the next 50 years. As such this plan assigns all three earthquake scenarios a medium probability of occurrence – all are likely to occur within 100 years.

Vulnerabilities and Impacts

Impacts to People

The immediate life safety impacts from collapsing buildings and other structures or from secondary hazards such as fires can cause serious injuries and fatalities. The 2010 and 2011 Christchurch, New Zealand earthquakes claimed 185 lives. Other near-term earthquake life safety risks include:

- Potential infections from untreated wounds.
- Disruption to water and wastewater utilities.
- Contamination of drinking water systems.
- Increased morbidity and risks of complications for people with chronic diseases due to interruption of medical treatment.
- Increased risk of complications related to pregnancy and childbirth due to interruption of neonatal and obstetric services.
- Increased mental health incidents due to post traumatic stress.
- Increased sheltering demand from individuals who are displaced due to damaged or uninhabitable residences.

Earthquake damage to transportation and utilities will disrupt manufacturing and supply chains and create critical shortages in goods and services that will impact individuals, households, and communities. Most homeowners do not have earthquake hazard insurance policies. Earthquake damage to homes, local economic impacts, and job losses will make it difficult for socially vulnerable individuals and households to recover from earthquake damage.

The entire Thurston County population is at risk to earthquakes. The risk assessment factors that 100 percent of each jurisdiction's population is exposed to earthquake hazards for all three earthquake scenarios (Table 4.2.1). Table 4.2.2 shows estimates of the number of households that will be displaced due to residential earthquake damage and the number of people who will require short-term sheltering.

Table 4.2.1 Thurston County Population Exposed to Earthquake Risks

		% Population Exposed		
Jurisdiction	**Total Population**	**Cascadia M9.3**	**Nisqually M7.2**	**Seattle M7.2**
Bucoda	610	100%	100%	100%
Lacey	58,180	100%	100%	100%
Olympia	56,370	100%	100%	100%
Rainier	2,510	100%	100%	100%
Tenino	2,030	100%	100%	100%
Tumwater	26,360	100%	100%	100%
Yelm	10,680	100%	100%	100%
Unincorporated Thurston County	143,760	100%	100%	100%
Total Planning Area	**300,500**	**100%**	**100%**	**100%**

Table 4.2.2 Thurston County Earthquake Household Displacement and Individual Sheltering Needs

Jurisdiction	Cascadia M9.3		Nisqually M7.2		Seattle M7.2	
	Households Displaced	Individuals Needing Shelter	Households Displaced	Individuals Needing Shelter	Households Displaced	Individuals Needing Shelter
Bucoda	40	24	2	1	0	0
Lacey	1,572	877	152	85	38	21
Olympia	2,010	1,096	185	97	47	26
Rainier	14	8	1	0	0	0
Tenino	13	7	0	0	0	0
Tumwater	811	406	68	35	15	8
Yelm	68	43	4	3	1	1
Unincorporated Thurston County	655	369	30	17	9	5
Total Planning Area	**5,182**	**2,830**	**443**	**237**	**111**	**61**

Impacts to Structures and Systems

A Cascadia Subduction Zone Earthquake will cause damage to homes, buildings, structures, and their contents. Aside from damage from shaking and ground failures, buildings may suffer damage from fires or water damage from severed water lines. In the Puget Sound Region, older unreinforced masonry structures such as buildings, walls, chimneys, and facades are vulnerable to crumbling from ground shaking. Areas with soft soils, such as downtown Olympia and adjacent neighborhoods have experienced this type of destruction during the 1949, 1965, and 2001 earthquakes and many homes and buildings remain vulnerable.

Transportation infrastructure including roads, bridges, transit facilities, rail lines, marine terminals, and airport runways will suffer damage and cause full or partial closure of facilities. All modes of transportation are vulnerable and major traffic disruptions will occur.

Energy distribution for electricity, natural gas, and fuel are vulnerable and will experience damage and disruptions. Drinking water and wastewater systems are also vulnerable as evidenced in previous earthquakes. Communications networks including internet, landline phone, and wireless services will experience disruptions from damage or power disruption and may be unreliable for prolonged periods. Major utility interruptions will force people and communities to adapt to life without the accustomed modern conveniences of indoor plumbing, electricity, and natural gas.

Hospitals and healthcare facilities could suffer damage resulting in a reduction in services or operational capacity. Even in the absence of damage, healthcare facilities that lack backup power or emergency water supply will be inoperable until utilities are restored.

Equipment in office buildings such as computers, monitors, and other equipment is subject to damage if not secured. Libraries, grocery stores, and other merchandisers are likely to suffer losses from damaged goods or experience closures due to unsafe business conditions.

The Pacific Northwest is heavily dependent on truck freight distribution. Any major disruption to transportation, energy, and communications will impact production and distribution of food and other general merchandise resulting in critical shortages for communities.

Estimates of Structural and Content Damage

Hazus modeling results for the Cascadia Subduction Zone M9.3 earthquake estimates there will be over $3.5 billion in structural losses and $1.5 billion in content losses countywide (Table 4.2.3).

Table 4.2.3 Thurston County Estimated Value of Earthquake Structural and Content Damage

	Cascadia M9.3		Nisqually M7.2		Seattle M7.2	
Jurisdiction	Structure Damage Value	Contents Damage Value	Structure Damage Value	Contents Damage Value	Structure Damage Value	Contents Damage Value
Bucoda	$6,483,618	$2,086,159	$1,135,105	$1,396,488	$38,530	$23,758
Lacey	$652,953,041	$294,139,558	$146,583,916	$165,638,440	$20,699,242	$13,927,947
Olympia	$1,120,596,938	$456,206,118	$198,776,101	$234,573,117	$48,840,580	$27,970,420
Rainier	$8,703,252	$3,693,126	$1,829,173	$2,062,368	$106,093	$67,599
Tenino	$12,441,838	$6,159,193	$2,200,024	$2,631,481	$85,319	$66,855
Tumwater	$682,594,027	$314,297,626	$109,742,430	$133,975,231	$16,949,031	$10,225,500
Yelm	$32,826,674	$17,612,336	$10,756,046	$11,772,790	$769,636	$558,440
Unincorporated Thurston County	$984,579,057	$357,753,068	$161,594,486	$177,886,479	$29,791,008	$15,264,168
Total Planning Area	$3,501,178,444	$1,451,947,183	$632,617,281	$729,936,394	$117,279,439	$68,104,686

Estimates of Structural Debris

A Cascadia Subduction Zone earthquake is estimated to generate nearly 1.4 million tons of structural debris countywide. Table 4.2.4 shows estimated debris generation for each earthquake scenario.

Table 4.2.4 Thurston County Estimated Earthquake Structure Debris

	Structure Debris (x 1000 tons)		
Jurisdiction	Cascadia M9.3	Nisqually M7.2	Seattle M7.2
Bucoda	16.79	1.67	0.22
Lacey	272.95	36.22	12.18
Olympia	474.69	61.57	20.12
Rainier	11.36	1.25	0.24
Tenino	22.72	2.05	0.40
Tumwater	198.35	24.70	6.59
Yelm	44.59	5.70	1.31
Unincorporated Thurston County	315.83	29.64	9.07
Total Planning Area	1,357.28	162.80	50.13

Estimates of Lifeline Damage Levels

Over 1,200 community lifeline assets were evaluated. The Hazus models provide estimates of the level of damage that facilities would experience in each earthquake scenario. Tables 4.2.5 - 4.2.7 show the number of buildings that have a 50 percent or greater probability of damage.

Table 4.2.5 Thurston County Community Lifelines Cascadia M9.3 Earthquake Estimated Damage Levels

		Number of Buildings with a 50% or Greater Probability for Damage			
Lifeline	Total Critical Facilities Evaluated	Slight	Moderate	Extensive	Complete
Communications	139	0	43	75	21
Energy	56	0	1	42	13
Food, Water, and Sheltering	298	25	78	133	59
Hazardous Material	54	1	3	41	9
Health & Medical	286	212	63	11	0
Safety & Security	301	63	116	105	9
Transportation	143	26	21	24	7
Total	1,277	327	325	431	118

Table 4.2.6 Thurston County Community Lifelines Nisqually M7.2 Earthquake Estimated Damage Levels

Lifeline	Total Critical Facilities Evaluated	Number of Buildings with a 50% or Greater Probability for Damage			
		Slight	Moderate	Extensive	Complete
Communications	139	60	55	0	0
Energy	56	25	29	2	0
Food, Water, and Sheltering	298	135	70	24	0
Hazardous Material	54	28	20	1	0
Health & Medical	286	108	2	0	0
Safety & Security	301	86	39	0	0
Transportation	143	26	15	0	0
Total	1,277	468	230	27	0

Table 4.2.7 Thurston County Community Lifelines Seattle M7.2 Earthquake Estimated Damage Levels

Lifeline	Total Critical Facilities Evaluated	Number of Buildings with a 50% or Greater Probability for Damage			
		Slight	Moderate	Extensive	Complete
Communications	139	5	0	0	0
Energy	56	0	0	0	0
Food, Water, and Sheltering	298	1	2	0	0
Hazardous Material	54	0	0	0	0
Health & Medical	286	0	0	0	0
Safety & Security	301	1	0	0	0
Transportation	143	4	0	0	0
Total	1,277	11	2	0	0

Impacts to Natural, Cultural, and Historic Resources

A major earthquake can compromise the containment of hazardous materials resulting in a release of pollutants that could pose health risks to areas of communities including impacting air quality, spills in populated areas, or infiltration of pollutants into water resources. Major disruptions to solid waste disposal services, water services, and wastewater treatment will require public education and interventions to protect public health and the environment from improper disposal of refuse and human waste.

Earthquakes can cause landslides that could impact river flows and subsequently cause flooding to surrounding areas. Major ground elevation changes such as subsidence could alter marine and freshwater habitats (see Tsunami Risk Assessment for related environmental impacts).

Without adequate proactive measures, historic homes, buildings, monuments, and other structures could be damaged or become total losses.

Impacts to Activities

A major earthquake is expected to change daily life for people and communities in Thurston County. All sectors of society will be affected. Recovery could take years and community members will need effective adaption measures and guidance from governments, private utilities, volunteer organizations involved in recovery, and media to overcome the challenges posed by earthquake damage and disruptions. Earthquake damage can disrupt work, school, access to healthcare, and access to goods and services.

Transportation

Disruptions to surface transportation networks and energy distribution will have a major impact on the movement of people, freight, goods, and services. All trip purposes will be affected. Commutes to workplaces and schools may be interrupted for prolonged periods. The lack of power and communications networks will also impact remote work/school options for large areas. In the near-term there will likely be a shortage of skilled workers in healthcare, construction, utilities, and other industries as people will be unable to commute long distances to their workplace.

Personal discretionary travel, especially by automobile, will be limited as transportation authorities will prioritize fuel and routes for emergency services and essential personnel for the restoration and reconstruction of transportation, utilities, and other critical facilities. Bicycling, walking, and adapted transit services could become effective modes to satisfy some basic travel needs.

Safety and Security

In the near term, fire and emergency medical services, police services, and public works will be in high demand. Communications and transportation disruptions will impact emergency response times in the days and weeks following a major earthquake. Community members will need to rely on neighborhood social networks to help address non-life-threatening emergencies.

Substandard living conditions and prolonged shortages of food, medicine, and other essential goods will be stressful to the unprepared population. Communities could experience increased rates of crime and civil unrest.

Commerce

Damage to buildings, power and water disruptions, and the inability of employees to commute to work will impact local businesses. Owners are likely to lose their businesses, and employees their jobs. The loss of revenue will impact local governments and public services.

Portions of Downtown Olympia are highly susceptible to liquefaction and there are many older buildings with unreinforced masonry that are vulnerable to earthquake damage. A major earthquake could render several buildings uninhabitable and cripple business activity. Some buildings may be so badly damaged, they will need to be demolished. Buildings not directly impacted by earthquake damages could be impacted by surrounding debris and street closures for response and recovery activities.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.2.5 shows all of Thurston County's building stock that is exposed to a major earthquake.

The Federal Emergency Management Agency National Risk Index (NRI) for earthquake in Thurston County is 98.9 (relatively high). The rating represents a community's relative risk for earthquake when compared to the rest of the United States. For comparison, Pierce County's NRI for earthquake is 99.5 (also relatively high). The NRI reports an estimated earthquake hazard annual loss of $96 million for Thurston County.

Community Hazard Risk Ratings for Earthquake Scenarios

The countywide Cascadia M9.3, Nisqually M7.2, and Seattle M7.2 risk ratings are high, medium, and medium, respectively. All special purpose districts' risk ratings for each earthquake scenario are 32, a medium rating. Tables 4.2.8 and 4.2.9 show community and special purpose earthquake hazard risk ratings. The details of the earthquake hazard risk assessment calculations are shown in Appendix C.

Table 4.2.8 Community Earthquake Hazard Risk Ratings

	Cascadia M9.3		Nisqually M7.2		Seattle M7.2	
Municipal Plan Participants	Risk Ranking Score	Risk Rating	Risk Ranking Score	Risk Rating	Risk Ranking Score	Risk Rating
Bucoda	36	High	32	Medium	32	Medium
Lacey	34	High	32	Medium	32	Medium
Olympia	34	High	32	Medium	32	Medium
Rainier	32	Medium	32	Medium	32	Medium
Tenino	32	Medium	32	Medium	32	Medium
Tumwater	36	High	32	Medium	32	Medium
Yelm	32	Medium	32	Medium	32	Medium
Unincorporated Thurston County	34	High	32	Medium	32	Medium
Total Planning Area	34	High	32	Medium	32	Medium

Table 4.2.9 Special Purpose District Dam Failure Hazard Risk Ratings

	Cascadia M9.3		Nisqually M7.2		Seattle M7.2	
Special Purpose District Plan Participants	Risk Ranking Score	Risk Ranking Score	Risk Ranking Score	Risk Rating	Risk Ranking Score	Risk Rating
East Olympia Fire District	32	Medium	32	Medium	32	Medium
Intercity Transit	32	Medium	32	Medium	32	Medium
Lacey Fire District	32	Medium	32	Medium	32	Medium
McLane Black Lake Fire District	32	Medium	32	Medium	32	Medium
Olympia School District	32	Medium	32	Medium	32	Medium
SE Thurston Fire Authority	32	Medium	32	Medium	32	Medium
South Bay Fire District	32	Medium	32	Medium	32	Medium
The Evergreen State College	32	Medium	32	Medium	32	Medium
Thurston PUD	32	Medium	32	Medium	32	Medium
West Thurston Regional Fire Authority	32	Medium	32	Medium	32	Medium

Changes in Earthquake Hazard Risks Since Last Plan Update

The 2017 Natural Hazards Mitigation Plan for the Thurston Region rated a M9.0 earthquake scenario risk as high for the overall planning area. The 2023 plan rates a Cascadia M9.3 earthquake as high, although a different risk rating methodology was used. Population exposure estimates are derived from residential units. Thurston County's total population has increased by approximately 30,000 since the plan was last updated. Overall, there are more people exposed to earthquake hazards. In the past year alone, over 11,000 people (3.9 percent of the County's population) located to Thurston County from outside of Washington State. It is likely that our region's newcomers are unfamiliar and unprepared for earthquake hazards.

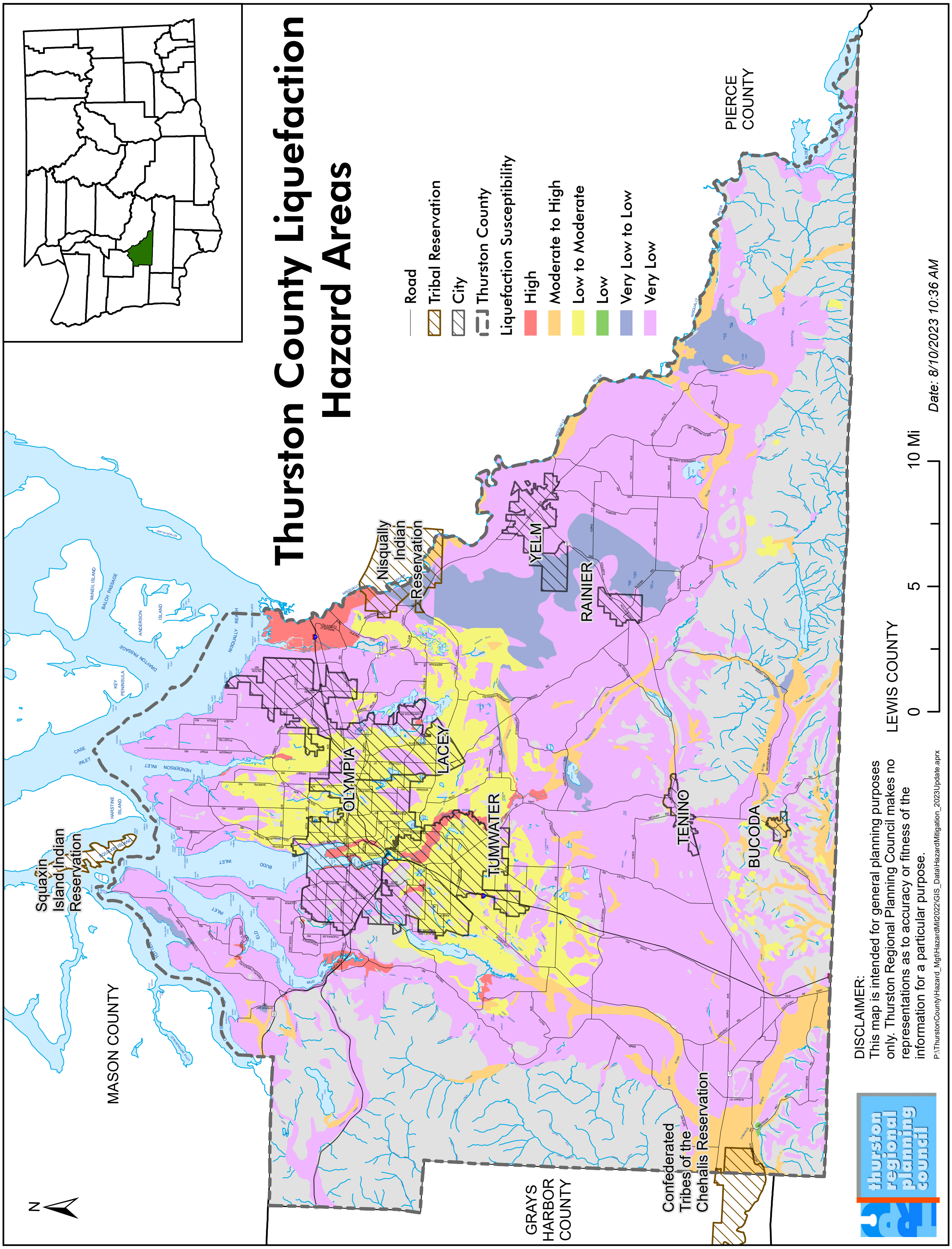
The COVID-19 pandemic dramatically changed how people work. A large share of the region's daytime working population shifted from traditional in-person office environments in central business districts to teleworking in residential areas. With the region being home to the state's capitol, a significant share of state and local government employees may face fewer risks than they did prior to 2020. An estimated 30 percent of the state's workforce teleworks 100 percent of the time while nearly 50 percent telework at least three days a week. This shift is expected to remain for the foreseeable future. As a consequence, fewer workers may be exposed to earthquake hazards. A reduction in peak hour commute trips to and from central business districts means a smaller share of the region's workforce will suffer transportation disruptions immediately following an event. Secondly, fewer workers will be in urban environments, which are likely to experience more damage than residential environments. As a consequence, remote workers may have a reduced risk for personal injuries that could occur in or around a more urbanized environment.

Connection to the Regional Mitigation Strategy

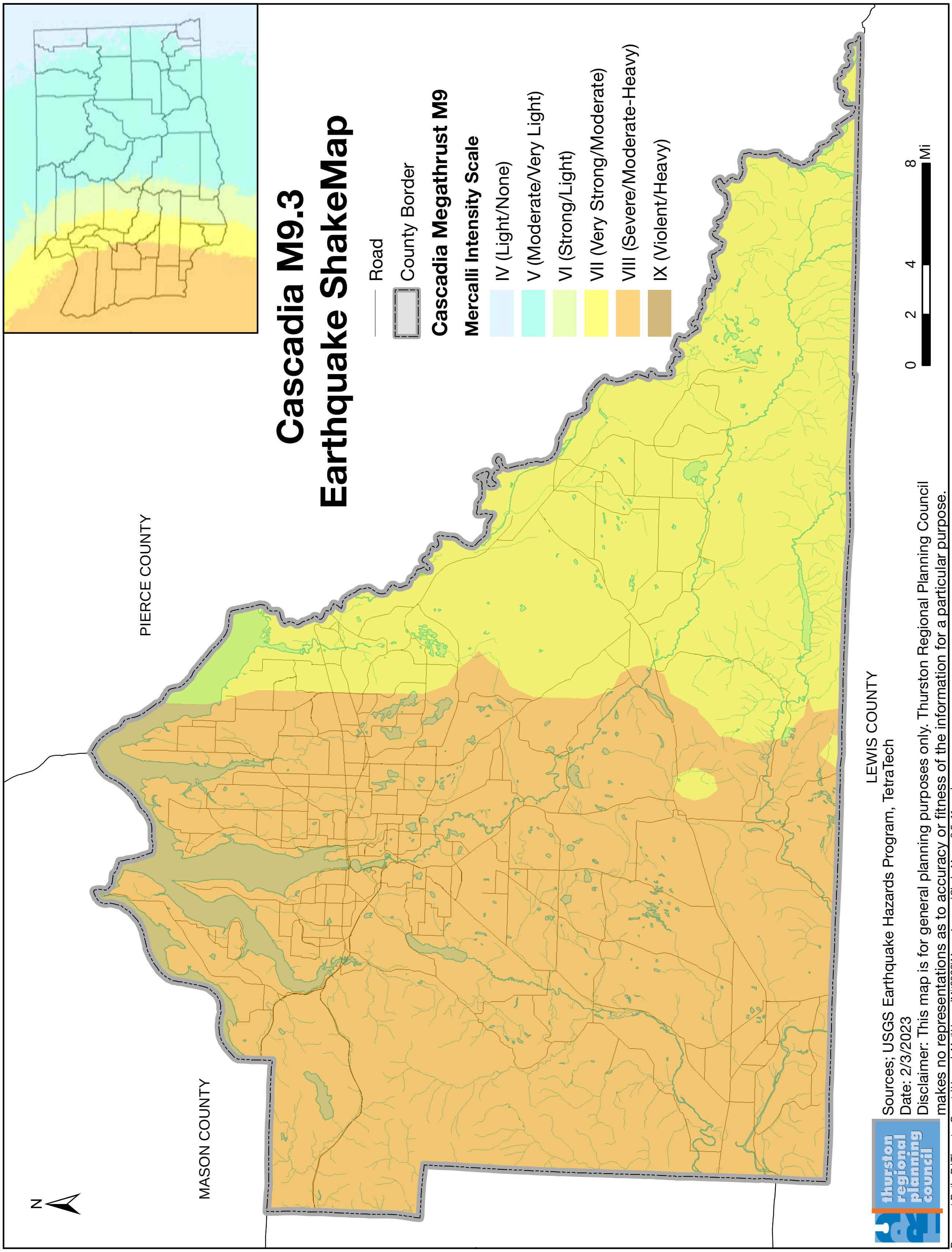
The 2022 "Thurston County Communities Natural Hazards and Resiliency Survey" results show that countywide, respondents ranked earthquake as the highest-rated hazard of concern. This is expected considering the region is prone to seismic hazards and residents recall the 2001 Nisqually earthquake. Only 43 percent of survey respondents indicated they have taken some steps to prepare for hazards. However, most households are likely very unprepared for the impacts from a megathrust earthquake. Earthquake hazard education and preparedness for community residents is critical. Earthquake hazard information will be included through Regional Hazard Mitigation Public Outreach Strategy initiative.

The region's planning partners recognize that more work is necessary to broaden the inventory and documentation of the location, characteristics, and vulnerabilities of the region's lifelines and critical infrastructure. To this end, the Critical Infrastructure Inventory will help inform and prioritize investments in strengthening communities' vital assets. The Hazard Modeling and Loss Estimation Capacity Building initiative will build local knowledge and technical skills to develop, operate, and maintain community-specific GIS-based hazard modeling tools that include local data. Local modeling tools can inform planning and decision making for hazard mitigation, emergency management, and disaster recovery, and training. The Lifeline Transportation Resiliency Plan will identify priority transportation projects to strengthen bridges, roads, and other multimodal transportation assets so they withstand the effects of earthquakes.

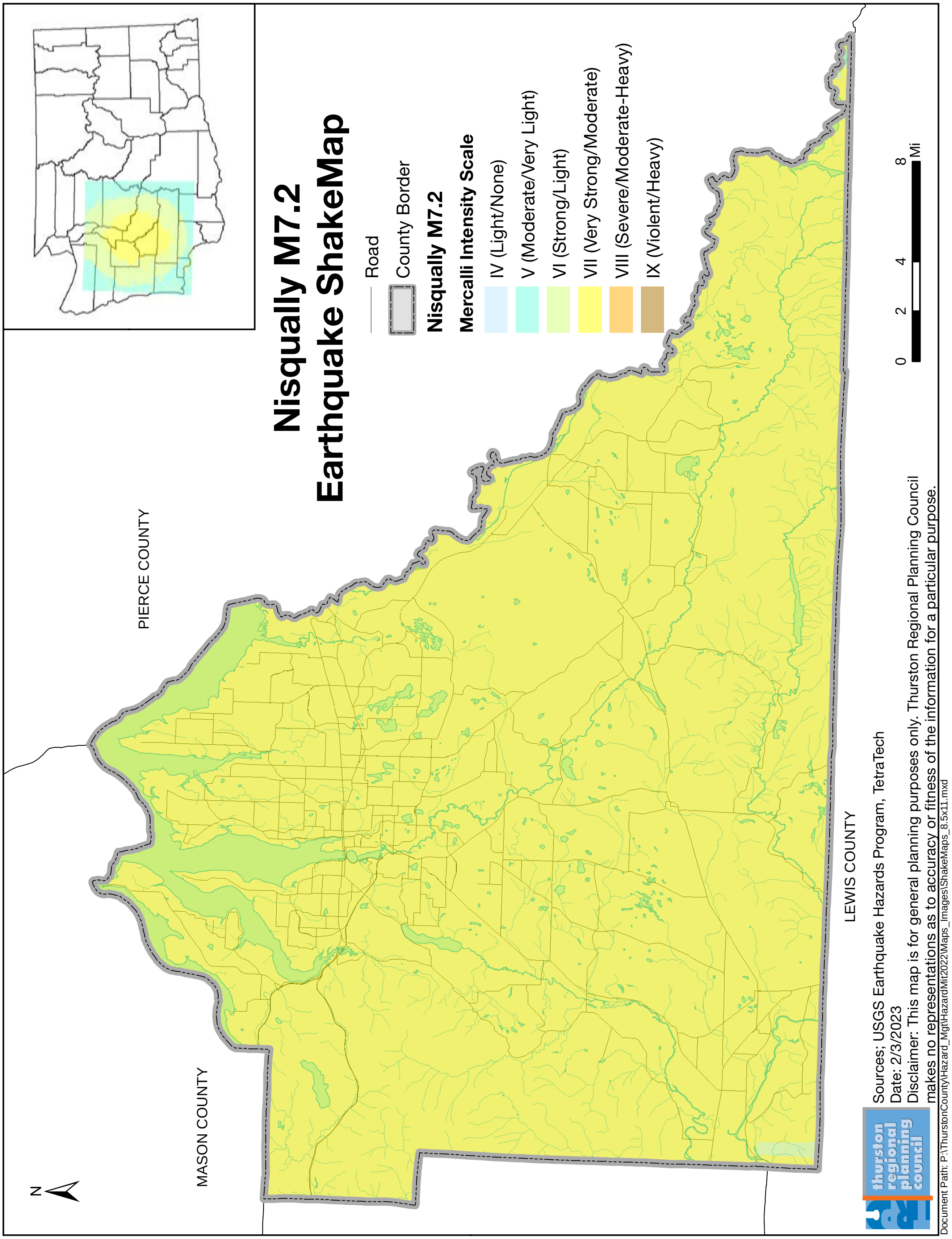
Map 4.2.1 Thurston County Liquefaction Susceptibility



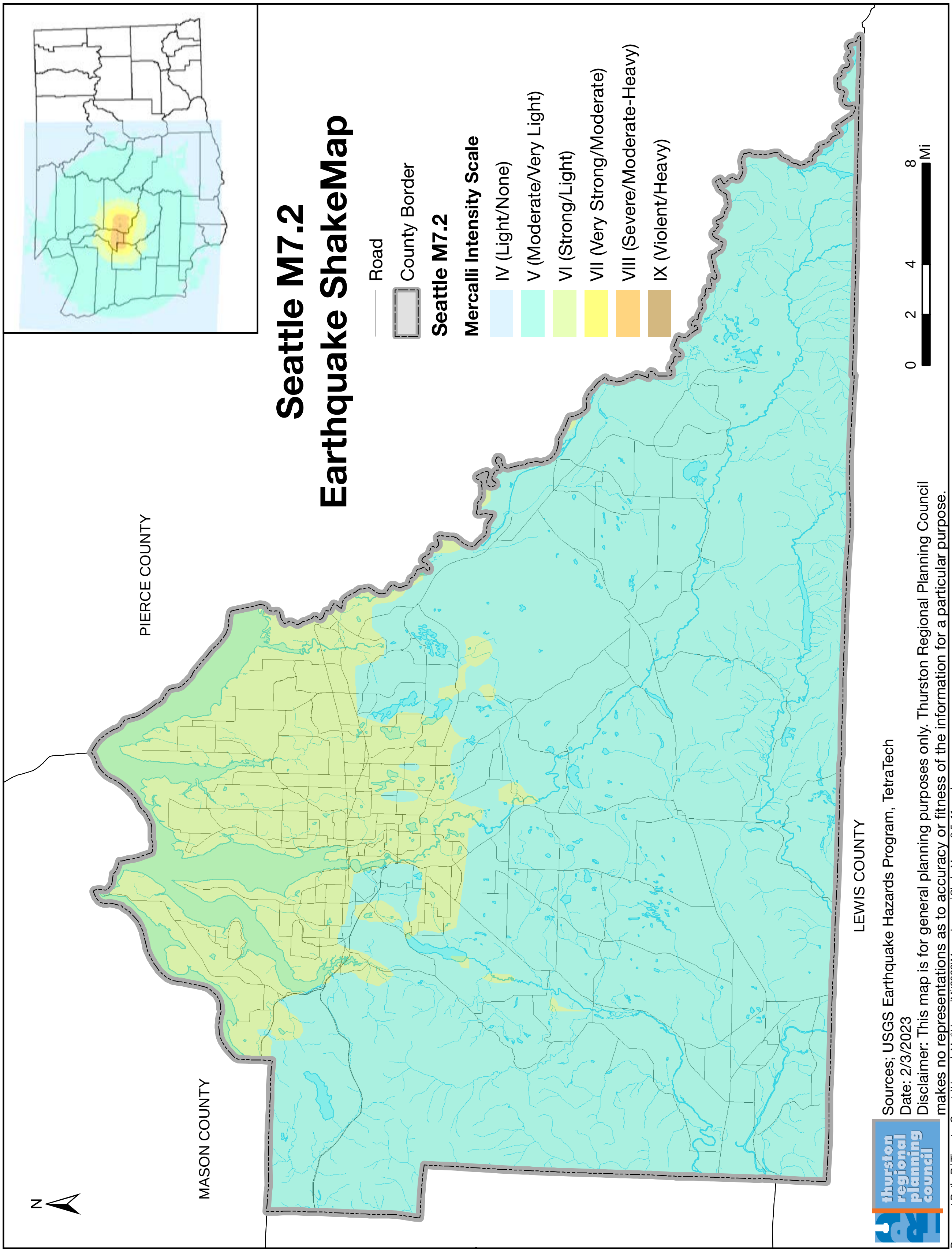
Map 4.2.2 Cascadia Subduction Zone M9.3 Earthquake Scenario ShakeMap



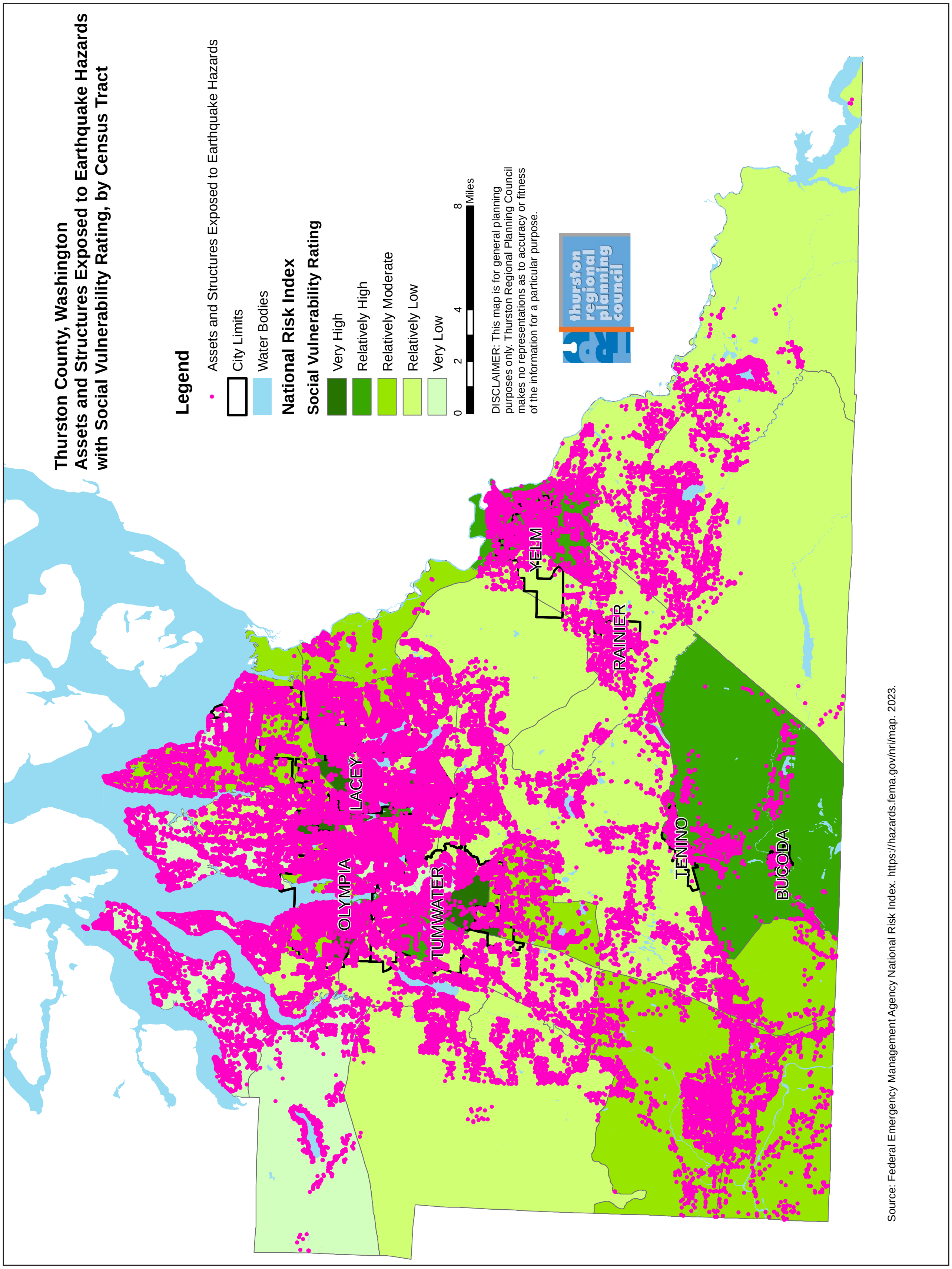
Map 4.2.3 Nisqually M7.2 Earthquake Scenario ShakeMap



Map 4.2.4 Seattle M7.2 Fault Earthquake Scenario ShakeMap



Map 4.2.5 Assets and Structures Exposed to Earthquake Hazards with Thurston County Social Vulnerability Index Rating by Census Tract



Endnotes

[1]Stephen P. Palmer. 2004. Site Class Map of Thurston County. Washington State Department of Natural Resources, Division of Geology and Earth Resources. Open File Report 2004-20

[2]The Japan Times. May 12, 2013. "More than 9,500 aftershocks logged since mega-quake." http://www.japantimes.co.jp/news/2013/03/12/national/more-than-9500-aftershocks-logged-since-mega-quake/#.V6u2IU0rL0M

[3]Brian L. Sherrod. 2001. Evidence for earthquake-induced subsidence about 1100 yr ago in coastal marshes of southern Puget Sound, Washington. GSA Bulletin; October 2001; v. 113; no. 10; p. 1299–1311.

[4]Personal Communication with Timothy Walsh, Chief Geologist, Hazards Section, Washington Geological Survey, Division of Geology and Earth Resources, Washington Department of Natural Resources, August 20, 2008.

[5]USGS. 2008. Cascadia Earthquake Sources. http://geomaps.wr.usgs.gov/pacnw/pacnweq/#sources

[6]Pacific Northwest Seismic Network. "Earthquake: What does 'Magnitude' Mean?" Video Screen Capture. http://www.pnsn.org/outreach/about-earthquakes/magnitude-intensity

Chapter 4.3
Flood Hazard Risk Assessment

Introduction

Floods in Thurston County are common. Nearly half (12 out of 25) of major federal disaster declarations for Thurston County are related in some part to impacts from flood hazards. The February 1996 flood cost uninsured private property owners an estimated $22 million in losses. Flood hazard management is complex and must protect life safety and property protection and preserve the ecological functions of rivers and flood plains. This chapter assesses the impacts and risks for the most common types of flooding that affect Thurston County communities.

Definition

In general, a flood is a temporary condition in which a normally dry area of land or infrastructure is inundated by excess standing or flowing water. Flooding is most common in the fall and winter months. This hazard profile characterizes flood risks for 50-, 100-, and 500-year special flood hazard area flood scenarios and high groundwater flooding. There are four principal sources of flooding that impact Thurston County communities:

1. Riverine (river and stream)
2. Groundwater
3. Tidal
4. Urban

1. Riverine Flooding

Rivers and their floodplains are dynamic systems that perform important ecological functions, benefitting both wildlife and humans. Flooding is a natural function of rivers, with its effects supporting productivity of wildlife and potentially increasing the fertility of farmlands within flood plains. Attempts to control floods by altering the physical characteristics of rivers and flood plains with dams, levees, or other flood control facilities, result in the loss, alteration, or significant reduction in the intrinsic ecological benefits these systems offer.

Communities must balance the need to preserve the natural functions of floodplains vs. the need to protect life safety, property, communities, and human activities. Understanding how, when, and where to expect flood impacts is a first step in developing a mitigation strategy to minimize losses from floods and to protect the environment.

Riverine flooding occurs when excess flow and volume of water crests a river channel's normal capacity. Floodwater consequently inundates areas within the river's floodway, flood plain, and other low-lying areas that may not be mapped as flood hazard areas.

Cause of Riverine Flooding

Two to three days of prolonged rainfall, averaging 2 to 5 inches per day, a rapidly melting snowpack, or a combination of these conditions trigger such floods. The actual duration and rainfall amount needed to cause flooding depends on the initial condition of the river or stream, and groundwater and runoff conditions. The Nisqually River and the Chehalis River's extensive watersheds are subject to events outside the county that influence flooding downstream in the county.

Thurston County hydrological research documents increased rainfall intensity in the region in the last two decades. The county continues to analyze stream flow and precipitation gauge data from its own network of monitoring stations, as well as the National Weather Service and USGS data. This research provides clues about the types of precipitation patterns that trigger small stream, riverine, and shallow groundwater basin flooding in the county. Initial findings reveal that six precipitation patterns appear to affect peak flood flow pulses in small Thurston County streams and shallow groundwater basins. These heavy rainfall scenarios have occurred within the previous two decades. The precipitation patterns also correlate with larger river flood events. The previous five decades of the Olympia rainfall record show only one, two or three of the identified scenarios per decade.

Atmospheric River events are common triggers of major flooding events in Thurston County. These storms are generated in the tropical Pacific Ocean and contain a vast amount of moisture that is transported by the jet stream directly to areas of the Pacific Northwest. They can be highly targeted and may have regional or watershed-specific effects depending on positioning of the guiding jet stream patterns and topographic features the moisture stream encounters on land. Many of the region's major floods events have occurred as a result of such storm systems. These storms are typically associated with warm, tropical air and are responsible for rain-on-snow events causing rapid snowmelt if they occur after snow has fallen. Very large atmospheric river events are known as ARkStorms.

Late wet season precipitation patterns seem to have the most significant effect on groundwater flooding and deep-seated landslide susceptibility. Saturation of the subsurface soils peaks in March. Any additional rainfall during this natural high-water season tends to rapidly overwhelm the remaining horizontal groundwater flow component in near-saturated soils.[1] Table 4.3.1 shows the precipitation patterns that cause major flood events on stream and rivers.

Table 4.3.1 Six Rainfall Patterns that influence Puget Sound Stream Flooding in Thurston County

<table>
<tr><th>Pattern</th><th>Description</th><th>Example</th></tr>
<tr><td>1</td><td>Early or late wet season rainfall (greater than 3-inch daily storm events) in October (Horton Overland Flow) or prolonged, above avg. rain in October or March and April</td><td>October 20, 2003: 4.14” storm event;
October 2, 1981: 3.56” storm event;
September – early October 2013 (September record rainfall);
March –April 2016 (prolonged well above average rainfall);
October –November 2016 (October record rainfall; November prolonged well-above average)</td></tr>
<tr><td>2</td><td>Five or six consecutive days of greater than 1-inch storm events punctuated by a greater than 2.5-inch storm event in the same series</td><td>November 2, 2006, 1.08”
November 3, 2006,1.02”
November 4, 2006, 1.5”
November 5, 2006, 1.88”
November 6, 2006, 4.31”
November 7, 2006, 1.02”</td></tr>
<tr><td>3</td><td>Two or more consecutive days of greater than 2.0-inch daily storm events</td><td>2007:
December 2, 2.2”;
December 3, 3.19”</td></tr>
<tr><td>4</td><td>Greater than 4-inch daily storm events (high landslide potential</td><td>January 7, 2009, 4.82 inches
November 6, 2006, 4.31 inches
October 20, 2003, 4.14 inches
November 19, 1962, 4.25 inches</td></tr>
<tr><td>5</td><td>Three or more consecutive months of at or greater than 11-inch monthly totals (larger potential for ground water flooding in key basins)</td><td>Monthly Totals
<table>
<tr><th>Years</th><th>Nov</th><th>Dec</th><th>Jan</th><th>Feb</th></tr>
<tr><td>1955 – 1956</td><td>12.18</td><td>12.59</td><td>10.75</td><td></td></tr>
<tr><td>1973 – 1974</td><td>12.95</td><td>11.61</td><td>10.57</td><td></td></tr>
<tr><td>1998 – 1999</td><td>15.28</td><td>12.99</td><td>12.25</td><td>15.5</td></tr>
<tr><td>2001 – 2002</td><td>13.01</td><td>11.86</td><td>11.42</td><td></td></tr>
</table></td></tr>
<tr><td>6</td><td>A greater than 15-inch monthly total</td><td>November, 2006, 19.68”
February, 1999, 15.5”
November, 1998, 15.28”
November, 1990, 15.06”
November, 1964, 15.00”
November, 1962, 15”
January, 1953, 19.84”</td></tr>
</table>

Extent of Riverine Flooding

Many factors influence the severity of riverine flooding such as the pre-existing condition of the ground water saturation levels, the topography and size of the watershed, freezing level, and the influence of human activity on the landscape (total amount of impervious surface, stormwater management, and other large-scale land uses such as logging). Thurston County Emergency Management issues three levels of flood severity to monitor flood stages and notify the public[2]:

1. **Minor flooding (or flood stage):** A 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.
2. **Moderate flooding:** Individual residential structures are threatened and evacuation is recommended for selected properties. Some roads may be closed. Moderate damage may be experienced.
3. **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.

Thurston County Emergency Management identifies flood severity thresholds based on stream flow rates and gauge heights for the Deschutes, Chehalis, Nisqually, and Skookumchuck rivers using select gauges in the region (no USGS gauges are established on the Black River). Rivers are dynamic and all channels are subject to dimensional changes over time due to factors such as sediment and coarse woody debris deposition, and channel migration and braiding. Therefore, a direct comparison of flood events between years or decades for any given river based on flood gauge heights will vary.

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the greater the potential for damage and adverse impacts. Shallow flooding with high velocities is also capable of causing damage, as is deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges. Table 4.3.2 lists peak flows FEMA uses to map the floodplains of the planning area.[3]

Table 4.3.2 Summary of Peak Discharges of Streams and Rivers within Thurston County

Source	Location	Drainage area (sq. mi.)	Discharge (cubic feet/second) 10-Year	50-Year	100-Year	500-Year
Black River	At County limits	124	2,820a	4,100a	4,940a	6,790
	Downstream of confluence with Beaver Creek	99	1,550	2,220	2,490	3,200
	Downstream of confluence with Waddell Creek	58.7	1,250	1,770	2,000	2,560
	Outlet of Black Lake - At Black Lake	5	210	303	342	431
Chehalis River	U.S. Geological Survey Gauge #12027500 near Grand Mound	895	38,600	50,100	55,000	66,600
Deschutes River	Downstream of Henderson Blvd.	160	5,990	7,960	8,800	10,800
	Upstream of confluence with Spurgeon Creek	127	5,630	7,450	8,230	10,100
	At Vail Loop Rd, Crossing	89.8	4,950	6,500	7,150	8,690
	Upstream of confluence with Mitchell Creek	44.1	2,690	3,590	3,980	4,900
	Upstream of limit of detailed study	33.3	2,120	2,860	3,180	3,930
Nisqually River	At Mouth	711	21,500	29,000	33,000	45,000
	Upstream of confluence with Horn Creek	488	21,000	28,000	32,000	44,000
	Upstream of Confluence with Tanwax Creek	446	20,500	27,000	31,000	43,000
Percival Creek	At Sapp Rd., SW	1.8	94	128	145	180
	At 54th Ave., SW	0.5	33	45	50	62
Scatter Creek	At downstream limit of detailed study	15.5	403	561	633	803
	At confluence with Scatter Creek tributary	11.0	314	436	492	622
	Upstream confluence with Scatter Creek tributary	4.6	167	230	258	324
	Scatter Creek Tributary - At confluence with Scatter Creek	6.4	212	293	330	415
	Scatter Creek Tributary - At State Route 507	10.3	66	90	102	126
Skookumchuck River	At State Route 507	113	6,990	9,100	9,980	12,100
	Upstream of Bucoda	90.2	6,400	8,290	9,060	10,900
	Upstream of confluence with Thompson Creek	65.9	5,790	7,440	8,110	9,700
Woodland Creek	At Pleasant Grade Rd., NE	24.6	151	205	228	284
Yelm Creek	From 1st St. to Centralia Canal	11.2	220	310	350	445
	From 103rd Ave. to 1st St.	9.8	200	285	325	410
	Upstream end of study reach, to 103rd Ave.	9.3	185	265	300	375

a= Includes effect of overflow from Chehalis River

Frequency of Riverine Floods

Floods are commonly described as having a 10-, 50-, 100-, and 500-year recurrence interval, meaning that floods of these magnitudes have (respectively) a 10, 2, 1, or 0.2 percent chance of occurring in any given year. The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a one percent chance of being equaled or exceeded in any given year. The "annual flood" is the greatest flood event expected in a typical year.

Many agencies use the extent of flooding associated with a one percent annual probability of occurrence (the base flood or 100-year flood) as the regulatory boundary. Also referred to as the special flood hazard area (SFHA), this boundary serves as a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities' maps show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water resulting from a given discharge level, which is one of the most important factors used in estimating flood damage.

These measurements reflect statistical averages only; it is possible for two or more rare floods (with a 100-year or higher recurrence interval) to occur within a short time period. Assigning

Flood Definitions

Flood Plain: A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and deposited in the slack water beyond the influence of the swiftest current.

100-Year Floodplain: Lands which are subject to a one percent chance of flooding in any year. These areas are mapped as the "A" zone on the Flood Insurance Rate Maps (FIRM) of the Federal Emergency Management Agency.

500-Year Floodplain: Lands which are subject to a 0.2 percent chance of flooding in any year. These areas are mapped as the "B" zone on the FIRM of the Federal Emergency Management Agency.

Flood Stage: The stage at which overflow of the natural streambanks begins to cause damage in the reach in which the elevation is measured. Flood stages for each USGS gaging station are usually provided by the National Weather Service.

Floodway: The portion of the floodplain adjoining and including the river channel which discharges the flood water and flow of the river. It does not include portions of the floodplain where water is just standing. These areas are mapped as "Floodway" on both the Floodway and the FIRM of the Federal Emergency Management Agency.

Special Flood Hazard Area (SFHA): The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA) on NFIP maps. The SFHA is the area where the National Flood Insurance Program's floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V.

recurrence intervals to historical floods on different rivers can help indicate the intensity of a storm over a large area. For example, the 1996 flood event exceeded the flood with 100-year recurrence interval on the Chehalis River, while the recurrence interval of that event for tributaries to the Chehalis such as the Skookumchuck River was determined to be 75 years.[4] Recent history shows that Thurston County can expect an average of one episode of minor river flooding each winter. Large, damaging floods typically occur every 2 to 5 years.

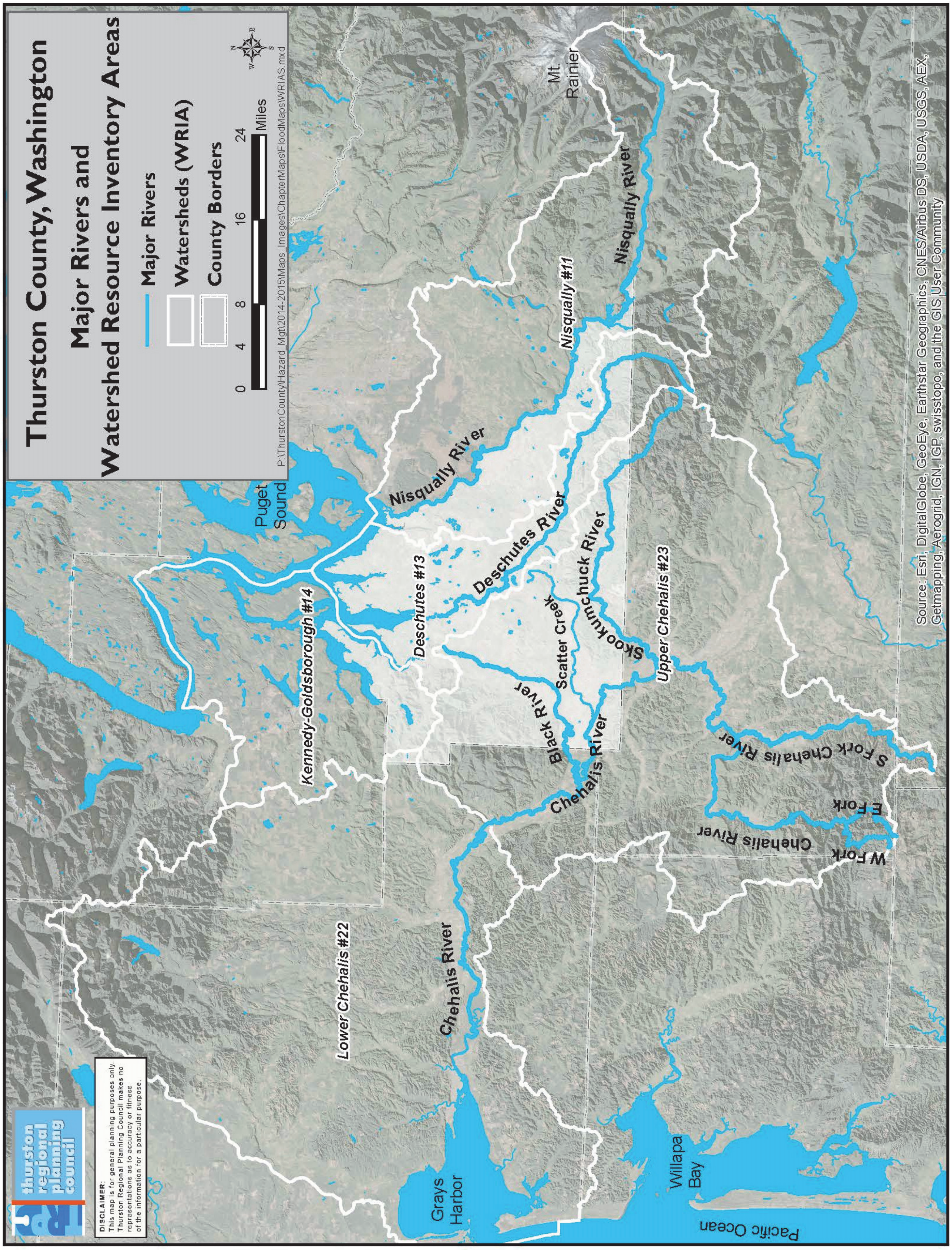
Sources of Riverine Floods

Six rivers in Thurston County (Map 4.3.1) experience episodic flooding: 1) Black; 2) Chehalis; 3) Deschutes; 4) Nisqually; 5) Scatter Creek; and 6) Skookumchuck. All the rivers, except for the Nisqually River, are lowland rivers that are fed primarily by watershed precipitation and groundwater flows. FEMA has mapped the Special Flood Hazard Areas (SFHA) for each river (Map 4.3.2). Although not a major river, Scatter Creek also has a designated high risk flood zone and has historically produced major floodwaters in southwest Thurston County.
The top ten historic crests for the Nisqually, Deschutes, Skookumchuck, and Chehalis rivers are shown in table 4.3.3. The six river systems and their flood stages within the planning area are presented in the sections that follow.

Table 4.3.3 Top Ten Historic Crests for Thurston County Rivers[5]

	Nisqually at McKenna		Deschutes near Rainier		Skookumchuck near Bucoda		Chehalis near Grand Mound	
Rank	Gauge Ht	Date	Gauge Ht	Date	Gauge Ht	Date	Gauge Ht	Date
1	17.13	02/08/1996	17.01	01/09/1990	17.87	02/08/1996	20.23	12/04/2007
2	13.00	01/29/1965	15.74	02/08/1996	17.72	01/08/2009	19.98	02/09/1996
3	12.48	11/30/1995	15.68	01/15/1974	17.33	01/10/1990	19.34	01/10/1990
4	12.39	12/26/1980	15.28	01/21/1972	17.23	11/25/1990	18.41	11/25/1986
5	12.38	12/12/1955	14.29	12/29/1996	16.82	01/21/1972	18.39	12/29/1937
6	11.78	11/23/1959	14.10	01/08/2009	16.82	04/05/1991	18.21	01/21/1972
7	11.31	01/10/1990	13.76	04/05/1991	16.76	12/30/1996	18.18	01/09/2009
8	11.30	02/11/1951	13.75	12/03/2007	16.60	02/11/1990	18.12	11/25/1990
9	11.14	04/05/1991	13.55	11/26/1998	16.60	12/09/2015	17.73	12/05/1975
10	11.04	12/10/1953	13.42	12/28/1998	16.51	03/09/1977	17.66	04/06/1991

Map 4.3.1 Major Rivers and Watershed Resource Inventory Areas, Thurston County



Black River Basin

The Black River drains southwest from the south end of Black Lake into the Chehalis River near Oakville in Grays Harbor County. The Black River drainage is approximately 144 square miles, with 105 square miles in Thurston County. In general, the Black River is a slow flowing river with a broad floodplain. Most flooding along the main stem of the river is inundation flooding with low-velocity floodwaters.

The Black River drainage basin is divided in two parts. The west half of the basin drains the Capitol Forest area. The main tributaries in this section include Dempsey, Waddell, and Mima creeks. This area ranges in elevation from 2,659 feet at Capitol Peak to 200 feet at the Black River valley floor. The basin is subject to high-intensity, short-duration rain events that can produce flash flooding in these creeks.   In general, snowmelt alone does not cause flooding in this area, however snow can compound this flooding.

The east half of the basin drains the relatively flat area south of Tumwater, west of Offutt Lake and north of Tenino. The elevation difference here is approximately 200 feet. The Salmon and Beaver creeks and Bloom Ditch are the main streams that drain this basin. These very slow-flowing water systems tend to cause inundation flooding with no velocity. This side of the basin is susceptible to high-groundwater flooding during periods of extended rain.

Because of its flat topography, the Black River is also susceptible to flooding by waters backing up from the Chehalis River. This appears to be the situation when flooding on the Chehalis River is concurrent with high tides along the coast.

Black River Flood Stage Levels

In April 2005, the Washington State Department of Ecology established a river gauging station on the Black River where it crosses U.S. Highway 12 at River Mile 2. Unlike the gauging stations on the Chehalis at Prather Road Bridge and at Porter, this gauge has not been rated and is not modeled to forecast flood levels. Figure 4.3.1 shows the Thurston County Emergency Management summary for flood stages levels at this river gauge.

Figure 4.3.1 Black River Gauge Flood Stages and Historic Crests

Flood Stage	Gauge Height	Conditions and Previous Years of Occurrence
Action	6 Feet	At 6 feet, residents should be aware that the river is likely to flood. 2006, 2007, 2009, 2010, 2011, 2012, 2015
Flood	8 Feet	At 8 feet, the Black River has reached flood stage; the river will spill out of its banks into nearby fields and woods with limited water over a few spots on local roads. 2006, 2007, 2010, 2011, 2015
Moderate	10 Feet	At 10 feet, moderate flooding will occur. This stage corresponds to 15.5 feet at the Prather Road Bridge on the Chehalis River. At this level, the Chehalis River in Thurston County will flood several roads in Independence Valley with swiftly moving water, including U.S. Highway 12 and James, Independence, Moon and Anderson Roads. Floodwaters will cut off access to and from the Chehalis Reservation and inundate nearby farmlands. Some residential structures may be threatened. 2006, 2007, 2015
Major	12 Feet	Major flooding occurs when the Black River reaches 12 feet. During the December 2007 flood, the gauge on the Black River recorded a stage of 14.5 feet. 2007

Chehalis River Basin

The 174-mile long Chehalis River emerges from three forks in remote forest lands in Lewis and Pacific counties. The river is divided into two watersheds, the Upper Chehalis (WRIA #23) and the Lower Chehalis (WRIA # 22). The Chehalis River grows at the confluence of the West Fork Chehalis River and East Fork Chehalis River. From there, the Chehalis flows north and east, collecting tributary streams that drain the Willapa Hills and other lowland mountains in southwestern Lewis County. The South Fork Chehalis River joins the main river a few miles west of the City of Chehalis. The Newaukum River joins the Chehalis River at Chehalis, after which the river turns north, flowing by the city of Centralia, where the Skookumchuck River joins. Beyond Centralia, the Chehalis River flows north and west for a nine-mile course through the southwestern corner of Thurston County.

The Chehalis River flows into Thurston County (WRIA #23) approximately two miles west of Interstate 5 and flows north toward Grand Mound where it drains the Michigan Hill area and receives water from Prairie Creek and Scatter Creek. The river courses west through largely undeveloped rural lowlands scattered with small farms and gentle sloping forested hills. The river continues west and passes through the Confederated Tribes of the Chehalis Reservation before entering Grays Harbor County where it joins the mouth of the Black River.

Beyond Thurston County, the Chehalis River continues northwest where it joins the tributaries of the Satsop and Wynoochee rivers near the City of Montesano. The Chehalis River becomes increasingly affected by tides beyond this location and gradually widens into the Grays Harbor estuary where it is joined by several other rivers, becoming Grays Harbor.

Due to its large drainage area, the Chehalis River tends to rise slowly over a long period. Thurston County Emergency Management describes the three common scenarios for flooding on the Chehalis River within Thurston County:

- The most predictable scenario for the Chehalis occurs when rains fall over all southwestern Washington and all regional rivers and streams rise.
- The Chehalis River can also experience flooding when there is little or no rain in Thurston or Grays Harbor counties, but heavy rain in Lewis and Pacific counties. This causes flooding to occur later than normal.
- Flooding also occurs when heavy rain falls in Grays Harbor County, but not in Thurston or Lewis counties. Feeder streams can then fill the Chehalis and cause water to "back up" into Thurston County.

Chehalis River Flood Stage Levels

The flood of record is 20.23 feet from December 4, 2007. Figure 4.3.2 summarizes the flood impacts based on the Chehalis River flood stages at the gauge near Grand Mound at Prather Road Bridge, River Mile 59.9.

Figure 4.3.2 Chehalis River Flood Stages and Historic Crests at the Gauge near Grand Mound

Flood Stage	Gauge Height and Discharge	Conditions and Previous Years of Occurrence
Action	12.2 Feet or 16,600 CFS	At 12.2 feet, the Chehalis River will locally spill out of its banks into nearby fields and over a few roads. 1933, 1936, 1943, 1945, 1946, 1948, 1949, 1953, 1954, 1955, 1956, 1964, 1966, 1980, 1983, 1984, 2003, 2009, 2011, 2012, 2013, 2014, 2015
Flood	14 or 22,900 CFS	At 14 feet, the Chehalis River will flood several roads in Independence Valley, including James Road, Independence Road and Moon Road. Flood waters will also cover nearby farm lands. 1933, 1937, 1939, 1941, 1945, 1946, 1947, 1948, 1949, 1950, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1963, 1964, 1965, 1966, 1967, 1968, 1970, 1971, 1972, 1974, 1975, 1980, 1981, 1982, 1983, 1986, 1989, 1990, 1992, 1995, 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2010, 2011, 2012, 2014, 2015
Moderate	15.5 Feet or 29,600 CFS	At 15.5 feet, the Chehalis River will flood several roads in Independence Valley with swiftly moving water, including SR-12 and James, Independence, Moon and Anderson Roads. Floodwaters will cut off access to and from the Chehalis Reservation and inundate nearby farm lands. Some residential structures may be threatened. 1934, 1936, 1949, 1953, 1954, 1955, 1962, 1964, 1966, 1970, 1976, 1977, 1982, 1986, 1987, 1994, 1996, 1997, 1999, 2001, 2006, 2015
Major	17 Feet or 38,800 CFS	At 17 feet, the Chehalis River will cause major flooding, inundating roads and farm lands in Independence Valley. Deep and swift floodwaters will cover SR-12 and James, Independence and Moon Roads. Flooding will occur all along the river, including headwaters, tributaries and other streams within and near the Chehalis River Basin. 1935, 1937, 1951, 1971, 1972, 1974, 1975, 1986, 1990, 1991, 1994, 1995, 1996, 1998, 1999, 2007, 2009, 2015

Deschutes River Basin

The Deschutes River is a 53-mile-long lowland river that gives rise within Mt. Baker-Snoqualmie National Forest in north Lewis County. The river is in the Deschutes Watershed (WRIA #13). The Deschutes lies west of the Nisqually River and flows in a parallel pattern. The Deschutes is the fastest rising and falling river in the county, responding quickly to local rainfall and runoff. The river's watershed encompasses a great majority of the land area for the cities of Lacey, Olympia, and Tumwater. As the Deschutes River enters the urban growth area and the City of Tumwater, the river bank and surrounding land use becomes more developed, with several residences in the Tumwater Valley around the periphery of the Tumwater Golf Course. A riprap bank and additional hard banking channels the river through the Tumwater Valley Golf Course and parts of Tumwater Falls Park before it discharges into Capitol Lake near the Historic Olympia Brewery in Tumwater, just south of Interstate 5.

Capitol Lake is an artificial lake formed by a small dam at the north end of the lake in downtown Olympia. Sediments carried down river are slowly accumulating on the lake bottom and effectively decreasing the lake's capacity. Washington State Department of Enterprise Services regulates the dam, which creates a freshwater lake to complement the Capitol Campus. Percival Creek joins the Deschutes River in Capitol Lake's central basin, near Marathon Park, just north of Interstate 5. When the tides and lake water level conditions permit the opening of the dam's radial gate, Capitol Lake drains into Budd Inlet.

A multi-year and multi-stakeholder study was completed to evaluate how the mouth of the Deschutes River will ultimately interface with Budd Inlet and how it will be managed within a heavily developed urban environment. This study evaluated the environmental, social, and economic implications for a variety of long-term management alternatives. The Washington State Department of Enterprise Services is recommending the removal of the dam, which will allow Capitol Lake to revert to an estuary.

Deschutes River Flood Stage Levels

The flood of record is 17.01 feet from January 9, 1990. Figure 4.3.3 summarizes the flood impacts based on Deschutes River flood stages at the Rainier Vail Loop Bridge Gauge, River Mile 25.9.

Figure 4.3.3 Deschutes River Flood Stages and Historic Crests at the Rainier Vail Loop Bridge Gauge

Flood Stage	Gauge Height and Discharge	Conditions and Previous Years of Occurrence
Action	9 Feet or 2,570 CFS	At 9 feet, the Deschutes River locally spills over its banks into low fields and forested lands, mainly along Vail Cutoff Road and Reichel Road. 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1964, 1965, 1966, 1967, 1968, 1970, 1972, 1974, 1975, 1977, 1979, 1982, 1989, 1990, 1991, 1992, 1994, 1995, 1996, 1997, 1998, 1999, 2001, 2002, 2007, 2009, 2011, 2015
Flood	11 or 3,950 CFS	At 11 feet, the Deschutes River will flood downstream in Tumwater Valley, including the golf course. Minor flooding will also occur in several residential areas, mainly Cougar Mountain and Driftwood Valley. Many roads and farm lands will also be flooded. 1949, 1953, 1955, 1957, 1960, 1962, 1963, 1964, 1966, 1967, 1970, 1971, 1972, 1975, 1977, 1982, 1987, 1988, 1990, 1994, 1996, 1997, 1998, 2001, 2003, 2006, 2011, 2012, 2014, 2015
Moderate	13.5 Feet or 5,970 CFS	At 13.5 feet, the Deschutes River will flood residential areas, especially Cougar Mountain, Driftwood Valley and Falling Horseshoe. Downstream flooding will occur in areas of Tumwater Valley, including the golf course. Many roads and farm lands will also be flooded. 1991, 1996, 1998, 2007, 2009
Major	15 Feet or 7,330 CFS	At 15 feet, the Deschutes River will cause major flooding, with swift and deep water flooding roads, farmlands and the residential areas of Cougar Mountain, Driftwood Valley, Falling Horseshoe and areas downstream in the Tumwater Valley. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Deschutes River Basin. 1972, 1974, 1990, 1996

The Nisqually River

The Nisqually River is the only river system within Thurston County that is fed primarily by melting snowpack and glacial ice. This 80-mile river is located within the Nisqually Watershed (WRIA #11). The river's headwaters begin on the southwestern slope of Mount Rainier at the base of the Nisqually Glacier in Mount Rainier National Park in Pierce County. The river flows west along the Pierce and Lewis County line until constrained by the Alder Dam; nearly halfway (river mile 44.2) to the river mouth at the Puget Sound. From Alder Reservoir, the Nisqually River forms a natural border for approximately 48 miles between Pierce and Thurston counties. The Nisqually River is particularly prone to atmospheric river flooding due to its alpine origins and susceptibility to rain-on-snow melting in the upper elevations near Mt. Rainier.

Alder Dam is a 330-foot-high concrete arch dam with a crest length of about 1,600 feet, with a spillway designed for a maximum discharge of 85,000 cubic feet per second (cfs). Alder Reservoir is about seven miles long with a 3,065-acre surface area and a 214,500-acre-foot total storage capacity. The LaGrande Dam, a gravity structure 212 feet high and about 710 feet long, is 1.7 miles downstream from Alder Dam. The dam's spillway was also designed for a maximum discharge of 85,000 cfs. The LaGrande Reservoir provides a total storage capacity of 2,676 acre-feet. Tacoma Power operates both dams for hydroelectric power generation.[6] The reservoirs of both dams are relatively small, and Tacoma Power is not required to provide flood control. Even so, Tacoma Power lowers the elevation of the lake, when possible, during winter months to enable some capture of high-water inflows from rainstorms and snow melt.

The Nisqually River resumes a mostly natural unrestricted flow as it traverses northwest away from the LaGrande Dam, passing a diversion dam owned by the City of Centralia. The diversion dam and a canal divert water from the Nisqually River to generate 12 megawatts of hydroelectric power during peak flows at a plant northwest of the city of Yelm. The dam provides no floodwater storage capacity. The river courses past scattered residences in unincorporated Thurston County before it passes the communities of McKenna, Yelm, the Nisqually Pines neighborhood, the Nisqually Indian Reservation, and the undeveloped range lands of Joint Base Lewis McChord. Several small farms and residences are in the Nisqually Valley in the vicinity around Interstate 5 and Old Pacific Highway. The river enters the Puget Sound near the Nisqually National Wildlife Refuge.

Nisqually River flooding relates largely to the amount of water released from Alder and LaGrande dams. Feeder streams such as Ohop, Yelm, and Tanwax creeks also influence flooding, as do high tides in the Nisqually Delta. Conservation efforts including dike removal and revegetation work was recently completed to restore ecological functions of the Nisqually Estuary. It is unknown how this restoration will affect floods in the lower reaches of the river, as major flooding has not occurred since this work was completed.

Nisqually River Flood Stage Levels

The flood of record is 17.13 feet from February 8, 1996. The National Weather Service issues a flood warning for the Nisqually River when forecast models indicate the river will reach a stage of 12 feet or higher at the McKenna Gauge at River Mile 21.8. Figure 4.3.4 summarizes the flood impacts based on Deschutes River flood stages at this gauge.

Figure 4.3.4 Nisqually River Flood Stages and Historic Crests at the McKenna Gauge

Flood Stage	Gauge Height and Discharge	Conditions and Previous Years of Occurrence
Action	8 Feet or 9,970 CFS	At 8 feet, residents should be aware that the river is likely to flood. 1967, 2011, 2014
Flood	10 or 14,700 CFS	At 10 feet, the Nisqually River will flood at the lower end near the mouth. High tide levels on Puget Sound may increase the amount of flooding. The Nisqually River will also spill over its banks between LaGrande and McKenna. 1951, 1953, 1955, 1959, 1961, 1964, 1977, 1980, 1982, 1990, 1991, 1994, 1995, 1997, 2003, 2006, 2009, 2015
Moderate	13 Feet or 23,300 CFS	At 13 feet, the Nisqually River will flood from LaGrande downstream through McKenna to the mouth. Swift waters will flood roads, farms and some residential areas, including the residential care facility in McKenna. Erosion will likely damage properties along river banks. 1991, 1996, 1998, 2007, 2009
Major	14 Feet or 26,500 CFS	At 14 feet, the Nisqually River will cause major flooding from LaGrande downstream through McKenna to the mouth. Deep and swift waters will flood roads, farms and residential areas, including the residential care facility in McKenna. Erosion may cause severe damage. Flooding will occur all along the river, including headwaters, tributaries and other streams within and near the Nisqually River Basin. 1972, 1974, 1990, 1996

Scatter Creek

Located in the Upper Chehalis Watershed (WRIA #23), Scatter Creek is approximately 20 miles long with an additional 9.5 miles of tributaries. The creek flows west-southwest from McIntosh Lake, east of Tenino, to the Chehalis River near Rochester.

The creek crosses lands chiefly composed of highly porous glacial outwash materials. After Scatter Creek passes through the City of Tenino, the river flows through mostly undeveloped small farmland with scattered residences through unincorporated Thurston County. The lower end of the creek passes through the Grand Mound area which is scattered with residences and light industrial plants and businesses. The lower six miles maintains a year-round flow of water due to pumped groundwater sourced from effluent from a commercial fish farm. Significant reaches of the creek up stream remain dry during the summer because of a lowering of the water table from a variety of active water rights and exempt wells within the watershed.

The Scatter Creek Aquifer system is like a "propped up bathtub" that feeds into the Chehalis (a high ground water gradient and velocity). Ground water flooding in Scatter Creek impacts the municipal well field which is shallow – only 90 feet below ground surface. Even in years where the Chehalis does not flood, the ground water comes to ground surface at the well field. Also, the LIDAR data reveals Scatter Creek as large ancestral flood channels, so the stream itself does not seem to overbank as dynamically as a normal flood plain in the upgradient areas. The river just follows the larger ancestral 'scours.'[7]

No permanent long-term stream flow gauges exist on this creek, so little is known about its long- term hydrography. In addition, very little flood history data is published for this riverine system. The Scatter Creek Habitat Conservation Plan states that from 1993 to 1999, the wet season flows typically ranged from 80 to 400 cfs, with less frequent peaks in the range of 400 to 1,400 cfs. The maximum mean daily discharge during this period was 1,362 cfs on February 14, 1996 (historically a very wet year, coinciding with record flood levels for the Skookumchuck River).

A long-term (> 20-year) stream flow gauge exists on this creek near the confluence with the Chehalis River at James Road which provides historical and near real-time data on flow levels. The Scatter Creek Habitat Conservation Plan states that from 1993 to 1999, the wet season flows typically ranged from 80 to 400 cfs, with less frequent peaks in the range of 400 to 1,400 cfs. The maximum mean daily discharge during this period was 1,362 cfs on February 14, 1996 (historically a very wet year, coinciding with record flood levels for the Skookumchuck River).The Scatter Creek Habitat Conservation Plan includes the following passage regarding flood flows[8]:

> …About 50 percent of the basin delivers stormflow runoff to the valley bottom from the hill portions of the basin. This flow is mostly delivered from seven tributary creeks that enter Scatter Creek and elevated groundwater return flow. If stormflow runoff enters from the tributaries after a dry summer, it takes a while to fill the local groundwater and channel areas. Stormflow onto wet basin conditions creates the largest stormflow peaks. There are insufficient years of recorded flows on Scatter Creek to determine the relationship between flood frequency and magnitude.

In 1996, Scatter Creek experienced major flooding, covering several county roads along its westward flow including Old Highway 99, Sargent Road, 183rd Avenue, State Route 12, and Denmark Street.[9]

The Skookumchuck River Basin

The Skookumchuck River is 43 miles long with headwaters originating within Mt. Baker- Snoqualmie National Forest in north Lewis County. Located in the Upper Chehalis Watershed (WRIA #23), the river is arch-shaped and arcs upward into Thurston County for nearly 26 miles before it returns to Lewis County. The river flows northwest into Thurston County through commercial forest lands with relatively steep forested valley slopes. The Skookumchuck Dam, located about ten miles east and upstream from the town of Bucoda, constrains the river as it traverses west. The dam - a rolled earthfill embankment with a crest length of 1,320 feet and a height above streambed of 160 feet – has a gross storage capacity of 35,000 acre-feet. The dam's spillway, an ungated concrete ogee section 130 feet long, can pass the Probable Maximum Flood of 32,500 cfs.[10] TransAlta operates the dam, with a primary function to provide a controlled release of cooling water at the Centralia Steam Electric Plant in Lewis County.

The Skookumchuck River emerges from the reservoir and passes through a relatively flat open valley comprised of scattered small farms and residences. As the River bends south toward Lewis County, the valley narrows as the river flows through the town of Bucoda. The river winds along the eastern edge of the town's core developed area. From here, the river flows southwest and runs roughly parallel with State Route 507 into Lewis County. The river continues south until it enters the more densely populated City of Centralia. The Skookumchuck River drains into the Chehalis River, in Centralia, just west of Interstate 5 and south of Harrison Avenue.

Skookumchuck River Flood Stage Levels

The flood of record is 17.87 feet from February 8, 1996. The National Weather Service issues a flood warning for the Skookumchuck River when forecasts indicate that the river will reach a stage of 13.5 feet at the gauge near Bucoda. Figure 4.3.5 summarizes the flood impacts based on Skookumchuck River flood stages at the gauge four miles downstream from Bucoda.

Figure 4.3.5 Skookumchuck River Flood Stages and Historic Crests at the Gauge near Bucoda

Flood Stage	Gauge Height and Discharge	Conditions and Previous Years of Occurrence
Action	11.5 Feet or 2,750 CFS	At 11.5 feet, residents should be aware that the river is likely to flood. 1968, 1970, 1972, 1977, 1980, 1982, 1986, 1987, 1994, 1997, 1998, 2001, 2006, 2007, 2010, 2012, 2014
Flood	13.5 Feet	At 13.5 feet, the Skookumchuck River will flood a few roads and low pasture lands near Bucoda. 1968, 1972, 1974, 1975, 1976, 1982, 1983, 1986, 1994, 1995, 1996, 1998, 1999, 2001, 2002, 2004, 2005, 2006, 2007, 2011
Moderate	15 Feet or 5,500 CFS	At 15 feet, the Skookumchuck River will flood several residential and business areas around Bucoda. Flood waters will cover many roads. 1971, 1972, 1974, 1975, 1977, 1986, 1987, 1990, 1991, 1995, 1996, 1998, 1999, 2001, 2003, 2006, 2014, 2015
Major	17 Feet or 8,650	At 17 feet, the Skookumchuck River will cause major flooding in the Bucoda area, with deep and swift flood waters inundating residential and business areas and numerous roads. Flooding will occur all along the river, including headwaters, tributaries and other streams within and near the Skookumchuck River Basin. 1990, 1996, 2009

2. Groundwater Flooding

Groundwater flooding occurs when there is a high-water table and persistent heavy rains in an area where an upper, thin layer of permeable soils overlays an impermeable layer of hard pan. As the ground absorbs more and more rainwater, the groundwater table rises and causes flooding where it is higher than the surface of the ground. Map 4.3.3 shows high groundwater hazard areas in Thurston County.

Modes of Groundwater Flooding in Thurston County[11]

Combined local and National Oceanic and Atmospheric Administration data reveal two types of weather patterns that trigger groundwater flood events:

Type 1: Intense – Short Duration Successional Storms: ARkStorm systems are driven by the Pacific jet stream that draw sub-tropical moisture from the Pacific Ocean and release abundant rainfall as they reach land in the Pacific Northwest. They are characterized by warmer than normal temperatures and intense steady rainfall lasting for 1-3 days. Groundwater flooding occurs with two separate but successive storm events within a month, or if an atmospheric river system arrives later in the season after normal winter rains have "primed" the groundwater levels to near maximum. Normal high groundwater levels occur in mid- to late March, so if an atmospheric river system coincides with this normal peak, the capacity of the soils is exceeded and groundwater flooding occurs. This pattern appears to be increasing in frequency and intensity. Type 1 storm events also contribute to urban and stream flooding and landslides.

Type 2: Persistent Low-intensity Precipitation Pattern: This weather pattern is less common, but produces similar groundwater flooding effects. Type 2 patterns are characterized by weeks of persistent low intensity daily rainfall measuring less than an inch per day that gradually topples the groundwater table. In most cases, this weather pattern causes more widespread flooding throughout the County, both in areas that routinely flood and in those not generally susceptible to groundwater flooding. The county has only experienced this pattern twice in the last two decades – in 2002-2003 and in 2006-2007. In both instances, groundwater flooding was widespread and included areas not previously identified as susceptible to routine groundwater flooding. This implies that Type 2 events generate more widespread flooding than Type 1 events. Type 2 events do not appear to cause riverine flooding or landslides, but the data is insufficient to be certain of this conclusion.

Area of Impact of Groundwater Flooding

Nearly 54 square miles or 34,363 acres countywide (around 7 percent) have experienced groundwater flooding. Areas that experience such flooding are scattered throughout the lowlands in Thurston County (Map 4.3.3), but it is most prevalent around the western and southern end of the Olympia Regional Airport, near Littlerock Road, and south of Tumwater along Case Road. Although groundwater flooding occurs sporadically throughout Thurston County, the geologic conditions present in the Salmon Creek Basin south of Tumwater create the "worst case scenario" for such flooding here.

Since 1999, this basin has experienced floods four more times, though none were as severe as in 1999. The combination of increasing storm severity and intensity in the past decade, coupled with population increases in the County, have brought people and floods ever closer together in developing areas of the county. Other affected areas are in the Scatter Creek/lower Black system near Grand Mound and Rochester, eastern portions of the Lacey UGA, Beaver Creek, the Spurgeon Creek systems, and in the Yelm UGA.[12]

Extent of Groundwater Flooding

Since areas of high groundwater are relatively flat, flood waters can remain standing for several months, resembling ponds or lake like conditions. The Salmon Creek Basin experienced significant flooding in 1999, resulting in contiguous bodies of standing flood waters ranging from small puddles to 113 acres. Depths ranged from near ground surface to over 12 feet deep. The volume of flood water above the surface of the ground in the basin was equivalent to 603 football fields covered with four feet of water. This amount combined with the volume of groundwater below the surface at the septic drain field level would be equal to 977 football fields or 28,655 acre-feet.[13]

Historic groundwater flooding has been most severe in the second and subsequent years of consecutive wet years. According to the U.S. Army Corps of Engineer's post event report on the winter storm of 1996-1997, the frequency of a groundwater flooding disaster in Thurston County is probably on the order of every 25 years. This first widespread groundwater flood event since 1972 and the worst on record until the winter of 1998-1999. The 1998-1999 flood is now the "event of record." This event set the benchmark for high groundwater flood hazard requirements implemented by Thurston County.

3. Tidal Flooding

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. Tidal flooding can also occur without the effect of storm surge. The tides can also enhance flooding in delta areas when rivers or creeks are at or near flood stage.

Photo courtesy of West Thurston Fire District.

Area of Impact of Tidal Flooding

The downtown Olympia waterfront, including Port of Olympia properties, face the greatest risk from tidal flooding. Localized flooding is common along 4th and 5th Avenues near the isthmus between Capitol Lake and Budd Inlet and nuisance tidal flooding occurs downtown at 17 feet mean lower low water. Low-lying farmlands in the Nisqually Valley and along McLane Creek near Mud Bay are at risk. Tidal flood impacts are also a concern in delta areas when rivers are at flood stage and high tide exacerbates the situation. Sea level rise will increase the extent of inundation during tidal flooding.

Extent of Tidal Flooding

Puget Sound marine flooding by itself does not produce major flooding in the region. However, such flooding will become more frequent and present more adverse impacts in the second half of the 21st Century as sea levels rise.[14] Tidal flooding generally subsides as tides recede. Presently, tidal floods are short, often lasting only one to two hours. Chapter 4.5 Sea Level Rise Hazard Risk Assessment includes more information about coastal/tidal flooding and its extent for Downtown Olympia and unincorporated Thurston County.

4. Urban Flooding

Urban flooding occurs when excess precipitation is not readily absorbed by the ground and stormwater runoff exceeds the ability of stormwater facilities' capacity to safely convey and divert water within suburban and urban environments. As a result, streets, parking lots, homes, and businesses may experience localized flooding.

Excess water accumulation flowing off and over impervious surfaces from heavy rainfall or melting snow over a short period is the most common cause of urban flooding in the cities and developed areas of the county. Leaves, branches, snow or ice, and other debris that clogs stormwater drains compounds the problem. Other forms of urban flooding occur in residential neighborhoods constructed with insufficient stormwater conveyance capacity. Until flooding reveals the problem, residents or municipalities may be unaware of deficient drainage systems in newer developments. New urban development or neighborhoods with faulty stormwater systems may adversely impact adjacent neighborhoods that previously did not experience stormwater flooding.

Area of Impact of Urban Flooding

Although it occurs throughout every city in Thurston County, urban flooding has historically impacted west Olympia and downtown Olympia more than other communities.

Extent of Urban Flooding

In general, properties impacted by urban flooding are not widespread and flood conditions are often localized. However, the impacts to transportation networks can be great. Downtown Olympia is vulnerable to urban flooding when extreme high tides coincide with persistent heavy rainfall and major flooding on the Deschutes River. The city can easily mitigate some stormwater flooding through regular cleaning and maintenance of stormwater conveyance systems.

Effects of Climate Change on Flooding

Research and climate forecasts offer evidence that long-term climate change will have a measurable impact on the frequency and severity of flooding. The University of Washington Climate Impacts Group (UWCIG) published a detailed report on the state of science on climate change and its effects within the region titled, "State of Knowledge: Climate Change in the Puget Sound." The report identifies several factors that will influence flooding for these communities. Thurston County is currently conducting long term analysis to quantify climate change impacts recorded in the vast quantities of hydrologic data collected by the County since 2000.

Air temperatures are increasing in the Puget Sound Region, and are projected to warm rapidly during the 21st century, especially during the summer. By mid-century, warming will be outside of the range of historical variations. Because of warmer winters, watersheds will become increasingly rain dominant with streamflow projected to peak earlier in winter and decrease in spring and summer. Winter streamflow is projected to increase by 28 to 34 percent on average by the 2080s.

Overall annual precipitation levels are forecast to remain the same, but with greater seasonal variation. Summers will become drier and winters wetter. The frequency of the region's peak 24-hour rain events is expected to more than triple by the end of the 21st century. Such heavy storms are also expected to become more intense, with greater rainfall occurring in shorter periods of time.

Climate Change on the Region's Hydrology

Changes in temperature and precipitation will continue to decrease snowpack, affecting stream flow and water quality throughout the Pacific Northwest. Warmer temperatures will result in more winter precipitation falling as rain rather than snow, particularly in mid-elevation basins where average winter temperatures are near freezing. This change will result in less winter snow accumulation and higher winter stream flows. The Nisqually River, fed by snowmelt, will likely see earlier peak spring stream flow and lower summer stream flows.

The decline of the region's snowpack is predicted to be greatest at low and middle elevations due to increases in air temperature and less precipitation falling as snow. The average decline in snowpack in the Cascade Mountains, for example, was about 25 percent over the last 40 to 70 years, with most of the decline due to the 2.5°F increase in cool season air temperatures over that period. As a result, seasonal stream flow timing will likely shift significantly in sensitive watersheds.

Thurston County's rivers are less impacted by snowpack than other rivers in western Washington, so would see less impact from changes to snowpack. However, any change in hydrograph associated with more concentrated, intense rainfall would greatly impact Thurston County's rivers.

Rivers with dams could experience significant impacts from a changed hydrograph, since dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased flows earlier in a storm cycle to maintain required margins of safety. Such early releases of flow can increase flood potential downstream. Throughout the western United States, communities downstream of dams are already experiencing increases in stream flows caused by earlier releases from dams.

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method assumes that the climate of the future will be like that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted.

Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty of water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection and emergency response.
- Drought is likely to become an annual summer event causing impacts to agriculture, aquatic species survivability, and increasing wildfire danger.

The UWCIG provides climate forecast projections for the percent change in the magnitude of streamflow on the day of the year with the most streamflow (Table 4.3.4).[15]

Table 4.3.4 Percentage of Stream Lengths in Thurston County – Percent Change in Annual Maximum Streamflow[1]

Scenarios	Over 100	70 to 100	50 to 70	30 to 50	10 to 30	-10 to 10
1980-2009						
Historical Baseline	0	0	0	0	0	100
2020-2049						
Higher Scenario (RCP 8.5)	0	0	0	0	21.8	78.2
Lower Scenario (RCP 4.5)	0	0	0	0	22.1	77.9
2030-2059						
Higher Scenario (RCP 8.5)	0	0	0	0	90.1	9.9
Lower Scenario (RCP 4.5)	0	0	0	0	43.5	56.5
2040-2069						
Higher Scenario (RCP 8.5)	0	0	0	4.9	94.9	0.2
Lower Scenario (RCP 4.5)	0	0	0	0	69.5	30.5
2050-2079						
Higher Scenario (RCP 8.5)	0	0	0	21.8	78	0.2
Lower Scenario (RCP 4.5)	0	0	0	0	87.4	12.6
2060-2089						
Higher Scenario (RCP 8.5)	0	0	0	21.8	78	0.2
Lower Scenario (RCP 4.5)	0	0	0	0	72.4	27.6
2070-2099						
Higher Scenario (RCP 8.5)	0	0	0	0	99.8	0.2
Lower Scenario (RCP 4.5)	0	0	0	0	99.8	0.2

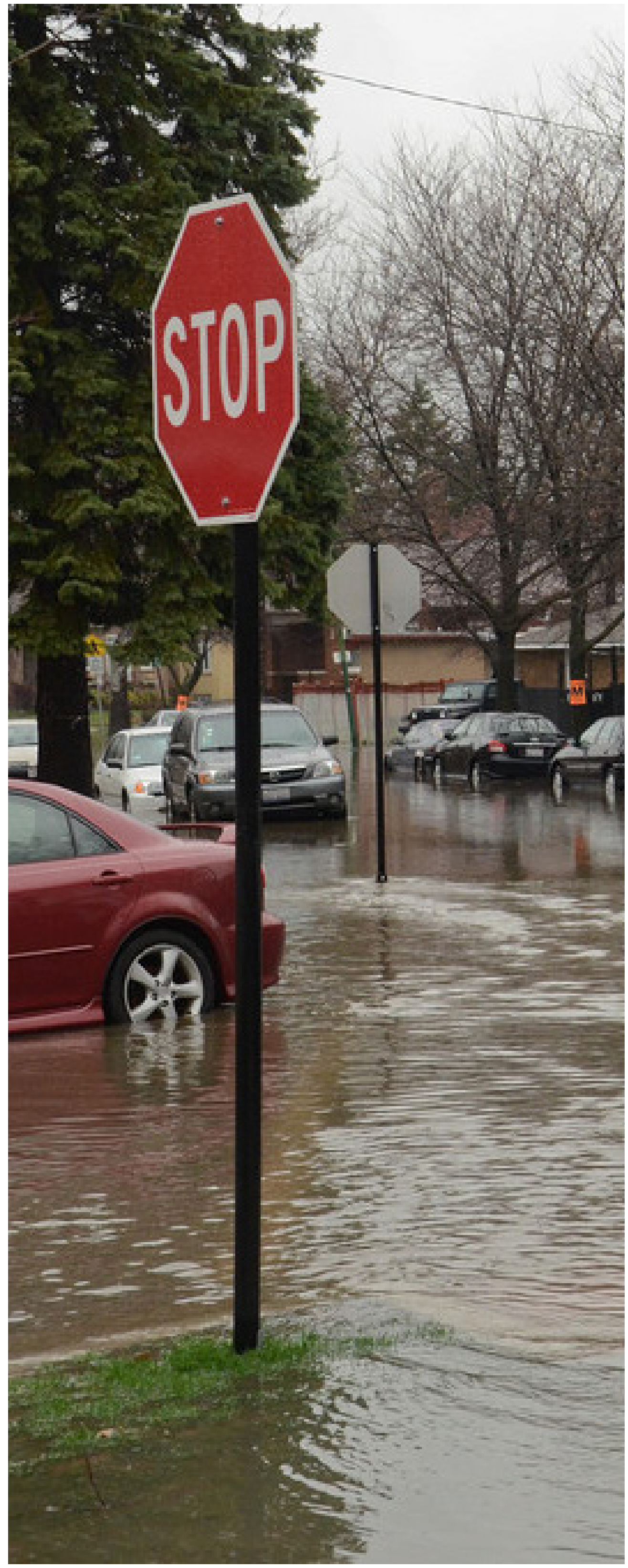
[1] Representation concentration pathways, or RCPs are climate model scenarios for the 21st century. RCP 4.5 — a “low” scenario that assumes greenhouse gas emissions (GHG) stabilize by mid-century and fall sharply thereafter; and RCP 8.5 — a “high” scenario that assumes substantial GHG increases until the end of the 21st century.

Previous Incidents

Several major floods have impacted the Thurston County region over the last several decades resulting in 12 major federal disaster declarations. The following accounts describe the range of flood impacts to community assets including people, structures and systems, natural, cultural and historic resources, and activities. The impacts reveal potential vulnerabilities from future floods.

December 26, 2021 – January 15, 2022, Severe Winter Storms, Straight-Line Winds, and Flooding. DR 4650.

Winter storms, snow, and heavy rains caused major flooding on the Chehalis and Skookumchuck rivers. On January 6, the Thurston County Emergency Coordination Center activated to a Level 2 partial activation due to anticipated major flooding. On January 7, the Chehalis River near Grand Mound crested at 145 feet and the Skookumchuck River near Bucoda crested at 216 feet, both reached major flood stage. Evacuation advisements were issued for residents in affected areas. Several rescues were performed in the West Thurston Fire District. 35 county roads were closed, and 113 additional roads were signed for roadway flooding. A surge in demand to dispose of residential debris from the winter storm combined with road closures created a backlog of waste at disposal sites.



97 residents reported over $556,000 in uninsured losses. Flooding caused damage to crawl space HVAC systems, first floor structures and contents, and damaged or destroyed outbuildings and septic systems. The flooding resulted in a combined local government assessment of $701,433 in public assistance needs.[16]

January 20 – February 10, 2020, Severe Storms, Flooding, Landslides, and Mudslides. DR 453917

A period of abnormally wet weather began in late December and persisted through early February across the Pacific Northwest. An area of strong, persistent low pressure over the eastern Pacific generated a series of strong atmospheric river events that hit in quick succession resulting in overlapping storms. Water vapor transport into Washington State was 200 to 250 percent of normal during the period. These events led to widespread sustained riverine flooding and other winter storm impacts across Washington State.

Weeks of heavy rain and snow resulted in significantly higher than normal flows on the Nisqually River. To prevent the pooled reservoir from overtopping the La Grande Dam, Tacoma Power increased the dam flow from approximately 2,200 cfs to 17,000 cfs, peaking on February 6 and continuing through February 7, 2020. The sustained release of water had major implications on downstream communities, especially for hundreds of Thurston County residents, businesses and Nisqually Indian tribal members residing in the Lower Nisqually Valley area.

Thurston County Department of Emergency Management activated their Emergency Operations Center and issued evacuation orders beginning February 6 for approximately 700-1,000 individuals living in the low-lying areas along the river. The Thurston County Sheriff's department and dive/swift water search and rescue teams assisted with the evacuations of people, pets, and domestic livestock. The County assisted with emergency sandbagging operations and public messaging. The rapid rate of rising water in communities along the Nisqually River required life-saving decisions for several evacuating residents at the time of the flooding. There was major flood damage reported to garages, sheds, personal property, and homes in neighborhoods with a high number of very low-income families.

The Red Cross operated a shelter in Lacey from February 6 to February 11, 2020, in response to the evacuation and flooding impacts. The evacuation advisory remained in place for four days. The Riverside Manor Apartments in Nisqually were flooded as the river overtopped its banks, resulting in several units with reported flood damage. Dozens of other homes and businesses in the area were also impacted by the flooding. Data from a 2016 American Community Survey (ACS) identifies nearly 16 percent of families living in the Nisqually Valley to be below the poverty line, and an estimated 18.1 percent of the population is living with a disability. The primary impact of the flooding directly affected an estimated 2,669 individuals, 43 percent of which were over the age of 60, and 40 percent were families receiving supplemental or cash public assistance. The impacted individuals faced major challenges finding alternate affordable housing options in the area due to their economic constraints. Another major challenge impacting residents' ability to recover from this flooding was the widespread and ongoing response to the COVID-19 pandemic.

The severe winter weather damaged roads, recreational sites, private and commercial fishing facilities, downed large trees on top of power lines and other critical infrastructure and caused widespread damage to homes and businesses. Schools cancelled classes and bus routes were interrupted due to the flooding. The Nisqually Indian Tribe's Wa He Lute Indian School also sustained major flood damages from this severe winter storm system. Strong winds and heavy rains toppled trees across the County, knocking down utility lines and eroding and destroying popular hiking trails in the area. A large tree fell on a pedestrian bridge over Percival Creek, destroying the bridge and severing a watermain, sewer line and conduit containing private utility communications lines. Approximately 30,000 gallons of untreated sewage flowed directly into the creek, Capitol Lake, and the Lower Budd Inlet. The bridge supports sewer, water, and utility infrastructure lines serving thousands of residents in multiple counties. Approximately 765 residential units and 42 commercial accounts including the Thurston County Courthouse were impacted by the broken sewer main line and approximately 2,100 residential units and 64 commercial accounts were impacted by the broken water main. The embankment around the structure also suffered major erosion damage. A 53-foot span of the bridge will need to be replaced to support replacement of the utilities at an estimated cost of $2.5 million.

The Washington Department of Fish and Wildlife (WDFW) reported damage to its facilities after the Nisqually River flooded approximately five feet over its banks, damaging a juvenile fish trap site. The historic flows broke the anchor line, damaging the trap, flooding hatchery facilities, and severely eroded the parking lot and access area. Hatchery operations are a crucial economic driver for the state, serving as an important asset to the tourist and recreation fishing industry. The loss of a normal cycle of fish into the rivers disrupts the return of fish to the waters on schedule, adversely impacting the entire state economy.

The Nisqually Indian Reservation community also relies heavily on the abundance of salmon in the region for economic and cultural reasons. As a result of the historic flows, an estimated 600,000 Coho salmon, 500,000 Chinook salmon, and 500,000 Chum salmon were affected by the flooding to the Tribe's salmon hatchery. Erosion occurred around the fish ladder, upper site intake dam and along the roadway at the Kalama Creek Hatchery Facility resulting in major damages. Floodwater contaminated with sediment, sewage, and petroleum products inundated containment tanks holding hundreds of thousands of Coho and Chinook salmon. The full extent of the loss is still being calculated at this time, but the compounding adverse effects on the economy, environment and livelihoods of the community may be felt for years to come.

Representatives from FEMA and Washington State Emergency Management Division met with the Nisqually Indian Tribe on February 27 to discuss the flooding impacts to their hatchery operations and community at large. The Tribe reiterated and stressed the cultural, economic, and environmental implications of the threatened salmon habitat and the adverse impacts because of this disaster.

January 6-16, 2009, Severe Winter Storms, Landslides, Mudslides, and Flooding. DR-1817.

An atmospheric river storm raised temperatures and dropped heavy rains throughout western Washington following one of the worst Pacific Northwest snowstorms in decades. Severe flooding occurred throughout western Washington, including the Chehalis, Skookumchuck, Deschutes, Nisqually, and Black rivers. The Skookumchuck River crested at 17.72 feet on January 8, making it the second worst flood in the river's recorded history. The Chehalis River crested at 18.18 feet near Grand Mound causing major flooding in the Chehalis River Basin only 13 months after the December 2007 floods.

Interstate 5 was closed for 20 miles for nearly two days. State Route 12, State Route 8 and Highway 101 were also closed for a period, some for multiple days. During the height of the flood event, 49 county roads were closed. Over 200 homes were isolated in the Bald Hills Road/Clearwood area, and likely over 100 in the Rochester, Grand Mound, and Gate communities, and likely another 50 homes had access issues in the area around Bucoda.

Damage to homes throughout Thurston County was estimated at $3 million. Damage was concentrated in and around the town of Bucoda, the Rochester community, and along the Deschutes River outside of Yelm. Damage to public facilities and roads around Thurston County and the overtime cost for city and county officials to respond to the flooding cost $2.5 million.

Volunteer firefighters went door to door in Bucoda warning residents of imminent flooding before floodwaters swallowed a nine-block stretch of the town (the town's worst flood event since 1996). Residents were forced to evacuate, and a Thurston County dive team was deployed to assist residents. At least two households required rescue assistance. One home was identified as too dangerous to inhabit and 12 homes were deemed moderately damaged and only accessible during the daytime. The Intersection of 3rd Avenue and North Nenant Street incurred damages exceeding $12,000. Extensive road damage along five blocks of Market Street also occurred. At least one municipal well was forced to shut down due to possible contamination. The town-owned RV park restroom was also contaminated by floodwaters and required extensive clean up.

On January 8, the City of Lacey shut down two streets for the first time in at least nine years due to urban flooding. Crews closed Rainier Road at the south end of city limits around the Burlington Northern Santa Fe (BNSF) railroad trestle. The city also closed 32nd Avenue Northeast off Marvin Road in the Hawks Prairie area. The heavy rains entering the sewer system in Olympia forced the LOTT Alliance to discharge 6.3 million gallons of partially treated wastewater from its Budd Inlet Sewer Treatment Plant via its emergency outfall at the Fiddlehead Marina.

December 1-7, 2007, Federal Disaster 1734: Severe Winter Storms, Flooding, Landslides, and Mudslides18

Snow followed by an atmospheric river on December 2 and 3 caused major flooding throughout southwest Washington. Heavy rainfall and melting snow resulted in record flooding on the Chehalis River, which crested at 20.23 feet, six feet over flood stage at the Grand Mound gauge. Some sites in the Willapa Hills area collected 14 to 18 inches of rain over the two-day period. Widespread flooding occurred in southwest Thurston County heavily impacting the Rochester community, Grand Mound, and the Independence Valley area. Lewis County was especially hard hit, particularly around the cities of Centralia and Chehalis and the farms around Adna and the Boistfort Valley.

The Deschutes and Black rivers also rose above their banks. The Deschutes River crested 2.75 feet above flood stage near Rainier and flooded residential areas and the Tumwater Valley. The region also experienced stream and urban flooding and flash flood conditions in the Capitol Forest, resulting in washouts and landslides (see landslide hazard profile for other details on this event).

On December 4, Rochester Fire Department developed a command post for evacuation and rescue. They partnered with the Thurston County Sheriff's Office Dive Team, local search and rescue volunteer groups, and the Washington State National Guard and rescued 63 people - 17 by helicopter. Nearly 300 people were rescued or forced to evacuate in Lewis County – some seeking refuge in local area shelters. Thurston County opened a flood relief center at the Rochester Community Center to assist affected residents.

Thurston County documented 44 county roads and bridges that closed from storm and flood damage. The county and cities carried out round-the-clock road repair and maintenance. Estimates reflect that over 400 homes in the area were affected by the road closures in the southwest Thurston County. Interstate 5 closed for 20 miles between Chehalis and Grand Mound for five days. Some portions of Interstate 5 were covered with 10 feet of water. The Washington State Department of Transportation estimated that the closure resulted in $47 million in lost of economic output statewide.[19] Additional closures along Highway 101 and Highway 8 disrupted traffic for thousands of people who live or work in Thurston County, or who were passing through. A railroad bridge over the Nisqually River suffered significant damage due to debris collection against the bridge, resulting in a disruption of statewide rail traffic. West coast rail traffic was also shut down for several days due to flooding.

Nearly 10 inches of rain fell on the City of Olympia's west side resulting in the worst urban flooding ever experienced in that area. On December 3, 2007 during the morning peak commute period, the west side of Olympia experienced major traffic backups for hours due to road closures. One of the highest traffic volume intersections in the region, Cooper Point Road and Black Lake Boulevard off Highway 101, experienced major flooding resulting in permanent damage to the signal controller. Several motorists attempted to drive through the water only to become stranded and forced to abandon their vehicles. Some vehicles were eventually completely submerged. Inundation forced the closure of the Percival Creek Bridge on Cooper Point Road. Several businesses on Olympia's west side were affected by floodwaters and power outages. Puget Sound Energy turned off power as a safety precaution requiring businesses to temporarily close their doors. The Woodshed, a furniture retailer, lost their entire inventory to three feet of water. Replacement cost was estimated at $250,000.

On December 3, the enormous volume of rainfall and runoff caused LOTT Alliance's Budd Inlet Sewer Treatment Plant to discharge untreated wastewater into Budd Inlet. At its peak, an estimated 1 million gallons per hour bypassed treatment processes and was sent through the emergency outfall near Fiddlehead Marina. After the flooding, many wells and water supplies were contaminated and non-functional in the unincorporated areas of the county. Public health advisories were issued to flood affected areas to inform the public to boil their water or consume only bottled water.

Preliminary cost estimates for the response, preventive measures, and the damage to public facilities exceeded $4.6 million throughout Thurston County. In many ways, the dollar figures reported for response costs only reflect a fraction of the actual response costs to local governments. For example, the estimates may not include volunteers, such as the local fire districts' volunteer firefights who provided emergency response. Damage to Thurston County roads and bridges for non-federal aid routes was $2.7 million. Three sites of federal aid roads incurred over $32,000 in damages.

For this disaster, nearly 267 Thurston County residents applied to FEMA for assistance with over $6 million claims in property damages. FEMA awarded $544,928 in aid and the Small Business Administration granted $1.7 million to 30 homeowners and 2 businesses.

October 15-23, 2003, Federal Disaster 1499: Severe Storms and Flooding

At least 11 people reported flood damage within Thurston County, with at least two structures possibly incurring damage exceeding their replacement value. Thurston County was not seriously impacted by this storm event and received a disaster declaration because it bordered counties that experienced more severe flooding (Mason, Pierce, and Grays Harbor counties).

February 1999 High Ground Water Flooding

Higher than normal rainfall caused major groundwater flooding and urban stormwater flooding throughout Thurston County and its communities. Although no federal disaster was issued, major flooding affected over 200 properties in Lacey, Olympia, Tumwater, and Thurston County. (See landslide hazard profile for more on landslide impacts during this event).

December 1996 (Federal Disaster 1159) to February 1997 Winter Storm and Flooding

1996 was the third wettest year of the 20th Century. December was especially wet, receiving over twice its normal monthly rainfall. During this time:

- 200 homes countywide were flooded
- 200 drinking water wells were contaminated
- Septic system failures occurred throughout the county
- Response and recovery efforts cost Thurston County government over $340,000
- Response, recovery, and repair costs for other government entities and utilities exceeded $750,000
- Private property owners incurred over $1.75 million in uninsured losses

February 1996, Federal Disaster 1100: Flooding

The February 1996 flood is one of the most devastating floods on record for Thurston County. Every major river and stream crested their banks. Record flooding occurred on the Nisqually River near McKenna when the river crested at 17.13 feet, seven feet over flood stage on February 8, 1996. Record flooding also occurred on the Skookumchuck River near Bucoda when the river crested at 17.87 feet, four feet over flood stage. Major flooding also occurred on the Deschutes and Chehalis rivers. The 1996 flood resulted in the following impacts:

- Inspections declared 190 homes uninhabitable
- 47 homes were destroyed in the Nisqually Valley; over two dozen homes were destroyed elsewhere
- Nearly 1,000 people evacuated their homes
- 300 people required rescuing
- More than 300 sections of the county road system were damaged
- Wa He Lut, a contract U.S. Bureau of Indian Affairs School, was destroyed by the Nisqually River
- I-5 was closed between Chehalis and Thurston County
- The main north-south railroad line at the Pierce County line was closed
- Response and recovery efforts cost Thurston County government over $2 million
- Response, recovery, and repair costs for other government entities and utilities exceeded $20 million
- Private property owners incurred over $22 million in uninsured losses.

January 1990, Federal Disaster 852: Severe Storm and Flooding

The Deschutes River at Rainier crested at 17.01 feet, six feet over flood stage – setting the flood record. Major flooding also occurred on the Nisqually, Deschutes, Skookumchuck, and Chehalis rivers. The Thurston Region experienced the following impacts:

- Flood waters in Lewis County killed two people
- I-5 closed for several days between Chehalis and Thurston County
- 83 elderly residents from the Nisqually Valley Care Center in McKenna were evacuated to a Red Cross Shelter at the Yelm High School gymnasium
- Floodwaters reached four feet deep on Bucoda streets and prompted nearly 600 residents to evacuate; one elderly man died from natural causes during the evacuation
- Lowland Nisqually Valley residents were urged to evacuate their homes
- Portions of downtown Olympia experienced urban flooding

Probability of Occurrence

Probability of Riverine Flooding

Because rivers and streams cause nuisance flooding annually, and major riverine flooding occurs about every 2 to 5 years in Thurston County, there is a high probability of occurrence.

Probability of Groundwater Flooding

Statistically, the U.S. Army Corps of Engineers estimates an approximately 70 percent chance that the county will equal or exceed the 1996-1997 flooding at least once during a 30-year mortgage cycle. The Corps estimates that the frequency of a groundwater flooding disaster in Thurston County is probably on the order of every 25 years. In the past decade, Thurston County's precipitation and groundwater monitoring is showing that large rainfall events have increased, and climate models indicate that this trend will continue. The probability for groundwater flooding is high.

Probability of Tidal Flooding

Olympia experiences nuisance tidal flooding one to two times a year. King tides combined with even moderate levels of sea level rise will increase the frequency of tidal floods. The probability of tidal flooding is high. The most recent tidal flooding occurred during the December 2022 King tides. Low atmospheric pressure further contributed to portions of Downtown Olympia experiencing floodwater over city streets.

Probability of Urban Flooding

Some level of minor to moderate urban flooding coincides with major flooding on the Deschutes River; about every four and a half years. This frequency suggests a high probability of occurrence.

Vulnerabilities and Impacts

Impacts to People

People caught unprepared and isolated by swift moving flood waters can die from drowning, hypothermia, or trauma. Flood waters can rise quickly and strand people who are unable or unprepared to evacuate on their own. People with disabilities, the elderly, and people who lack transportation are vulnerable to floods as they require assistance to evacuate.

Estimates of People Exposed to Flood Hazards

Flood Modeling and GIS exposure analysis estimated the number of people who live in areas that are prone to flooding. Over 50 percent of the Town of Bucoda's population lives in the 100-year special flood hazard area. Table 4.3.5 shows the percent of communities population that are potentially exposed to flood hazards.

Table 4.3.5 Thurston County Population Exposed to Flood Risks

		% Population Exposed			
Jurisdiction	Total Population	50-Year	100-Year	500-Year	High Groundwater
Bucoda	610	47.3	53.2%	59.5%	0.0%
Lacey	58,180	0.0%	0.0%	0.0%	0.3%
Olympia	56,370	0.0%	0.2%	0.2%	0.0%
Rainier	2,510	0.0%	0.0%	0.0%	0.1%
Tenino	2,030	0.2%	0.2%	0.2%	0.0%
Tumwater	26,360	0.1%	0.1%	0.1%	0.1%
Yelm	10,680	0.5%	0.6%	0.9%	0.1%
Unincorporated Thurston County	143,760	0.9%	1.7%	2.0%	0.1%
Total Planning Area	**300,500**	**0.6%**	**1.0%**	**1.1%**	**0.1%**

Flood damage makes homes and businesses unsafe for occupancy, displacing individuals and families. Sheltering facilities are crucial for socially vulnerable individuals. Homes or structures that aren't inundated may be surrounded by floodwater depths and make it difficult for people to enter and leave their properties. People suffer immense financial losses from damaged homes and vehicles, lost possessions, lost pets and livestock, spoiled food, and other property damage.

Estimates of People Displaced or Requiring Shelter

Table 4.3.6 shows modeled estimates of the number of individuals who could be displaced or require short-term sheltering for 50-, 100-, and 500-year flood events.

Table 4.3.6 Number of Individuals Displaced and Individuals Needing Shelter due to Flooding[2]

	50-Year Flood		100-Year Flood		500-Year Flood	
Jurisdiction	Displaced Individuals	Individuals Needing Shelter	Displaced Individuals	Individuals Needing Shelter	Displaced Individuals	Individuals Needing Shelter
Bucoda	143	2	174	6	203	10
Lacey	0	0	0	0	0	0
Olympia	0	0	2	1	18	0
Rainier	0	0	0	0	0	0
Tenino	0	0	0	0	0	0
Tumwater	0	0	0	0	10	0
Yelm	1	0	2	0	11	0
Unincorporated Thurston County	24	0	79	16	191	27
Total Planning Area	**168**	**2**	**257**	**23**	**434**	**37**

[2]Estimates of household displacement and sheltering needs are unavailable for high groundwater flooding.

Public Health and Safety

Floods and their aftermath present threats to public health and safety to victims and people assisting with recovery. The following health and safety risks are commonly associated with flood events.

Mental Health Impacts

The recovery period is stressful and disruptive for flood victims. Children miss school days, people lose income absent emergency leave from their employer, and businesses that are forced to close lose revenue. Individuals may experience mental stress or fatigue. The expense and effort required to repair flood-damaged homes places severe financial and psychological burdens on the people affected, especially for the unprepared and uninsured. Post-flood recovery—especially when it becomes prolonged, causes mental disorders, anxiety, anger, depression, lethargy, hyperactivity, sleeplessness, and, in an extreme case, suicide. Behavior changes may also occur in children. There is also a long-term concern among the affected that their homes can be flooded again in the future.

Post-Flood Hazards

Hazards can persist during cleanup and recovery. Flooded buildings can pose significant health hazards after floodwaters recede. Electrical power systems, including fallen power lines, can cause electrocution. Gas leaks from pipelines or propane tanks can trigger fires and explosions. Flood debris, such as broken glass and other sharp objects can cause injuries. Unstable structures could collapse and cause injuries during demolition. Containers of hazardous chemicals, including pesticides, insecticides, fertilizers, car batteries, propane tanks and other industrial chemicals, may be hidden or buried under flood debris.

Contaminated Drinking Water

Flooding contaminates clean water resources with pollutants. Direct and indirect contact with the contaminants can result in waterborne illnesses and infectious disease. Pollutants can infiltrate to groundwater or infiltrate into waterlines in areas with low water pressure. Wastewater treatment plants, if flooded and caused to malfunction, can be overloaded with polluted runoff waters and sewage beyond their operating capacity, resulting in backflows of raw sewage to receiving waters and nearby low-lying areas. Wells can be contaminated or damaged. Lack of potable water sources coupled with lack of adequate sewage treatment, can lead to disease outbreaks.

Vector-Borne Disease and Mold Infestation

Floodwaters provide breeding grounds for mosquitoes and can lead to an increase in the number of mosquito-borne diseases. Molds can spread within 24 to 48 hours in wet and damp areas of buildings and homes that have not been cleaned after flooding. Mold spores can be easily inhaled by humans and, in large enough quantities, cause allergic reactions, asthma episodes, and other respiratory problems. Excessive exposure to molds and mildews can cause flood victims, especially those with chronic respiratory problems, to contract upper respiratory diseases. Infants, children, the elderly, and pregnant women are most vulnerable to mold-induced health problems. Fast rising flood waters place livestock and pets at risk. Public health risks may arise if animal carcasses are not properly disposed.

Impacts to Structures and Systems

Flood waters can damage or destroy buildings, homes, and their contents. Electric, gas, water, and communication utilities are also at risk for damage and disruption. Table 4.3.7 shows the number of buildings that are exposed to flooding in the 50-, 100-, and 500-year Special Flood Hazard Areas. Swift moving floodwaters can cause erosion and damage or destroy infrastructure including electric, gas, water, and communications utilities. Bridges, roads, and railroads are also vulnerable. Major and moderate flooding frequently inundates low lying roads around Thurston County, resulting in area-wide transportation disruptions. As flood waters recede, woody debris and other objects left behind can pose hazards to travelers. Floodwaters have forced the closure of State Route 12 near Rochester and Interstate 5 near Centralia, snarling traffic in both directions, multiple times due to major flooding. In urban areas, flooding can cause power outages or disable traffic signal controllers resulting in traffic signal blackouts. Map 4.3.3 shows roads in Thurston County Communities vulnerable to flood water inundation.

During extreme high tide events, low lying areas are vulnerable to marine flooding. Numerous downtown Olympia stormwater outlets to Budd Inlet lack valves or flood gates and will back up, causing stormwater drains to overflow. High tides influence the timing of dam water release from Capitol Lake near 5th Avenue in downtown Olympia. During the re-construction of portions of Heritage Park, an earthen berm was installed around the north and eastern perimeter of Heritage Park to prevent major flood waters from flowing into downtown from Capitol Lake. However, if the Deschutes River experiences major flooding and a high tide prohibits discharge of lake water into Budd Inlet, floodwaters could crest the lake bank at the southeast end of the north basin and flow into downtown Olympia along the utility road between the Capitol Campus Steam Plant and Water Street.[20] Such flood conditions have not occurred since the berm was constructed.

Table 4.3.7 Estimates of Buildings Exposed in 50-, 100-, and 500-Year Special Flood Hazard Areas

		50-Year Flood		100-Year Flood		500-Year Flood	
Jurisdiction	Total Buildings	Buildings Exposed	% Buildings Exposed	Buildings Exposed	% Buildings Exposed	Buildings Exposed	% Buildings Exposed
Bucoda	245	113	46%	128	52%	145	59%
Lacey	18,985	0	0.0%	1	0.1%	1	0.1%
Olympia	18,242	0	0.0%	77	0.4%	125	0.7%
Rainier	875	0	0.0%	0	0%	0	
Tenino	751	1	0.1%	1	0.1%	1	0.1%
Tumwater	9,513	5	0.1%	16	0.1%	23	0.2%
Yelm	3,139	19	0.6%	17	0.6%	29	0.2%
Unincorporated Thurston County	53,104	515	0.9%	908	1.7%	1,069	2%
Total Planning Area	104,854	653	0.6%	1,148	1.1%	1,393	1.3%

Estimates of Flood Structural and Content Damage

Hazus modeling for flood scenarios estimates there will be nearly $36 million in combined structural and content losses countywide for a 100-year flood event and over $44 million in losses countywide for a 500-year flood (Table 4.3.8). A combined 145 structures and their contents, valued over $46 million, are exposed to high groundwater flood hazards (Tables 4.3.9 and 4.3.10).

Table 4.3.8 Thurston County Estimated Value of Flood Structural and Content Damage for 50-, 100-, and 500-Year Special Flood Hazard Areas

	50-Year Flood		100-Year Flood		500-Year Flood	
Jurisdiction	Structure Damage Value	Contents Damage Value	Structure Damage Value	Contents Damage Value	Structure Damage Value	Contents Damage Value
Bucoda	$123,924	$86,399	$223,241	$177,927	$1,351,160	$1,449,167
Lacey	$0	$0	$0	$0	$0	$0
Olympia	$0	$0	$2,656,715	$5,873,652	$2,900,374	$6,684,489
Rainier	$0	$0	$0	$0	$0	$0
Tenino	$30,450	$17,164	$37,083	$20,770	$53,044	$29,308
Tumwater	$0	$0	$42,427	$81,452	$54,419	$2,027,259
Yelm	$11,938	$4,793	$16,783	$6,123	$64,075	$56,956
Unincorporated Thurston County	$7,249,832	$8,084,559	$12,928,749	$13,865,202	$13,564,185	$16,220,072
Total Planning Area	$7,416,145	$8,192,915	$15,904,998	$20,025,126	$17,987,258	$26,467,250

Table 4.3.9 Number of Structures in the High Groundwater Flood Hazard Areas

Jurisdiction	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	61	0	0	0	0	0	0	61
Olympia	0	1	0	0	0	0	0	1
Rainier	1	0	0	0	0	0	0	1
Tenino	0	0	0	0	0	0	0	0
Tumwater	6	2	1	0	0	0	0	9
Yelm	2	0	0	0	0	0	0	2
Unincorporated Thurston County	71	0	0	0	0	0	0	71
Total	141	3	1	0	0	0	0	145

Table 4.3.10 Value of Structures and Contents in the High Groundwater Flood Hazard Areas

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building and Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$63,726,655	0	$0	0.0%
Lacey	18,985	17,637	$17,357,526,547	61	$11,420,250	0.1%
Olympia	18,242	16,257	$19,116,213,011	1	$804,710	0.0%
Rainier	875	814	$393,003,023	1	$86,917	0.0%
Tenino	751	651	$404,778,123	0	$0	0.0%
Tumwater	9,513	8,408	$9,362,171,728	9	$3,831,565	0.0%
Yelm	3,139	2,827	$2,077,637,133	2	$650,731	0.0%
Unincorporated	53,104	51,429	$24,765,596,428	71	$29,687,929	0.1%
Total Planning Area	104,854	98,260	$73,540,652,648	141	$46,482,102	0.1%

Estimates of Flood Damage Structural Debris

Flood Hazus modeling estimates the tons of structural debris that will be generated by major flood events. Countywide, a 100-year flood will produce over 15,400 tons of debris and a 500-year flood will generate over 16,500 tons. Table 4.3.11 shows estimated debris generation for each flood scenario by jurisdiction.

Table 4.3.11 Thurston County Estimated Flood Structure Debris for 50-, 100-, and 500-Year Special Flood Hazard Areas

	Structure Debris (tons)		
Jurisdiction	50-Year Flood	100-Year Flood	500-Year Flood
Bucoda	400	458	731
Lacey	0	143	216
Olympia	0	1,833	1,840
Rainier	0	1	1
Tenino	60	63	148
Tumwater	608	738	995
Yelm	336	369	441
Unincorporated Thurston County	7,471	11,867	12,211
Total Planning Area	8,876	15,472	16,583

Estimates of Lifeline Exposure

Over 1,200 community lifeline assets were evaluated for exposure to flood hazards. Estimates of flood damage are calculated by the Hazus model. The Hazus flood model scenarios provide estimates of the level of damage that facilities would experience for each jurisdiction. Tables 4.3.12 through 4.3.17 show lifeline estimates for each flood scenario. High groundwater flood exposure analysis reveals a stormwater facility in Lacey is within a high groundwater flood hazard area.

Table 4.3.12 Community Lifelines located in the 50-Year Special Flood Hazard Area

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	2	0	0	1	0	3
Lacey	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	1	0	0	1	2
Unincorporated Thurston County	0	1	4	0	0	2	14	21
Total Planning Area	0	1	6	1	0	3	15	26

Table 4.3.13 Damage Estimates of Community Lifelines for a 50-Year Flood Event

Lifelines	Number of Facilities Affected	Average % of Total Value Damaged	
		Structure	Content
Safety and Security	1	5.5%	10.2%
Food, Water and Sheltering	1	8.6%	22.0%
Health and Medical	0	N/A	N/A
Energy	1	0.2 %	0.00
Communications	0	N/A	N/A
Transportation	1	1.3%	N/A
Hazardous Material	1	N/A	N/A
Total/Average	5	3.9%	10.7%

Table 4.3.14 Community Lifelines located in the 100-Year Special Flood Hazard Area

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	3	0	0	2	0	5
Lacey	0	0	0	0	0	0	0	0
Olympia	4	0	1	0	3	0	4	12
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	1	1
Unincorporated Thurston County	0	3	4	0	0	2	14	23
Total Planning Area	4	3	8	0	3	4	19	41

Table 4.3.15 Damage Estimates of Community Lifelines for a 100-Year Flood Event

Lifelines	Number of Facilities Affected	Average % of Total Value Damaged	
		Structure	Content
Safety and Security	2	5.9%	22.5%
Food, Water and Sheltering	1	8.6%	21.0%
Health and Medical	1	5.8%	16.7%
Energy	1	19.6%	27.7%
Communications	1	1.1%	5.0%
Transportation	1	2.5%	N/A
Hazardous Material	0	N/A	N/A
Total/Average	7	7.2%	18.6%

Table 4.3.16 Community Lifelines located in the 500-Year Special Flood Hazard Area

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	3	0	0	3	0	6
Lacey	0	0	0	0	0	0	0	0
Olympia	4	1	2	0	4	0	8	19
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	3	0	0	0	0	3
Yelm	0	0	0	0	0	0	1	1
Unincorporated Thurston County	0	3	4	0	0	2	14	23
Total Planning Area	4	4	12	0	4	5	23	52

Table 4.3.17 Damage Estimates of Community Lifelines for a 500-Year Flood Event

Lifelines	Number of Facilities Affected	Average % of Total Value Damaged Structure	Content
Safety and Security	2	8.6%	33.5%
Food, Water and Sheltering	1	6.0%	18.0%
Health and Medical	2	5.8%	16.7%
Energy	1	20.2%	28.7%
Communications	1	1.1%	5.0%
Transportation	1	2.5%	N/A
Hazardous Material	1	N/A	N/A
Total/Average	9	7.4%	20.4%

Impacts to Natural, Cultural, and Historic Resources

Flooding can impact the environment in negative ways — especially when human development is factored in. Migrating fish can wash over streambanks and dikes and into flooded roads and fields. Oily road runoff and hazardous materials can be swept up by flood waters and then wash into waterways and seep into farm fields. Bridge abutments can exacerbate streambank erosion and cause rivers to migrate into non-natural courses.

Many species of mammals, birds, reptiles, amphibians and fish are dependent upon such riparian streambanks, as well as streams, wetlands and marshes — which, collectively, provide important ecosystem services beyond habitat. Changes in hydrologic conditions, as well as human disturbance of riparian areas, can alter the plant community and thus reduce vital access to food, shelter and water.

Mammals depend upon a supply of water to survive. Riparian communities have a greater diversity and structure of vegetation than other upland areas.

Despite the many adverse impacts from floods, river flooding is a natural process that can also benefit a variety of wildlife and natural resources. Flood waters can force rivers to change their course. The natural processes of erosion, stream braiding, sediment deposits, and channel migration are critical to the long-term viability of fish and wildlife habitat. The formation of oxbow lakes provides important habitat to amphibians, birds, mammals, and fish. Deposits of gravel and sediments can foster the growth of alders, willows, and other vegetation and establish new riparian habitat. Trees that fall into rivers from bank erosion can entangle with other trees and coarse woody debris to form fish habitat. The deposition of upland sediments onto floodplains enhances the fertility of valley floors and further supports agriculture.

Protection of biological resources is very important to Thurston County communities. Equipped with planning tools and data, the region is establishing a diverse inventory of preserve areas that maintain the natural and beneficial functions of the floodplain. This is occurring through proactive land use regulations, and property acquisitions that are identifying critical habitat to be preserved. The combination of these two tools is resulting in a floodplain that is predominantly free of high-density development.

Impacts to Activities

Major flooding disrupts daily routines for areas of the region that are affected. Floods close schools, businesses, and other public and private sector services located in affected areas. Flood waters can impact all surface transportation modes and impact all trip types. Closures to I-5 and State Route 12 create major disruptions to the movement of freight, people, goods, and services. Transportation disruptions have significant impacts on the economy.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.4.4 shows assets in Thurston County that are located in the 100-year special flood hazard area with census tract social vulnerability ratings.

The Federal Emergency Management Agency National Risk Index (NRI) for flood in Thurston County is 17.3 (very low). The rating represents a community's relative risk for flood when compared to the rest of the United States. For comparison, Pierce County's NRI for flood is 46.2 (relatively low). The NRI reports an estimated flood hazard annual loss of $53,000 for Thurston County.

Community Hazard Risk Ratings for Special Flood Hazard Area Scenarios and High Groundwater Flood Hazard Areas

The countywide 50-, 100-, and 500-year flood risk are medium, medium, and low, respectively. All special purpose districts' risk ratings for each flood scenario are a low rating. Tables 4.3.18 and 4.3.19 show community and special purpose special flood hazard area risk ratings. Tables 4.3.20 and 4.3.21 show high groundwater flood hazard risk ratings. The details of the flood hazard risk assessment calculations are shown in Appendix C.

Table 4.3.18 Community Hazard Risk Ratings for 50-, 100-, and 500-Year Special Flood Hazard Areas

Municipal Plan Participants	50-Year Flood Risk Ranking Score	50-Year Flood Risk Rating	100-Year Flood Risk Ranking Score	100-Year Flood Risk Rating	500-Year Flood Risk Ranking Score	500-Year Flood Risk Rating
Bucoda	48	High	48	High	32	Medium
Lacey	0	Low	0	Low	0	Low
Olympia	0	Low	0	Low	12	Low
Rainier	0	Low	0	Low	0	Low
Tenino	18	Medium	18	Medium	12	Low
Tumwater	15	Low	15	Low	12	Low
Yelm	15	Low	15	Low	10	Low
Unincorporated Thurston County	18	Medium	18	Medium	12	Low
Total Planning Area	18	Medium	18	Medium	12	Low

Table 4.3.19 Special Purpose District Hazard Risk Ratings 50-, 100-, and 500-Year Special Flood Hazard Areas

Special Purpose District Plan Participants	Cascadia M9.3 Risk Ranking Score	Cascadia M9.3 Risk Ranking Score	Nisqually M7.2 Risk Ranking Score	Nisqually M7.2 Risk Rating	Seattle M7.2 Risk Ranking Score	Seattle M7.2 Risk Rating
East Olympia Fire District	9	Low	9	Low	6	Low
Intercity Transit	0	Low	0	Low	0	Low
Lacey Fire District	9	Low	9	Low	6	Low
McLane Black Lake Fire District	0	Low	9	Low	6	Low
Olympia School District	0	Low	9	Low	6	Low
SE Thurston Fire Authority	9	Low	9	Low	6	Low
South Bay Fire District	0	Low	9	Low	6	Low
The Evergreen State College	0	Low	0	Low	0	Low
Thurston PUD	18	Medium	15	Low	12	Low
West Thurston Regional Fire Authority	9	Low	9	Low	6	Low

Table 4.3.20 Community High Groundwater Flooding Hazard Risk Ratings

Municipal Plan Participants	Sea Level Rise Hazard Risk Ranking Score	Risk Rating
Bucoda	0	Low
Lacey	12	Low
Olympia	0	Low
Rainier	10	Low
Tenino	0	Low
Tumwater	12	Low
Yelm	10	Low
Unincorporated Thurston County	12	Low
Total Planning Area	12	Low

Table 4.3.21 Special Purpose District High Groundwater Flooding Hazard Risk Ratings

Special Purpose District Plan Participants	Sea Level Rise Hazard Risk Ranking Score	Risk Rating
East Olympia Fire District	6	Low
Intercity Transit	0	Low
Lacey Fire District	6	Low
McLane Black Lake Fire District	6	Low
Olympia School District	6	Low
SE Thurston Fire Authority	6	Low
South Bay Fire District	6	Low
The Evergreen State College	0	Low
Thurston PUD	6	Low
West Thurston Regional Fire Authority	6	Low

Changes in Flood Hazard Risks Since Last Plan Update

A different methodology was used to estimate hazard risks and the vulnerability of community assets since the plan was last updated. It is not possible to perform a regional assessment of any changes in flood hazard risks since the previous plan was adopted.

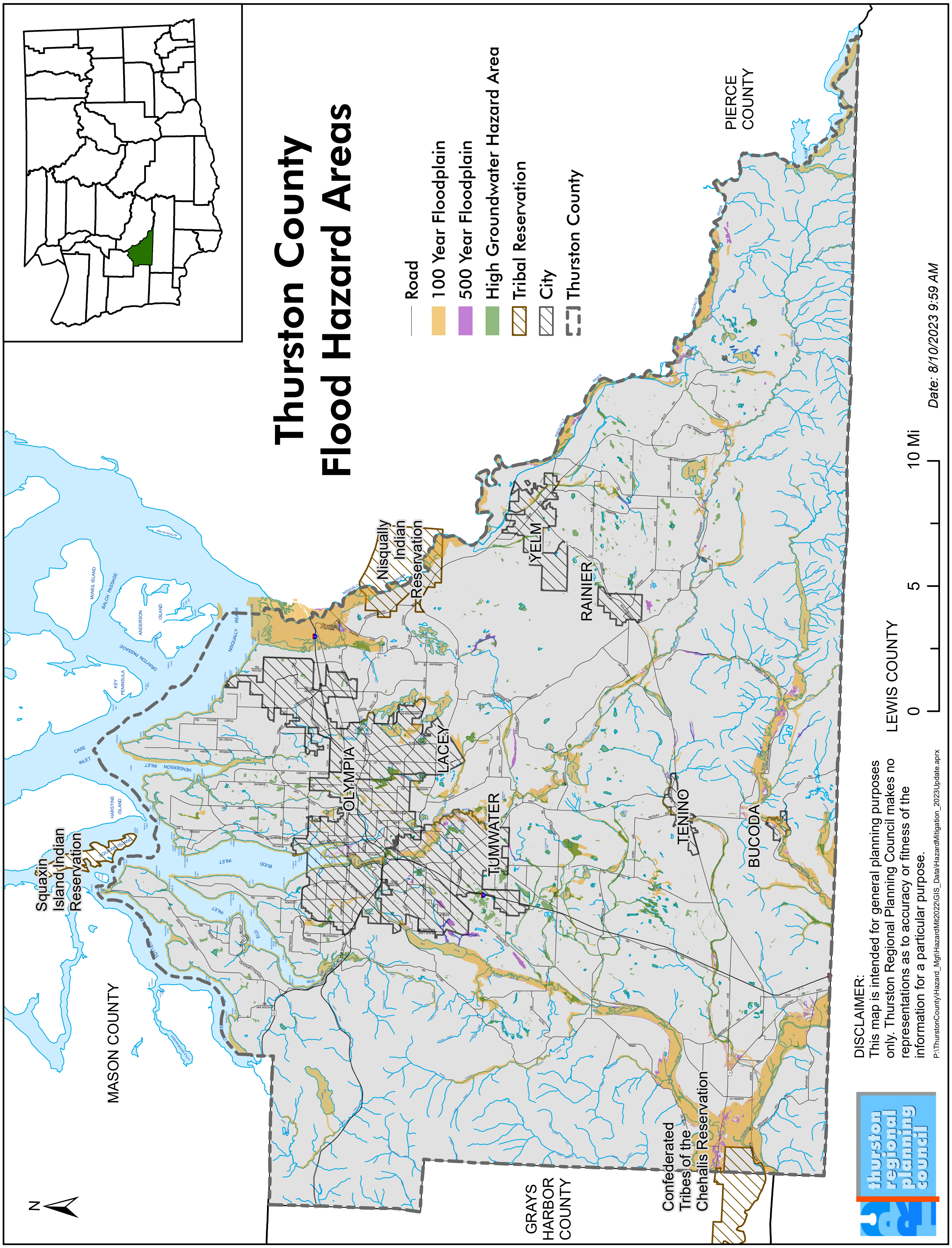
Addressing Flood Risk in the Regional Mitigation Strategy

Flood risk is a high concern for Thurston County due to the frequency of flood incidents and the history of federal disaster declarations. Thurston County is a Class 2 National Flood Insurance Program Community Rating System (CRS) Participant. Within the CRS Program, Thurston County maintains and updates a separate Flood Hazard Mitigation Plan.

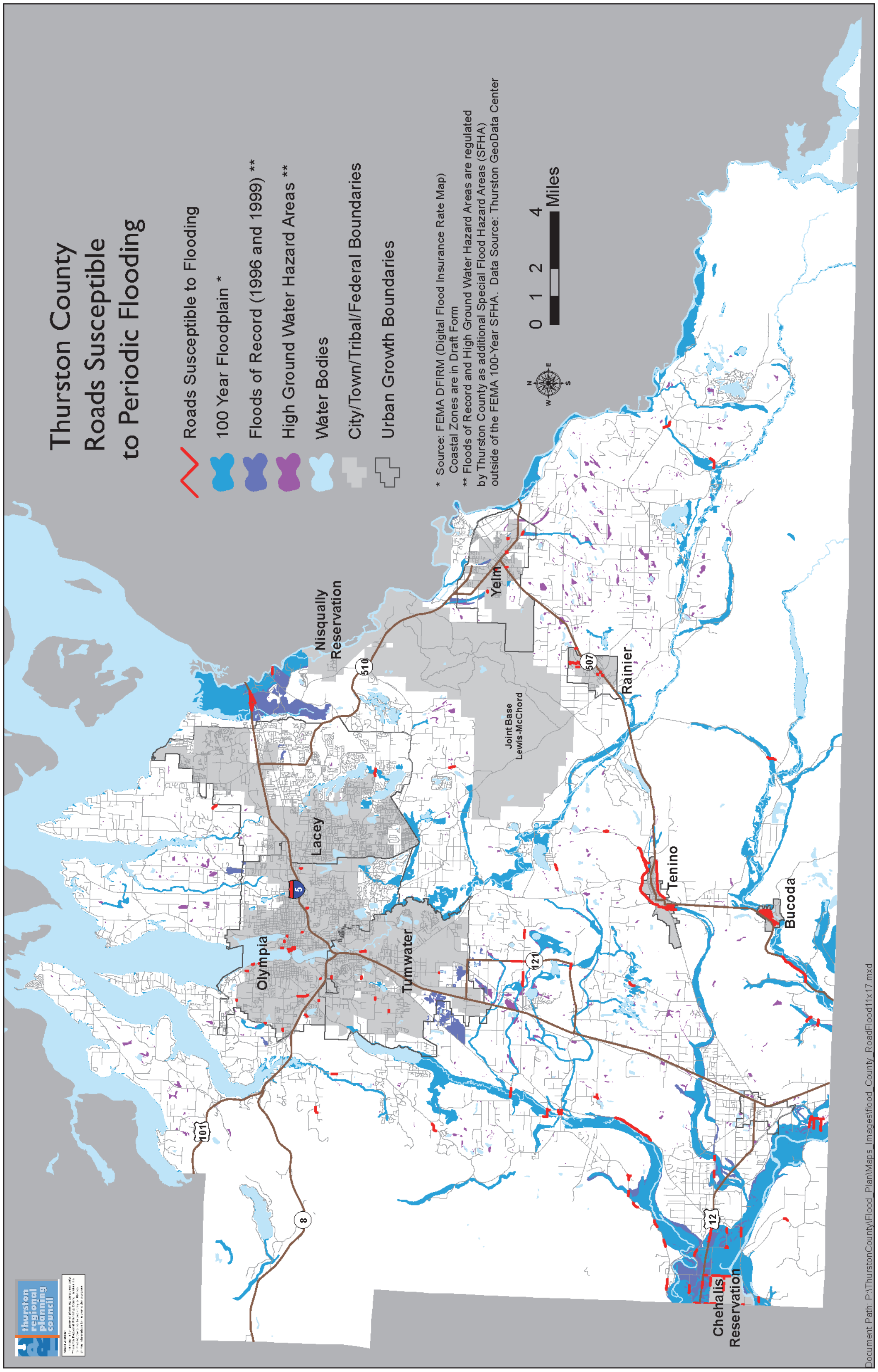
The 2022 "Thurston County Communities Natural Hazards and Resiliency Survey" region wide and unincorporated county results both show that respondents ranked flood as the sixth highest-rated hazard of concern. Although floods have caused more damage and have displaced more residents than any other hazard, survey respondents rank concerns about flood hazards as relatively low. Flood hazard education and preparedness for community residents remains a high priority. Flood hazard information will be included through Regional Hazard Mitigation Public Outreach Strategy initiative including the annual Fall Flood Bulletin.

The region's planning partners recognize that more work is necessary to broaden the inventory and documentation of the location, characteristics, and vulnerabilities of the region's lifelines and critical infrastructure. To this end, the Critical Infrastructure Inventory initiative will help inform and prioritize investments in strengthening communities' vital assets. The Hazard Modeling and Loss Estimation Capacity Building initiative will build local knowledge and technical skills to develop, operate, and maintain community-specific GIS-based hazard modeling tools that include local data. Local modeling tools can inform planning and decision making for hazard mitigation, emergency management, disaster recovery, and training. The Lifeline Transportation Resiliency Plan initiative will identify priority transportation projects to strengthen bridges, roads, and other multimodal transportation assets so they are less prone to floodwater inundation and closures.

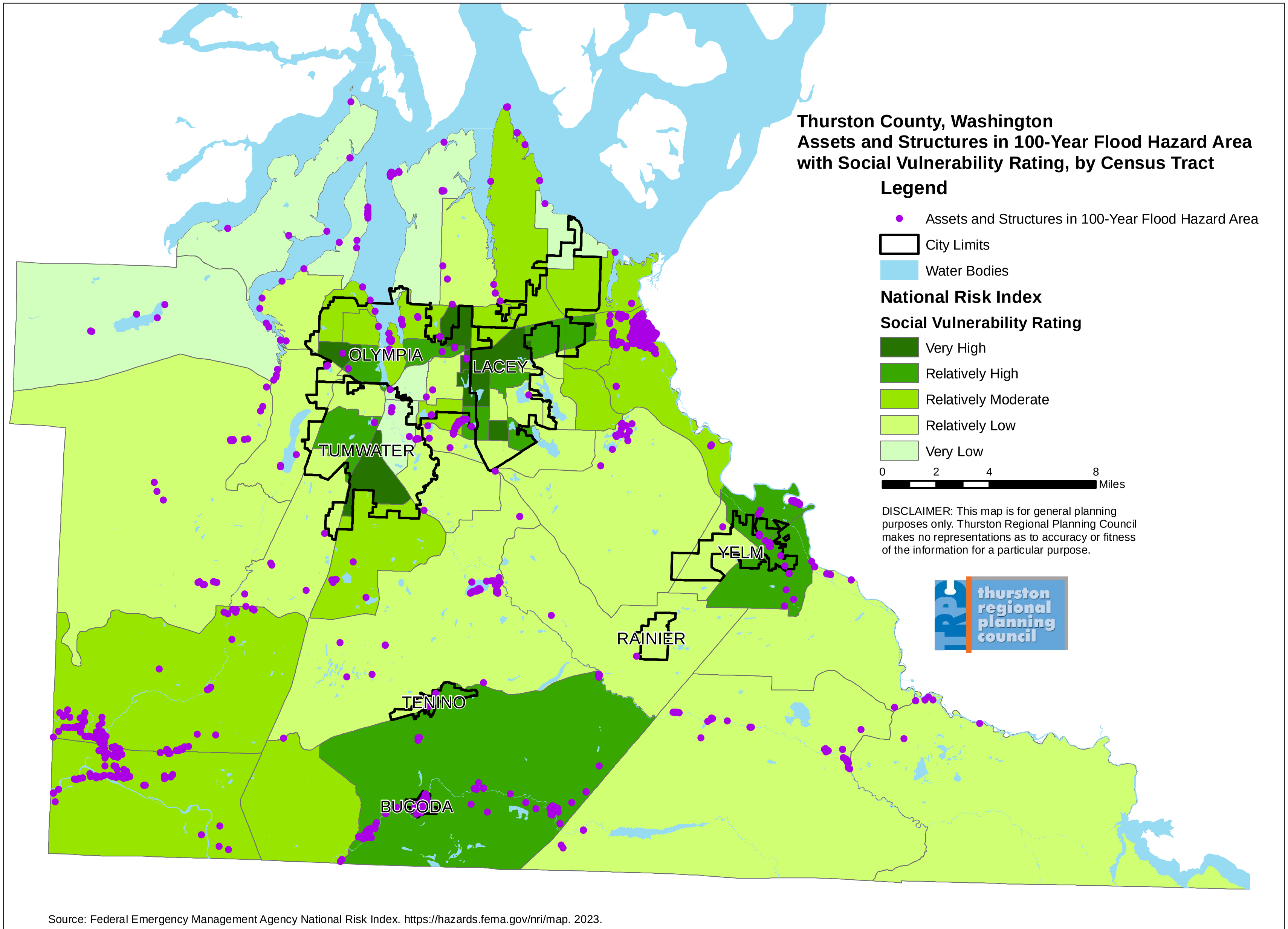
Map 4.3.2 Flood Hazard Areas of Thurston County



Map 4.3.3 Thurston County Region Roads Susceptible to Flood Inundation



Map 4.3.4 Exposed Assets and Structures in the 100-Year Special Flood Hazard Areas and Thurston County Social Vulnerability Index Rating by Census Tract



Source: Federal Emergency Management Agency National Risk Index. https://hazards.fema.gov/nri/map. 2023.

Endnotes

[1]Thurston County Water and Waste Management. 2017. Unpublished Data, Courtesy of Mark Biever, Thurston County Environmental Monitoring Program Supervisor

[2]Thurston County Emergency Management. 2017. River Flood Stage Levels. http://www.co.thurston.wa.us/em/Rivers/Rivers.htm

[3]Thurston County. 2013. Thurston County Flood Hazard Mitigation Plan.

[4]Ibid

[5]United States Geological Survey. 2023. National Water Information System: Web Interface, USGS Water Data for Washington, Surface Water Data. http://waterdata.usgs.gov/wa/nwis/

[6]Tacoma Power. 2016. Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862

[7]Contributed by Nadine Romero, Hydrogeologist, Thurston County Environmental Health. April 22, 2009.

[8]Parametrix. 2003. Scatter Creek Habitat Conservation Plan and Associated Reports. Prepared for Thurston Conservation District.

[9]Thurston County Development Services. 2009. Unpublished Data, Thurston County Flood of Record Reference

Monument Locations. Courtesy of Joe Butler.

[10]TransAlta Centralia Generation LLC. 2007. Emergency Action Plan: Skookumchuck Hydroelectric Project FERC Project No. 4441 NATDAM No. WA00153. Revision H, December 2007.

[11]Contributed by Mark Biever, Environmental Monitoring Program Supervisor, Thurston County Water and Waste

Management. April 29, 2009.

[12]Ibid

[13]Thurston County. 2004. Salmon Creek Comprehensive Drainage Basin Plan.

[14]Mauger, G.S., et.al. 2015. State of Knowledge: Climate Change in Puget Sound. Report prepared for the Puget Sound Partnership and the National Oceanic and Atmospheric Administration. Climate Impacts Group, University of Washington, Seattle.

[15]University of Washington Climate Impacts Group. 2023. Climate Mapping for a Resilient Washington: a Web Application for Climate Resilience Planning in Washington. https://cig.uw.edu/resources/analysis-tools/climate-mapping-for-a-resilient-washington/.

[16]Thurston County. 2022. Emergency Coordination Center Archive of Situation Reports, Public Assistance Damage Assessments, and Individual Assistance Requests. On file with Thurston County Emergency Management.

[17]Washington State Govenor’s Office. 2020. Washington State Request for Major Disaster Declaration for the January 20-Februay 10, 2020 Severe Winter Storm and Flooding Events.

[18]Thurston County Emergency Management. 2007. Supplemental Justification Report. December 2-7, 2007 Severe

Storm.

[19]Washington State Department of Transportation. 2008. Storm-Related Closures of I-5 and I-90: Freight Transportation Economic Impact Assessment Report Winter 2007-2008.

[20]Personal Communication with Andy Haub, Planning and Engineering Manager, City of Olympia Public Works, Water Resources on September 29, 2008.

Chapter 4.4
Landslide Hazard Risk Assessment

Introduction

Washington State is prone to landslides. On March 22, 2014, the deadliest landslide in U.S. history occurred two miles east of Oso in Snohomish County along State Route 530. Higher than normal rainfall and other factors contributed to the collapse of a portion of an unstable slope, north of the Stillaguamish River, generating an unprecedented debris-avalanche flow that crossed the river and covered nearly one-half square mile. The landslide killed 43 people and buried over 40 homes and other structures in a rural neighborhood known as Steelhead Haven.

The United States Geological Survey (USGS) estimated that the area overrun by the landslide moved 18 million tons of sand, till, and clay – enough material to cover approximately 600 football fields 10 feet deep. The landslide was believed to have reached an average speed of 40 miles per hour. Countless citizens and local, state, and federal personnel including staff from Thurston County Emergency Management assisted Snohomish County during the recovery.

Definition

A landslide is the movement of rock, soil, or other debris down a slope. In general, the term landslide covers a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly saturates the ground from precipitation or a sudden influx of water that destabilizes the ground. As materials give way to gravity and move down a slope, a flowing river of mud or "slurry" can reach avalanche speeds and grows as it picks up trees, rocks, and other materials along the way.

Area of Impact

For the purposes of the hazard risk assessment, the landslide hazard area in Thurston County is defined as a combination of the following areas (see map 4.4.1):

1. Areas with slopes that are 40 percent or greater (slope was calculated using light detection and ranging or LIDAR using GIS); and
2. Washington State Department of Natural Resources mapped known and historic landslides database.

General building stock and critical facilities and known property replacement cost values were overlaid with the landslide hazard area. Using GIS, population exposure, building exposure, and dollar-value estimates of damage were generated to characterize a hazard risk rating (see Impacts and Vulnerabilities).

The Washington State Department of Natural Resources Geological Survey has mapped shallow and deep-seated landslide occurrences and landslide landforms along the entire Thurston County marine shoreline zone and the shorelines of Capitol Lake. Though useful, the data is not a comprehensive summary of all landslide events and hazards for Thurston County. Geologists mapped data based on interpretation of aerial photos, LiDAR data, topography, and field visits. This information is useful as a reconnaissance-level screening tool, but it is no substitute for a site-specific evaluation of geological conditions.

GIS exposure analysis shows that most of Thurston County's marine shoreline is vulnerable to landslides (Map 4.4.1), especially near bluffs.1, [2] Residences near steep slopes are potentially at risk for landslide hazards in the following areas: Totten Inlet, Carlyon Beach, Hunter Point, Eld Inlet, Budd Inlet, Henderson Inlet, Nisqually Reach, Summit Lake, Capitol Lake, Lake St. Claire, and Clear Lake.

Extent

Extreme winter precipitation such as heavy rain or rain following heavy snow produces most landslides. Landslides are also triggered by earthquakes and volcanoes. However, a landform's stability can be compromised by construction of buildings, roads and other infrastructure, and other activities such as logging and mining.

Severity can be measured in total cost of damages, impacts to transportation or utility systems, displaced households, or in terms of injuries and fatalities. The landslides on Steamboat Island Peninsula in winter 1998-1999 – the most damaging landslide recorded in Thurston County's history – cost $24 million in damages and response and recovery costs. This slow-moving landslide caused no serious injuries or deaths, but many residents in the densely developed Carlyon Beach community lost their homes. This incident did not impact the region's residents outside the affected area, but Thurston County staff, other emergency management personnel, and local area residents were significantly impacted by their losses.

The severity of a landslide can also be measured in terms of its size and composition: from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. 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 amount of saturation with water.

Factors that Contribute to Landslides

Landslides are caused by a variety of factors including:

- Earthquake induced stressors
- Erosion caused by rivers, glaciers, or ocean waves
- Human activity can drastically modify landforms and groundwater conditions – development activities with poor drainage control, cutting, filling, and grading along roads, logging practices that remove timber from steep slopes, and leaking pipes
- Hydrologic factors – Abundant rain, high water tables, little or no ground cover
- Increase of lateral pressures – Hydraulic pressures, tree roots, crystallization, swelling of clay soil
- Load - Weight of rain/snow, fills, vegetation, stockpiling of rock or ore from waste piles or from human-made structures
- Regional tilting – geological movements
- Volcanic eruptions

Landslide prediction is difficult. Most Puget Sound shoreline landslides occur from October through April, peaking December through February. The USGS has researched past shoreline landslides and rainfall levels in the Seattle area to identify when such landslides are likely to occur. One measure is a formula called the "precipitation threshold." The cumulative precipitation threshold measures precipitation over the previous 18 days and indicates when the ground is saturated enough to be susceptible to landslides. Between 3.5 and 5.3 inches exceeds this threshold.

The Washington State Department of Ecology Shorelands and Environmental Assistance Program summarizes where slides are likely to occur along marine shorelines[3] in Figure 4.4.1.

Figure 4.4.1 Areas Where Landslides Occur

Where Landslides Occur	Factors
Sites of previous landslides	Large, deep-seated slides tend to be a reactivation of existing landslide complexes. Slope stability maps can provide an excellent indication of unstable areas. A competent geological analysis can usually provide an estimate of stability of problem areas on a site. It cannot reliably provide a probability of failure or an exact map of the area to be affected.
Steep slopes	Steep slopes are typically found along shorelines where centuries of wave or river currents have eroded the toe of the slope. Most steep slopes around Puget Sound have experienced sliding in the past one or two hundred years.
Benches	Relatively level benches on an otherwise steep slope often indicate areas of past slope movement.
Sites where drainage is causing a problem	Landslides are often triggered by the failure of drainage systems. Large amounts of water flowing from driveways, roof areas, roads and other impermeable surfaces can cause slides.
Sites where certain geologic conditions exist	Landslides occur where certain combinations of soils are present. When layers of sand and gravel lie above less permeable silt and clay layers, groundwater can accumulate and zones of weakness can develop. In Puget Sound, this combination is common and widespread. Glacial outwash, often Esperance Sand or gravel overlies the fine-grained Lawton Clay or Whidbey formation.

Despite the difficulty in predicting landslides, the environment provides visual indicators of where the earth is moving. Discovering sites of prehistoric landslides is difficult, as telltale signs are often obscured by vegetation or human development. The Washington State Department of Ecology describes warning signs of earth movement[4] in Figure 4.4.2.

Figure 4.4.2 Warning Signs of Landslides

Environment	Warning Signs
Landscape	Head scarps or steep cliffs at the top of a slope Benches, scarps, and large cracks Exposed clays uplifted on the beach Hummocky and uneven terrain Trees or large blocks of clay partially buried in beach, not just drift logs
Roads, Utilities, Buildings	Sagging or taut utility lines Separation of foundation from sill plate Growing cracks in walls and window corners Broken or leaking water or sewer lines Doors not closing properly Significant cracking of concrete slabs and pavement
Vegetation	Tilted trees Curved trees Split trunks and stretched roots Large clusters of trees of similar age (often Alder)
Water	Small ponds on otherwise sloping terrain Disrupted natural drainage Unusually heavy or muddy seepage Unusual increase or decrease in flow from springs

Effects of Climate Change

Research and climate forecasts provide clear evidence that long-term climate change will have a measurable impact on the frequency of landslides. The University of Washington Climate Impacts Group published a detailed report on the state of science on climate change and its effects within the region titled, "State of Knowledge: Climate Change in the Puget Sound." The report identifies several factors that will influence landslides for communities around the Puget Sound.

Air temperatures are increasing in the Puget Sound Region. They are projected to warm rapidly during the 21st century. By mid-century, warming will be outside of the range of historical variations. Warming is projected for all seasons but will be greatest for summer. As the risk for wildfires increases with warmer drier summers, the risk for landslides could increase for steep slopes that lose their vegetation from wildfires. As a result of warmer winters, watersheds will become increasingly rain dominant and streamflow is projected to peak earlier in winter and decrease in spring and summer. Winter streamflow is projected to increase by 28 to 34 percent on average by the 2080s. For the Thurston County planning area, excess saturation of soils during warmer and wetter winters will make steep and unstable slopes vulnerable to landslides and mudslides.

Overall annual precipitation levels are forecast to remain the same, but there will be greater seasonal variation. Summers will become drier, and winters will be wetter. The frequency of the region's peak 24-hour rain events is expected to more than triple by the end of the 21st century. Such heavy storms are also expected to become more intense, with greater rainfall occurring in shorter periods of time. The region's frequency and risks for landslides is likely to increase due to the effects of more intense winter storms.

Previous Incidents

Several landslides have impacted Washington State and the Thurston County region over the last several decades. Previous incidents offer insights into the types of losses that Thurston County communities could experience in future landslide activity.

December 1-7, 2007, Severe Winter Storms, Flooding, Landslides, and Mudslides. DR-1734.

On December 3, an estimated 97 households were isolated by a complete washout of Cedar Flats Road in northwestern Thurston County. Washington State Department of Natural Resources' landslide reconnaissance found that heavy "...warm rains rapidly melted snow on the ground in Capitol State Forest, saturating soils that began to slide. Three landslides on the tributary to Swift Creek triggered three debris flows, carrying debris and sediment into Swift Creek and creating a hyper concentrated flow. By 8:30 a.m., debris appeared to have clogged the culverts where Swift Creek flows under Cedar Flats Road."[5] The clogged culverts impeded creek flow and forced the surrounding embankment under the road to wash out. By the following day, the McLane Fire Department shuttled residents who needed to move in and out on a footpath and logging road. By Thursday, the County Road Department opened a temporary one-and-a-half-mile detour route that served residents for several months until a temporary bridge was constructed. The emergency detour route construction cost nearly $135,000 and construction of the temporary and new bridge cost $891,000.

On December 3, a mudslide on Kennedy Creek Road in northwestern Thurston County destroyed the Ranch House BBQ restaurant and surrounding structures. Damage was estimated at $1 million. The owners received a $914,000 Small Business Administration loan to rebuild. Slides also caused at least two homes to be tagged as uninhabitable off Sunset Beach Road.

February 28, 2001, Nisqually Earthquake. DR-1361

The 2001 Nisqually Earthquake resulted in a landslide that wiped out the northbound lanes of U.S. Highway 101 near Mud Bay in northwest Thurston County. This landslide caused nearly

$1 million in damages. Area commuters were forced to use a 30-mile detour through the town of McCleary, causing two and one-half-mile backups through the small Grays Harbor County community.

Winter 1998 - 1999, South Puget Sound Landslides

Sixty-two inches of rain fell between November 1998 and March 1999. Several landslides occurred during this time along several south Puget Sound shorelines in north Thurston County. Landslides in Sunrise Beach, Sunset Beach, Gravelly Beach, Carlyon Beach, and Hunter Point forced many families out of their homes. County inspectors initially condemned or deemed 55 homes uninhabitable. In the end, 39 homes were condemned, and 113 properties had their values significantly reduced or zeroed by the Thurston County Assessor's Office. The northeastern corner of Carlyon Beach was the hardest hit area with thirty-seven homes declared unsafe for habitation. This landslide occurred on relatively flat to gentle sloping ground. Pencil cracks in driveways slowly expanded from inches to several feet causing slumping and subsidence, destroying the foundations of many residents' homes.

Geologists determined that the landslide – likely caused by heavy winter rains – was a reactivation of an ancient slide. The 66-acre slide caused substantial damage to the private community which maintains its own streets and water treatment system.[6]

The landslides resulted in $15 million in uninsured losses to homeowners and businesses and $9.5 million in costs to county government.[7] Despite declarations of emergency and requests for federal aid from both Thurston County and Washington State Governor Gary Locke, no Federal Disaster Declaration was issued, however Federal Small Business Administration loans were provided to some families to rebuild new homes. While some families had their mortgages dismissed, others were less fortunate.

The landslide hazard persists for the Carlyon Beach/Hunter Point area although movement has ceased. Thurston County has subsequently identified 54 parcels in this area as a designated landslide hazard area. The County's Critical Areas Ordinance prohibits substantial improvements to these properties.

February 1996, Flooding. DR 1100

On February 8, Nisqually River flooding and groundwater under heavy pressure from near record rains caused a 70-foot deep, 50-foot long, by 40-foot-wide landslide. Nearly 100 dump trucks of material disappeared into the river in the Nisqually Pines neighborhood on Thuja Avenue west of Yelm. Although no homes were destroyed, the landslide threatened area residences. Thurston County declared seven homes unsafe for occupancy.[8]

On February 10, heavy rains caused a mudslide on the steep slope below Capitol Way, just west of Carlyon Avenue. It broke two sewer lines that served nearly two-thirds of Tumwater and the Olympia Brewing Company. The mudslide also tore out 50 feet of Burlington Northern rail line. It is possible that the pipes leaked prior to heavy rains and contributed to the weakening of the slope. Before repair, the damaged pipes leaked over five million gallons of untreated wastewater into Capitol Lake. Public health notices were posted around the lake to warn residents not to touch lake waters and Tumwater residents were asked to curtail their water use until the line was repaired. Emergency repairs took nearly two weeks and cost nearly $1 million.[9]

The February floods caused nearly $2.5 million in damages to Thurston County Roads. Heavy rains triggered a landslide on a steep slope over Flumerfelt Road, southwest of Bucoda, closing the road for several months. A Burlington Northern railroad tunnel collapsed onto Durgin Road SE and a 20-foot-wide by 100-foot-deep pothole closed Old Pacific Highway just before the Nisqually River bridge.

Probability of Occurrence

Landslides occur nearly annually, with a high probability of occurrence overall for the region's planning area and for all the planning partners.

Vulnerabilities and Impacts

Impacts to People

Landslides are very dangerous. People in the direct path of a landslide could experience trauma from moving rocks, mud, or other debris and result in serious injury or death. Landslides can leave people stranded or separated from their property for prolonged periods in areas with limited road access. People who lose their homes can experience temporary or long-term displacement and housing insecurity. Loss from landslides, like other disaster events, can cause grief and mental stress. An estimated 5,732 people throughout Thurston County live in areas that are potentially at risk for landslides (Table 4.4.1).

Table 4.4.1 Thurston County Population Residing in the Potential Landslide Hazard Areas

Jurisdiction	Population	Population Exposed	% Population Exposed
Bucoda	610	0	0%
Lacey	58,180	66	0.1%
Olympia	56,370	2,434	4.3%
Rainier	2,510	12	0.5%
Tenino	2,030	3	0.1%
Tumwater	26,360	223	0.8%
Yelm	10,680	11	0.1%
Unincorporated	143,760	2,983	2.0%
Total Planning Area	300,500	5,732	1.9%

Impacts to Structures and Systems

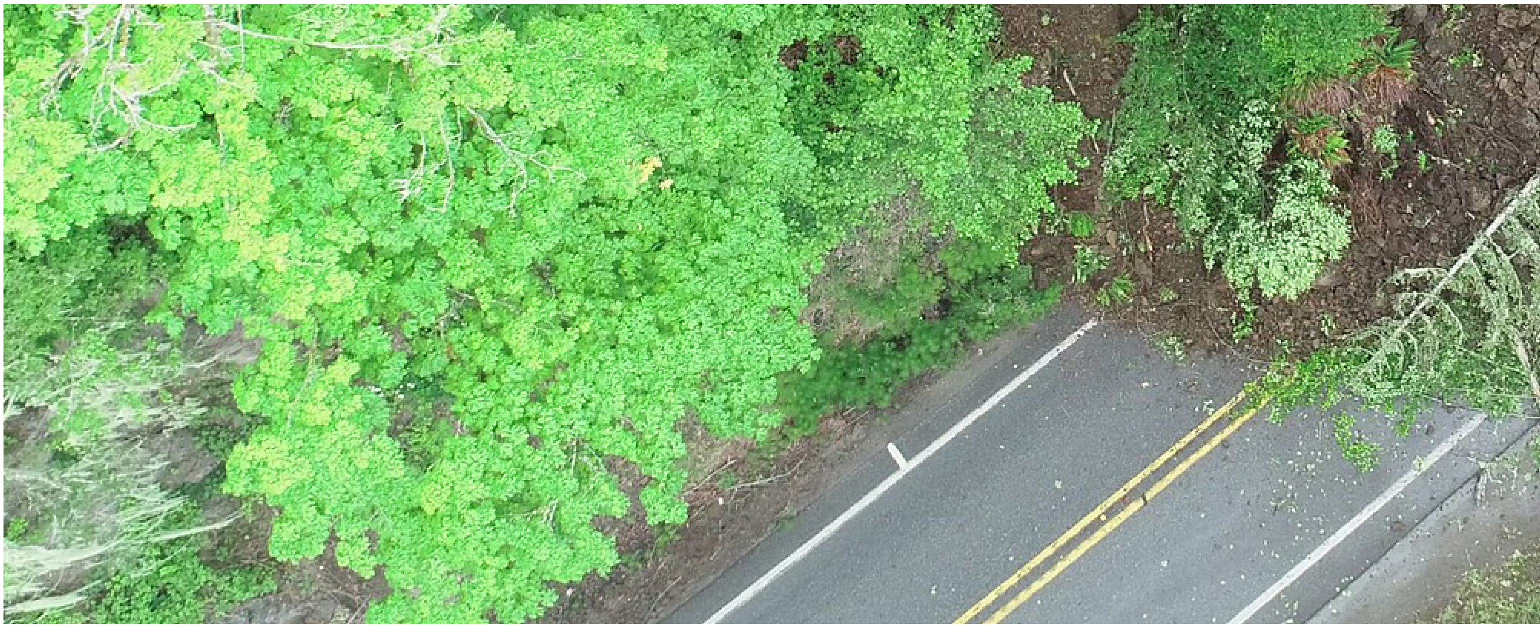
Landslides can destroy and damage structures including homes, buildings, roads, bridges, power transmission facilities, communication infrastructure, water reservoirs, sewer lines, government services, and agricultural resources. Disruptions to transportation, power, water, sewer, and communications systems can have far reaching consequences for public and private sector systems and services. There are 1,868 residential units, 179 commercial buildings, and three government facilities located in landslide hazard areas in Thurston County. In total, there are 2,050 buildings valued over $1.26 billion that are exposed to potential landslide hazard areas (Tables 4.4.2 and 4.4.3).

Table 4.4.2 Number of Structures in the Potential Landslide Hazard Areas

Jurisdiction	Number of Structures in Landslide Hazard Areas							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	20	0	0	0	0	0	0	20
Olympia	702	166	0	0	0	3	0	871
Rainier	4	0	0	0	0	0	0	4
Tenino	1	0	0	0	0	0	0	1
Tumwater	71	3	0	0	0	0	0	74
Yelm	3	0	0	0	0	0	0	3
Unincorporated	1,067	10	0	0	0	0	0	1,077
Total	**1,868**	**179**	**0**	**0**	**0**	**3**	**0**	**2,050**

Table 4.4.3 Value of Structures and Contents in the Potential Landslide Hazard Areas

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building & Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$63,726,655	0	$0	0.0%
Lacey	18,985	17,637	$17,357,526,547	20	$9,257,909	0.1%
Olympia	18,242	16,257	$19,116,213,011	871	$775,469,886	4.1%
Rainier	875	814	$393,003,023	4	$1,483,443	0.4%
Tenino	751	651	$404,778,123	1	$387,095	0.1%
Tumwater	9,513	8,408	$9,362,171,728	74	$46,334,133	0.5%
Yelm	3,139	2,827	$2,077,637,133	3	$1,264,720	0.1%
Unincorporated	53,104	51,429	$24,765,596,428	1,077	$426,737,853	1.7%
Total Planning Area	**104,854**	**98,260**	**$73,540,652,648**	**2,050**	**$1,260,935,041**	**1.7%**



There are approximately 29 community lifeline assets that are located in potential landslide hazard areas (Table 4.4.4). Exposed assets include cellular towers and other communications transmission facilities, electric substations, potable water facilities, a wastewater lift station, a long-term residential care facility, a fire station, and several state highway bridges.

Table 4.4.4 Thurston County Community Lifelines located in the Potential Landslide Hazard Areas

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	1	0	0	1
Olympia	0	2	1	1	1	0	4	9
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	1	0	0	0	1
Unincorporated Thurston County	8	0	2	0	0	1	7	18
Total Planning Area	**8**	**2**	**3**	**2**	**2**	**1**	**11**	**29**

Impacts to Natural, Cultural, and Historic Resources

Landslides occur in undeveloped areas along steep riverbanks and marine shorelines. Large landslides can alter the course of a river or impact fish and wildlife habitat. Loss of roads near rivers could reduce access to fishing areas. A GIS analysis of general building stock did not indicate any landslide hazard exposure for historic buildings, churches, or other structures of cultural or social significance.

Impacts to Activities

Landslides that cover or damage roads disrupt transportation. Delays in transportation impact a variety of essential and non-essential travel.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.4.2 shows assets in Thurston County that are located in potential landslide hazard areas by census tract social vulnerability ratings.

The Federal Emergency Management Agency National Risk Index (NRI) provides a Landslide Risk Index score and rating. The rating represents a community's relative risk for landslides when compared to the rest of the United States. According to the NRI, Thurston County's landslide risk index rating is "relatively moderate." The NRI reports an estimated landslide hazard annual loss of approximately $222,675.

Community Hazard Risk Ratings for the Landslide Hazard Areas

The overall countywide landslide risk ranking score is 18 – a medium risk rating. Risk rankings vary from low to medium for most jurisdictions (Tables 4.4.5 and 4.4.6 show community and special purpose landslide hazard risk ratings). The details of the landslide hazard risk assessment calculations are shown in Appendix C.

Table 4.4.5 Community Landslide Hazard Risk Ratings

Municipal Plan Participants	Landslide Hazard Risk Ranking Score	Landslide Hazard Risk Rating
Bucoda	0	Low
Lacey	18	Medium
Olympia	18	Medium
Rainier	18	Medium
Tenino	18	Medium
Tumwater	18	Medium
Yelm	18	Medium
Unincorporated Thurston County	18	Medium
Total Planning Area	**18**	**Medium**

Table 4.4.6 Special Purpose District Landslide Hazard Risk Ratings

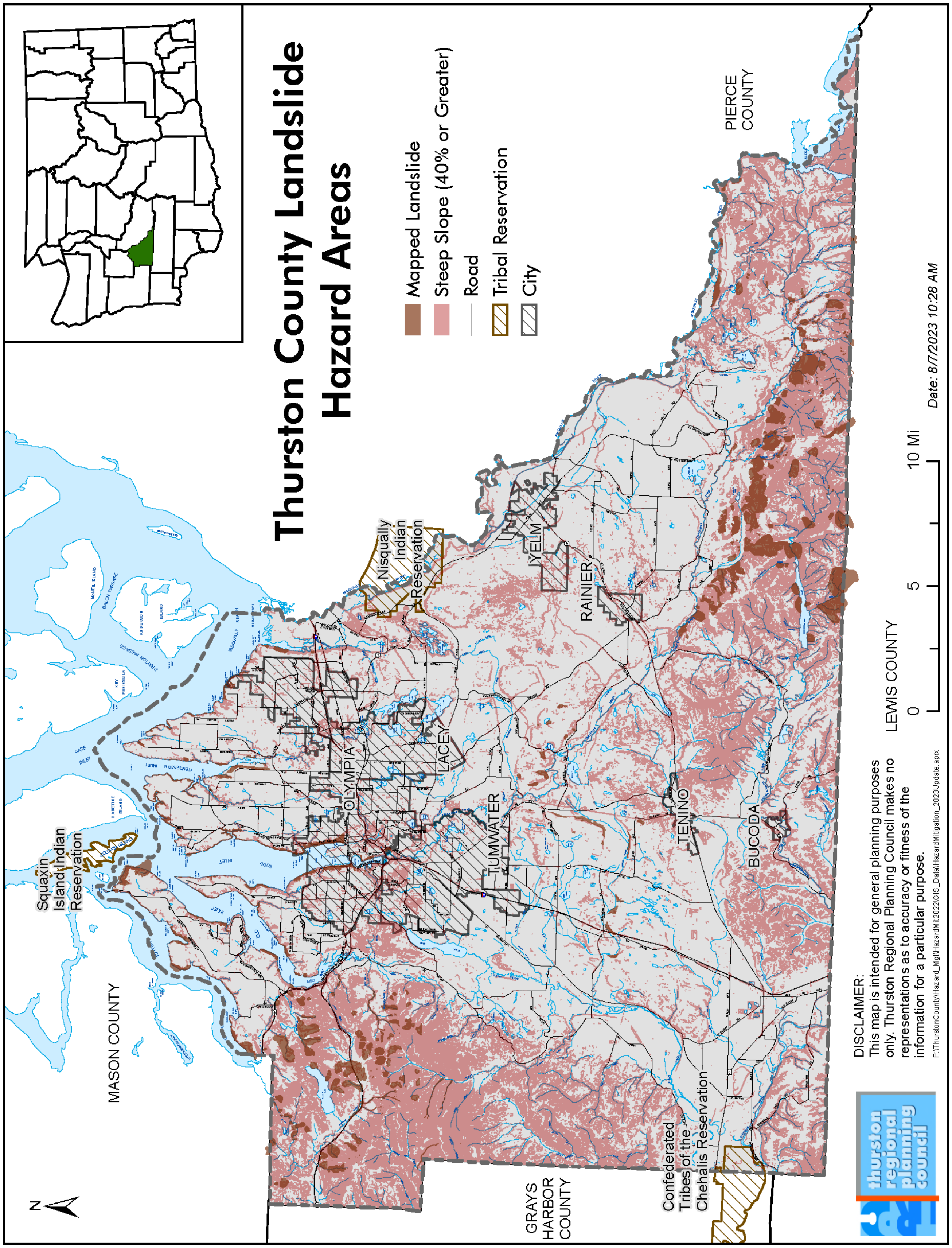
Special Purpose District Plan Participants	Landslide Hazard Risk Ranking Score	Landslide Hazard Risk Rating
East Olympia Fire District	9	Low
Intercity Transit	0	Low
Lacey Fire District	21	Medium
McLane Black Lake Fire District	9	Low
Olympia School District	0	Low
SE Thurston Fire Authority	12	Low
South Bay Fire District	9	Low
The Evergreen State College	0	Low
Thurston PUD	9	Low
West Thurston Regional Fire Authority	9	Low

Changes in Landslide Hazard Risks Since Last Plan Update

A different methodology was used to estimate hazard risks and the vulnerability of community assets since the plan was last updated. It is not possible to perform a regional assessment of any changes in landslide hazard risks since the previous plan was adopted.

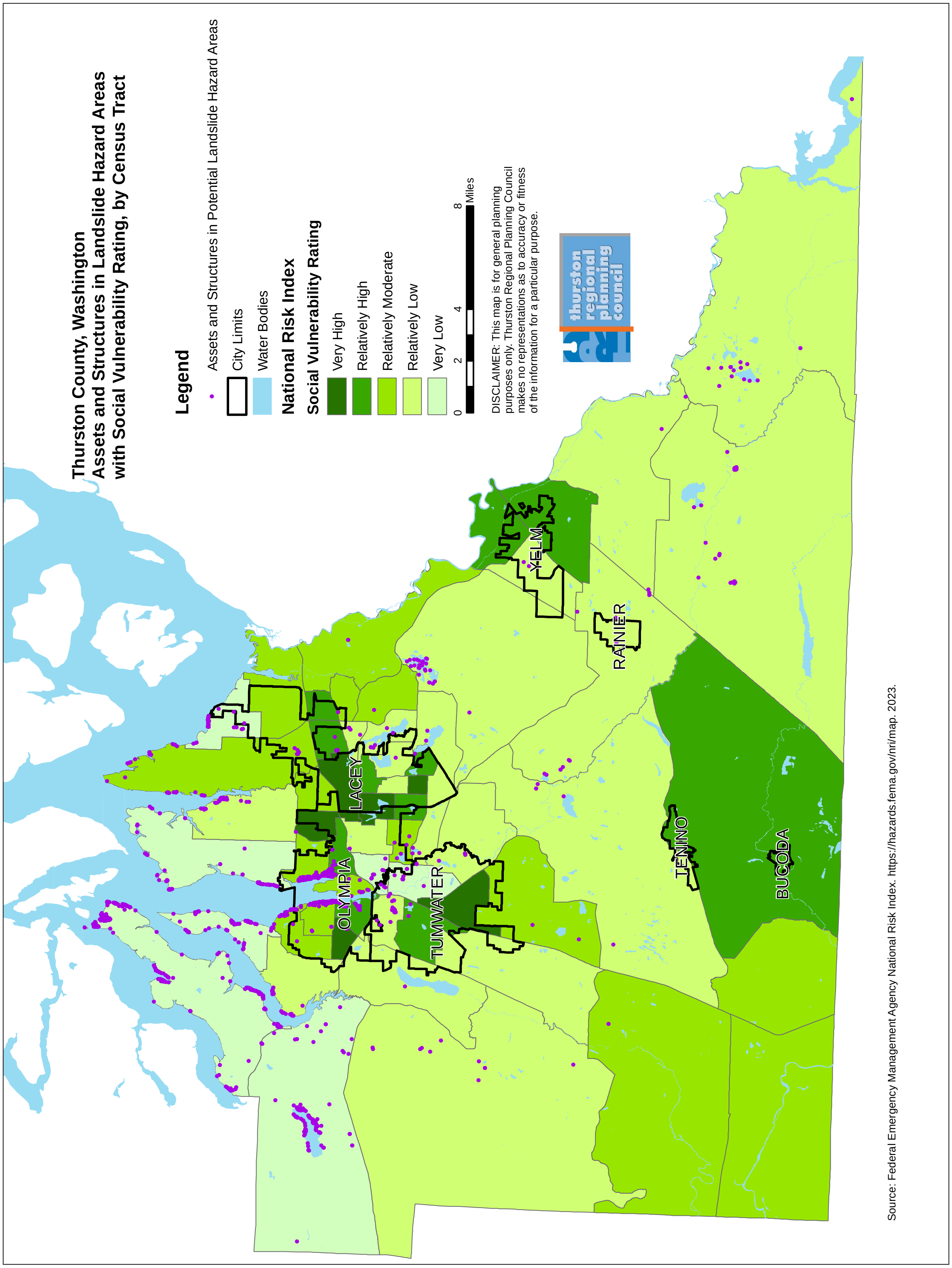
Addressing Landslide Risk in the Regional Mitigation Strategy

Local governments need more current and accurate landslide hazard mapping to improve their understanding of landslide risks. During the plan update process, the region's mitigation planning partners identified a new mitigation action to enroll in the Washington Geological Survey Landslide Hazards Program. The program will produce maps and data to assist communities with identifying landslide hazard areas, reducing potential future losses, and updating comprehensive plans, zoning codes, development regulations, and policies.



Map 4.4.1 Landslide Hazard Areas of Thurston County

Map 4.4.2 National Risk Index Landslide Annual Loss



Endnotes

[1]Michael Polentz, et al. 2008. Thurston County Marine Shore Landslides and Landforms Data. Unpublished Data. Washington Geological Survey Division on Geology and Earth Resources, Washington Department of Natural Resources.

[2]Personal Communication with Michael Polenz and Tim Walsh, Geologists, Washington Geological Survey Division on Geology and Earth Resources, Washington Department of Natural Resources. March 9, 2009.

[3]Washington State Department of Ecology. 2009 Puget Sound Landslides: Signs of Movement. http://www.ecy.wa.gov/programs/sea/landslides/signs/signs.html

[4]Ibid

[5]Washington State Department of Natural Resources. 2009. Landslide Reconnaissance Following the December 3, 2007 Storm – Thurston County.

[6]Lorrine Thompson. 2001. Struggle to Recover Continues After Slide. Published in The Olympian. February 17, 1996.

[7]Jennifer Olson. 1999. Landslide Victims Won't Get Aid. Published in The Olympian, August 27, 1999.

[8]Joel Coffidis. 1996. Nisqually Rips Yard from Homeowners. Published in The Olympian, February 17, 1996.

[9]John Dodge. 1996. Sewage Flow Into Lake Halted. Published in The Olympian, February 23, 1996.

Chapter 4.5

Sea Level Rise Hazard Risk Assessment

Introduction

Scientists project that the Puget Sound region will experience sea level rise throughout the 21st century. These changes will impact communities and the natural environment in profound ways.

The rise in global mean temperatures from human influenced climate change is increasing ocean thermal expansion and the rate of glacial melting – the primary drivers of sea level rise. Low lying coastal communities are most at risk. Coastal flooding is expected to become about 10 times more common and will impact the estimated 10 million Americans who live in areas prone to coastal flood hazards.1 Sea level rise will cause shoreline erosion, pose challenges for transportation, damage infrastructure, and endanger public health. Hazard mitigation planning for sea level rise is critical to protect public safety, community assets, and to sustain the region's overall livability and economic vitality. To this end, the City of Olympia, Port of Olympia, and the LOTT Clean Water Alliance have formed a partnership and developed an Olympia Sea Level Rise Response Plan in 2019. This response plan is a major cornerstone for assessing sea level rise vulnerabilities and adapting to and mitigating its impacts on the population, the community, and its valued assets.

Definition

Rising sea levels and land subsidence combined with coastal flooding, storm surge, and heavy rainfall will threaten Thurston County. As sea level rises, there will be an increase in the exposure and vulnerability of the population, critical infrastructure, water and wastewater treatment, trade and economic development, and natural environment. The adverse effects from sea level rise will impact communities principally by flooding, erosion, sedimentation, saltwater intrusion, and hazardous materials release.

Area of Impact

For the risk assessment, a six-inch sea level rise scenario was used to estimate vulnerabilities and potential losses. Higher sea level rise scenarios exist, but the project budget could not support multiple sea level rise analysis scenarios. A six-inch scenario is consistent with near-term sea level rise projections and is a useful mitigation planning scenario. The Olympia Sea Level Rise Response Plan includes higher sea level rise scenarios. The next five-year update to the hazard mitigation plan risk assessment will account for higher sea level rise scenarios.

The sea level rise inundation area data was generated using the effective Digital Flood Insurance Rate Map V-zone data. Using the inundation area boundary (see Map 4.5.1 Sea Level Rise Inundation Area), and 3-foot LiDAR digital elevation model data, depth grids were generated and integrated into the GIS-based natural hazards model, Hazus. General building stock and critical facilities were uploaded into the Hazus coastal flood model. By inputting depth data and known property replacement cost values, population exposure, building exposure, and dollar-value estimates of damage were generated to characterize a hazard risk rating.

Communities Most Vulnerable to Sea Level Rise

Communities and neighborhoods in low lying areas, estuaries, and the inlets of Thurston County including the Nisqually River Delta will be subject to inundation. The risk assessment GIS exposure analysis shows following communities have shorelines at risk to the six-inch sea level rise scenario:

- **Thurston County** – The entirety of the unincorporated Thurston County Puget Sound shoreline is in the sea level rise inundation area. Mud Bay and the Nisqually Delta will experience the greatest impacts.
- **City of Lacey** – approximately 3,100 feet of the north city limits of the City of Lacey near Waldron Road NE is in the inundation zone, however the shoreline is undeveloped.
- **City of Olympia** – Downtown Olympia all along Budd Inlet including the Port Peninsula, Percival Landing, portions of historic downtown, and areas around Capitol Lake will be most affected. This area is highly developed and includes critical infrastructure for the City of Olympia, Intercity Transit, the LOTT Clean Water Alliance, and Port of Olympia.
- **Griffin Fire District** – There are no district assets located in the inundation areas, however Totten Inlet and Eld Inlet shorelines are within the district's taxing boundary and service area. Sea level rise will impact routing for emergency response.
- **Griffin School District** – There are no school district assets located in the inundation areas, however student households, the district's service area, and school bus routes are within the inundation areas.

- **Intercity Transit** – The Downtown Olympia Transit Station and portions of its connecting routes are in the inundation area.
- **McLane Black Lake Fire District 9** – There are no district assets located in the inundation areas, however Cooper Point, Eld Inlet, Mud Bay, and Budd Inlet shorelines are within the district's taxing boundary and service area. Sea level rise will impact routing for emergency response.
- **Olympia School District** – There are no school district assets located in the inundation areas, however student households, its service area, and school bus routes are vulnerable.
- **South Bay Fire District 8** – There are no district assets located in the inundation areas, however sea level rise will impact routing and timing for emergency response.
- **The Evergreen State College** – Over 3,000 feet of the north campus property adjoins Eld Inlet. The shoreline is undeveloped, but it is an important learning environment and popular outdoor recreation area for students and community members alike.
- **Thurston Public Utilities District** – There are no district assets located in the inundation zone, however as a countywide district, sea level rise could pose transportation issues for accessing utilities near inundation areas.

Extent and the Effects of Climate Change

The University of Washington Climate Impacts Group (UWCIG) "State of Knowledge: Climate Change in the Puget Sound" provides an overview of projections for sea level rise conditions that will affect the Puget Sound Region and Thurston County. [2]

Local sea level variations are driven by global, regional, and local factors. The rate of sea level rise for the Puget Sound depends on how much global sea level rises. Regional wind patterns and rainfall for the Puget Sound region also influence sea level rise. Local land elevation changes, whether land is rising or subsiding due to geological or hydrological effects will also affect sea level rise. While most of Thurston County's shoreline is stable, downtown Olympia is estimated to be subsiding by 2.5 millimeters (0.9 inches) per decade. A large Cascadia Subduction Zone earthquake or inland earthquake along the Seattle, Tacoma, or Nisqually fault could also result in an abrupt increase in sea level rise due to a sudden drop in land elevation. Short-term sea-level variations can also be temporarily offset or accelerated by up to a foot in the winter as a result of natural variations in climate patterns such as El Niño or La Niña.

Observed Changes

The UWCIG documents the following observed changes in its report:

- The global average sea level rose about +8 inches from 1900-2009. During the same time the Puget Sound level rose by +8.6 inches at the Seattle tidal gauge.
- There is no evidence that there will be an increase in the frequency or severity of storm surge in the Puget Sound.
- Wave heights in the Puget Sound are driven by local winds and it is unknown how wave heights will be influence by climate change.
- There is no conclusive evidence on changes in windspeed.

Projected Changes

The following are projected changes for sea level rise conditions and impacts. Sea level rise will:

- Increase by +14 to +54 inches in the Puget Sound by 2100.
- Increase +11 to +38 inches globally by 2100 depending on the amount of 21st century greenhouse gas emissions.
- Have no change in wind speed or the strength of low-pressure systems affecting the Puget Sound region.
- Increase the potential for higher tidal/ storm surge reach and increased coastal inundation, erosion, and flooding. Small amounts of rise can shift the risk of coastal hazards in potentially harmful ways.
- Permanently inundate some low-lying areas.
- Increase the duration, extent, and depth of flooding as rivers are unable to effectively drain to the Puget Sound.
- Increase the frequency of coastal flood events. For Olympia, +6 inches of sea level rise shifts the probability of a coastal flood event from a 1% annual chance (100-year flood) to a 5.5% annual chance (1-in-18-year flood) event.
- Increase the rate of coastal bluff erosion.

Probabilistic Sea Level Rise Projections

The UWCIG provides model projections for Thurston County for a 50 percent likely and one percent likely (high) sea level rise scenarios. Tables 4.5.1 shows relative amount of sea level rise with a 50% likelihood of occurring for future decades compared to the average sea level in 1991-2009. For example, a value of 1.0 means that there is a 50% chance that the county will experience 1.0 feet of relative sea level rise. Table 4.5.2. shows the amount of sea level rise with a one percent likelihood relative to the 1991-2009 average sea level. Table 4.5.3 shows the most likely and high-range sea level rise projections for Olympia. Olympia's projections account for local subsidence that is not conveyed in the Thurston County projections.

Table 4.5.1 Thurston County Relative Sea Level Rise with 50% Likelihood (likely scenario)[3]

	Model Mean[1]	Model Range (10th to 90th percentile)
1980-2009		
Historical Baseline	n/a	n/a
2030		
Higher Scenario (RCP 8.5)	0.4 feet	0.3 to 0.4 feet
Lower Scenario (RCP 4.5)	0.4 feet	0.3 to 0.4 feet
2050		
Higher Scenario (RCP 8.5)	0.8 feet	0.8 to 0.9 feet
Lower Scenario (RCP 4.5)	0.8 feet	0.7 to 0.8 feet
2100		
Higher Scenario (RCP 8.5)	2.3 feet	2.2 to 2.4 feet
Lower Scenario (RCP 4.5)	1.8 feet	to 1.9 feet

Table 4.5.2 Thurston County Relative Sea Level Rise with 1% Likelihood (high scenario)[iii]

	Model Mean[1]	Model Range (10th to 90th percentile)
1980-2009		
Historical Baseline	n/a	n/a
2030		
Higher Scenario (RCP 8.5)	0.7 feet	0.7 to 0.8 feet
Lower Scenario (RCP 4.5)	0.7 feet	0.7 to 0.8 feet
2050		
Higher Scenario (RCP 8.5)	1.5 feet	1.4 to 1.6 feet
Lower Scenario (RCP 4.5)	1.4 feet	1.3 to 1.5 feet
2100		
Higher Scenario (RCP 8.5)	5.1 feet	5.0 to 5.2 feet
Lower Scenario (RCP 4.5)	4.4 feet	to 4.5 feet

[1]Representation Concentration Pathways, or RCPs are climate model scenarios for the 21st century. RCP 4.5 — a "low" scenario that assumes greenhouse gas emissions (GHG) stabilize by mid-century and fall sharply thereafter; and RCP 8.5 — a "high" scenario that assumes substantial GHG increases until the end of the 21st century.

Table 4.5.3 Sea Level Rise Projections for Olympia[4]

Year	Most Likely (inches)	High Range (inches)
2020	3	7
2030	5-7	11-13
2040	8-10	16-18
2050	11-13	23-25
2060	15-17	30-32
2070	18-20	37-39
2080	22-25	46-49
2090	27-31	54-58
2100	32-36	64-68

Previous Incidents

December 27, 2022. High tide and coastal flooding in Olympia5

On December 27, 2022, the high tide in Budd Inlet rose to 18.40 feet at 9:25 am and was 1.77 feet over the predicted tide of 16.33 feet. The barometric pressure during the morning bottomed out at approximately 28.6, but rose at the time of the flooding. This was the worst flooding event on record for Olympia. The previous worse record was 17.99 in 1987. During the January 7, 2022, Capitol Lake flooding event, the tide rose to approximately 17.9 feet.

Because the December 27, 2022 flood event was primarily a marine tidal flooding event, it was of short duration. As usual, flooding first occurred at Sylvester Street where it was controlled by sandbags. Marine water overtopped the shoreline in several locations including along 4th Avenue between Thurston Avenue and A Avenue and between B Avenue and Corky Avenue. Structural flooding was observed at Budd Bay Café, Capitol City Yacht Sales, Olympia Autohaus and the Row Restaurant. The storm drainage system associated with the Fiddlehead outfall was overwhelmed. Several streets were closed – 4th Avenue between Sylvester and Water Streets, Water Street between 4th Avenue and State Avenue, State Avenue between Water Street and Columbia Street.

Probability of Occurrence

Sea level rise is occurring. The probability for sea level rise impacts for communities with assets or service areas bordering the Puget Sound is high. This includes unincorporated Thurston County, the cities of Lacey and Olympia, Griffin Fire District 13, Griffin School District, Intercity Transit, McLane Black Lake Fire District 9, Olympia School District, South Bay Fire District 8, The Evergreen State College, and Thurston Public Utilities District.

Vulnerabilities and Impacts

Impacts to People

Sea level rise and storm incidents can be readily forecast and sufficient warning time can be provided to affected populations to protect property and public safety in affected areas. In general, coastal flooding exacerbated by sea level rise results in the same impacts as coastal and other types of flooding. Without effective mitigation measures, sea-level rise induced coastal flooding, inundation, or landslides can damage or destroy homes making them uninhabitable. People will suffer personal property losses and could be displaced for prolonged periods. Residential wells located in the inundation areas could become contaminated from frequent saltwater intrusion or hazardous materials from nearby industrial areas.

An estimated 375 people in unincorporated Thurston County and 114 people in Olympia reside in the six-inch sea level rise inundation area and are at risk from sea level rise hazards (Table 4.5.4).

Table 4.5.4 Thurston County Population Residing in the Six-Inch Sea Level Rise Inundation Area

Jurisdiction	Population	Population Exposed	% Population Exposed
Bucoda	610	0	0%
Lacey	58,180	0	0%
Olympia	56,370	114	0.2%
Rainier	2,510	0	0%
Tenino	2,030	0	0%
Tumwater	26,360	0	0%
Yelm	10,680	0	0%
Unincorporated Thurston County	143,760	375	0.3%
Total Planning Area	**300,500**	**489**	**0.2%**

Impacts to Structures and Systems

Sea level rise will inundate and impact low lying roads and bridges causing damage to infrastructure. Transportation impacts are disruptive to a community’s economy and overall quality of life. Delay will impact transportation across all sectors and trip purposes including personal travel, commutes to work and school, public transit, emergency services, and the movement of freight, goods, and services.

Coastal flooding and inundation could disrupt the availability of electricity, water, and communications. The long-term operations for the Port of Olympia Marine Terminal will need to adapt and mitigate the effects of sea level rise to remain a viable shipping and freight facility for the region. Other Port of Olympia properties including the cargo yard, Warehouse A, Port Plaza, and the Farmers Market are likely to be inundated and impact operations and business.

The LOTT Clean Water Alliance Budd Inlet Treatment Plant is vulnerable due to its low elevation location on the Downtown Olympia Port Peninsula. Without effective mitigation measures, coastal flooding could impact the safe operation of the facility. An overland flow of water from Budd Inlet or Capitol Lake entering the city's combined sewer/stormwater system will overwhelm the capacity of the plant which in turn could result in the discharge of untreated hazardous sewage and further contaminate marine and freshwater bodies and other areas of the community.

There are an estimated 167 residential, 102 commercial, 3 industrial, and 4 government buildings in the region that are in the six-inch sea level rise inundation area. In total, there are 276 buildings valued over $40 million that are potentially at risk to sea level rise hazards (Tables 4.5.6 and 4.5.7).

There are an estimated 14 community lifeline assets located in the sea level rise inundation area (Table 4.5.8). Exposed assets include a 911 radio facility, an electric substation, wastewater facilities, the Cascade Pole site, the Olympia Family Support Center, the Olympia Center, Swantown Boatworks, and six state highway bridges.

Table 4.5.6 Number of Structures in the Six-Inch Sea Level Rise Inundation Area

	Number of Structures in Sea Level Rise Inundation Areas							
Jurisdiction	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	**0**
Lacey	0	0	0	0	0	0	0	**0**
Olympia	33	83	3	0	0	3	0	**122**
Rainier	0	0	0	0	0	0	0	**0**
Tenino	0	0	0	0	0	0	0	**0**
Tumwater	0	3	0	0	0	0	0	**0**
Yelm	0	0	0	0	0	0	0	**0**
Unincorporated Thurston County	134	19	0	0	0	1	0	**154**
Total	**167**	**102**	**3**	**0**	**0**	**4**	**0**	**276**

Table 4.5.7 Value of Structures and Contents in the Six-Inch Sea Level Rise Inundation Area

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building and Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$63,726,655	0	$0	0.0%
Lacey	18,985	17,637	$17,357,526,547	0	$0	0.0%
Olympia	18,242	16,257	$19,116,213,011	122	$556,524,151	2.9%
Rainier	875	814	$393,003,023	0	$0	0.0%
Tenino	751	651	$404,778,123	0	$0	0.0%
Tumwater	9,513	8,408	$9,362,171,728	0	$0	0.0%
Yelm	3,139	2,827	$2,077,637,133	0	$0	0.0%
Unincorporated	53,104	51,429	$24,765,596,428	154	$71,205,795	0.3%
Total Planning Area	104,854	98,260	$73,540,652,648	276	$627,729,946	0.9%

Table 4.5.8 Community Lifelines located in the Six-Inch Sea Level Rise Inundation Area

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0
Olympia	1	1	1	1	0	2	1	7
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated Thurston County	0	0	1	0	0	0	6	7
Total Planning Area	**1**	**1**	**2**	**1**	**0**	**2**	**7**	**14**

Impacts to Natural, Cultural, and Historic Resources

Sea level rise aggravated erosional forces, dispersion of pollutants and toxic substances, sediment deposition, and debris can create near-term or permanent adverse impacts to agricultural lands and on and offshore natural resources. There could be loss of wildlife habitat and changes to the quality and availability of fresh water due to inundation by salt water. Beaches, shellfish beds, estuaries, wetlands, and tide flats could be adversely impacted. Changes to these resources can be detrimental to areas that are valued by communities and tribes for their economic, ecological, food resource, and recreational benefits.

Tolmie State Park, Squaxin Park in Olympia, and Burfoot and Frye Cove parks in Thurston County are the region's most popular Puget Sound beach destinations. The highly valued shorelines of these parks are at risk to inundation from a six-inch or greater sea level rise. The loss of such park acreage would dramatically reduce public access to local marine shorelines.

Impacts to Activities

Downtown Olympia is the region's most dynamic economic, social, cultural, and artistic hub. It is a major employment center for both the private and public sectors. Downtown shops and restaurants attract residents and visitors alike. Capitol Lake, Percival Landing, and the Port Plaza are year-round popular outdoor attractions and gathering places, especially during festivals and events. Sea level rise threatens this vitality. However, the Olympia Sea Level Rise Response Plan includes strategies for protecting these assets.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.5.2 shows assets and structures in Thurston County that are located in the sea level rise inundation areas by census tract social vulnerability ratings. Most areas affected by sea level rise have a rating that ranges from very low to relatively moderate.

The Federal Emergency Management Agency does not include a sea level rise hazard in its National Risk Index (NRI). However, the NRI for coastal flooding in Thurston County is 74.4 or relatively low. The rating represents a community's relative risk for coastal flooding when compared to the rest of the United States.

For comparison, Pierce County's NRI coastal flooding score is 73.6, also relatively low. The NRI reports an estimated coastal flooding hazard annual loss of $1.2 million.

Community Hazard Risk Ratings for Sea Level Rise Inundation Areas

The countywide sea level rise inundation risk ranking score is 18, a medium risk. Unincorporated Thurston County and the City of Olympia risk ranking scores are also 18. McLane Black Lake Fire District, Olympia School District, South Bay Fire District, and Thurston PUD each scored 9, a low risk. Sea level rise risk ranking scores are zero for all other communities. Tables 4.5.9 and 4.5.10 show community and special purpose sea level rise hazard risk ratings. The details of the sea level rise hazard risk assessment calculations are shown in Appendix C.

Table 4.5.9 Community Sea Level Rise Hazard Risk Ratings

	Sea Level Rise Hazard	
Municipal Plan Participants	Risk Ranking Score	Risk Rating
Bucoda	0	Low
Lacey	0	Low
Olympia	18	Medium
Rainier	0	Low
Tenino	0	Low
Tumwater	0	Low
Yelm	0	Low
Unincorporated Thurston County	18	Medium
Total Planning Area	18	Medium

Table 4.5.10 Special Purpose District Sea Level Rise Hazard Risk Ratings

	Sea Level Rise Hazard	
Special Purpose District Plan Participants	Risk Ranking Score	Risk Rating
East Olympia Fire District	0	Low
Intercity Transit	0	Low
Lacey Fire District	0	Low
McLane Black Lake Fire District	9	Low
Olympia School District	9	Low
SE Thurston Fire Authority	0	Low
South Bay Fire District	9	Low
The Evergreen State College	0	Low
Thurston PUD	9	Low
West Thurston Regional Fire Authority	0	Low

Changes in Sea Level Rise Hazard Risks Since Last Plan Update

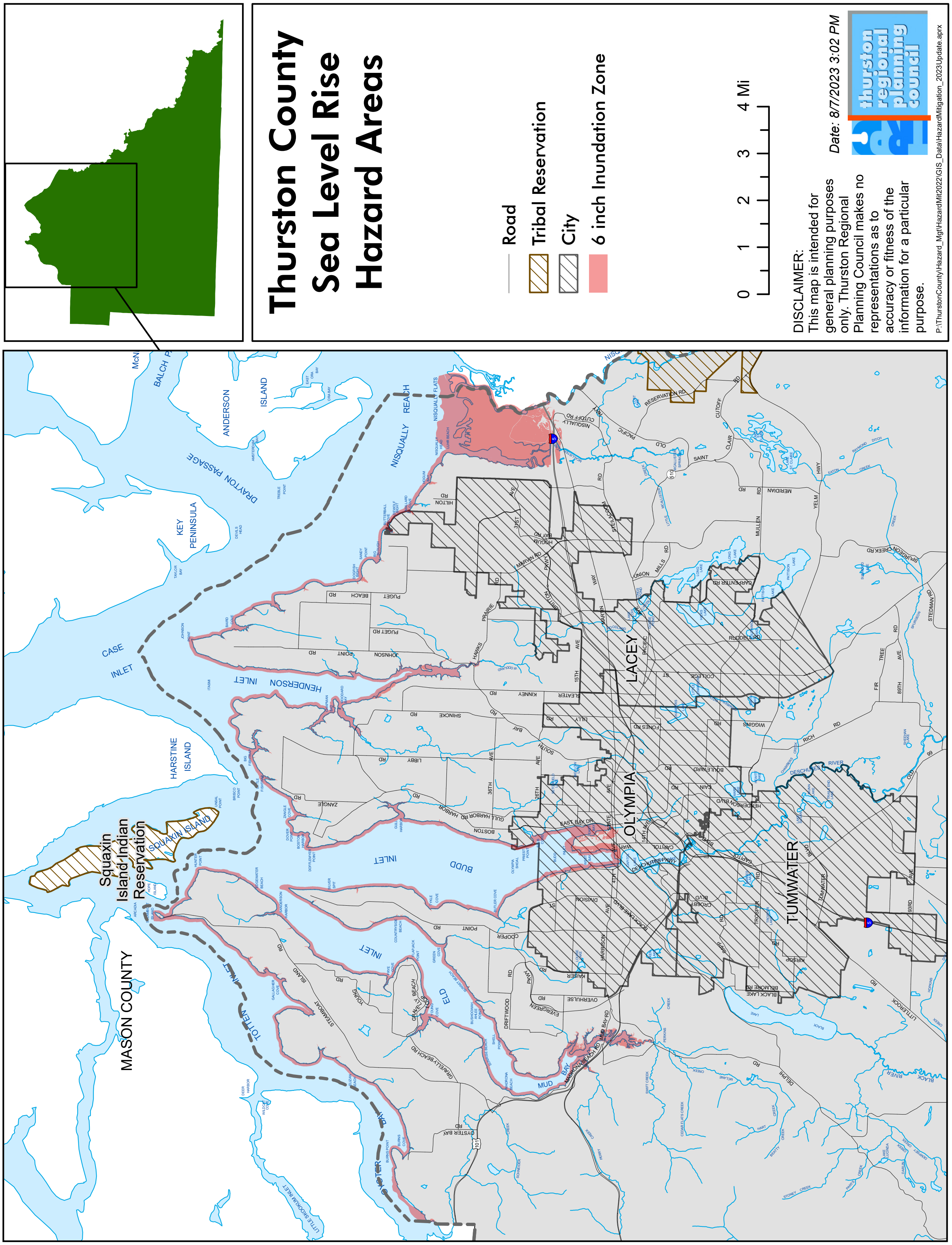
A countywide sea level rise scenario inundation map was unavailable to perform a vulnerability analysis and risk assessment during the development of the 2017 Hazard Mitigation Plan. The 2023 plan update process identified that approximately 0.9 percent of the population, 0.1 percent of assessed value of structures, and 14 community lifeline assets are potentially at risk for a six-inch sea level rise. This provides a baseline sea level rise hazard assessment for future evaluation of the region's vulnerabilities and risks.

Connection to the Regional Mitigation Strategy

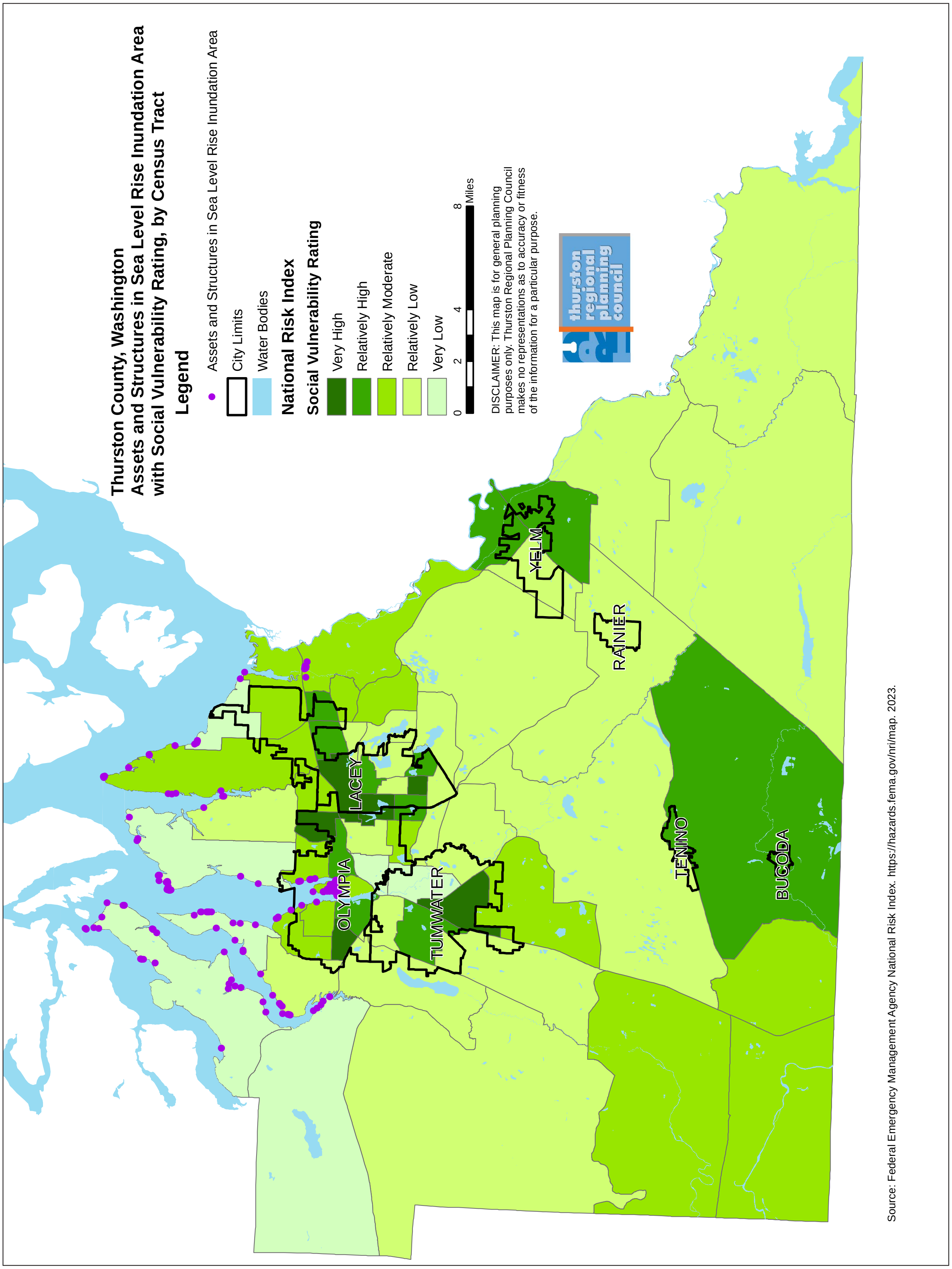
Downtown Olympia is one of the region's core economic and cultural hubs. Sea level rise impacts will extend well beyond downtown residents and businesses. The 2022 "Thurston County Communities Natural Hazards and Resiliency Survey" results show that City of Olympia, Tumwater, and Unincorporated Thurston County residents ranked climate change as one of the highest rated hazards of concern. Implementation of the Olympia Sea Level Rise Response Plan should be a regional priority.

Climate change induced hazards are novel and sea level rise education and preparedness for community residents is useful, both for its applicability to mitigation measures but also awareness to promote preparedness for residents who live on or near Thurston County's marine shoreline Sea level rise hazard information will be included through the Regional Hazard Mitigation Public Outreach Strategy initiative.

Map 4.5.1 Six-Inch Sea Level Rise Inundation Areas of Thurston County



Map 4.5.2 Exposed Assets and Structures in Six-Inch Sea Level Rise Inundation Area and Thurston County Social Vulnerability Index Rating by Census Tract



Endnotes

[1]Sweet, W.V. et. al. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report NOS 01. National Oceanic and Atmospheric Administration. https://oceanservice.noaa.gov/hazards/sealevelrise/noaa-nostechrpt01-global-regional-SLR-scenarios-US.pdf

[2]Mauger, G.S. et. al. 2015. State of Knowledge: Climate Change in Puget Sound. Report prepared for the Puget Sound Partnership and the National Oceanic and Atmospheric Administration. Climate Impacts Group, University of Washington, Seattle.

[3]University of Washington Climate Impacts Group. 2023. Climate Mapping for a Resilient Washington: a Web Application for Climate Resilience Planning in Washington. https://cig.uw.edu/resources/analysis-tools/climate-mapping-for-a-resilient-washington/.

[4]City of Olympia, LOTT Clean Water Alliance, Port of Olympia. 2019. Olympia Sea Level Rise Response Plan.

[5]Personal Communication. August 11, 2023. Susan Clark, City of Olympia Water Resources and Drinking Water Utility, Engineering and Planning Supervisor.

Chapter 4.6

Severe Weather Risk Assessment

Introduction

Thurston County has received nine federal disaster declarations related to severe storms since 1965. Hazardous temperatures and storm activity impacts people, property, and the economy every year. When not accounting for extreme heat deaths, Washington State has suffered over 103 fatalities and over $2.2 billion in weather related losses over the last decade (Table 4.6.1).[i]

A record-breaking heat wave killed 156 people in Washington in June 2021. Climate change will exacerbate weather hazards, and greater losses may be experienced in the decades to come. The Pacific Northwest is expected to experience warmer wetter winters and longer warmer and dryer summers that will pose challenges to communities to adapt to and mitigate the effects of climate hazards.

This chapter profiles the three major types of weather hazards that affect Thurston County:

- Hazardous temperatures
- Hazardous precipitation
- Hazardous wind

Each hazard is described including their impacts, previous incidents, probability of occurrence, and the effects of climate change on the hazards for Thurston County communities.

Table 4.6.1 2012-2022 Summary of Hazardous Weather Fatalities, Injuries, and Damage Costs in Washington State

Year	Fatalities	Injuries	Property Damage (millions $)	Crop Damage (millions $)	Total Damage (millions $)
2012	6	5	$27.3	$1.1	$28.5
2013	4	16	$12.8	$0.5	$13.3
2014	50	34	$328.2	$1.1	$329.3
2015	8	7	$28.9	$0.0	$29.0
2016	5	6	$8.4	$0.0	$8.4
2017	1	7	$82.5	$0.0	$82.5
2018	2	0	$141.8	$0.0	$141.8
2019	1	17	$5.0	$0.0	$5.0
2020	6	12	$1,340.3	$0.5	$1,340.8
2021*	17	7	$85.0	$0.1	$85.1
2022	3	2	$210.1	$0.2	$210.3
Totals	**103**	**113**	**$2,270.3**	**$3.5**	**$2,273.8**

**Note: Totals for 2021 do not include heat related deaths and injuries.*

Hazardous Temperatures

Daytime and nighttime surface air temperatures are generally mild throughout the year in the Pacific Northwest. Periods of above normal highs in the summer and below normal lows in the winter can be hazardous in Thurston County, especially for socially vulnerable populations.

Definition - Extreme Heat or Heat Wave

A heat wave is a prolonged period with higher-than-average summer daytime air surface temperatures without significant nighttime cooling. The Center for Disease Control and Prevention (CDC) describes extreme heat conditions when the temperature reaches extremely high levels or when a combination of heat and humidity makes the air become oppressive. Washington Department of Labor and Industries requires employers to implement measures to prevent heat-related illnesses for outdoor workers when the temperature reaches 80° F. Several public health institutions, including the Washington Department of Health cite extreme heat as the deadliest weather-related hazard in the United States. Prolonged periods of summer heat without appreciable precipitation increases the likelihood and severity of wildfires.

Area of Impact for Extreme Heat

In general, all Thurston County communities are affected by extreme heat events. Most homes in Western Washington lack air conditioning and the region's population is not accustomed to hot summer temperatures. Temperatures can vary geographically. The region's urban areas are susceptible to the heat island effect from buildings, parking lots, and roadways. This effect raises ambient daytime temperatures and reduces nighttime cooling. Conditions for lower daytime temperatures and greater nighttime cooling occurs in areas with sparse development, denser tree canopy, and naturally vegetated ground cover. More research is necessary to map areas that are most prone to heat island effects.

Extent for Extreme Heat

For western states, the National Weather Service uses the HeatRisk prototype forecast to issue excess heat watches, warnings, and advisories. This system provides risk guidance to decision makers and heat sensitive populations. HeatRisk identifies unusual heat conditions specific to a location's climate and date over a seven-day period. HeatRisk temperature thresholds vary by time of year; lower in the winter and fall and higher in the spring and summer. The temperature thresholds are related to regional emergency department heat-related injury data from the CDC that accounts for populations who are vulnerable to heat illness and deaths.

The HeatRisk system assigns a daily (24 hour) value that is displayed in a numeric and color-coded green, yellow, orange, red, magenta four-level scale. The scale communicates the level of heat risk for groups who are at risk (Figure 4.6.1). HeatRisk warnings are issued when forecast maximum and minimum temperatures exceed the established thresholds over a 48-hour period. HeatRisk levels 3 and 4 present the greatest risk for the majority of the population of Thurston County. For these events, the maximum daytime temperature exceeds 90° F and minimum nighttime temperatures generally do not fall below the upper 80° F.

Previous Incidents for Extreme Heat

There have been no federal disaster declarations for Thurston County for extreme heat events. Between 2005 and 2022, Thurston County experienced five level 3 (red) days: two in 2006, two in 2009, and one in 2021. On June 26 and 27, 2021, Thurston County experienced its first ever HeatRisk level 4 (magenta). Thurston County Public Health and Social Services reported 131 people visited or were admitted to local hospital emergency rooms in 2021 for heat related illnesses including effects of heat and light, heat stroke, heat exhaustion, heat cramps, exposure to excess natural heat, and accidents. 108 people visited or were admitted to Emergency Rooms heat related health impacts in 2022.

Figure 4.6.1 National Weather Service HeatRisk Forecast Prototype Levels and Risks (modified)[ii]

Level	Who is at Risk?*	How Common in Thurston County	Count of Daily HeatRisk Levels for Thurston County 2005-2022
0	• Level of heat poses little to no risk	Most Common	4,024
1	• Heat of this type is tolerated by most; however, there is a low risk for sensitive to experience health effects	Very Common	2,353
2	• Moderate risk for members of heat sensitive groups to experience health effects • Some risk for the general population who are exposed to the sun and are active • For those without air conditioning, living spaces can become uncomfortable during the day, but should cool below dangerous levels at night	Common	186
3	• High risk for much of the population who are 1) exposed to the sun and active, or 2) are in a heat sensitive group • Dangerous to anyone without proper hydration or adequate cooling • Poor air quality is possible • Power interruptions may occur as electrical demand increases for cooling	Uncommon	5
4	• Very high risk for entire population • Very dangerous to anyone without proper hydration or adequate cooling. • This is a multi-day extreme heat event. Prolonged heat is dangerous to anyone not prepared. • Poor air quality is likely • Power outages are increasingly likely as electrical demands for cooling may reach critical levels	Rare	2

**Risk descriptions courtesy of Public Health Seattle and King County.*

June 25-29, 2021, Heat Dome

An anomalous pattern of atmospheric conditions led to multiple days with daytime temperatures exceeding 100° F in Western Washington. The National Weather Service issued a Level 3 HeatRisk warning for June 26 and a Level 4 HeatRisk for June 27-28. On June 28, the Olympia Regional Airport recorded an all-time high record of 110° F.

The Washington State Department of Health reported the record-breaking heat from this event led to 157 heat-related fatalities statewide; six deaths were reported for Thurston County. This event produced the largest number of weather-related fatalities recorded in recent history. 74 people visited or were admitted to Olympia hospital emergency departments for heat-related illnesses during this period.[1] Thurston County Emergency Management did not activate the Emergency Coordination Center for this event, but it distributed public information about cooling shelters throughout the county. The Thurston County Hazardous Weather Task Force was activated to provide emergency cooling shelters for people experiencing homelessness. Shelter providers served 272 individuals during this period. There were no appreciable impacts to property or infrastructure documented for this event.

Probability of Occurrence for Extreme Heat Events

Thurston County communities have experienced five HeatRisk Level 3 and two Level 4 days in the last 17 years. From June through August 2022, the Olympia Regional Airport recorded 14 days with daytime high temperatures exceeding 89° F. There is a high likelihood the region will experience multiple extreme heat events with a HeatRisk Level 3 or higher in the next 25 years. As such there is a high probability of occurrence for an extreme heat event.

Researchers estimate the June 2021 Heat Dome event has a 0.1 percent chance of an annual occurrence. Although this was a rare event, some climatologists believe it would have been virtually impossible without climate change.[iii]

Effects of Climate Change on Extreme Heat

Research and climate forecasts offer evidence that long-term climate change will have a measurable impact on the frequency of extreme heat events. The University of Washington Climate Impacts Group "State of Knowledge: Climate Change in the Puget Sound" reports that air temperatures are projected to warm

[1] 2023. Data courtesy of Thurston County Public Health and Social Services.

rapidly during the 21st century. By mid-century, warming will be outside of the range of historical variations. Warming is projected for all seasons but will be greatest for summer. The impacts of these changes are documented in Thurston Regional Planning Council's 2018 Climate Adaptation Plan Vulnerability Assessment. Warmer drier summers will have adverse impacts on Thurston County communities.

Table 4.6.2 shows the average summer maximum temperature changes from a 1980-2009 historical baseline compared to two modeled scenarios.[iv]

Table 4.6.2 Thurston County Change in Average Summer (June - Aug) Maximum Temperature[2]

	Model Median	Model* Range (10th To 90th Percentile)
1980-2009		
Historical Baseline	75 °F	75 to 76 °F
2020-2049		
Higher Scenario (RCP 8.5)	3.4 °F	2.2 to 4.4 °F
Lower Scenario (RCP 4.5)	2.7 °F	1.4 to 4.1 °F
2030-2059		
Higher Scenario (RCP 8.5)	4.4 °F	2.9 to 6.0 °F
Lower Scenario (RCP 4.5)	3.4 °F	1.6 to 4.7 °F
2040-2069		
Higher Scenario (RCP 8.5)	5.9 °F	3.7 to 7.5 °F
Lower Scenario (RCP 4.5)	4.2 °F	2.2 to 6.0 °F

Vulnerabilities and Impacts for Extreme Heat

Impacts to People

The CDC reports that more than 600 people in the United States are killed by extreme heat every year. Outdoor workers, older adults, the very young, people who are unsheltered, and people with mental illness and chronic disease are at highest risk.

[2] Representation concentration pathways," or RCPs are climate model scenarios for the 21st century. RCP 4.5 — a "low" scenario that assumes greenhouse gas emissions (GHG) stabilize by mid-century and fall sharply thereafter; and RCP 8.5 — a "high" scenario that assumes substantial GHG increases until the end of the 21st century.

Heat related illnesses such as heat exhaustion or heat stroke occur when people are exposed to high temperatures, become dehydrated, and their body is no longer able to properly cool itself. Increased rates of accidental drownings are often attributed to high temperatures for inexperienced swimmers attempting to seek relief from heat. The effects of heat can also compound air quality problems from wildfire smoke and pose health issues for people with chronic respiratory disease.

Impacts to Structures and Systems

Surges in heat related illnesses can overwhelm first responders, emergency medical services, and hospital emergency room capacities. Prolonged periods of extreme weather events can stress the ability of social service providers and shelter operators to provide adequate resources to people seeking refuge from heat. Extreme heat complicates fire service operations as firefighters need to adapt protective equipment and tactics to reduce their risk for heat injuries.

Extreme heat events create drought-like conditions and can place above average demands on municipal water systems from households using excess water for landscape irrigation or recreational uses. Wildfires can disrupt electricity transmission resulting in disruptions to communications networks, healthcare, and businesses.

Impacts to Natural, Cultural, and Historic Resources

Extreme heat and drought conditions can stress native plants in both forest and prairie ecosystems resulting in loss of wildlife habitat. Heat can exacerbate algal blooms and deteriorate lake and marine water quality impacting the health of humans, fish, and wildlife. Warming can increase drought-like conditions and increase risks for wildfires which can threaten historic or community valued properties.

Impacts to Activities

Hazardous temperatures can result in suspension of outdoor sporting events, concerts, and recreational activities. Outdoor construction activity can be slowed or suspended and can increase costs.

Definition – Extreme Cold or Cold Wave

An extreme cold event is a prolonged period with sustained lower than average daytime and nighttime winter air surface temperatures that fall below 32° F. Cold air conditions result when an Arctic front pushes cold air by northeasterly winds through the Fraser River Valley gap in British Columbia into Northwest Washington and further south to Oregon. Cold weather conditions can be hazardous for individuals depending on their length of exposure. Increases in wind speed cause more rapid loss of body heat.

Area of Impact for Extreme Cold

While extreme cold weather events are uncommon for Thurston County, all areas within the county are subject to subfreezing temperatures.

Extent for Extreme Cold

The National Weather Service issues hazardous winter weather advisories, watches, and warnings when the maximum daily temperature fall below freezing for two or more days. In general, such threat levels are issued for cold events when maximum daily temperatures fall below 25° to 20° F.[v]

Previous Incidents for Extreme Cold

Thurston County has not received federal disaster declarations related specifically to hazardous freezing temperatures. However freezing temperatures accompany severe winter storms. An examination of Olympia Regional Airport weather records from 1972 to 2022 shows there have been at least 28 incidents where maximum daily temperatures did not exceed 32° F for at least two consecutive days. For these incidents, minimum daily temperatures ranged from 30° to -8° F. Since the adoption of the last Hazard Mitigation Plan in 2017, the Thurston County Hazardous Weather Task Force activated emergency warming shelters for hazardous cold weather in 2019, 2020, and 2021 and served a combined total of 1,670 individuals experiencing homelessness. Between 2019 and 2023, Hospitals and emergency departments received 252 and 526 visits, respectively, for cold-related illnesses including hypothermia, frostbite, and other cold-related conditions.[3] During the same period, there was a combined estimate of 58 visits to hospitals and emergency departments for unintentional carbon monoxide exposure among Thurston County residents.

Probability of Occurrence for Extreme Cold

Thurston County has experienced hazardous cold weather events in 27 of the last 50 years. There is a high likelihood the region will experience multiple cold weather hazard incidents in the next 25 years.

Effects of Climate Change on Extreme Cold

Long-term climate projections for the Puget Sound Region indicate that winters will become warmer through the 21st Century. However, Thurston County is expected to continue experiencing cold weather events with daily maximum temperatures below freezing level.

[3] Washington Department of Health. Rapid Health Information Network (RHINO), 2019-2023. Data courtesy of Thurston County Public Health and Social Services.

Vulnerabilities and Impacts for Extreme Cold

Impacts to People

Exposure to cold winter temperatures may lead to serious health problems. Older adults, the very young, people who are without shelter or who are stranded, or who live in a home that is poorly insulated or without heat are at greatest risk. People can suffer medical emergencies from hypothermia and frost bite. People using unsafe heating sources in non-ventilated spaces can suffer burns or asphyxiation from carbon monoxide poisoning. People can suffer falls and fractures from hazardous icy surfaces.

Impacts to Structures and Systems

After rain or snowfall, subfreezing temperatures can produce hazardous icy conditions for most modes of travel resulting in collisions, injuries, death, loss of property, and delay. A prolonged freeze can rupture exposed water pipes causing damage to homes and buildings that are not adequately insulated. The use of unsafe heating devices in interior spaces can create risks for structure fires.

Impacts to Activities

Hazardous cold temperatures can result in suspension of outdoor events and activities. Icy road conditions cause school and business closures or delays. Outdoor construction activity is slowed or suspended and can increase costs.

Storm Activity

Western Washington storms typically occur October through February but can extend through late spring. Winter storm systems often arrive in succession consisting of multi-day periods with higher-than-normal precipitation, sustained high speed-directional winds with higher speed wind gusts, and sub-freezing temperatures. Thunderstorm activity is less common but can occur throughout the year. Winter storms also cause destructive flooding and landslides. This section describes the storm weather elements including precipitation and winds that impact Thurston County communities.

Definitions for Hazardous Precipitation

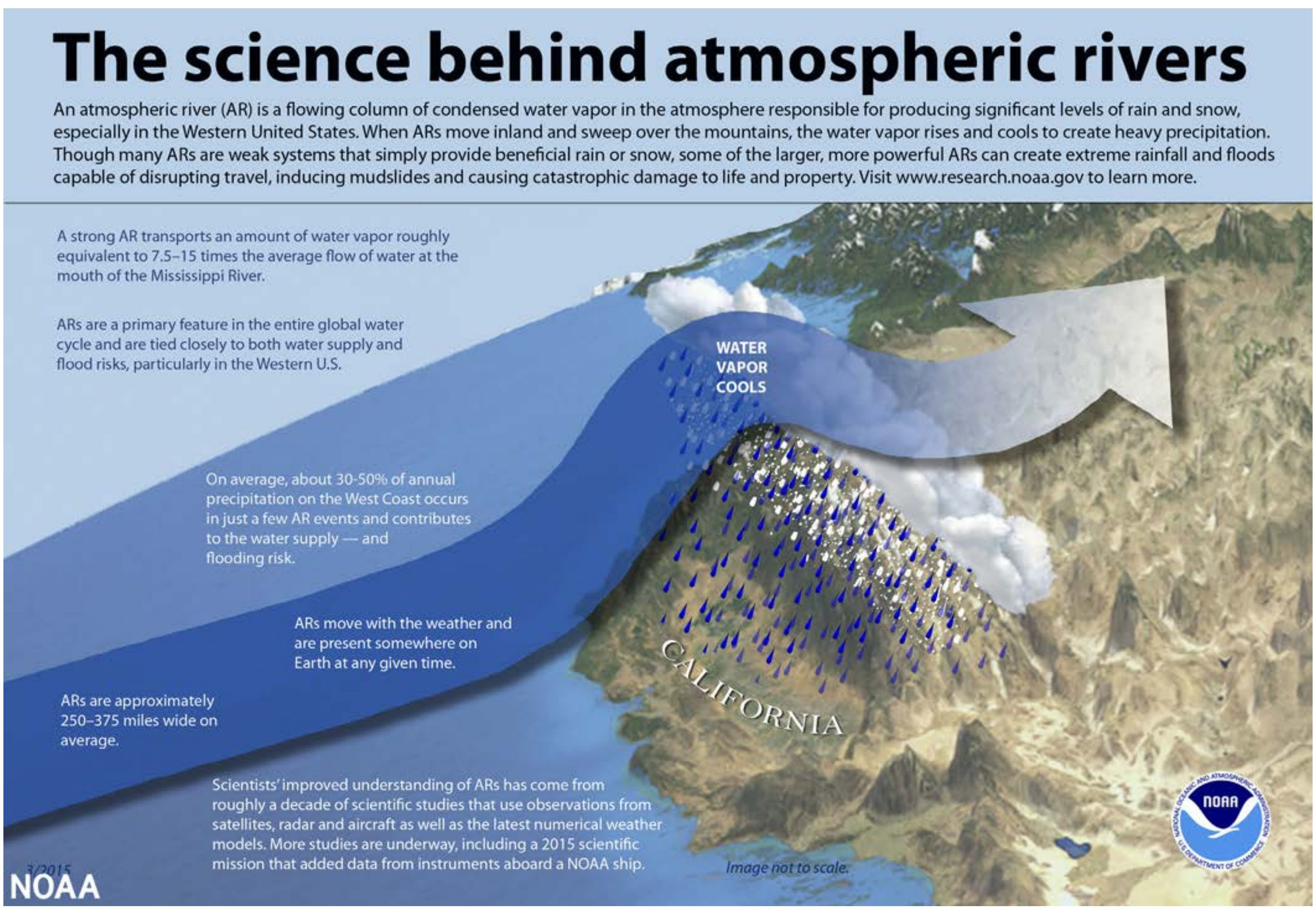
Hail

Hail consists of ice particles that form small ball shaped clusters that range from 3 to 10 mm in diameter. Hail forms in cumulonimbus or thunderstorm clouds that have strong updrafts. The region typically experiences hail in the early spring. While not a source of major impacts to communities that warrants mitigation, hail is short lived and can produce hazardous conditions for transportation or potential injury to people who are exposed.

Heavy Rain

Heavy rain is defined as 3 to 4 inches of rain that falls in a 12-hour period. Stormwater flows can overwhelm the capacity of stormwater infrastructure within a neighborhood or streams within a watershed. Heavy rain is common to the Pacific Northwest during the fall and winter seasons, especially during years with La Niña conditions generating deep low-pressure storms in the eastern Pacific. Large scale atmospheric rivers are the principal source of sustained heavy rains. For western states, atmospheric rivers are the primary source for mountain snowpack, but also the primary cause riverine flooding. Atmospheric rivers deliver massive volumes of warm water vapor from the tropical and subtropical Pacific Ocean through a narrow band in the atmosphere. As these systems make landfall, the water vapor cools and descends as rain in the lowlands.

Heavy rains are the leading cause of riverine and high groundwater flooding and can lead to slope failure causing mudslides or landslides. On its own, heavy rain produces urban flash flooding, erosion, roof failure, foundation failure, and structural and interior damage from excess stormwater leaks and penetration.



Freezing Rain

Ice storms are infrequent but common to the Pacific Northwest. Freezing rain occurs when rain descends and passes through a subfreezing air mass. The precipitation remains in liquid form, but rapidly becomes supercooled and freezes on contact with cold surfaces. A glaze of ice continues to accumulate as long as conditions persist. Accumulations can range from a trace amount to over one inch thick. Severe ice storms create extremely hazardous conditions for all forms of surface transportation. Ice storms cause large tree limbs to break and down powerlines. Ice storms followed by a windstorm can cripple electric power transmission over a very large area and cause substantive damage to vehicles, roofs, and other property.

Heavy snow

Heavy snow is characterized as four inches of snowfall in 12 hours or six inches in 24 hours for lowland areas. Sustained periods with subfreezing temperatures and excess snowfall and accumulations frequently exceeds communities' ability to remove snow from roadways. Western Washington communities regularly experience significant transportation disruptions when excess snow and subfreezing conditions persist over several days.

Definitions for Hazardous Winds

High Winds/Windstorms

The National Weather Service defines high winds as “sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration.” Figure 4.6.2 shows the impacts of wind speed based on the Beaufort Scale. Generally, winds above 30 mph can cause widespread damage and those above 50 mph can lead to more serious disasters. Most large windstorms that affect the region are generated by mid-latitude eastern Pacific cyclones. Northern Hemisphere cyclones are large-scale storms with winds that rotate counterclockwise around a central region of low atmospheric pressure. Cyclones obtain their energy from the large horizontal variation in temperature in the mid-latitudes (30° to 60° north). While not as powerful as tropical hurricanes, cyclones can produce wind speeds in excess of 100 mph and can maintain their strength farther inland and affect a much larger area.[vi] The Puget Sound Region’s most powerful southerly and westerly winds typically come from these storm systems when their low-pressure centers move from southwest to northeast and cross the coast between the northern tip of the Olympic Peninsula and central Vancouver Island. Other landfall trajectories from northern Oregon to the central Washington coast are also capable of causing widespread destruction in Thurston County.

Figure 4.6.2 Beaufort Wind Scale

Beaufort Scale	Wind Speed mph	Description	Conditions
0	<1	Calm	Calm. Smoke rises vertically.
1	1 to 3	Light air	Wind motion visible in smoke.
2	3 to 7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8 to 12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-17	Moderate breeze	Dust and loose paper raised. Small branches begin to move.
5	18-24	Fresh breeze	Branches of a moderate size move. Small trees begin to sway.
6	25-30	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.
7	31-38	High wind, Moderate Gale, Near Gale	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	39-46	Fresh Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Strong Gale	Larger branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to tents and canopies.
10	55-63	Whole Gale/Storm	Trees are broken off or uprooted, saplings bent and deformed, poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	64-72	Violent storm	Widespread vegetation damage. More damage to most roofing surfaces, asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	≥73	Hurricane-force	Considerable and widespread damage to vegetation, a few windows broken, structural damage to mobile homes and poorly constructed sheds and barns. Debris may be hurled about.

Tornado

The National Weather Service defines a tornado as “a violently rotating column of air, usually pendant to a cumulonimbus [cloud], with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. Tornadoes are unpredictable weather phenomena. While rare in the Pacific Northwest, tornados have been observed in Thurston County. Of the documented tornadoes, they have been Fujita Scale 0-1 events, and their impacts have been limited and isolated. Figure 4.6.3 shows the impacts of tornadoes by windspeed based on the Fujita Scale.

Figure 4.6.3: The Fujita Scale

F-Scale	Wind Strength	Description of Damage
F0	40-72 mph	Minimal Damage - Some damage to chimneys, TV antennas, roof shingles and windows. Breaks branches off trees, pushes over shallow-rooted trees, damages sign boards.
F1	73-112 mph	Moderate Damage - Automobiles overturned, carports destroyed, trees uprooted, peels surface off roofs, mobile homes pushed off foundations or overturned, moving autos pushed off the roads.
F2	113-157 mph	Major Damage - Roofs torn off frame homes, sheds and outbuildings are demolished, mobile homes overturned or destroyed, boxcars pushed over; large trees snapped or uprooted, light object missiles generated.
F3	158-206 mph	Severe Damage - Exterior walls and roofs blown off well-built houses, metal buildings collapsed or are severely damaged, trains overturned, forests and farmland flattened, heavy cars lifted off the ground and thrown.
F4	207-260 mph	Devastating Damage - Few walls, if any, standing in well-built houses, structures with weak foundations blown off some distance, large steel and concrete missiles thrown far distances, cars thrown.
F5	261-318 mph	Incredible Damage - Homes leveled with all debris removed, strong frame houses lifted off foundations and carried considerable distances to disintegrate. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone, steel reinforced concrete structures badly damaged. Automobile sized missiles fly through the air in excess of 100 meters, trees debarked.

Thunderstorm/Microburst Winds

Thunderstorms are uncommon in the Pacific Northwest, but they have been observed and documented in Thurston County. They typically include lightning and thunder. Notably, microbursts can produce high speed wind gusts that can exceed 70 mph. Microbursts are associated with a sudden emergence of dark cloud formations. These small energetic storms are short lived but can be locally destructive in developed areas. Winds from these storms can knock down limbs, snap large trees, and topple power poles causing damage to surface infrastructure, vehicles, structures, and other personal property. Wet microbursts can produce heavy rainfall that quickly overwhelms stormwater systems and cause urban flash flooding.

Location of Storm Activity

All areas of Thurston County experience storm activity. The countywide risk assessment for storms and severe weather treats the entire planning area uniformly.

Previous Incidents of Storm Activity

From 1965 to 2022, Thurston County has been included in 21 federal disaster declarations that included losses from storm incidents. Of these, 12 declarations were issued principally for flood losses. Table 4.6.3 summarizes federal disaster declarations issued principally for storm losses.

Table 4.6.3 Federal Disaster Declarations for Thurston County Resulting from Storm Losses

Disaster Number	Title	Begin Date	End Date
DR 981	Severe Storms & High Wind	1993-01-20	1993-01-21
DR 1079	Severe Storms, High Wind, and Flooding	1995-11-07	1995-12-18
DR 1159	Severe Winter Storms, Land & Mudslides, and Flooding	1996-12-26	1997-02-10
DR 1499	Severe Storms and Flooding	2003-10-15	2003-10-23
DR 1671	Severe Storms, Flooding, Landslides, And Mudslides	2006-11-02	2006-11-11
DR 1682	Severe Winter Storm, Landslides, and Mudslides	2006-12-14	2006-12-15
DR 1734	Severe Storms, Flooding, Landslides, and Mudslides	2007-12-01	2007-12-17
DR 1825	Severe Winter Storm and Record and Near Record Snow	2008-12-12	2009-01-05
DR 4056	Severe Winter Storm, Flooding, Landslides, and Mudslides	2012-01-14	2012-01-23

Probability of Occurrence of Storm Activity

Over the last 50 years, Thurston County has experienced 21 federal disaster declarations attributed in a large part to storms from higher-than-normal levels of precipitation and higher-than-normal wind speeds. There is a high likelihood that Thurston County communities will experience strong storm activity that will impact people, property, and the environment in the next 25 years.

Effects of Climate Change on Storm Activity

The University of Washington Climate Impacts Group "State of Knowledge: Climate Change in the Puget Sound" reports that overall annual precipitation levels are forecast to remain the same, but there will be greater seasonal variation. Winters will become wetter. Climate change models are not forecasting significant variation for the nature and type of windstorms that are presently common in the region. The frequency of the region's peak 24-hour rain events is expected to more than triple by the end of the 21st century. Winter storms are also expected to become more intense, with greater rainfall occurring in shorter periods of time. For the Thurston County planning area, such changes in precipitation patterns are anticipated to impact flood and landslide conditions and endanger public safety and welfare.

A continued rise in the average annual temperature over the 21st century will result in more winter precipitation falling as rain instead of snow in the Puget Sound region. Watersheds will become increasingly rain dominant and streamflow is projected to peak earlier in winter and decrease in spring and summer. Winter streamflow is projected to increase by 28 to 34 percent on average by the 2080s.

Table 4.6.4 shows the percent change in the maximum amount of water from the 24-hour rainstorm that occurs on average once every two years relative to the average for 1980-2009.[IV] Table 4.6.5 shows the percent change in the amount of water contained in snowpack on April 1 relative to the average for 1980-2009.

Table 4.6.4 Thurston County Percent Change in Maximum in Water from 24-hour Rainstorms, 2020-2069[1]

	Model Median	Model Range (10th to 90th percentile)
1980-2009		
Historical Baseline	n/a	n/a
2020-2049		
Higher Scenario (RCP 8.5)	7%	-3 to 15 %
2030-2059		
Higher Scenario (RCP 8.5)	7%	-1 to 21 %
2040-2069		
Higher Scenario (RCP 8.5)	14%	-4 to 25 %

[1] Representation concentration pathways, or RCPs are climate model scenarios for the 21st century. RCP 8.5 — a "high" scenario that assumes substantial GHG increases until the end of the 21st century.

Table 4.6.5 Thurston County Percent Change in Water in Snowpack, 2020-2069[4]

	Model Median	Model Range (10th to 90th percentile)
1980-2009		
Historical Baseline	0 inches	0 to 0 inches
2020-2049		
Higher Scenario (RCP 8.5)	-95%	-100 to -4 %
Lower Scenario (RCP 4.5)	-95%	-100 to -40 %
2030-2059		
Higher Scenario (RCP 8.5)	-100%	-100 to -11 %
Lower Scenario (RCP 4.5)	-99%	-100 to -53 %
2040-2069		
Higher Scenario (RCP 8.5)	-100%	-100 to -87 %
Lower Scenario (RCP 4.5)	-100%	-100 to -78 %

Vulnerabilities and Impacts for Storm Activity

Impacts to People

Hazardous winds, precipitation, and winter temperatures pose a great number of known risks. Underserved communities and socially vulnerable individuals and households are at greater risk of impacts from winter storms and extended power outages. People who are unsheltered, experiencing homelessness, or are low income and cannot afford safe adequate heating sources are vulnerable to hypothermia. They are also at a higher risk for carbon monoxide poisoning or structure fires as a result of using unsafe devices to heat improperly ventilated spaces. Falling branches, trees, and other debris caused by high-speed winds also creates risk for injuries and fatalities for people who are unsheltered. Extended power outages can result in spoilage of food, exacerbating food insecurity.

Snow and ice create hazardous conditions for surface transportation and increases the traveling public's risk for accidents, property damage, injuries, and fatalities. Fallen trees on roadways, downed power lines, and other transportation disruptions cause delays and impact people who are commuting to work, school, medical appointments, and other important trips.

Impacts to Structures and Systems

Homes, outbuildings, commercial buildings, and other structures are susceptible to a variety of damage from hazardous weather. Roofs not adequately constructed could suffer failure from excess loads of snow or excess loads of stormwater if drainage systems are not properly maintained. Crawl spaces and foundations can also suffer erosion, subsidence, or flood damage from excess stormwater. Excess stormwater can erode steep slopes or cause landslides and cause structural failure of power, water, wastewater utility lines, and transportation infrastructure.

Saturated soils and high-speed winds can topple large trees which can cause significant damage to buildings. Buildings can be further damaged if fire suppression sprinkler system water lines are severed in ceilings resulting in interior flooding.

Ice and snowstorms can topple numerous trees across power lines resulting in prolonged electrical blackouts for neighborhoods or some areas of the county. Power disruptions force the closure of government offices, businesses, and schools impacting a wide range of services and operations. Winter storms also disrupt multimodal transportation networks impacting the mobility of people, freight, goods, and services.

When power outages occur simultaneously with heavy stormwater flows, sewer lift stations are prone to failure without auxiliary power supplies. Computer servers and other equipment can be damaged if auxiliary power, cooling equipment, or shut down procedures fail during power outages.

Hazardous winter weather can stress the capacity of shelter providers and strain resources to protect people who are unsheltered or experiencing homelessness. It can also strain police and fire services from responding to numerous vehicle collisions and accidents.

Impacts to Natural, Cultural, and Historic Resources

Storms can damage valued trees and vegetation in parks and open spaces. Fallen trees or limbs can damage historic homes, monuments, or other valued community assets. Losses are more pronounced from impacts caused by flooding, landslides, and wildfires. The effects of climate change will likely present landscape level ecological changes throughout the planning area. Natural resource areas that were established to preserve and protect the region’s unique ecological areas could be at risk. The areas’ endemic flora and fauna will likely be stressed by warmer drier summers and will eventually be succeeded by other resilient native or invasive species.

Impacts to Activities

The region's population is accustomed to taking refuge indoors during winters' inclement weather. The shorter days and longer nights also influence behavior to spend time indoors. On the other hand, Pacific Northwesterners embrace their summers and want to maximize their time outdoors. Communities will experience challenges increasing public awareness and education about summer hazards that posed very little risk just a decade ago. Outdoor sports, events, and recreational activities will be impacted more frequently as extreme heat and poor air quality from wildfire smoke becomes more common due to the effects of climate change. People with respiratory diseases and other chronic health problems are at greater risk for summer hazards. Interventions and outreach efforts to inform people about steps they can take to reduce their exposure to inclement weather should focus on underserved communities and socially vulnerable populations.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability Score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level.

A community's Social Vulnerability Score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Thurston County's overall Social Vulnerability Score is 37.24 or relatively low. Thurston County's Social Vulnerability Score and Ratings vary by Census Tract from very low to very high (Map 4.6.1).

The Federal Emergency Management Agency National Risk Index (NRI) provides risk index ratings for severe weather hazards in Thurston County. The rating represents a community's relative risk for a hazard when compared to the rest of the United States. In addition, the NRI provides an Expected Annual Loss (EAL). This represents the average economic loss in dollars resulting from natural hazards each year. It is calculated for each hazard type and quantifies loss for relevant consequence types including buildings, people, and agriculture. Figure 4.6.9 shows Thurston County NRI ratings and EAL for each severe weather hazard.

Table 4.6.6 Thurston County National Risk Index Ratings for Severe Weather Hazards

Hazard Type	Risk Index	Estimated Annual Loss
Heat Wave	66.6, Relatively Low	$0.21 million
Cold Wave	No rating	$0
Hail	7.5, Very Low	$5.8 thousand
Ice Storm	74.6, Relatively Moderate	$0.19 million
Lightning	52.7, Relatively Low	$0.11 million
Strong Wind	4.9, Relatively Low	$15 thousand
Tornado	27.9, Relatively Low	$0.39 million
Winter Weather	35.3, Relatively Low	$30 thousand

Community Hazard Risk Ratings for Severe Weather Hazards

Severe weather including hazardous temperatures and storm activity has no geographic boundaries in Thurston County. There is no means to measure loss estimates for weather hazards in the absence of a defined hazard area and readily available modeling tools. As such, no severe weather hazard exposure and loss estimation tables were developed. For planning purposes, an overall subjective risk rating is presented for the combined severe weather elements including hazardous temperatures, and storm activity (hazardous precipitation and hazardous winds) that impact Thurston County communities (Table 4.6.7) and special purpose districts (Table 4.6.8).

The risk rating for severe weather hazards is medium for all the planning partners.

- The probability of hazardous weather occurring in the planning areas over the next 25 years is high.
- Hazardous weather has a low impact on people as events typically affect less than ten percent of the population.
- Impacts on property is low as less than ten percent of the total replacement value of assets are exposed.
- The impact on the economy is medium as the estimated losses from the hazard is between five and nine percent of the total replacement value of damaged assets.

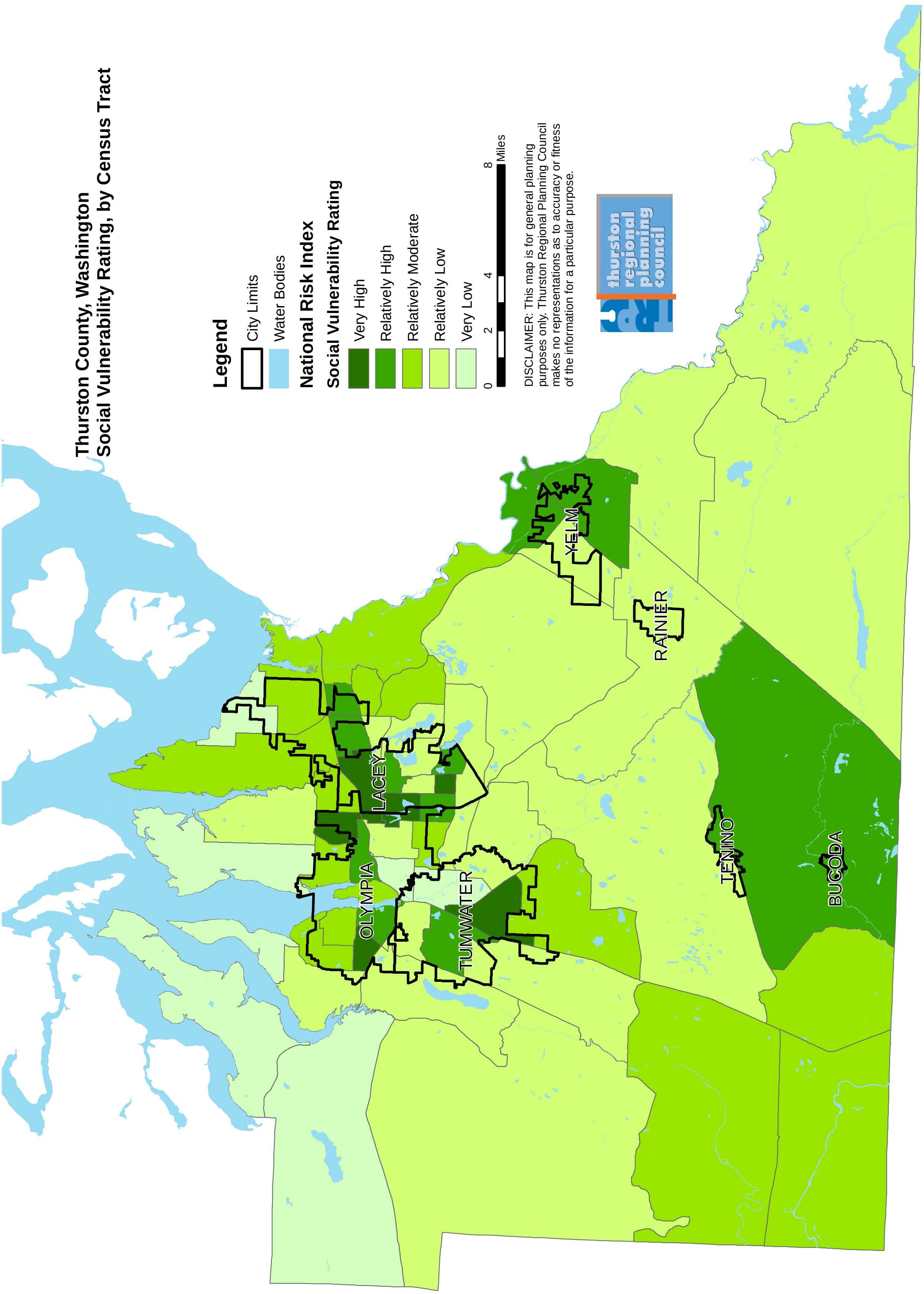
Table 4.6.7 Hazardous Weather Hazard Risk Rating for Thurston County Communities

Community	Probability	Impact on People	Impact on Property	Impact on Economy	Hazard Risk Rating
Bucoda	High	Low	Low	Medium	Medium
Lacey	High	Low	Low	Medium	Medium
Olympia	High	Low	Low	Medium	Medium
Rainier	High	Low	Low	Medium	Medium
Tenino	High	Low	Low	Medium	Medium
Tumwater	High	Low	Low	Medium	Medium
Yelm	High	Low	Low	Medium	Medium
Unincorporated	High	Low	Low	Medium	Medium
Total	High	Low	Low	Medium	Medium

Table 4.6.8 Hazardous Weather Hazard Risk Rating for Thurston County Special Purpose Districts

Community	Probability	Impact on People	Impact on Property	Impact on Economy	Hazard Risk Rating
East Olympia Fire District	High	Low	Low	Medium	Medium
Intercity Transit	High	Low	Low	Medium	Medium
Lacey Fire District	High	Low	Low	Medium	Medium
McLane Black Lake Fire District	High	Low	Low	Medium	Medium
Olympia School District	High	Low	Low	Medium	Medium
SE Thurston Fire Authority	High	Low	Low	Medium	Medium
The Evergreen State College	High	Low	Low	Medium	Medium
Thurston PUD	High	Low	Low	Medium	Medium

Map 4.6.1 Thurston County Social Vulnerability Index Rating by Census Tract



Source: Federal Emergency Management Agency National Risk Index. https://hazards.fema.gov/nri/map. 2023.

Endnotes

[i]NOAA National Centers for Environmental Information Storm Events Database, https://www.ncdc.noaa.gov/stormevents/

[ii]National Weather Service HeatRisk Prototype. 2023. https://www.wrh.noaa.gov/wrh/heatrisk/

[iii]The New York Times. July 7, 2021. Climate Change Drove Western Heat Wave's Extreme Records, Analysis Finds. https://www.nytimes.com/2021/07/07/climate/climate-change-heat-wave.html.

[iv]Climate Mapping for a Resilient Washington, University of Washington, Climate Impacts Group in partnership with the University of Idaho, Research Data & Computing Services for web development. https://cig.uw.edu/resources/analysis-tools/climate-mapping-for-a-resilient-washington/

[v]Personal Communication, Reid Wolcott, Warning Coordination Meteorologist, NWS, Seattle. February 10, 2023.

[vi]Cliff Mass. 2008. The Weather of the Pacific Northwest. The University of Washington Press, Seattle, WA.

NOAA Tsunami warning siren at Ocean Shores.
Photo courtesy of NOAA.

Chapter 4.7

Tsunami Hazard Risk Assessment

Introduction

Tsunamis are rare in Washington, but they have struck throughout the Pacific Northwest in the past. We are reminded of their dangers and their chances of occurring by the tsunami evacuation route signs that are visible throughout Washington's coastal communities.

Tsunamis are among the world's deadliest natural hazards. The United States Geological Survey (USGS) reports that the 2004 Indian Ocean tsunami reached heights of 65 to 100 feet in Sumatra and caused over 200,000 deaths from Indonesia to East Africa.[1] The 1964 Alaska tsunami killed 110 people, with some fatalities occurring as far as Crescent City, California. Although there is scant evidence of a major tsunami inundating Thurston County's shoreline, a computer model simulating a Cascadia Subduction Zone (CSZ) source tsunami shows the South Puget Sound is not risk free.

Tsunami evacuation routes lead people to high ground

Definition

Tsunamis are a series of massive ocean waves triggered by earthquakes. They are generated by a sudden change in the sea floor elevation (uplift or subsidence) which displaces a significant volume of water that travels as waves in all directions. They can travel up to 500 miles per hour in the deep water. Tsunamis can also occur in inland waters and the Puget Sound. Inland tsunamis are initiated by onshore landslides, submarine landslides, and volcanic eruptions where a large land mass of falling debris could generate a hazardous wave.

Subduction zone earthquakes can generate Tsunamis that are tens to thousands of kilometers in length and 10 to 45 meters tall. They can travel across oceans and threaten shoreline communities around the entire Pacific Rim. The movement and behavior of tsunamis is complex. Most tsunamis do not result in giant breaking waves. Rather they behave more like very strong and fast-moving tides. Inundation can last for several hours from multiple wave sets. Tsunamis can travel much farther inland than normal waves. Tsunamis cause damage and destruction by flooding, wave impacts, erosion, strong currents, and floating debris such as logs, vehicles, and structures.

Area of Impact

For the purposes of the risk assessment, the tsunami hazard area for Thurston County is defined by the modeled tsunami inundation zone from a CSZ magnitude 9 earthquake scenario produced by the Washington State Department of Natural Resources (WADNR). [2] This planning level geographical delineation (Map 4.7.1) was then related to Thurston County Assessor parcel data to estimate the region's population and assets that are potentially vulnerable to tsunami risks.

Communities Most Vulnerable to a Tsunami

Low lying areas, estuaries, and the inlets of Thurston County will be subject to inundation. The tidal condition and the level of subsidence a coastline experiences from a major earthquake can also influence the extent of inundation. The WADNR model scenario infers that most of Thurston County's marine shoreline will experience tsunami activity. The risk assessment GIS exposure analysis shows every inlet in Thurston County is potentially at risk for land and property impacts. Unincorporated Thurston County and the City of Olympia have people, homes, and other assets that are in the tsunami inundation zone.

Extent

WADNR describes four types of tsunami risks that threaten Washington's coastal communities. Figure 4.7.1 describes their area of impact and the time needed to evacuate from the hazard area.[3]

Figure 4.7.1 Types of Tsunamis risks in Washington

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

Note: Evacuation time for a Cascadia earthquake tsunami for Puget Sound communities is hours

In 2021, WADNR published a map series and report on tsunami inundation areas from a CSZ earthquake generated tsunami. The scenario focused on modeling maximum tsunami inundation and timing of waves for the Puget Sound and its adjacent waters. Thurston County marine shorelines are included in the study. This section highlights the general findings of the tsunami model scenario results.

Tsunami waves would impact communities from Blaine at the U.S./Canada border to Olympia. After the onset of the earthquake, the tsunami wave would reach Blaine in approximately two hours and five minutes and Olympia in approximately four hours. The model estimates that wave troughs would precede crests in all locations. The leading trough would look similar to a sudden low tide. This would provide visual warning (in addition to strong and extended ground shaking) that a tsunami would be imminent.

Inundation

Inundation is the depth of tsunami-induced flooding over previously dry land. The model forecasts the tsunami will flood many low-lying regions along the Puget Sound. Inundation depths are dependent on the topography and may reach or exceed 10 feet in locations such as Bellingham, Deception Pass State Park, Vashon Island Ferry Terminal, Theler Wetlands near Belfair, and other areas. Inundation could extend well into many other populated areas such as Skagit and Snohomish counties lowlands and the Port of Tacoma. Significant river floodplain inundation could also occur upstream for the Skagit, Stillaguamish, Quilcene, Duckabush, Skokomish, Nisqually, and other rivers. The tsunami model does not account for the influences of tidal changes or projections in sea level rise.

Inundation estimates are noted for the following areas in Thurston County:

- Nisqually Delta North, 11.5 feet
- Nisqually Delta South, 1.4 feet
- Nisqually Delta, End of Boardwalk, at the Billy Frank Jr. National Wildlife Refuge, 2.9 feet
- Port of Olympia Marine Terminal, 0.5 feet
- Eld Inlet, 5 feet
- Oyster Bay, 5.7 feet

Current Speed

The speed of a tsunami depends on the depth of water; the deeper the faster. In the Puget Sound, the current speed could range from 1 to greater than 9 knots (1 knot is approximately 1.15 land miles per hour). Figure 4.7.2 shows ranges of current speed and the approximate hazards to port, ship, and docking facilities. Tsunamis slow as they reach shallow waters near land, however they can maintain speeds of 20 to 30 miles per hour.

Figure 4.7.2 Potential Damage by Current Speed

Speed (knots)	Potential damage
0-3	No expected damage
3-6	Minor/moderate damage possible
6-9	Major damage possible
>9	Extreme damage possible

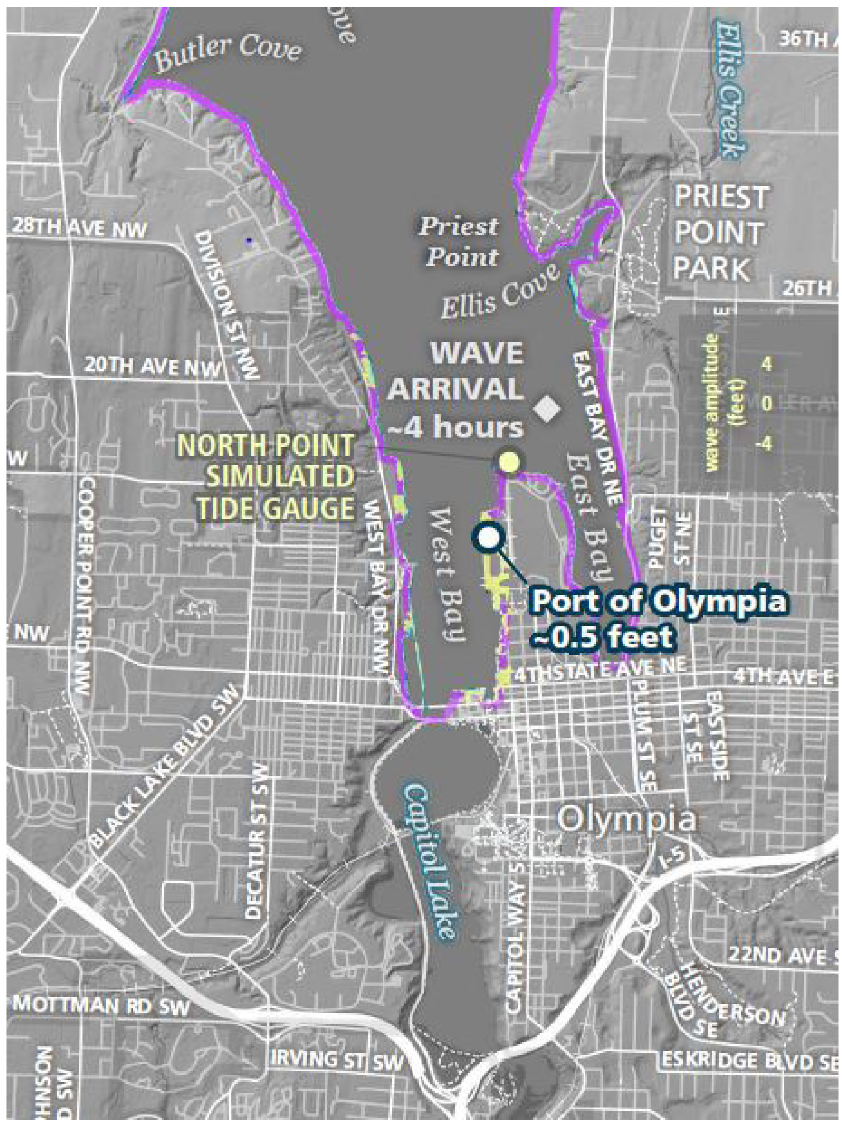
The tsunami model scenario estimates the following areas will experience current speeds of 3 knots or greater:

- Nisqually Delta Boardwalk, 0-3 knots
- Johnson Point, 3-6 knots
- Dana Passage, 10 knots
- Little Fishtrap to Big Fishtrap, 6-9 knots Squaxin Passage, 7 knots
- Port of Olympia Marine Terminal, 0-3 knots
- Edgewater Beach (near Cooper Point), 3-6 knots
- Squaxin Passage, 7 knots
- Oyster Bay, 0-3 knots

Timing of Tsunami Arrival

The estimated time of wave arrival for a given location correspond to the time that has elapsed from the beginning of earthquake shaking to the time when water first rises above the mean high water level. This timing doesn't account for the receding water levels that precede the first incoming wave. The first wave would not be the largest wave. Several minutes or hours could pass between the first wave arrival and the wave that produces the maximum current speed, inundation depth, or inundation extent.

At Olympia's North Point (near KGY Radio station), there will be a gradual drop in sea level by approximately 3 feet approximately three hours after the start of the earthquake. In



Inundation at the Port of Olympia is estimated to be a half-foot and the peak wave will arrive approximately 10 hours after the earthquake.

approximately four hours and 15 minutes after the earthquake, a wave of three feet will arrive. The largest wave is estimated to be the fourth wave (four feet) that arrives approximately 10 hours after the earthquake. Wave activity may last for 14 or more hours following the earthquake.

Effects of Climate Change

In general, tsunami hazards are not a climate change aggravated natural hazard. However, sea level rise, depending on the tide during a tsunami event would influence the depth and extent of tsunami inundation areas. It was beyond the scope of the WADNR study and modeling to account for the effects of sea level rise.

Previous Incidents

Historic Pacific Northwest Tsunamis

Thurston County has never experienced a tsunami event in recorded history. However, there is a history of local and distant tsunamis across the U.S. Pacific Coast.

The March 27, 1964 magnitude 9.2 subduction zone earthquake in Alaska caused ground shaking for three minutes. A tsunami ensued and impacted areas throughout the entire Pacific Ocean. The Tsunami was responsible for 110 deaths. It also caused a large submarine landslide which produced a separate 200-foot tsunami in Valdez Inlet.

Geologic evidence such as sediment deposits, ghost forests in Washington and Oregon, and records from Japan reveal that a large (M8.7-9.0) earthquake occurred off the Washington/ Oregon coast. Scientists estimate it occurred in January 1700 and produced nearly a 100-foot tsunami.

Probability of Occurrence

The likelihood of a large tsunami striking Thurston County as described in this risk assessment is tied to the probability for a large Cascadia Subduction Zone earthquake. While estimates vary, there is about a 37 percent chance of a megathrust 7.1+ magnitude earthquake occurring in the next 50 years.[4] This region's earthquake risk assessment categorizes earthquake as a medium probability – a major earthquake occurring within 100 years. For the region and communities with municipal boundaries or service areas that adjoin the Puget Sound shoreline a medium probability for tsunami is assigned. All other jurisdictions are characterized as having a low probability.

Vulnerabilities and Impacts

Impacts to People

Tsunamis are very dangerous due to their speed and volume of water. In the U.S., tsunami warnings are issued through the Emergency Alert System. Communities on Washington's outer coast are at greater risk for tsunami hazards due to the short time available for evacuation.

Tsunamis can kill or injure people and result in mass casualties. A destructive CSZ tsunami will impact and displace people in neighboring coastal communities. Thurston County's location between I-5 and US 101 makes the region a logical hub for evacuation and recovery support activities for Washington's central coastal communities. Thurston County will likely experience a surge in displaced individuals and families seeking safe refuge from disaster struck coastal areas.

An estimated 109 people in Unincorporated Thurston County and 52 people in Olympia are in the mapped tsunami inundation area and are potentially at risk for tsunami hazards (Table 4.7.1).

Table 4.7.1 Thurston County Population Residing in the Tsunami Inundation Areas

Jurisdiction	Population	Population Exposed	% Population Exposed
Bucoda	610	0	0%
Lacey	58,180	0	0%
Olympia	56,370	52	0.1%
Rainier	2,510	0	0%
Tenino	2,030	0	0%
Tumwater	26,360	0	0%
Yelm	10,680	0	0%
Unincorporated Thurston County	143,760	109	0.1%
Total Planning Area	**300,500**	**161**	**0.1%**

Impacts to Structures and Systems

Earthquake generated tsunami damage will likely be secondary to impacts from the direct ground shaking effects of an earthquake. Tsunamis can cause damage and destruction of homes, businesses, ports and harbors, boats, utilities, and critical infrastructure and facilities such as roads, bridges, power transmission, and water and wastewater systems. Communications, ground and marine transportation, and health and public safety services may be disrupted. A substantial volume of debris could overwhelm existing waste disposal and debris management systems.

Crescent City, California experienced damage from the 2011 Japan tsunami, about 10 hours after the initial earthquake. Courtesy of NOAA

Impacts from tsunamis can cause other hazards such as structural fires, transportation accidents, and hazardous materials release.

There are an estimated 54 residential, 28 commercial, and 2 industrial buildings located in Thurston County's tsunami inundation zone. In total, there are 84 buildings valued over $94 million that are exposed to a large tsunami event (Tables 4.7.2 and 4.7.3). There are an estimated four community lifeline assets located in the tsunami inundation area (Table 4.7.4). Exposed assets include a wastewater pump station and three state highway bridges.

Table 4.7.2 Number of Structures in the Tsunami Inundation Area

Jurisdiction	Number of Structures in Tsunami Inundation Areas							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0
Olympia	15	18	2	0	0	3	0	35
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated Thurston County	39	10	0	0	0	0	0	49
Total	**54**	**28**	**2**	**0**	**0**	**0**	**0**	**84**

Table 4.7.3 Value of Structures and Contents in the Potential Tsunami Inundation Area

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building & Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$63,726,655	0	$0	0.0%
Lacey	18,985	17,637	$17,357,526,547	0	$0	0.0%
Olympia	18,242	16,257	$19,116,213,011	35	$72,696,331	0.4%
Rainier	875	814	$393,003,023	0	$0	0.0%
Tenino	751	651	$404,778,123	0	$0	0.0%
Tumwater	9,513	8,408	$9,362,171,728	0	$0	0.0%
Yelm	3,139	2,827	$2,077,637,133	0	$0	0.0%
Unincorporated	53,104	817	$24,765,596,428	49	$22,215,710	0.1%
Total Planning Area	**104,854**	**817**	**$73,540,652,648**	**84**	**$94,912,042**	**0.1%**

Table 4.7.4 Thurston County Community Lifelines located in the Tsunami Inundation Area

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0
Olympia	0	0	1	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated Thurston County	0	0	0	0	0	0	3	3
Total Planning Area	**0**	**0**	**1**	**0**	**0**	**0**	**3**	**4**

Impacts to Natural, Cultural, and Historic Resources

Tsunami induced erosional forces, pollutants and toxic substances, sediment deposition, and marine debris can create near-term or permanent adverse impacts to agricultural lands and on and offshore natural resources. There could be loss of wildlife habitat and changes to the quality and availability of fresh water due to inundation by salt water. Changes to these resources can be detrimental to areas that are valued by communities and tribes for their economic, ecological, and recreational benefits. The Nisqually River Delta and portions of the Billy Frank Jr. Nisqually National Wildlife Refuge are estimated to receive 1.4 feet of inundation.

Impacts to Activities

Earthquake and tsunami losses will impact the region's economy. Communities throughout the Pacific Northwest will be challenged with recovery and rebuilding activity due to transportation disruptions, critical shortages of construction materials, contractors, skilled labor, and equipment.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.7.2 shows assets and structures in Thurston County that are located in the tsunami inundation areas by census tract social vulnerability ratings. Most areas affected by tsunami have a rating that ranges from very low to relatively moderate.

The Federal Emergency Management Agency National Risk Index (NRI) reports Thurston County's tsunami Index score as zero. The rating represents a community's relative risk for tsunami when compared to the rest of the United States. For comparison, Pierce County's NRI tsunami score is 86.5, a relatively moderate ranking. The NRI reports an estimated tsunami hazard annual loss of $0.

Community Hazard Risk Ratings for the Tsunami Inundation Areas

The countywide tsunami risk ranking score is 12, and Olympia's score is 6, both are low risk. Tsunami risk ranking scores are zero for most other communities. Tables 4.7.5 and 4.7.6 show community and special purpose tsunami hazard risk ratings). The details of the tsunami hazard risk assessment calculations are shown in Appendix C.

Table 4.7.5 Community Tsunami Hazard Risk Ratings

Municipal Plan Participants	Tsunami Hazard Risk Ranking Score	Risk Rating
Bucoda	0	Low
Lacey	0	Low
Olympia	12	Low
Rainier	0	Low
Tenino	0	Low
Tumwater	0	Low
Yelm	0	Low
Unincorporated Thurston County	12	Low
Total Planning Area	**12**	**Low**

Table 4.7.6 Special Purpose District Tsunami Hazard Risk Ratings

	Tsunami Hazard	
Special Purpose District Plan Participants	Risk Ranking Score	Risk Rating
East Olympia Fire District	0	Low
Intercity Transit	0	Low
Lacey Fire District	0	Low
McLane Black Lake Fire District	6	Low
Olympia School District	6	Low
SE Thurston Fire Authority	0	Low
South Bay Fire District	6	Low
The Evergreen State College	0	Low
Thurston PUD	6	Low
West Thurston Regional Fire Authority	0	Low

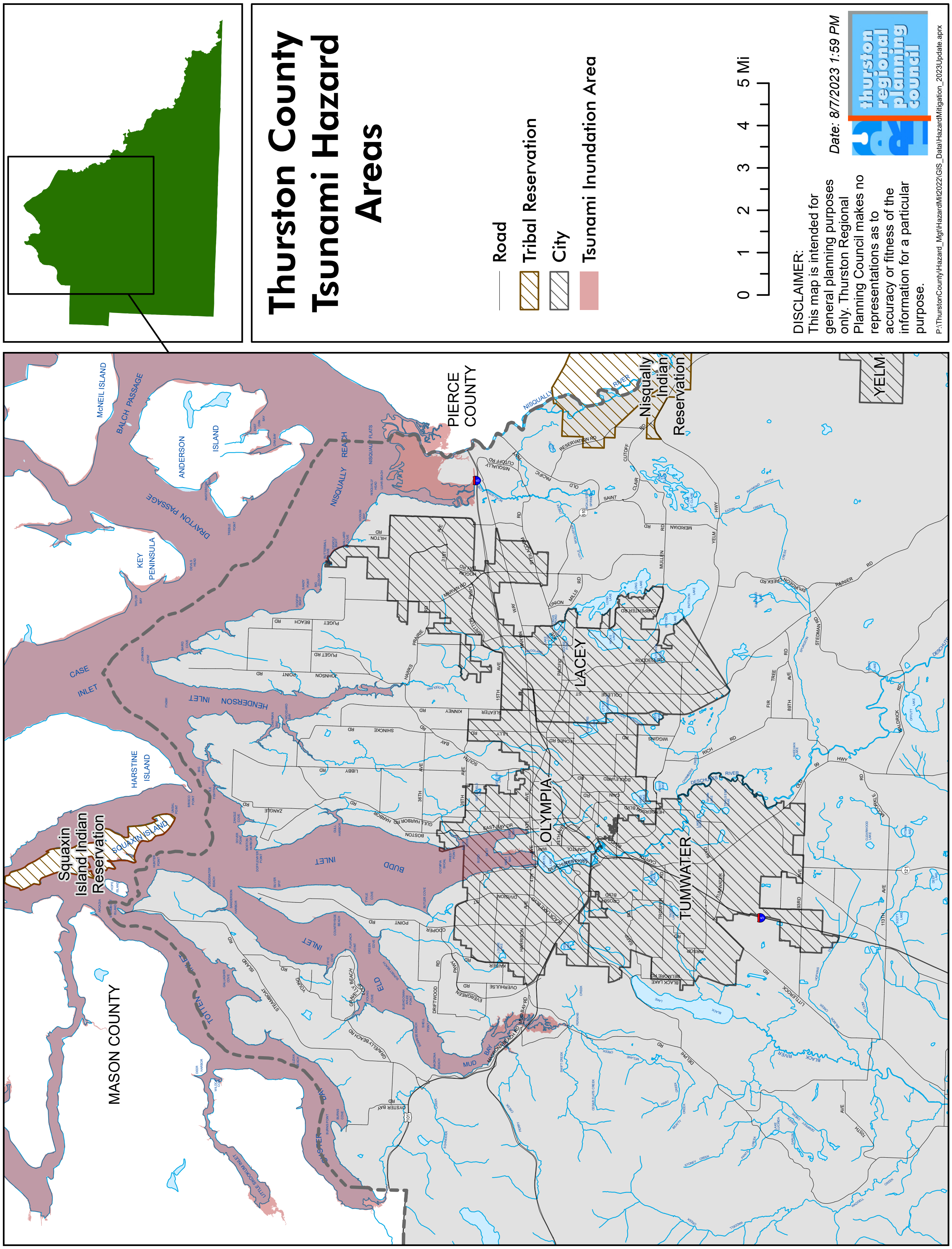
Changes in Tsunami Hazard Risks Since Last Plan Update

Tsunami inundation maps were unavailable to perform a vulnerability analysis and risk assessment during the development of the 2017 Hazard Mitigation Plan. The 2023 plan update process identified that approximately 0.1 percent of the population, 0.1 percent of assessed value of structures, and four community lifeline assets are potentially at risk for tsunami hazards. This provides a baseline tsunami hazard assessment for future evaluation of the region's tsunami vulnerabilities and risk.

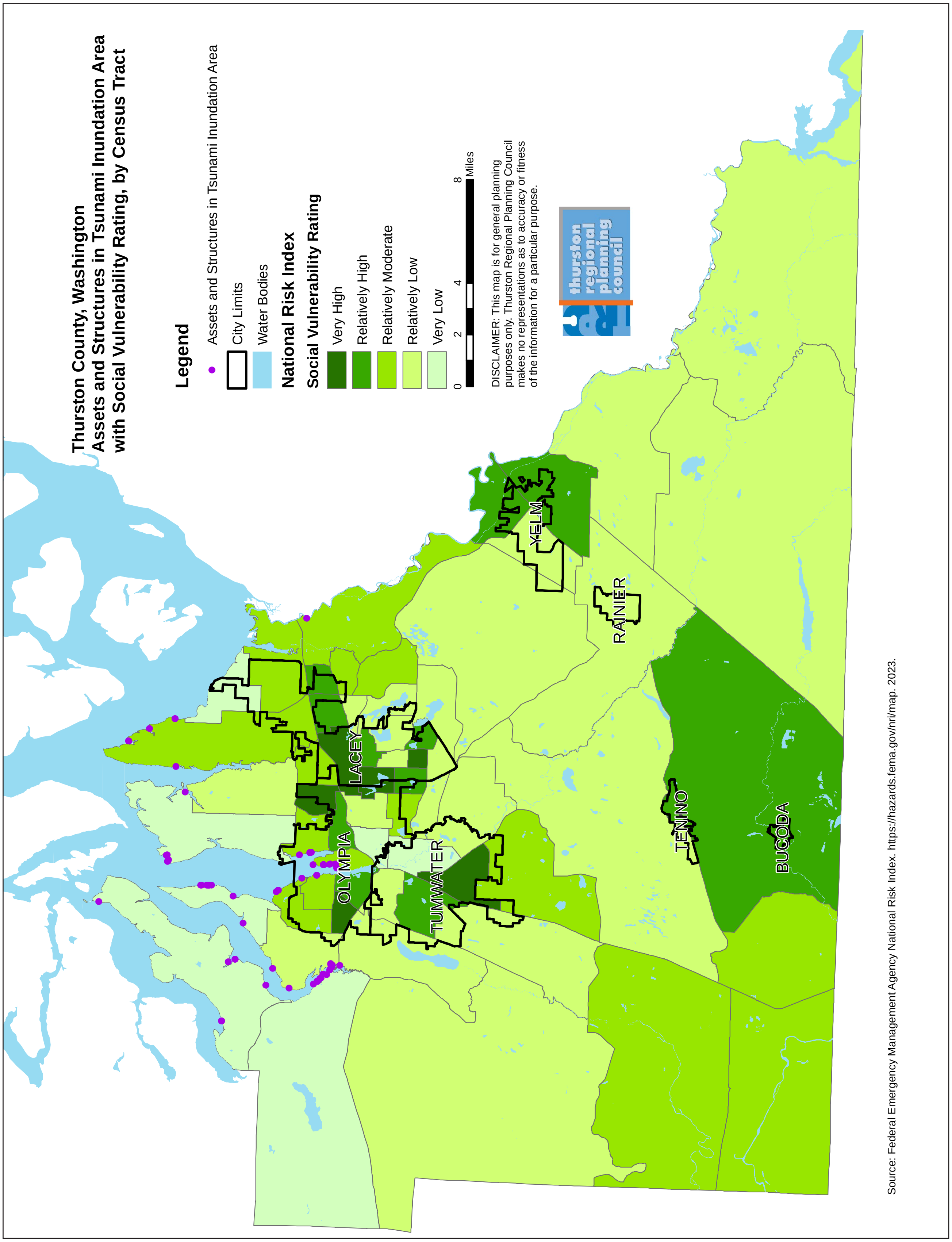
Connection to the Regional Mitigation Strategy

The 2022 "Thurston County Communities Natural Hazards and Resiliency Survey" results show that City of Olympia and Unincorporated Thurston County residents ranked tsunami as the lowest rated hazard of concern. This is expected considering the region has never experienced a tsunami and the probability of occurrence is low. Nonetheless, tsunami hazard education and preparedness for community residents is useful, both for its applicability to mitigation measures but also awareness to promote preparedness for residents who visit coastal communities. Tsunami hazard information will be included through the Regional Hazard Mitigation Public Outreach Strategy initiative.

Map 4.7.1 Tsunami Inundation Areas of Thurston County



Map 4.7.2 Exposed Assets and Structures in Tsunami Inundation Area and Thurston County Social Vulnerability Index Rating by Census Tract



Source: Federal Emergency Management Agency National Risk Index. https://hazards.fema.gov/nri/map. 2023.

Endnotes

[1]USGS. 2023. Tsunami Hazards Fact Sheet: https://pubs.usgs.gov/fs/2006/3023/2006-3023.pdf

[2]Dolcimascolo, Alexander, et. al. 2022. Tsunami hazard maps of the Puget Sound and adjacent waters – Model results from an extended L1 Mw 9.0 Cascadia subduction zone megathrust earthquake scenario: Washington Geological Survey Map Series 2021-01, originally published 2021. https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2021-01_tsunami_hazard_puget_sound.zip

[3]Washington State Department of Natural Resources. 2023. Geological Hazards Website: https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/Tsunamis#tsunamis-in-washington.

[4]Oregon Office of Emergency Management. 2023. Hazards Website: https://www.oregon.gov/oem/hazardsprep/pages/cascadia-subduction-zone.aspx#:~:text=Currently%2C%20scientists%20are%20predicting%20that,in%20the%20next%2050%20years.

Chapter 4.8

Volcanic Hazards Risk Assessment

Introduction

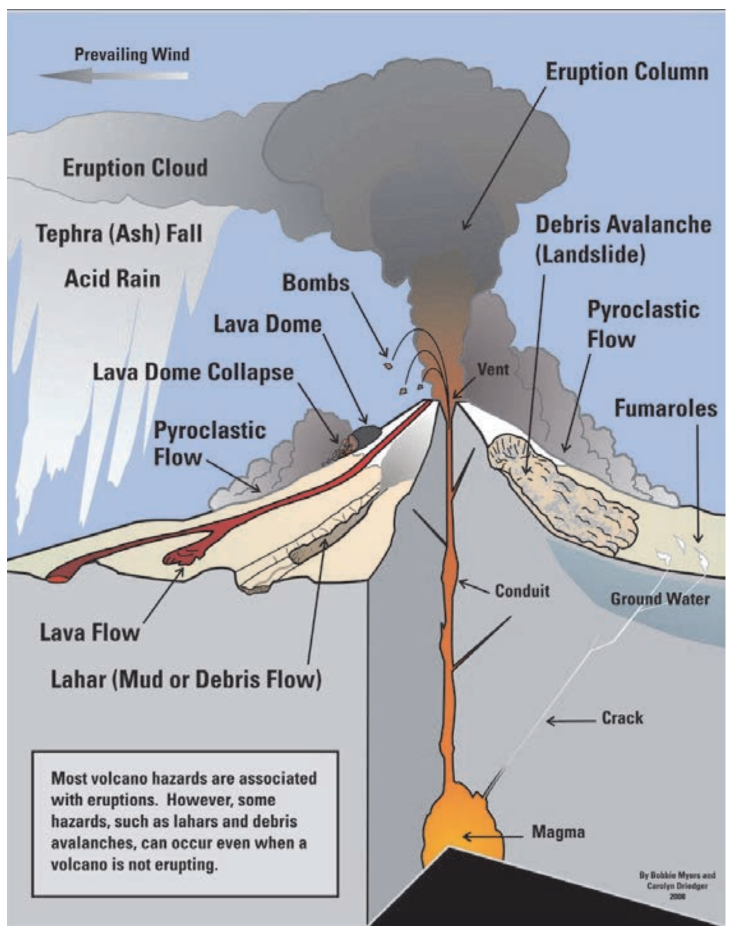
Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, and Mount Adams are part of the 1,200-mile Cascade Range of volcanoes extending from British Columbia to northern California. All five Washington Cascade mountains are classified as high threat volcanoes by the United States Geological Survey (USGS). The May 1980 eruption of Mount St. Helens resulted in a federal disaster declaration for Thurston County. Because it is the most active volcano, it will continue to pose a threat to Thurston County. Mount Rainier, at 14,410 feet above sea level and located only 30 miles from Thurston County's border, is the South Puget Sound Region's dominant volcanic threat.

Definition

There are numerous volcanic hazards including volcanic landslides, lava flows, and pyroclastic flows.

Only two volcanic hazards pose direct threats to areas within Thurston County and are the focus of this risk assessment: volcanic ash and lahar (Figure 4.8.1).

Figure 4.8.1 Volcanic Hazards



Graphic courtesy of USGS.

Volcanic Ash

Ash or tephra is the term for any type and size of rock fragment that travels in an airborne path from a forceful volcanic eruption. Cascade volcanoes can produce a hazardous column of suspended debris that subsequently falls to the ground in the direction of prevailing winds. A tephra column can travel for hundreds of miles and deposit ash in significant quantity. Both the thickness of the deposition and the size of the particles decrease with increasing distance from the site of eruption. Ash particles are less than 0.08-inch in diameter.

Lahar

Cascade volcanoes and their lower elevation valleys are ideal settings for massive debris flow- and mudflow-disasters because of the immense quantity of ice, water, rock, and sedimentary materials available that can suddenly mobilize downslope under the action of gravity. Such events, triggered by volcanoes, are known as lahars. The USGS describes a lahar as follows:

> *A lahar is a flowing mixture of water-saturated debris that moves downslope under the force of gravity. Debris flows consist of material varying in size from clay to blocks several tens of meters in maximum dimension. When moving, they resemble masses of wet concrete and tend to flow downslope along channels or stream valleys. Debris flows are formed when loose masses of unconsolidated wet debris become unstable. Water may be supplied by rainfall or by melting of snow or ice. Debris flows may be formed directly if lava or pyroclastic flows are erupted onto snow and ice. Debris flows may be either hot or cold, depending on their manner of origin and temperature of their constituent debris.*[1]

Removal of ash from Mount Saint Helens near the Yakima Airport. Photo courtesy of the Yakima Herald

Area of Impact

Volcanic Ash

No geographical analysis was performed to assess volcanic ash vulnerabilities for this hazard's risk assessment as there are no documented or mapped scenarios for Tephra hazards in Thurston County. It's plausible that some or all of Thurston County could receive ash from a dusting to greater depths from Mount Rainier or other Cascade volcanoes under the right wind conditions.

Lahar

For the purposes of the hazard risk assessment, the lahar hazard area in Thurston County is defined as the USGS mapped Case 1 Lahar inundation area (Map 4.8.1). General building stock and critical facilities were overlaid with the lahar inundation map. General building stock and critical facilities data with known property replacement cost values were overlaid with the lahar map to estimate population exposure, building exposure, and dollar-value estimates of damage to characterize a hazard risk rating (see Impacts and Vulnerabilities).

Volcanologists consider a Case 1 lahar originating from Mount Rainier the most appropriate scenario for hazard mitigation planning.[2] This type of lahar event is best historically represented by the Electron Mudflow (see Extent and Previous Incidents sections for more information about historic Lahars). The risk of this lahar type exceeds that of all smaller but more frequent flows. In addition, the risk is increased by a potential to occur without a major volcanic eruption, which may not afford downstream populations an early warning. A non-eruptive event could be initiated by non-magmatic seismic activity, by steam eruptions, or just by gravity in places where a failure plane has been loosened by clay and hydrothermal fluids.

Scientific research and mapping of hydrothermally altered rocks on Mount Rainier's high altitude slopes suggests that the west flank of the mountain, including the head of the Puyallup River, has the greatest potential for generating large landslides that are likely to initiate far-reaching lahars.[3] The Puyallup River valley, and to a lesser extent, the Nisqually River valley, whose basin also includes weakened rock, are at the most risk from large landslide-generated lahars. Lahars generated by eruptions could descend any of the mountain's valleys.[4]

Communities Most Vulnerable to a Lahar

Based on the Case 1 lahar scenario, properties along the Nisqually River Valley are the most susceptible to lahar hazards. Following the Nisqually River southeast to northwest, the following general vicinities and communities along the Nisqually River may be most affected under this scenario:

- Properties north of Clear Lake along Peissner Rd SE and Hobson Rd SE
- Properties northeast of Bald Hills Rd near Cook Rd SE and Dan Cook St SE
- McKenna Elementary School (Pierce County), Yelm Community School District
- Wa He Lut Indian School
- Properties between the Nisqually River and the Yelm Urban Growth Area Boundary near Bridge St SE and Flume Rd SE
- Properties northeast of Yelm in the northeast section of the Nisqually Pines residential community near Port Orford Blvd SE, Heather Ln SE, and Briar St SE
- The City of Centralia Power Plant off Mud Run Road
- Properties on the Nisqually Indian Reservation adjoining the Nisqually River migration zone
- Virtually all properties in the Nisqually Valley from Durgin Rd SE north to the Puget Sound.

Extent

Volcanic Ash

The severity of the hazard depends on the depth and geographic extent of ash deposition. Ash can travel great distances and cover areas over hundreds or thousands of square miles.

Lahar

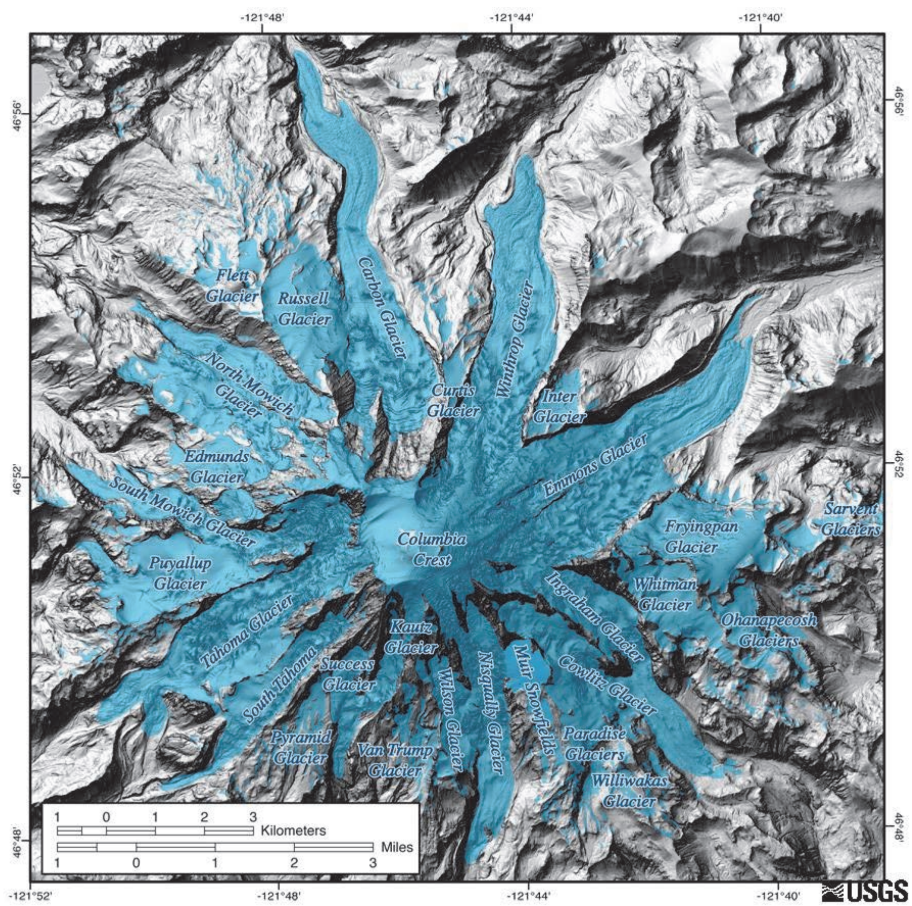
Lahar - Scientific literature for Cascade lahars identifies several size and origin classifications. The USGS has summarized two types of Mount Rainier lahar events that could threaten communities within the Nisqually River valley:

> ***Meltwater Generated Lahar*** *- A volcanic eruption can produce an explosive event which releases a mixture of hot gases and rock debris, known as a pyroclastic flow. A pyroclastic flow behaves almost like a fluid and flows down the topography of the mountain. This hot churning debris flow swiftly melts snow and ice and subsequently mixes with the meltwater to form a lahar. Such lahars are often preceded by volcanic events or seismic activity which can provide some warning of an impending eruption. Geological evidence indicates that several of Mount Rainier's past lahars were formed by this phenomenon.*
>
> ***Landslide Generated Lahars*** *- Landslides can occur on the flanks of Mount Rainier that can displace significant volumes of earth and water to form a substantial lahar. Magma can rise and force pressure against the internal structures of a mountain causing deformation and destabilization of the mountain's edifice. A modern example of this type of effect occurred with the bulge that formed on the north flank of Mount St. Helens in the months preceding the May 18, 1980 eruption. This bulge eventually collapsed creating one of the largest known landslides in modern times. Earthquakes can also initiate a landslide of unstable structures. Landslides can also occur from an eventual failure of a rock mass's cohesive strength. Rocks can be weakened by the chemical action of acidic fluids that are created from volcanic gases, heat and ground water. Over time, this acidic fluid infiltrates the rock and eventually converts the hard volcanic rock into weak, clay-rich rock. This process is called hydrothermal alteration or metamorphism. These altered rocks and water-saturated clay-rich deposits could eventually slough away from the mountain from the force of a volcanic eruption. These landslides can rapidly transform into a lahar. Many large scale lahars on Mount Rainier have formed in this fashion. Hydrothermally altered rock landslides have also produced lahars without the trigger of a volcanic eruption. One such lahar, known as the 500-year-old Electron Mudflow, is believed to have originated without a volcanic eruption. No eruptive volcanic deposits have been discovered that coincide with the age of this lahar. This lahar deposited debris as high as 20 feet thick, and contains remnants of an old-growth forest in the vicinity of the City of Orting in Pierce County.*

Origin, Course, and Timing of Lahar

At 14,410 feet, Mount Rainier is the highest peak in the Cascade Range and remains an active volcano. It is estimated to contain nearly one cubic mile of glacial ice, more than all the other Cascade volcanoes combined (see Figure 4.8.2).[5] The sheer volume, mass, rate of speed, and churning contents of a massive debris flow could destroy virtually all human made structures in its path. Past Cascade lahars surged nearly 45 to 50 miles per hour at steep slopes and were 100 feet or more thick. Scientists have identified more than 60 lahars originating from Mount Rainier in the past 10,000 years. Deposits of past lahars are found in all the valleys that originate on Mount Rainier's flanks.[6] The Washington State Hazard Mitigation Plan states that more than 150,000 people live on historic lahar deposits in the Puget Sound lowlands. The USGS rates the risk of a large lahar from Mount Rainier to the surrounding Western Washington population, as the Puget Sound Region's greatest volcanic hazard.

Figure 4.8.2 The Glaciers of Mount Rainier



Glaciers of Mount Rainier overlaid on base map LIDAR image. Steep Cascade volcanoes, rich with glaciers, and their lower elevation valleys are ideal settings for massive debris flow- and mudflow-disasters. Graphic courtesy of USGS.

The USGS has studied artifacts from past lahars to predict future impacts. Deposits are analyzed to determine the type, frequency, and magnitude of past events. Through these studies, scientists predicted a potential inundation hazard in the lower Nisqually River valley caused by a lahar entering and possibly flowing beyond Alder Reservoir. Because Alder Dam exists for power generation, Alder Lake is never empty. Scientists are concerned that a lahar entering the reservoir could either cause dam failure or catastrophically displace a significant volume of the stored water.

The Alder Dam and the Alder Lake Reservoir, owned and operated by Tacoma Power for power generation, creates uncertainty about the potential lahar flow dynamics downstream from the dam. This dam is vulnerable to a Case 1 Lahar. The travel time of a Case 1 flow from the edifice of Mount Rainier to the reservoir may be less than two hours. High reservoir water levels do not offer sufficient capacity to contain the volume of the lahar flow. Scientists report that the reservoir is most vulnerable to failure caused by a wave of translation, because the relatively confined valley upstream can convey a large lahar without great volume loss.[7] A wave of translation would likely cause water to overtop the dam and send waves of water downstream from the reservoir. Smaller lahars entering the reservoir may not pose immediate risks for downstream flooding but could increase the rate of sedimentation for the dam and thereby shorten its term of operation.

The Tacoma Power "Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862 [LaGrande and Alder Dams)" includes the following excerpt:

> *Another possible [hazard] event is that of a lahar or mudflow originating from Mt. Rainier. Travel time of a lahar or mudflow to Alder Lake is estimated between 0.5 and 4.2 hours. Most lahars having sufficient volume to cause a significant rise in the lake level will travel in less than 2 hours. Because of the rapid nature of the inflow, it is not possible to affect any meaningful advance spill to increase reservoir capacity. An advance spill of 20,000 cubic feet per second for one hour will only yield approximately half-foot of reservoir capacity at full lake. Therefore, should lake levels rise rapidly (>3 feet/hour) no spill is recommended and evacuation to an observation post should be made. The combined outflow of both a large spill and overtopping may be more adverse than would result from overtopping only. In the unusual case of a lahar causing more gradual rise in inflow, spill could be implemented, but is not recommended unless reduction in spill can be made remotely. Rapid evacuation should be planned prior to local operation of the spillway.*

Sensors and gauges at the Alder Dam would provide indication of changes in the level of water at the reservoir. Tacoma Power will notify multiple state and local emergency response agencies if failure of the Alder or LaGrande dams appeared imminent. Residents within the Nisqually River valley could evacuate to higher ground if given sufficient warning of a catastrophic dam failure. The Alder and LaGrande Sequential Dam Failure Flood Inundation zones approximate the USGS's extent of the inundation zone for a Case 1 lahar in the Nisqually River valley (Map 4.8.1).

Should a Case 1 lahar adversely affect the Alder dam, flood inundation could occur at the Nisqually River bridge at SR507 (McKenna, Pierce Co.) in two hours and 30 minutes. The inundation would peak at this same location in four hours and 36 minutes.[8]

Previous Incidents

May 18, 1980. Mount St. Helens Eruption. DR 623

Volcanic Ash

The 1980 eruption of Mount St. Helens emitted an ash column over 10 miles high. Over the course of the day of the eruption, winds blew nearly 540 million tons of ash to the east.[9] Fallout from the ash created complete darkness in Spokane, nearly 250 miles away; dropping one half inch of ash only a few hours after the start of the eruption. Preceding the May 18 eruption, other eruptions dusted layers of ash in areas of Thurston County.

Lahar

No lahars have impacted Thurston County in modern times. The USGS reports that during the May 18, 1980 eruption of Mount St. Helens, approximately 2.3 billion cubic meters (3 billion cubic yards) of material was deposited in the upper 27 km (17 mi) of the North Fork Toutle River valley resulting in massive lahars.

Historic Lahars Originating from Mount Rainier

Lahars originating from Mount Rainier were interspersed by thousands of years. They varied in size and magnitude. Past Nisqually River valley lahars are known to have flowed down the slopes of Mount Rainier all the way to the Puget Sound. The USGS provides the following short history of major lahar events originating from Mount Rainier:

> *The largest lahar originating from Mount Rainier is known as the Osceola Mudflow. This cohesive lahar occurred about 5,600 years ago, and was at least 10 times larger than any other known lahar from Mount Rainier. It was caused by a large debris avalanche composed mostly of hydrothermally-altered material, and may have been triggered by magma forcing its way into the volcano. Osceola deposits cover an area of about 550 square kilometers (212 square miles) in*

Remnants of the Lahar on the Toutle River from the May 18, 1980 Mount St. Helens. Photo courtesy of USGS.

the Puget Sound lowland, extending at least as far as the City of Kent, and to Commencement Bay, now the site of the Port of Tacoma. The communities of Orting, Buckley, Sumner, Puyallup, Enumclaw, and Auburn are also wholly or partly located on top of deposits of the Osceola Mudflow and, in some cases, of more recent debris flows as well.

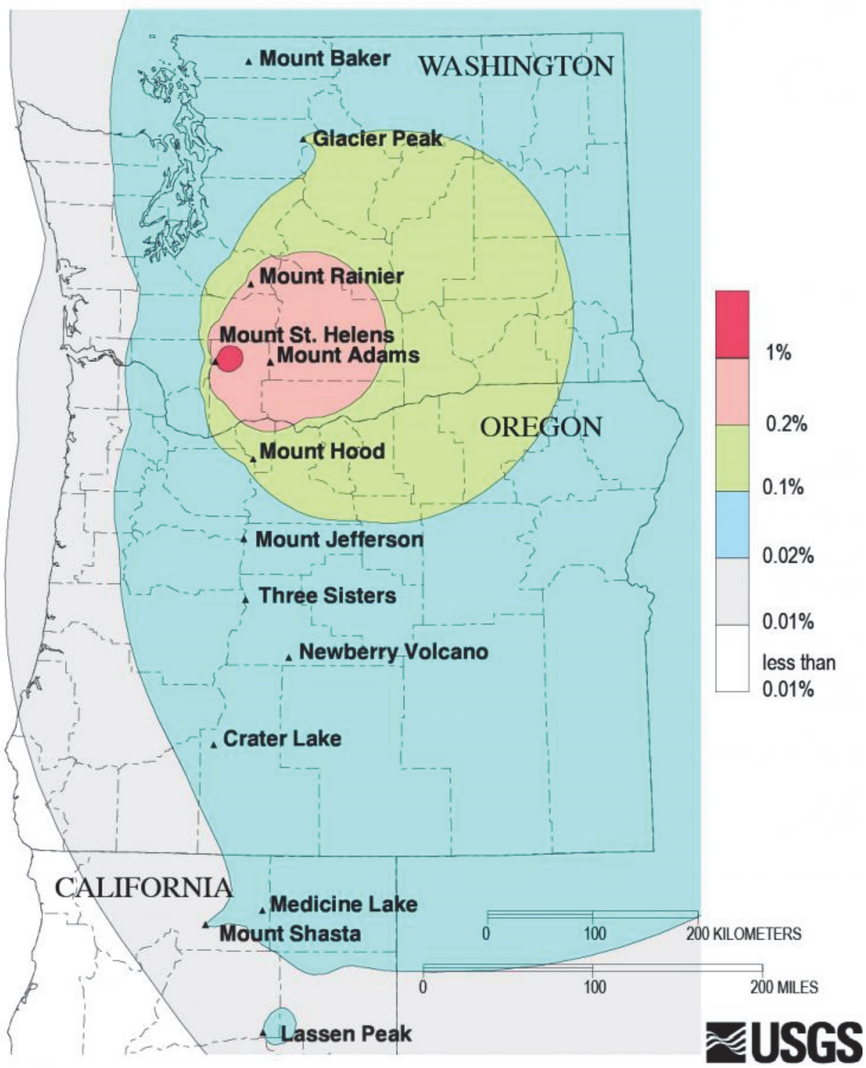
At least six smaller debris avalanches have spawned lahars in the past 5,600 years. One of these, the Electron Mudflow, which was derived from a slope failure on the west flank of Mount Rainier about 600 years ago, has not been correlated with an eruption. The Electron Mudflow was more than 30 yards deep where it entered the Puget Sound lowland at the community of Electron. Its deposits at Orting are as much as 6 yards thick and contain remnants of an old-growth forest.

Probability of Occurrence

Volcanic Ash

USGS reports that Mount Rainier has only produced moderate quantities of ash in past eruptions. The eruptions of Mount St. Helens in 1980 deposited a scant layer of ash in Thurston County, but the fallout did not pose a significant hazard to the region. Thurston County winds prevail from the south and west, therefore ash is more likely to disperse east of the Cascades. If Mount Rainier or Mount St. Helens were to erupt, a resultant ash plume would require an easterly wind to deposit ash in Thurston County. The USGS calculated a 0.02 percent annual probability for a significant ash deposit of one centimeter or greater for the southeastern tip of the county and 0.01 percent for most of the county and its most populated areas (Figure 4.8.3).[10] There is a low probability of a volcanic tephra event impacting Thurston County.

Figure 4.8.3 Probability of Cascades Tephra Hazard



Annual probability of the deposition of 1 centimeter (0.4 inch) or more of tephra (ash) from eruptions in the Cascade Range. Graphic courtesy of USGS.

Lahar

The historical occurrences of lahars are classified by size. The largest lahar, historically represented by the Osceola mudflow, is designated a Case M Lahar for a maximum lahar event. Scientists offer this scenario as "low probability and high consequence," with the implication that the risk may be unacceptable at even very small probabilities.[11] This lahar is estimated to occur about every 10,000 years. When compared with other historic lahars from postglacial times, scientists consider this maximum lahar a statistical outlier. There is no geologic record of a Case M Lahar affecting Thurston County.

A Case 1 lahar is estimated to have a recurrence interval of approximately every 500 to 1,000 years. The Washington State Hazard Mitigation Plan indicates there is a 1 in 100 to 1 in 500 annual probability of occurrence of lahar inundating the Nisqually River. The probability of a Case 1 Lahar is low.

Vulnerabilities and Impacts – Volcanic Ash

Because no geographical analysis was performed to assess volcanic ash vulnerabilities, a summary of ash impacts to people, systems, resources, and activities is limited. A quarter inch or more of ash fall will disrupt nearly every mode of transportation. Ash fall obscures visibility and wet ash creates hazardous driving conditions. Excess ash will delay transportation and will limit response times for emergency responders. Aircrafts are especially vulnerable as ash can disable engines, therefore air transportation would be grounded in the affected area while conditions pose a hazard. Inhalation of ash particles can cause respiratory irritation and pose more serious problems for people with respiratory diseases; but this can be mitigated by simply avoiding exposure. Ash can destroy crops, impact livestock access to pastures, contaminate lakes and streams, clog stormwater systems, and damage exposed motors and outdoor mechanical systems. Three inches of ash begins to exceed load capacities of some building rooftops and can cause structural failure. Failure may also occur with lower depths of ash when combined with excess precipitation. Wet ash is known to cause power lines to short. Ash removal and disposal would likely be the greatest cost to both the public and private sectors. The 1980 eruption of Mount St. Helens posed a major nuisance for communities in Eastern Washington. In Yakima, ash removal took ten weeks and cost $2.2 million.[12]

Vulnerabilities and Impacts – Lahar

The risk assessment for volcanic hazards is based on the USGS Mount Rainier Case I Lahar Scenario for the Nisqually River Valley and is summarized in the remainder of this section.

Impacts to People

Lahars are very dangerous and can occur without volcanic eruptions. People who live or work in the Nisqually Valley or near the mouth of the Nisqually River are at greater risk from lahar hazards than any other areas of Thurston County. Lahar damage principally occurs by impact from large boulders or logs carried in the lahar’s flow. Lahar forces present high drag and buoyancy forces that are created by its dense fluids. Lahars can cause damage by abrasion, blunt force trauma, drowning, and burial. With enough warning, people can evacuate from the Valley or retreat to higher ground. Lahars will destroy most human structures in their paths. People who lose their homes will experience housing insecurity and are likely to experience grief and other mental stress.

An estimated 2,284 people who live in Unincorporated Thurston County in the Nisqually River Valley are potentially at risk for lahar hazards (Table 4.8.1).

Table 4.8.1 Thurston County Population Residing in the Potential Lahar Hazard Areas

Jurisdiction	Population	Population Exposed	% Population Exposed
Bucoda	610	0	0%
Lacey	58,180	0	0.1%
Olympia	56,370	0	4.3%
Rainier	2,510	0	0.5%
Tenino	2,030	0	0.1%
Tumwater	26,360	0	0.8%
Yelm	10,680	0	0.1%
Unincorporated	143,760	2,284	1.6%
Total Planning Area	**300,500**	**2,284**	**0.8%**

Impacts to Structures and Systems

Buildings and other structures in the path of a debris flow can be buried or carried away. Because of their relatively high density and viscosity, Lahars can move and even carry away vehicles and other objects as large as bridges.

The following major bridges/routes are located within the Case I inundation zone and could be adversely impacted: State Route 507 Bridge between Yelm and McKenna, Old Pacific Highway, and Interstate 5. There are also three railroad bridge crossings: The Tacoma Rail Mountain Division railroad, the Yelm Prairie Line (non-operational – to be converted to a shared use trail), and the BNSF Railway mainline near I-5. The Centralia City Light Yelm Hydroelectric Project plant could also be impacted. A large lahar that inundated downstream below the Nisqually Hydroelectric Project would have major transportation and economic disruptions for a significant number of communities and Joint Base Lewis McChord along the South Sound I-5 Corridor.

There are 817 residential units, 35 commercial buildings, and four educational facilities located in lahar hazard areas in Thurston County. In total, there are 857 buildings valued over $258 million that are exposed to potential lahar hazard areas (Tables 4.8.2 and 4.8.3).

Table 4.8.2 Number of Structures in the Lahar Inundation Areas

	Number of Structures in Lahar Inundation Areas							
Jurisdiction	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	3	0	0
Rainier	4	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	3	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated Thurston County	817	35	1	0	0	0	4	857
Total	**817**	**35**	**1**	**0**	**0**	**0**	**4**	**857**

Table 4.8.3 Value of Structures and Contents in the Potential Lahar Inundation Areas

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building & Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$63,726,655	0	$0	0.0%
Lacey	18,985	17,637	$17,357,526,547	0	$0	0.0%
Olympia	18,242	16,257	$19,116,213,011	0	$0	0.0%
Rainier	875	814	$393,003,023	0	$0	0.0%
Tenino	751	651	$404,778,123	0	$0	0.0%
Tumwater	9,513	8,408	$9,362,171,728	0	$0	0.0%
Yelm	3,139	2,827	$2,077,637,133	0	$0	0.0%
Unincorporated Thurston County	53,104	817	$24,765,596,428	857	$258,088,648	1.0%
Total Planning Area	**104,854**	**817**	**$73,540,652,648**	**857**	**$258,088,648**	**0.4%**

There are approximately 16 community lifeline assets that are located in potential lahar hazard areas (Table 4.8.4). Exposed assets include electrical substations, water facilities, a school, and several state highway bridges.

Table 4.8.4 Thurston County Community Lifelines located in the Lahar Inundation Areas

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated Thurston County	0	2	5	0	0	1	8	16
Total Planning Area	**0**	**2**	**5**	**0**	**0**	**1**	**8**	**16**

Impacts to Natural, Cultural, and Historic Resources

Should a large lahar flow extend beyond the Nisqually Hydroelectric Project, it would have direct adverse impacts on downstream natural, cultural, and historic community assets. A lahar could have long-term impacts on Nisqually River fish and wildlife habitat which in turn would have significant cultural, economic, and sustenance impacts for the Nisqually Indian Tribe. Approximately 145 students are enrolled at the Wa He Lut Indian School, located in the Case 1 Lahar Inundation Zone. The school is an important educational, cultural, social center for the Nisqually people and the school's families and educators. The Billy Frank Jr. Nisqually National Wildlife Refuge is one of the highest quality and ecologically diverse estuaries on the Puget Sound. The loss of habitat restoration investments would have a lasting adverse impact on salmon and other sensitive wildlife species.

Impacts to Activities

The loss of bridges and impacts to roads will disrupt the transportation system creating delay. Major disruptions to the transportation system will in turn will impact the region's economy.

Risk Ratings

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. The lahar inundation area encompasses portions of Thurston County that range from relatively low to relatively high social vulnerability. Map 4.8.2 shows assets in Thurston County that are located in potential lahar hazard areas by census tract social vulnerability ratings.

The Federal Emergency Management Agency National Risk Index (NRI) provides a National Risk Index score and rating. The rating represents a community's relative risk for lahar when compared to the rest of the United States. According to the NRI, Thurston County's volcanic hazard risk index rating is "relatively high" at 95.5. The NRI reports an estimated volcanic hazard annual loss of approximately $14 million.

Community Hazard Risk Ratings for the Lahar Hazard Areas

The countywide lahar risk ranking score is 6 – a low risk rating. Lahar risk varies from none to low for most communities. Tables 4.8.5 and 4.8.6 show community and special purpose lahar hazard risk ratings. The details of the lahar hazard risk assessment calculations are shown in Appendix C.

Table 4.8.5 Community Lahar Hazard Risk Ratings

Municipal Plan Participants	Lahar Hazard Risk Ranking Score	Risk Rating
Bucoda	0	Low
Lacey	0	Low
Olympia	0	Low
Rainier	0	Low
Tenino	0	Low
Tumwater	0	Low
Yelm	0	Low
Unincorporated Thurston County	6	Low
Total Planning Area	**6**	**Low**

Table 4.8.6 Special Purpose District Lahar Hazard Risk Ratings

Special Purpose District Plan Participants	Lahar Hazard Risk Ranking Score	Lahar Hazard Risk Rating
East Olympia Fire District	0	Low
Intercity Transit	0	Low
Lacey Fire District	3	Low
McLane Black Lake Fire District	0	Low
Olympia School District	0	Low
SE Thurston Fire Authority	3	Low
South Bay Fire District	0	Low
The Evergreen State College	0	Low
Thurston PUD	6	Low
West Thurston Regional Fire Authority	0	Low

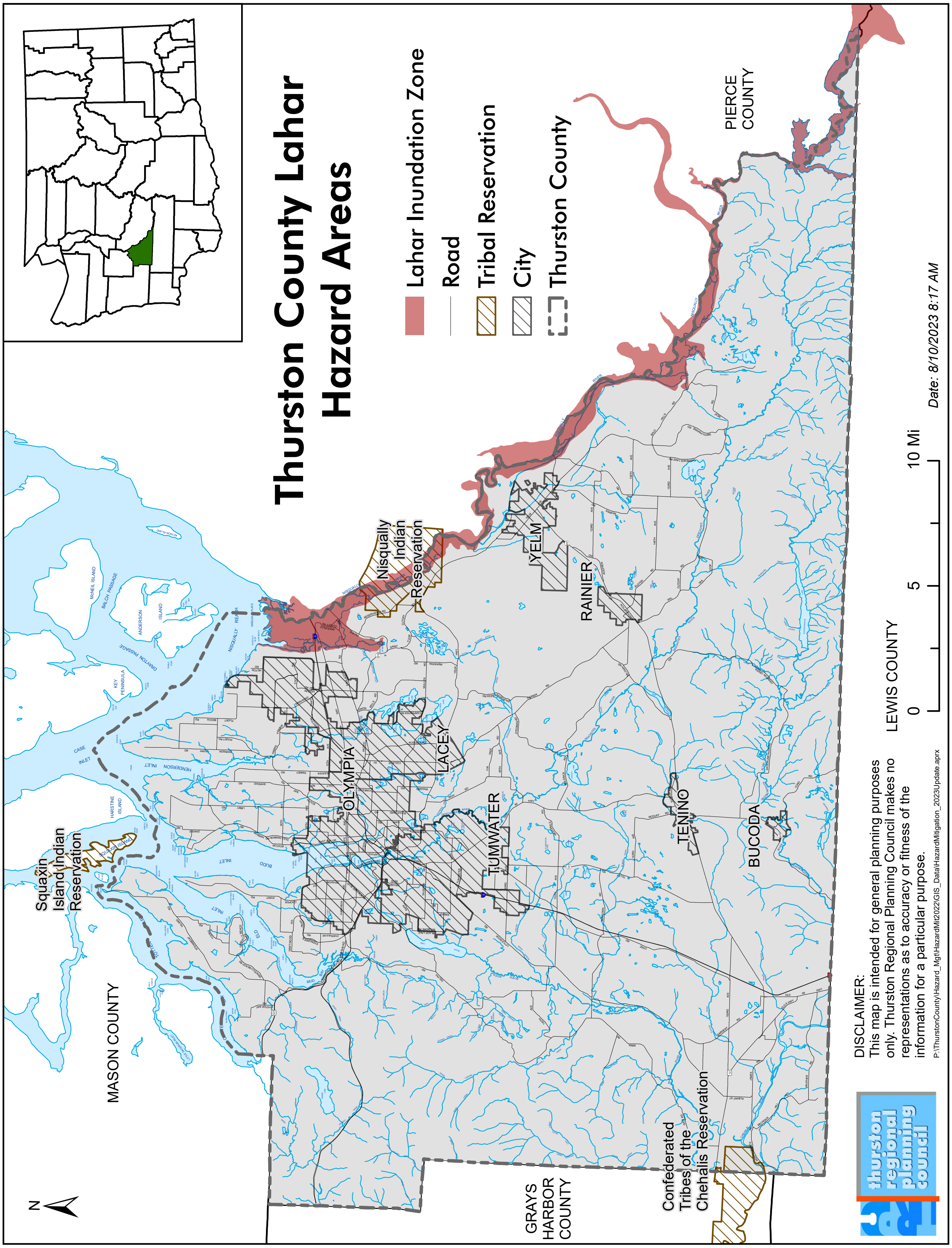
Changes in Lahar Hazard Risks Since Last Plan Update

A different methodology was used to estimate hazard risks and the vulnerability of community assets since the plan was last updated. It is not possible to perform a regional assessment of any changes in lahar hazard risks since the previous plan was adopted.

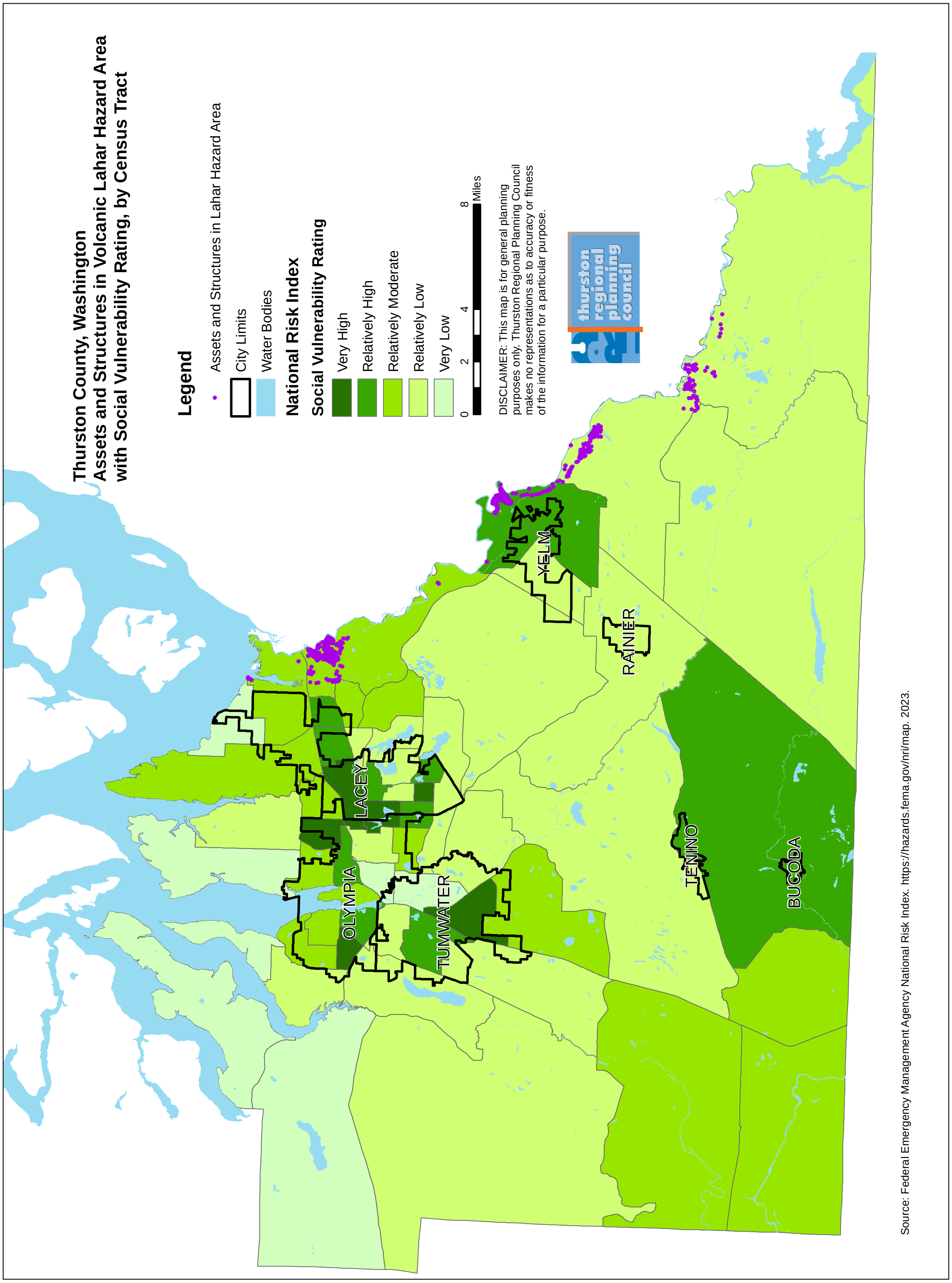
Connection to the Regional Mitigation Strategy

The Hazard Mitigation Planning Workgroup identified a regional initiative, Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar. This initiative will develop an evacuation plan for potential dam failure and lahar hazards in coordination with residents, businesses, and other stakeholders. The plan will include routes, alert notification protocols, signs, staging areas, public education, emergency sheltering needs, operational plans, and training for organizations and personnel who would be involved in evacuation operations.

Map 4.8.1 Lahar Hazard Areas of Thurston County



Map 4.8.2 Exposed Assets and Structures in Lahar Inundation Area and Thurston County Social Vulnerability Index Rating by Census Tract



Endnotes

[1]Miller. 1989. Potential Hazards from Future Volcanic Eruptions in California: USGS Bulletin 1847.

[2]Hoblitt,R.P., et.al. 1998. Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428

[3]Reid, Mark, E. et.al. 2001. Volcano Collapse Promoted by hydrothermal Alteration and Edifice Shape, Mount Rainier, Washington. Geology. V29; No.9.

[4]Scott, K.M., et.al. 1995. Sedimentology, Behavior, and Hazards of Debris Flows at Mount Rainier Washington. U.S. Geological Survey Professional Paper 1547.

[5]Driedger, Carolyn, L. and Scott, William, E. 2008. Mount Rainier - Living Safely With a Volcano in Your Backyard. USGS Fact Sheet 2008-3062.

[6]Ibid.

[7]Tacoma Power. 1999. Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862.

[8]Scott, K.M., et.al. 1995. Sedimentology, Behavior, and Hazards of Debris Flows at Mount Rainier Washington. U.S. Geological Survey Professional Paper 1547.

[9]Tilling,Robert, I. et.al. 1990. Eruptions of Mount St. Helens: Past, Present, and Future, U.S. Geological Survey Special Interest Publication.

[10]Hoblitt,R.P., et.al. 1998. Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428 Map Plate 2.

[11]Oral Communication from William E. Scott, Geologist, Cascades Volcano Observatory, U.S. Geological Survey, October 7, 2008.

[12]Ibid.

Image next page - Lahar (dark deposit on snow) on Mount Saint Helens after the March 19, 1982, eruption. Photo courtesy USGS.

Chapter 4.9
Wildfire Hazard Risk Assessment

Introduction

Between 2018 and 2022, a combined 8,138 wildfires burned 2,298,827 acres on all state and federal lands in Washington State. During the same period, 305 wildland fires burned 531 acres in Thurston County.

Wildfire is unique from other natural hazards:

- There was an annual average of 51 wildfire ignitions throughout Thurston County in the last decade; it is the most frequently occurring hazard in the Thurston Region.
- Human behavior and accidents start over 98 percent of wildfires in Thurston County; they are preventable.
- Local, state, and federal wildfire fighting capabilities and resources are readily available to suppress wildfire hazards, however these resources are increasingly in demand across western states.

Definition

A wildfire is an uncontrolled non-structural fire that occurs in undeveloped landscapes such as forests, prairies, brushlands and other naturally vegetated areas. In Thurston County, wildfires typically occur from June through October. Fires can rapidly burn natural resource lands, recreational areas, and wildlife habitat. Biologists, ecologists, foresters, and other natural resource managers view wildland fires as a natural process that is necessary to sustain the health of forests and prairie ecosystems, however wildfires threaten communities where wildlands meet human development. Wildfire hazards threaten public safety by destroying homes, neighborhoods, and infrastructure. They can injure or kill people, pets, livestock, and wildlife.

Area of Impact

For the purposes of the wildfire hazard risk analysis, the hazard assessment area is defined as the Washington State Department of Natural Resources (WADNR) wildland-urban interface and intermix mapped areas. In 2019, WADNR completed statewide mapping for wildlands and wildland-urban interface areas. In general, wildlands are areas covered with 50 percent or higher burnable vegetative cover (Map 4.9.1). There are two major land use characterizations for areas that are prone for wildfires:

1. **Wildland-Urban Interface (WUI)** – located on the periphery of urbanized areas where homes, businesses, and other structures meet wildlands. Areas mapped as a WUI include development that is bordered by wildlands on at least one side. Approximately 32 percent of Thurston County's population is located in areas mapped as a WUI.
2. **Wildland-Urban Intermix** – located between both the urban interface and wildlands. Most wildland-urban intermix areas in Thurston County are near lower density areas further away from urbanized areas. The urban intermix is where homes and structures intermingle with wildlands. Areas characterized as intermix consists of development or structures that are surrounded on two or more sides by wildlands. Approximately 33 percent of the county's population is located in areas mapped as wildland-urban intermix.

DNR's WUI map is not a wildfire risk map, but it is a useful planning tool to inform the region's wildland fire risk assessment. Interface and Intermix areas are prone to wildfires because they contain people and structures adjacent to wildland vegetation. People are attracted to natural and less developed rural landscapes. Over time, wildlands can convert to intermix as development spreads in unincorporated areas of Thurston County. The WUI communities and the adjacent wildlands are at risk for wildland fire hazards because a fire may originate in the wildland area and spread to structures and dwellings and vice versa.

Large areas outside of the urbanized areas of Lacey, Olympia, and Tumwater are prone to wildfires. Historic wildfire records show that fires occur throughout Thurston County, but most are small and burn less than one acre. Larger fires ranging from 10 to 300+ acres occur in areas with large continuous pastures or prairies intermixed with fragmented stands of trees. Southwest Thurston County, particularly around Scatter Creek Wildlife Area, Grand Mound, Rochester, and the Mima Mounds Natural Area Preserve (West Thurston Regional Fire Authority) have experienced the largest most destructive burns. Large fires have also occurred around Yelm, Lake Lawrence (Southeast Thurston Fire Authority) and Tenino (South Thurston Fire and EMS). Table 4.9.1 summarizes total wildland fires in Thurston County, by fire district from 2008 to 2022.

Table 4.9.1 Total Wildfire Starts and Acres Burned by Fire District, Thurston County, 2008-2022

Agency[1]	Total Starts[2]	Sum of Acres Burned	Average Acres Burned	Max Acre Burn Event
Bald Hills Fire Department FD 17	17	11.5	0.7	4.5
Bucoda	2	0.5	0.2	0.3
East Olmpia FD 6	28	8.1	0.3	2.0
Griffin Fire Department FD 13	17	3.3	0.2	1.0
Lacey FD 3	87	54.2	0.6	4.6
McLane Black Lake FD 9	63	43.2	0.7	8.5
Olympia	14	3.7	0.3	1.4
Outside Taxing Boundaries	37	24.4	0.7	9.7
South Bay FD 8	15	2.3	0.2	0.8
South East Thurston Fire Authority FD 2&4	117	144.2	1.2	29.0
South Thurston Fire and EMS FD 12	42	55.9	1.3	13.0
Tumwater	19	5.9	0.3	1.3
West Thurston Regional Fire Authority FD 1&11	179	859.0	4.8	384.0
Grand Total	**637**	**1216.1**	**1.9**	**384.0**

[1]Taxing district boundaries used for agency

[2]False alarm, unclassified records, and other agencies are omitted from results.

Extent

Human behavior, weather, fuel, terrain, and road access influence wildland fire behavior and suppression response activity.

Human Behavior

People desire to live in rural and less developed areas to own more land for livestock or farming, have greater privacy, and be closer to open space, forests, views, and wildlife. Over 196,000 people live in the WUI and Intermix areas in Thurston County (over 65 percent of the population). Nearly 98 percent of wildland fire starts in Thurston County are caused by accidental ignitions or other mechanical or technological means. Debris burns, campfires, vehicles, cigarettes, fireworks, and other accidental human-caused ignitions account for most wildfire starts that threaten people, property, pets, livestock, community, infrastructure, and the environment. The population density in the WUI and Intermix areas also enables early detection and reporting of wildfires through 9-1-1.

Weather

Humidity, temperature, and wind influence wildfire behavior. Low humidity and warmer ambient temperatures make fuels more susceptible to ignition. Winds blow oxygen onto flames and the stronger the wind, the faster the rate that wildfires can burn and spread. Precipitation in Western Washington tapers off in June and warmer dryer conditions generally persist through October. Winds in Thurston County generally prevail from the southwest and west. Stronger, dryer, and warmer easterly winds that prevail in the summer and early fall can produce extreme fire conditions. East wind events can persist for hours with wind speed reaching up to 60 miles-per-hour. While lightning ignitions are common east of the Cascades, they only account for about two percent of wildfire ignitions in Thurston County.

Fuel

Spring rains promote the growth of grasses, herbaceous plants, and shrubs in prairies and pastures. Fragmented conifer and oak stands are interspersed throughout the county’s landscapes. Glacial outwash soils are also prevalent throughout the county. These soils drain quickly. Combined with warm summer temperatures, the vegetation in these areas quickly dry out to create an abundance of fuels that can readily ignite and burn quickly. Where lighter fuels are in abundance, flame heights have been observed to reach 20 feet and greater with strong winds. In such conditions, fires can jump roads and breaks to spread to other areas. Denser fuels such as tree branches, logs, and trunks take longer to warm and ignite. Often the ground cover or understory layer of vegetation burns, leaving the timber. Larger mature trees often survive wildfire burns in Thurston County.

Map 4.9.2 shows the land cover for Thurston County. The map identifies areas of forest, dry grasses, soils, and non-forest vegetation with an overlay of the fire districts. Vegetative ground cover varies widely in Thurston County. For example, the forest vegetation type in the

Griffin, McLane, and Black Lake fire districts are characterized by a large amount of salal and Oregon grape, whereas the Tenino Fire District is chiefly composed of grasses and Scotch broom.

Terrain

The varied topography of Thurston County influences the amount of moisture and fuel. Terrain can either act as a barrier or conduit for a fire. Fire spreads more easily traveling uphill than downhill. Map 4.9.3 shows areas in Thurston County with steep slopes. Steep slopes are most pronounced in along the western and southern boundaries of the county. This map also shows the Natural Resource Conservation Service (NRCS) designation of Category 1 soil types, which are referred to as excessively-drained, glacial-outwash soils. The map clearly illustrates that almost all communities and fire districts contain glacial-outwash soils.

Road Access

Road access is crucial for on-ground fire suppression operations. Unlike large federal wildlands, the WUI and Intermix areas of Thurston County have well-developed and connected road network that support the mobilization of firefighting units. However, there are residences throughout Thurston County's intermix areas that have narrow private roads, tight turns, and inaccessible driveways that restrict the maneuverability or positioning of apparatuses and other emergency vehicles to effectively perform fire defense and suppression. Limited route options also pose challenges for evacuation of residents and livestock from affected areas.

Previous Incidents

Wildfires have impacted Washington State and the Thurston County region over the last several decades. Previous incidents offer insights into the types of losses that Thurston County communities could experience in future wildfire events.

September 8-11, 2020, Bordeaux Road Fire. FM-5359.

The Bordeaux Road Fire started on September 8, 2020 due to a blowout of an electrical transformer. The fire rapidly spread and West Thurston Regional Fire Authority requested state assistance to combat the fire. The fire burned in excess of 60 acres of private land by the time the state requested federal assistance. This fire incident resulted in the region's first federal Fire Management Assistance declaration. The fire threatened approximately 175 homes in and around the community of Littlerock. Level 3 "Get Out" evacuations were issued for approximately 475 people. The fire also threatened electrical utilities, agricultural resources, and a Washington State Department of Corrections prison facility in the area. The fire destroyed two homes and two outbuildings and burned 268 acres before it was extinguished.

August 22-30, 2017, Scatter Creek Fire.

The Scatter Creek Fire started as a result of sparks from someone cutting metal near 183rd Avenue SW and Wakly Lane SW and spread quickly near Interstate 5 on August 22. A second fire, east of I-5, was believed to be ignited by "superheated carbon particles" from a commercial vehicle traveling on I-5.

Approximately 100 households around Sargent Road SW were ordered to evacuate. The fire destroyed four homes, a business, and two barns, and burned over 380 acres. Combined with the second fire, the complex is estimated to have burned over 400 acres.

Probability of Occurrence

The Federal Emergency Management Agency National Risk Index score for wildfire in Thurston County is 50.3 which is classified as very low. Historic wildfire data from WADNR indicates that there is a high probability for wildfire ignitions, however the probability for destructive wildland fires varies across the planning area. Figure 4.9.1 shows the probability for destructive wildfires of 10-acres (fire size Class C) or larger by fire protection districts/departments.

Figure 4.9.1 Probability of a 10-Acre Wildland Fire Occurring within 25 Years

Probability Rating	Fire Protection District/Community
Low Event is unlikely to occur within 100 years	Bald Hills, Fire District 17 Bucoda East Olympia, Fire District 6 Griffin, Fire District 13 Lacey, Fire District 3 Olympia South Bay, Fire District 8 Tumwater
Medium Event is likely to occur within 100 years	McLane – Black Lake, Fire District 9
High Event is likely to occur within 25 years	South East Thurston Fire Authority, Fire Districts 2 and 4 South Thurston Fire and EMS, Fire District 12 West Thurston Regional Fire Authority, Fire Districts 1 and 11

Effects of Climate Change

Research and climate forecasts offer evidence that long-term climate change will have a measurable impact on the risk of wildland fires for Puget Sound lowland communities. The University of Washington Climate Impacts Group published a detailed report on the state of science on climate change and its effects within the region titled, "State of Knowledge: Climate Change in the Puget Sound." The report identifies several factors that will influence wildland fires for communities around the Puget Sound.

Air temperatures are increasing in the region. They are projected to warm rapidly during the 21st century. By mid-century, warming will be outside of the range of historical variations. Warming is projected for all seasons but will be greatest for summer. Warmer, drier, and longer summers will increase the number of high fire danger days and increase the likelihood of having vegetative fuel conditions that create wildfires.

The wildland-urban interface and intermix areas will face a greater risk for fires than they do at present. An increase in high fire danger days and an increase in future likelihood indicates greater potential for wildfire danger to damage infrastructure, interrupt businesses, and affect public health and individuals' and communities' overall well-being.

Table 4.9.2 shows climate model future forecast changes in annual high fire danger days compared to the 1971-2000 average. A high fire danger day is a day in which 100-hour fuel moisture is less than the historical 20th percentile. For example, a location with a value of 2 means that there are 2 additional days in which 100-hour fuel moisture is less than the 20th percentile.

Climate models also forecast the future likelihood of climate and fuel conditions being conducive to wildfire in a 30-year period compared to a baseline 1980-2009 average (Table 4.9.3). For example, a value of 0.50 means that there is a 50% chance that any year in that time period will have climate and fuel conditions that are favorable for wildfires. Climate change increases the probability for larger wildfires to occur in urban-interface and intermix areas. Jurisdictions that currently have a low to medium probability for wildfire can expect that their probability for wildfire will be medium to high by midcentury.

Table 4.9.2 Thurston County Change in High Fire Danger Days

	Model Median[3]	Model Range (10th to 90th percentile)
1971-2000		
Historical Baseline	56 days	56 to 56 days
2010-2039		
Higher Scenario (RCP 8.5)	7 days	-0 to 9 days
Lower Scenario (RCP 4.5)	4 days	-0 to 8 days
2040-2069		
Higher Scenario (RCP 8.5)	9 days	2 to 16 days
Lower Scenario (RCP 4.5)	7 days	1 to 15 days

Table 4.9.3 Thurston County Change in Wildfire Likelihood

	Model Median	Model Range (10th to 90th percentile)
1980-2009		
Historical Baseline	0	0 to 0
2020-2049		
Higher Scenario (RCP 8.5)	0.01	0.00 to 0.03
Lower Scenario (RCP 4.5)	0	0.00 to 0.01
2030-2059		
Higher Scenario (RCP 8.5)	0.03	0.00 to 0.05
Lower Scenario (RCP 4.5)	0.01	0.00 to 0.03
2040-2069		
Higher Scenario (RCP 8.5)	0.05	0.02 to 0.12
Lower Scenario (RCP 4.5)	0.03	0.00 to 0.04

[3] Representation concentration pathways, or RCPs are climate model scenarios for the 21st century. RCP 4.5 — a “low” scenario that assumes greenhouse gas emissions (GHG) stabilize by mid-century and fall sharply thereafter; and RCP 8.5 — a “high” scenario that assumes substantial GHG increases until the end of the 21st century.

Vulnerabilities and Impacts

Impacts to People

Wildfires are very dangerous. Smoke from wildfires burning outside the Puget Sound lowlands deteriorates Western Washington's air quality. Poor air quality is the most common, widespread, and frequent source of adverse wildfire impacts on individuals and communities in Thurston County. Finding respite from smoke is extremely difficult during extreme heat incidents for people who are unsheltered, experiencing homelessness, or do not have access to a cooling shelter. Community members with chronic respiratory diseases, heart disease, children, older adults, and pregnant women are especially at risk for health impacts. Outdoor workers in agriculture, roofers, road crews, and first responders are also at risk. Exposure and inhalation of wildfire smoke can irritate eyes and throats and cause coughing and shortness of breath. Excess smoke inhalation can lead to more serious illnesses including reduced lung function, bronchitis, asthma attacks, heart failure, and premature death.

Locally, heat from intense wind driven flames and rapid spreading fires can catch people off guard. People can suffer burn and non-burn injuries, or death while trying to escape a fire. People who lose a home, business, a loved one, pets, or livestock can suffer prolonged post-traumatic stress disorder. Tables 4.9.3 and 4.9.4 show the total population residing within the wildland-urban interface and intermix Areas.

Table 4.9.3 Thurston County Population Residing in Wildland-Urban Interface Areas

Jurisdiction	Population	Population Exposed	% Population Exposed
Bucoda	610	561	92.0%
Lacey	58,180	12,951	22.3%
Olympia	56,370	10,142	18.0%
Rainier	2,510	1,437	57.2%
Tenino	2,030	1,868	92.0%
Tumwater	26,360	11,431	43.4%
Yelm	10,680	9,226	86.4%
Unincorporated	143,760	49,279	34.3%
Total Planning Areal	**300,500**	**96,894**	**32.2%**

Table 4.9.4 Thurston County Population Residing in Wildland-Urban Intermix Areas

Jurisdiction	Population	Population Exposed	% Population Exposed
Bucoda	610	49	8.0%
Lacey	58,180	6,469	11.1%
Olympia	56,370	4,757	8.4%
Rainier	2,510	1,073	42.8%
Tenino	2,030	162	8.0%
Tumwater	26,360	3,499	13.3%
Yelm	10,680	1,454	13.6%
Unincorporated	143,760	81,849	56.9%
Total Planning Area	**300,500**	**99,313**	**33.0%**

Impacts to Structures and Systems

Structures that lack adequate defensible spaces from fire-prone vegetative fuels are at risk of ignition during a fast-moving fire. Wildfires can destroy or cause damage to homes, businesses, schools, vehicles, electric utilities, and critical infrastructure. Wildfires can delay transportation in and around affected areas. Loss of power disrupts communications which in turn can impact a wide range of public and private sector lines of service and business operations. There are a total of 34,630 structures located in the wildland-urban interface and 35,395 structures in the intermix areas. An estimated 43 billion dollars in structural and contents value is located in the combined WUI and intermix areas for the entire planning area. Tables 4.9.5 through 4.9.8 show the total value of buildings exposed.

Table 4.9.5 Number of Structures in the Wildland Urban Interface

	Number of Structures in Wildland-Urban Interface							
Jurisdiction	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	218	4	0	0	0	2	0	**224**
Lacey	3,926	347	19	0	5	1	44	**4,342**
Olympia	2,925	507	2	0	5	1	4	**3,444**
Rainier	466	42	0	0	2	1	6	**517**
Tenino	599	72	0	1	7	5	9	**693**
Tumwater	3,646	433	48	1	1	6	7	**4,142**
Yelm	2,442	262	10	1	13	5	11	**2,744**
Unincorporated	17,629	669	94	4	32	24	72	**18,524**
Total	**31,851**	**2,336**	**173**	**7**	**65**	**45**	**153**	**34,630**

Table 4.9.6 Value of Structures and Contents in the Wildland-Urban Interface

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building & Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$63,726,655	224	$58,588,795	91.9%
Lacey	18,985	17,637	$17,357,526,547	4,342	$5,971,417,351	34.4%
Olympia	18,242	16,257	$19,116,213,011	3,444	$4,786,058,977	25.0%
Rainier	875	814	$393,003,023	517	$239,746,104	61.0%
Tenino	751	651	$404,778,123	693	$382,700,888	94.5%
Tumwater	9,513	8,408	$9,362,171,728	4,142	$3,425,444,918	36.6%
Yelm	3,139	2,827	$2,077,637,133	2,744	$1,836,416,094	88.4%
Unincorporated	53,104	51,429	$24,765,596,428	18,524	$9,112,434,176	36.8%
Total Planning Area	**104,854**	**98,260**	**73,540,652,648**	**34,630**	**$25,812,807,303**	**35.1%**

Table 4.9.7 Number of Structures in the Wildland-Urban Intermix

	Number of Structures in Wildland-Urban Intermix							
Jurisdiction	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	19	2	0	0	0	0	0	21
Lacey	1,961	38	1	0	3	2	2	2,007
Olympia	1,372	52	0	0	1	0	2	1,427
Rainier	348	7	1	0	1	1	0	358
Tenino	52	4	0	0	0	2	0	58
Tumwater	1,116	41	2	0	3	0	0	1,162
Yelm	385	5	4	0	1	0	0	395
Unincorporated	29,281	557	24	1	37	28	39	29,967
Total Planning Area	**34,534**	**706**	**32**	**1**	**46**	**33**	**43**	**35,395**

Table 4.9.8 Value of Structures and Contents in the Wildland-Urban Intermix

Jurisdiction	Total Buildings	Total Residential Buildings	Total Building & Contents Value	Buildings Exposed	Total Building & Contents Exposed	% Total Value
Bucoda	245	237	$5,137,860	21	$5,137,860	8.1%
Lacey	18,985	17,637	$1,709,603,307	2,007	$1,709,603,307	9.8%
Olympia	18,242	16,257	$785,829,525	1,427	$785,829,525	4.1%
Rainier	875	814	$153,256,919	358	$153,256,919	39.0%
Tenino	751	651	$22,077,234	58	$22,077,234	5.5%
Tumwater	9,513	8,408	$756,650,143	1,162	$756,650,143	8.1%
Yelm	3,139	2,827	$241,221,039	395	$241,221,039	11.6%
Unincorporated	53,104	51,429	$13,646,602,334	29,967	$13,646,602,334	55.1%
Total Planning Area	**104,854**	**98,260**	**$17,320,378,361**	**35,395**	**$17,320,378,361**	**23.6%**

There are approximately 760 community lifeline assets that are located in the wildland-urban interface and intermix areas in Thurston County (Table 4.9.9).

Table 4.9.9 Count of Thurston County Community Lifelines located in Wildland-Urban Interface and Intermix Areas

Location in Planning Area	Comm-unications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Trans-portation	Total
Bucoda	1	0	4	0	0	5	0	**10**
Lacey	11	2	38	13	19	14	8	**105**
Olympia	11	2	5	1	40	5	8	**72**
Rainier	0	1	10	1	0	17	1	**30**
Tenino	0	1	5	0	1	9	0	**16**
Tumwater	4	3	3	6	12	8	27	**63**
Yelm	5	2	2	5	6	16	1	**37**
Unincorporated Thurston County	33	24	148	10	58	110	44	**427**
Total Planning Area	**65**	**35**	**215**	**36**	**136**	**184**	**89**	**760**

Impacts to Natural, Cultural, and Historic Resources

Historic structures such barns, churches, civic buildings, granaries, grange halls, museums, monuments residences, and other buildings and properties are located in wildland-urban interface and intermix areas. These historic resources are community gathering spaces for social, religious, and civic functions. Most of these structures predate modern building codes and are vulnerable to wildfires. These assets could suffer damage or total loss from a wildfire. Original historic structures and assets are irreplaceable.

Tribal reservation lands and traditional fishing, hunting, and foraging grounds are also located in the intermix areas. Reductions in fish, wildlife, and native flora due to habitat loss from wildfires would have adverse impacts on the social, cultural, and sustenance needs of tribal members who are dependent on these resources.

Impacts to Activities

Wildland firefighting requires significant local and state resources. A wildland fire in Thurston County requires rapid containment and suppression to protect public safety and property. Local capabilities can quickly become overwhelmed with larger faster spreading fires. Local agencies frequently rely on state air and ground resources for firefighting operations. During wildfire season, fire service agencies from Thurston County regularly assist wildland fire operations in Eastern Oregon and

Washington. When major wildland fires on federal and state lands mobilize firefighting personnel and assets across western states, local firefighting resources can become strained, reducing the capability to effectively respond to local wildfires.

Risk Ratings

There are varied wildfire fire risk characterizations for the planning area. The 2018 Washington State Enhanced Hazard Mitigation Plan rated Thurston County's wildfire risk as medium high. The United States Forest Service Missoula Fire Sciences Laboratory's Wildfire Hazard Potential (WHP) Map highlights areas where vegetation management could reduce the intensity of future wildfires. Thurston County's WHP ranges from very low to moderate (Map 4.9.4).

Social Vulnerability Rating and National Risk Index

Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. As a consequence enhancing risk component of the National Risk Index, a Social Vulnerability score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score. Map 4.9.5 shows assets and structures in Thurston County that are located in the wildland-urban interface and intermix Areas by census tract social vulnerability ratings.

The Federal Emergency Management Agency National Risk Index (NRI) for wildfire in Thurston County is 50.3 or very low. The rating represents a community's relative risk for wildfire when compared to the rest of the United States. For comparison, Pierce County's NRI wildfire rating is 69.7 or relatively low. The NRI reports an estimated wildfire hazard annual loss of $39,000.

Overall Risk Ratings

A GIS exposure analysis was performed for Thurston County population, general building stock, and critical facilities to calculate the risk ranking scores and risk ratings for the county, cities, and special purpose districts for wildland-urban interface and intermix areas. Risk ranking scores and risk ratings vary by jurisdiction due to variations in probability of 10-acre or larger fire scenario, and impacts on people, property, and the economy. The details of the wildfire risk assessment calculations and results is shown in Appendix C.

Wildfire Hazard Risk Ratings for the Wildland-Urban Interface and Intermix Areas

The countywide wildland fire risk rating score for the WUI is 34 – a high risk rating. Wildfire hazard risk rating scores varies among the plan participants from 0 to 54. The countywide wildfire hazard risk rating score for the Intermix areas is 30, a medium risk (Tables 4.9.10 and 4.9.11).

Table 4.9.10: Community Wildland-Urban Interface and Intermix Hazard Risk Ratings.

Municipal Plan Participants	Wildland-Urban Interface Risk Ranking Score	Wildland-Urban Interface Risk Rating	Wildland-Urban Intermix Risk Ranking Score	Wildland-Urban Intermix Risk Rating
Bucoda	18	Medium	6	Low
Lacey	14	Low	9	Low
Olympia	14	Low	6	Low
Rainier	18	Medium	17	Medium
Tenino	18	Medium	6	Low
Tumwater	17	Medium	9	Low
Yelm	18	Medium	11	Low
Unincorporated Thurston County	34	High	36	High
Total Planning Area	**34**	**High**	**30**	**Medium**

Table 4.9.11 Special Purpose District Wildland-Urban Interface and Intermix Hazard Risk Ratings.

Special Purpose District Plan Participants	Wildland-Urban Interface Risk Ranking Score	Wildland-Urban Interface Risk Rating	Wildland-Urban Intermix Risk Ranking Score	Wildland-Urban Intermix Risk Rating
East Olympia Fire District	12	Low	12	Low
Intercity Transit	0	Low	0	Low
Lacey Fire District	15	Low	15	Low
McLane Black Lake Fire District	36	High	36	High
Olympia School District	11	Low	11	Low
SE Thurston Fire Authority	54	High	54	High
South Bay Fire District	15	Low	15	Low
The Evergreen State College	18	Medium	18	Medium
Thurston PUD	24	Medium	24	Medium
West Thurston Regional Fire Authority	54	High	54	High

Changes in Wildfire Hazard Risks Since Last Plan Update

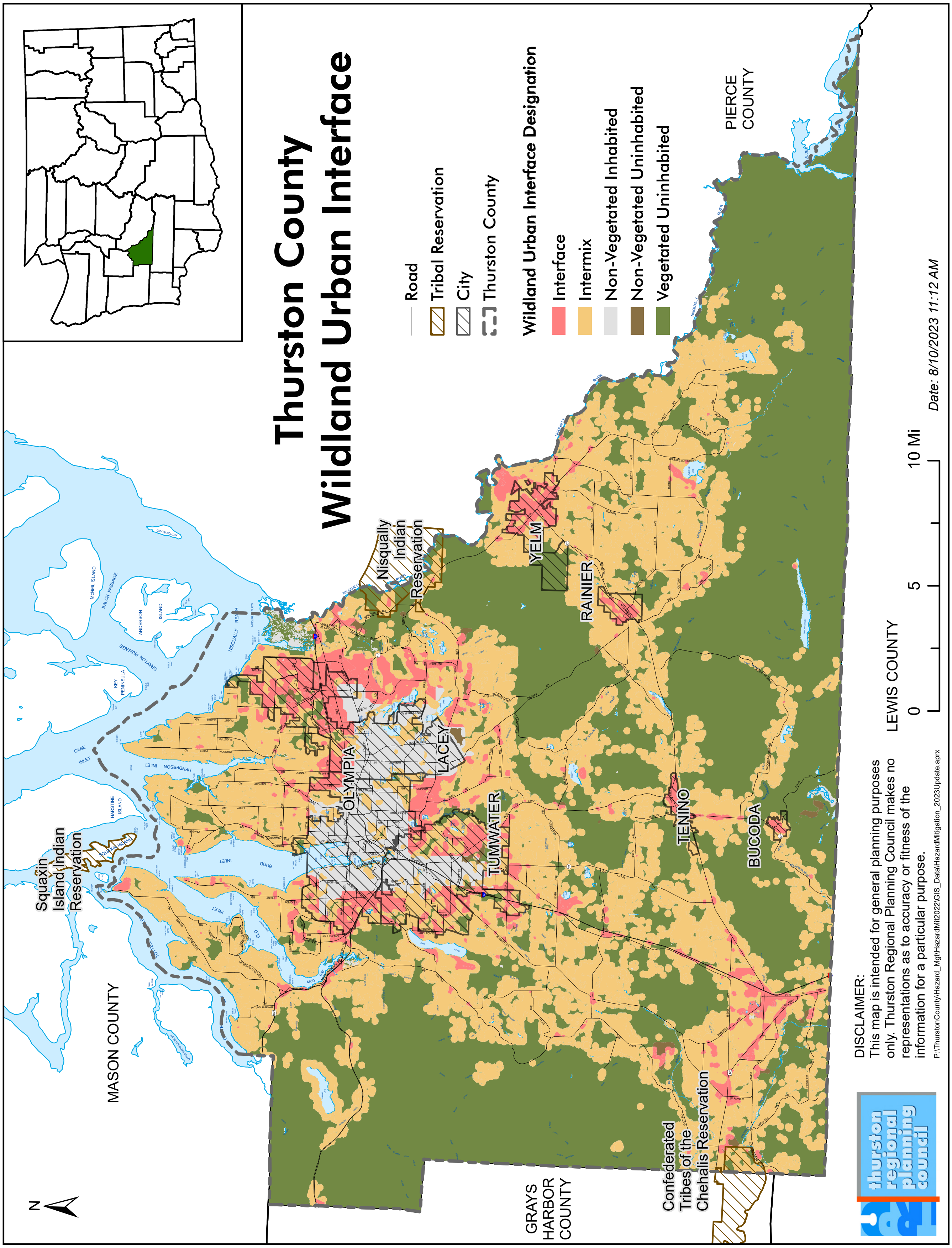
The availability of the WADNR Wildland-Urban Interface Map provided the 2023 Hazard Mitigation Plan update process the means to assess community wildfire risk using a new data-based approach. This new methodology allows the plan participants to assess their population and assets' exposure to the WUI classifications that differs from the previous plans' assessment. However, new assessment does not allow a direct wildfire risk comparison between this plan and the last plan as the geographies for the wildland fire hazard delineation areas are markedly different.

Thurston County's population is forecast to increase by 83,000 people over the next 22 years placing more homes and structures in the region's WUI and Intermix areas. The county and cities are required to adopt and enforce the International Wildland Urban Interface Building Code for new and substantial development occurring in areas classified as WUI and Intermix. These new codes will become effective in late 2023. The implementation of these new codes should considerably reduce structural losses from wildfires for new development occurring throughout Washington State.

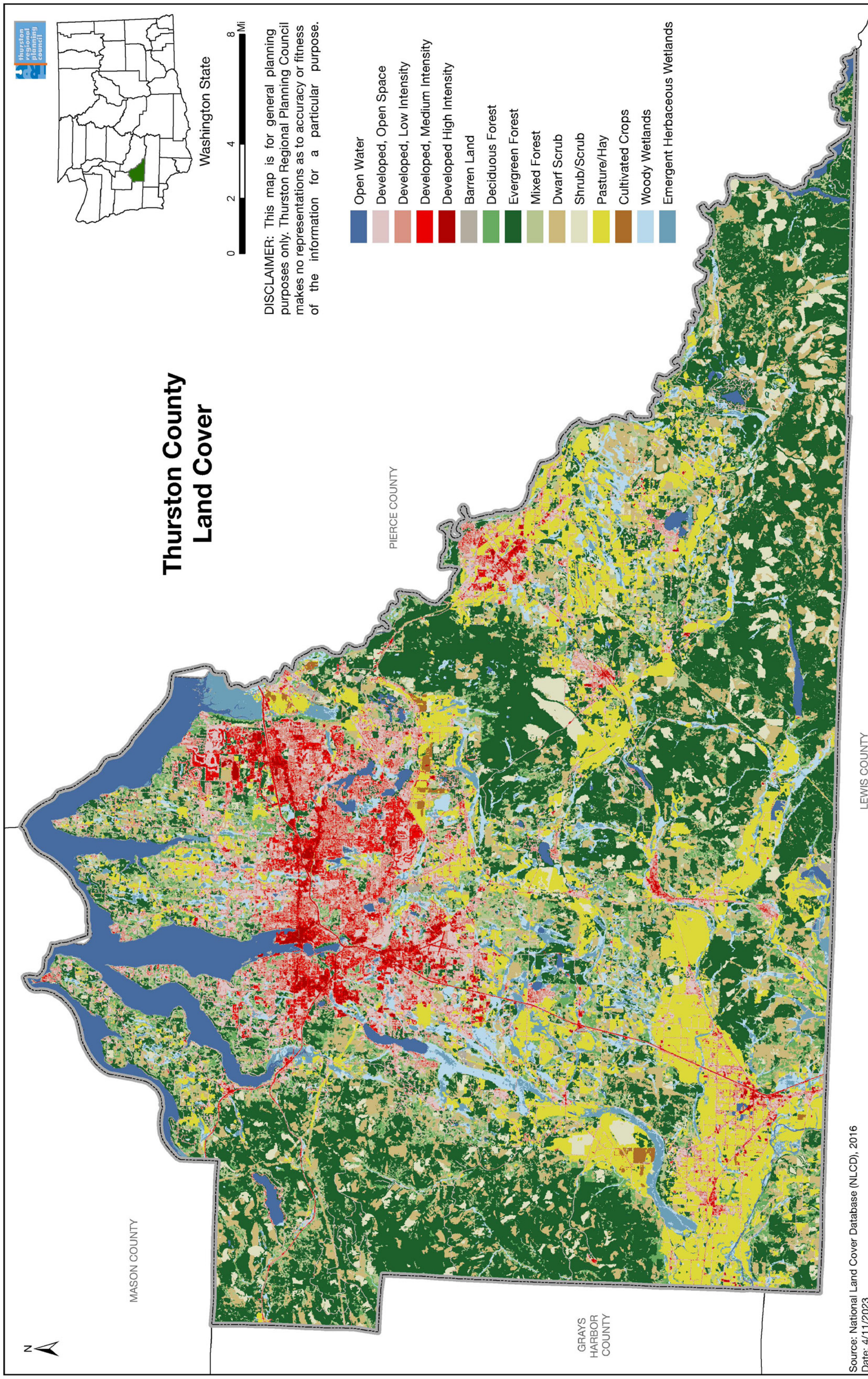
Connection to the Regional Mitigation Strategy

Threats from wildfires have been persistent since the adoption of the last plan in 2017. The September 2020 Bordeaux Fire in southwest Thurston County resulted in the region's first federal Fire Management Assistance Declaration. The August 2017 Scatter Creek fire was the largest and most destructive wildfire in Thurston County's modern history. The region's communities recognize that more research and coordination is necessary to gain a more comprehensive understanding of which sub areas and neighborhoods within the county are most prone to wildfire hazards, and to identify a strategy with a range of actions to reduce wildfire hazard potential and mitigate impacts to people, property, and other valued assets. To this end, this plan update includes a recommendation for the development of a Countywide Multijurisdictional Community Wildfire Protection Plan (see Chapter 2, Recommendations). This mitigation initiative is one of the highest scoring actions in the Countywide Mitigation Strategy.

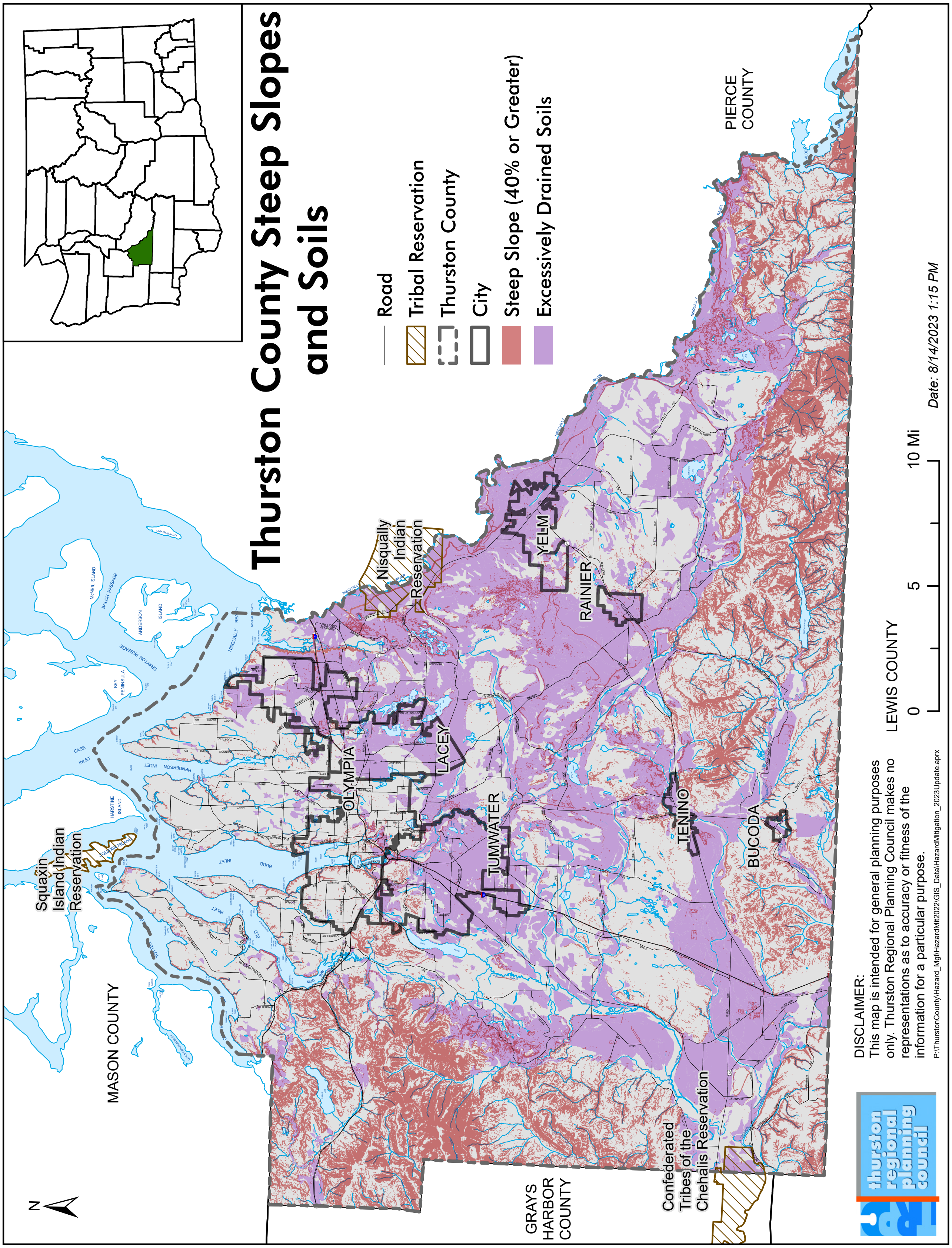
Map 4.9.1 Wildland-Urban Interface and Intermix Areas of Thurston County



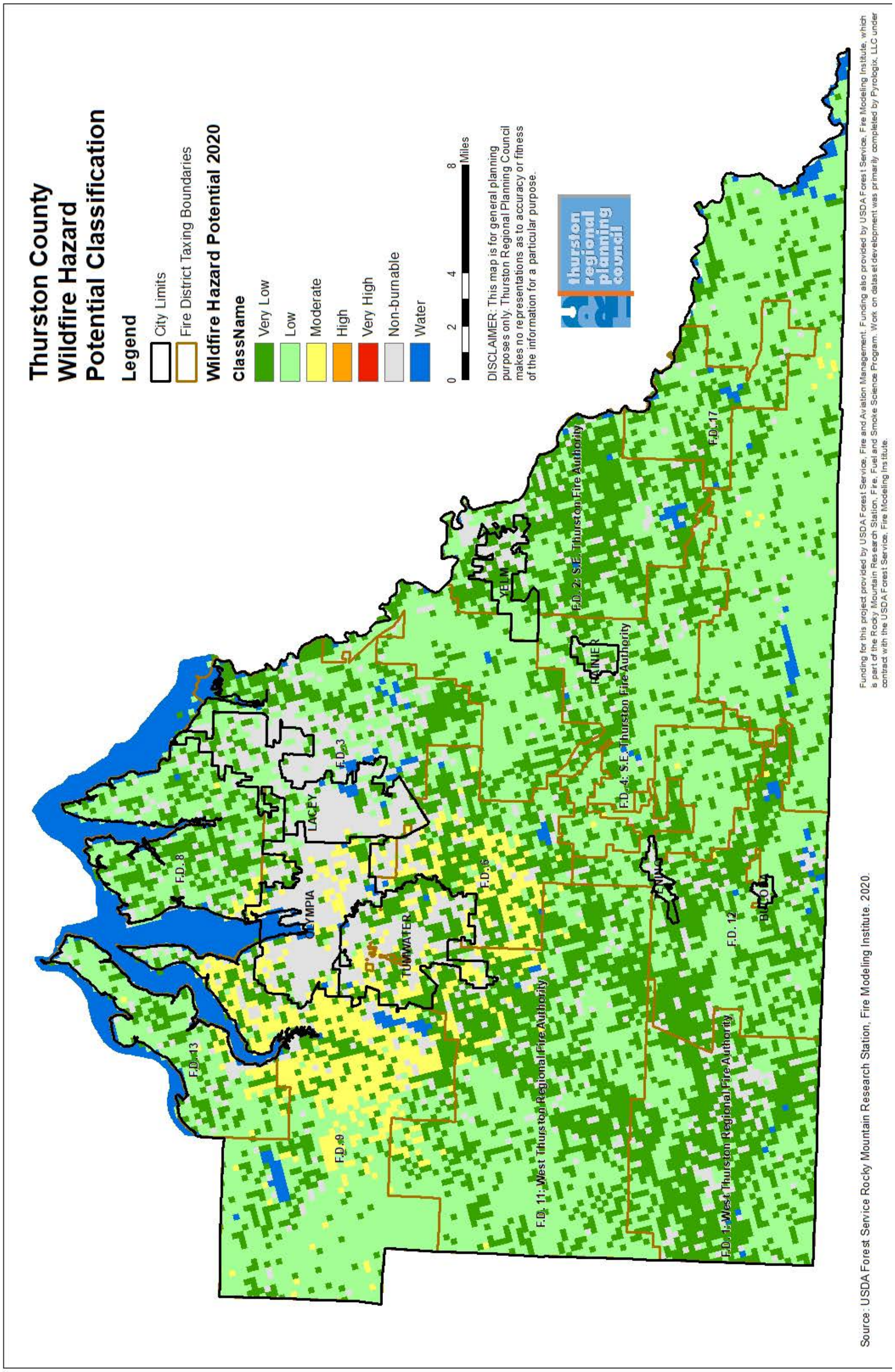
Map 4.9.2 Landcover of Thurston County



Map 4.9.3 Thurston County Steep Slopes and Excessively Drained Soils

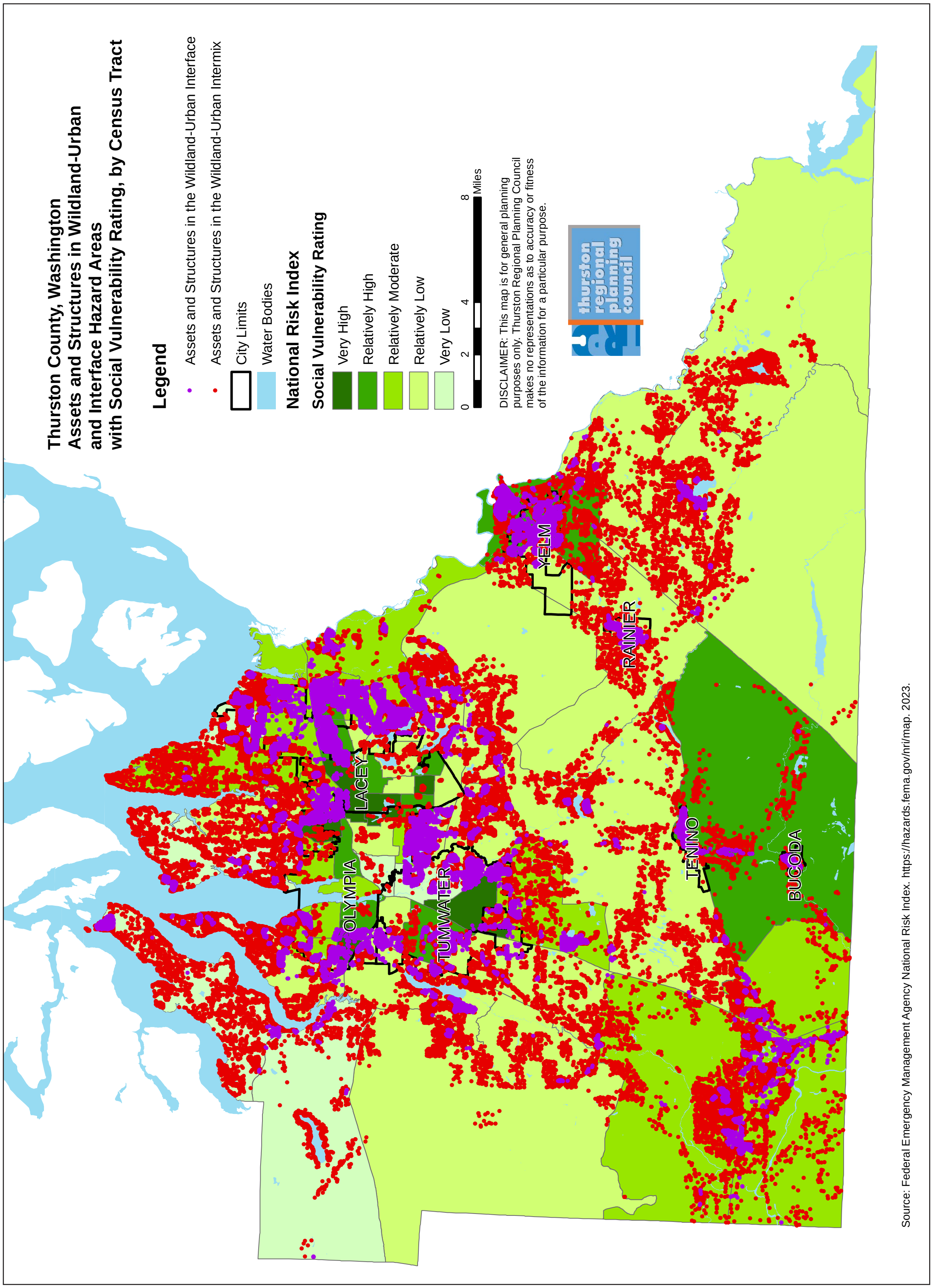


Map 4.9.4 US Forest Service Wildfire Hazard Potential Map for Thurston County



Explanation: Wildfire hazard potential (WHP) is an index that depicts the relative potential for wildfire that would be difficult for suppression resources to contain, based on wildfire simulation modeling.

Map 4.9.5 Assets and Structures in the Wildland-Urban Interface and Intermix Areas Thurston County Social Vulnerability Index Rating by Census Tract



Wildland Fire Hazard Profile Endnotes

[1]National Interagency Fire Center. 2023. Historical Year-End Fire Statistics by State. https://www.nifc.gov.

[2]Washington State Department of Natural Resources. Fire Statistics 2008 to 2022: https://data-wadnr.opendata.arcgis.com/datasets/wadnr::dnr-fire-statistics-2008-present/about

[3]University of Washington Climate Impacts Group. 2023. Climate Mapping for a Resilient Washington: a Web Application for Climate Resilience Planning in Washington. https://cig.uw.edu/resources/analysis-tools/climate-mapping-for-a-resilient-washington/.

[4]U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 2023. https://www.firelab.org/project/wildfire-hazard-potential

Chapter 5

Keeping the Plan Current

Introduction

This chapter describes the regional process for how the plan participants will monitor, evaluate, and update the core plan, and afford the public the means to participate in the process. Additionally, it outlines the Washington State and Federal review and approval processes that lead to plan adoption.

Plan Monitoring and Maintenance Overview

The multi-jurisdictional hazard mitigation plan is an integral component of the Thurston Region's public safety, emergency management, and disaster recovery strategies. Plan monitoring allows the participating jurisdictions to recognize changes in hazards or changes to the built or natural environments that could alter their communities' risks. The plan participants must adapt local and regional mitigation strategies to reduce risks and strengthen their resiliency. Plan participants should afford the public opportunities to provide feedback whenever consideration is given to reprioritizing actions or revising the plan's goals and policies.

A monitoring and maintenance strategy should be responsive to changes in leadership and staffing to provide continuity in planning and coordination among the participants to keep the hazard mitigation plan relevant. Successful plan implementation relies on the participants' commitment to attend coordination meetings, participate in training, and strengthen interdepartmental and interagency staff relationships. Investing in hazard mitigation as a regular work program strengthens opportunities to implement both the plan's regional and jurisdiction-specific mitigation initiatives.

Previous Plan Monitoring Challenges

Oversight to monitor the region's hazard mitigation plan from 2018 to 2021 was dormant until funding became available in 2021 to update the plan. The monitoring process described in the 2017 *Hazards Mitigation Plan for the Thurston Region* specified that the Emergency Management Council would perform an annual evaluation during its regularly scheduled October meeting. Plan participants would be invited to a special work session to perform a region wide assessment of the plan. A monitoring work session was never convened since the plan was adopted in late 2017. In addition, most of the plan participants didn't convene internally to monitor or assess the plan's progress. However, some jurisdictions did actively pursue federal mitigation assistance program grant funds for their projects.

Explanation for Challenges

There are several factors that contributed to the absence of plan monitoring:

- There were major changes in the representation of the Emergency Management Council members who were familiar with the plan and hazard mitigation planning principles.
- There were several staff retirements, departures, and agency/department reorganizations
- COVID-19 disruptions forced changes in communities' priorities, especially in emergency management departments.

Impacts

The absence of regular plan monitoring resulted in:

- Little progress made on several regional mitigation initiatives
- A lack of monitoring performed by plan participants at the local level
- A loss of the plan participants' familiarity with the plan's purpose and goals
- A loss in the continuity of staff hazard mitigation planning expertise and capacity building

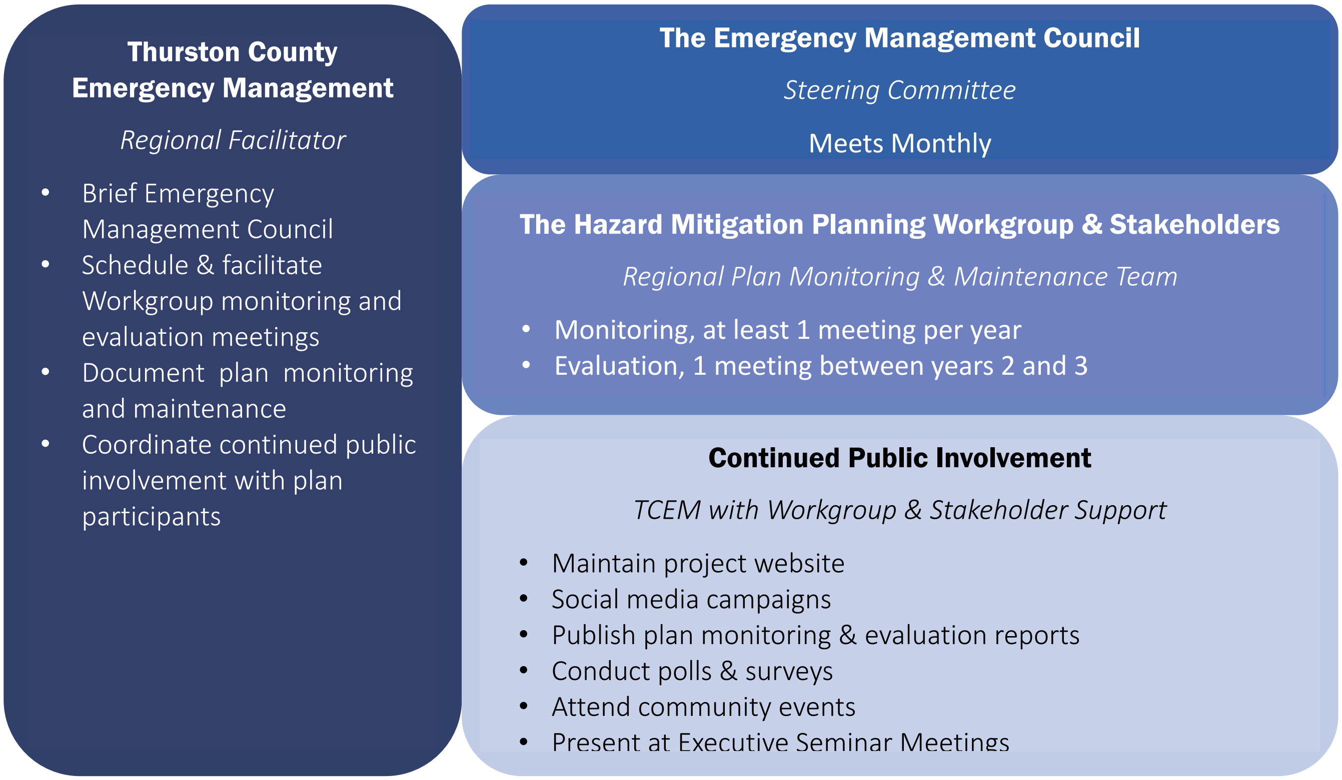
Updated Plan Monitoring and Evaluation Strategy

Monitoring Strategy

Plan monitoring provides the means for staff, policy makers, and community members to track the plan's progress over time. This includes any activities to implement the plan's mitigation initiatives, integrate hazard mitigation into organizational plans or functions, fulfill the plan's goals, and engage the public. Monitoring needs to occur at two levels:

1. **Local Plan Monitoring.** Each plan participant is responsible for internally tracking and reporting on their jurisdiction's mitigation actions and their risk assessment. A description of each participating jurisdiction's processes for monitoring and continued public involvement is documented in their respective annex.
2. **Regional Plan Monitoring.** A greater level of coordination among the plan participants and stakeholders is required to monitor the core plan's regional mitigation strategy, goals and policies, and the planning area's risk assessment. The roles and responsibilities of the entities involved in regional plan monitoring are described in detail in the section that follows (see figure 5.1).

Figure 5.1 Regional Plan Monitoring and Maintenance Roles and Responsibilities



Regional Plan Monitoring and Maintenance Roles and Responsibilities

Thurston County Emergency Management Council – Steering Committee

The Thurston County Emergency Management Council (EMC) is composed of the region's municipal and tribal emergency managers. The EMC is the plan's Steering Committee (see Chapter 6, Plan Process and Development). The EMC's monthly meetings include a standing agenda item for hazard mitigation. During a plan update cycle, staff brief the EMC members on the plan update process, survey results, and seek general direction on the planning process. Between plan updates, staff, EMC members, and guests are afforded opportunities to report on variety of hazard mitigation information such as:

- Grant notices
- Upcoming trainings
- Progress on mitigation initiatives
- Planning for biannual Executive Seminars
- Staff introductions

The Hazard Mitigation Planning Workgroup – Regional Plan Monitoring and Maintenance Team

During the plan update process, the Hazard Mitigation Planning Workgroup (referred to as the Workgroup) identified a new initiative for the existing Workgroup to maintain ongoing coordination to foster plan monitoring and implementation (CW-MH-13: Ongoing Hazard Mitigation Planning Workgroup Coordination).

The Workgroup will serve as the principal team to perform the regional plan monitoring and keep the plan current. The Workgroup will convene at least once a year to monitor the plan (see Figure 5.2). Momentum on plan progress is more effective when the Workgroup meets regularly. It provides the plan representatives a peer network to exchange information, maintain interagency staff relationships, build local and regional hazard mitigation planning skills, and communicate updates on best practices from agencies that provide grant funding and mitigation planning resources. Relevant and interested stakeholders will be invited to participate in the monitoring meeting.

Workgroup Member Expectations

Workgroup members are expected to report on their jurisdiction's mitigation plan progress and should meet with their local planning teams prior to the Regional Plan Monitoring meetings. Alternate Workgroup members should be identified by the plan participants to represent their jurisdiction when the primary Workgroup representative is unable to attend the meetings. Plan participants should notify TCEM if there are any changes to their Workgroup representatives. Stakeholders may be invited to provide presentations on risk reduction activities their organizations are pursuing.

Workgroup Monitoring Activities

Workgroup will be involved in the following monitoring activities:

- Exchange information and progress about the plan participants' integration of hazard mitigation in local plans, policies, and programs
- Share information about each jurisdiction's progress on their mitigation strategy

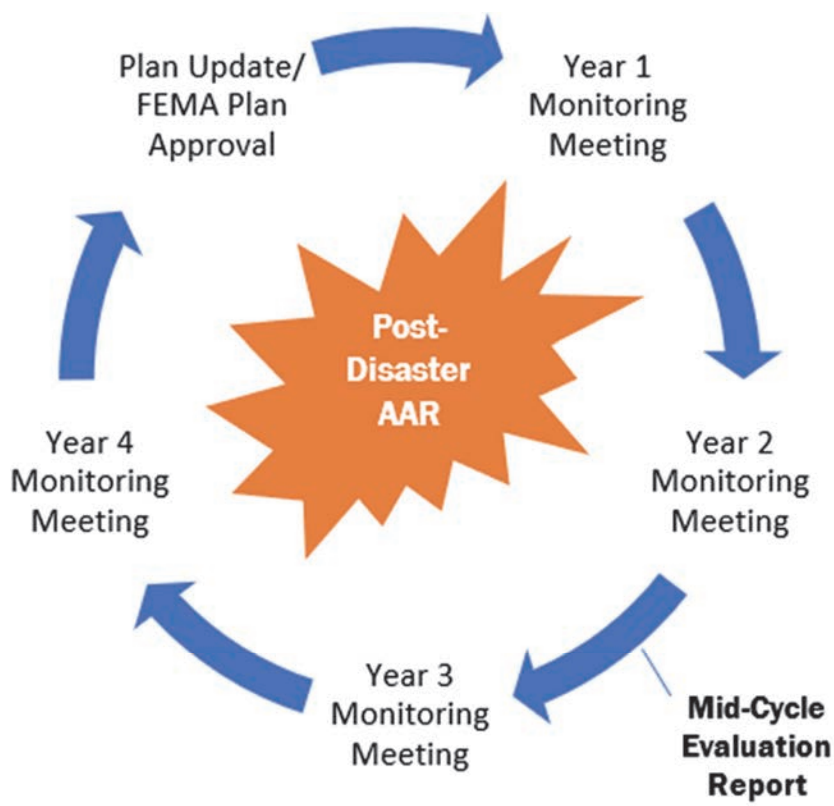
- Refine scopes of work and coordinate implementation strategies for the regional mitigation initiatives in concert with other leads and stakeholders
- Review progress on the regional mitigation initiatives
- Assess the plan's risk assessment for accuracy and provide feedback to the EMC for revisions, as necessary
- Identify opportunities to promote public awareness and conduct public outreach in support of plan maintenance activities and implementation strategies
- Obtain stakeholder feedback

Benefits for Plan Participants

The Regional Plan Monitoring Meetings will increase members' awareness of the following:

- Hazard mitigation planning best practices and upcoming training events
- Funding notices and opportunities to implement mitigation actions
- Inter-jurisdictional peers – creating opportunities to strengthen working relationships

Figure 5.2 Regional Plan Monitoring and Evaluation Strategy



Thurston County Emergency Management – Coordinator and Convener

Thurston County's Emergency Management (TCEM) department leads the region's efforts to secure funding for each five-year plan update. TCEM also regularly provides staff, resources, and logistical support to the region's multi-jurisdictional mitigation planning and other emergency management activities. A full-time emergency management coordinator manages the county's mitigation and recovery programs. In this role, TCEM staff will be responsible for coordinating and facilitating the plan's Regional Plan Monitoring and maintenance activities.

To support the regional plan monitoring and maintenance process, TCEM will:

1. Maintain a working copy of the Hazard Mitigation Plan and its data sources
2. Maintain a roster of the Workgroup members and their alternates and key mitigation stakeholders
3. Establish meeting schedules, set agendas, and invite participants and stakeholders to the monitoring and evaluation meetings
4. Document, distribute, and publish the notes and key findings from monitoring activities
5. Distribute notices for funding opportunities, training events, webinars, and other information that supports plan monitoring, maintenance, and implementation
6. Provide monthly briefings to the EMC
7. Perform any necessary revisions to the core hazard mitigation plan that are recommended by the Workgroup and approved by the EMC
8. Plan and coordinate public engagement activities with the plan participants

TCEM will distribute the meeting notes to Workgroup Members, stakeholders, and the EMC. TCEM will brief the EMC on the outcomes of the meeting.

Evaluation Strategy

The evaluation process examines the overall effectiveness of the plan in meeting its goals. The same roles, responsibilities and relationships identified for Regional Plan Monitoring applies to the plan's evaluation process. The Workgroup will serve as the principal team to evaluate the plan and provide feedback to TCEM staff who will prepare the Mid-Cycle Evaluation Report. Between plan update cycles, there are two touch points when the plan will be evaluated:

1. **Mid-Cycle Evaluation Report** – performed between the second and third years after FEMA approves the updated plan.
2. **Post-Disaster After-Action Review** – performed 45 to 60 days after a federal disaster declaration or following a major hazard event.

Mid-Cycle Evaluation Report

A Mid-Cycle Hazard Mitigation Plan Evaluation Report will summarize key findings about the plan's progress that the plan participants or Workgroup Members can readily share with their boards, commissions, and councils. Messaging about mitigation success stories and challenges can be shared with communities through news releases, social media, and presentations to community organizations.

TCEM will convene the Workgroup and stakeholders near the first quarter of the third year after the plan is approved. The Mid-Cycle Evaluation process will evaluate the following areas:

1. Hazard events that occurred during the reporting period
2. Changes in risks for the hazards that are profiled in the risk assessment
3. A review of the Regional Mitigation Strategy and the status of each initiative
4. Mitigation success stories
5. Changes in capabilities or conditions that impact the plan's implementation
6. Progress toward achieving the plan's goals
7. Recommendations for changes to the plan

TCEM will draft the Mid-Cycle Hazard Mitigation Plan Report following the template shown in Appendix D. The draft report will be distributed by email to Workgroup members and stakeholders for review and feedback.

Upon completion of the draft report, TCEM will present the final report to the EMC during their next available meeting. If there are recommendations for plan changes, staff will seek direction from the EMC to revise the plan. A copy of the final report and any subsequent actions will made available as follows:

- Distribution by email to Workgroup members, stakeholders, and EMC members
- Publication on the project website

Post-Disaster After-Action Review (AAR)

Information about disasters while it is fresh in the minds of first responders, emergency managers, public works personnel, transit operators, and others can benefit hazard mitigation planning efforts. This information can be used to make revisions to the current plan or referenced for the next plan update.

Major disasters that result in a federal disaster declaration, or a major hazard event that activates the Thurston County Emergency Coordination Center warrant an assessment of the conditions and documentation of lessons learned. When post-disaster conditions allow (approximately 45-60 days after an event), TCEM will schedule a joint AAR Meeting with the EMC, the Workgroup, other staff members involved in the event, and stakeholders to assess future mitigation planning needs. Alternatively, Workgroup members and stakeholders could be invited to another AAR to assess mitigation needs. A neutral entity may be invited to facilitate the discussion among the meeting participants. The AAR will assess relevant mitigation issues about the event with the following types of questions:

1. Did the disaster conditions or intensity of the hazard event require a change in the plan's risk assessment?
2. What community assets were lost or impacted by the event?
3. Did the event reveal unknown vulnerabilities for community assets?
4. Did any implemented mitigation measures produce the desired outcomes to reduce losses?
5. What types of additional hazard mitigation actions should be considered to reduce future losses?

TCEM or the facilitator will take notes and summarize the findings in an AAR report. Like the Mid-Cycle Report, the AAR report should be circulated for feedback among the meeting participants and the final report shared with the Workgroup, EMC, stakeholders, and affected parties.

Process for Plan Revisions

Periodic revisions can also make the five-year plan update less difficult. Changes to the mitigation plan are initiated based on outcomes that are realized as part of Regional Plan Monitoring, the Mid-Cycle Evaluation, or from information collected during an AAR following a major disaster.

Changes can also be made as needed to reflect the needs of the jurisdictions. For example, changes are made when a new planning partner joins the region's hazard mitigation planning process and adopts their plan after the five-year update is approved by FEMA. Each jurisdiction is responsible for maintaining their annex. TCEM is responsible for overseeing all revisions to the core plan.

Minor Revisions

Adding new maps, data, or making minor corrections will be handled by the Thurston County Emergency Management.

Major Revisions

Substantive revisions to the mitigation plan would include changing the plan's goals, adding new mitigation initiatives, revising the risk rating of a hazard, or adding a new hazard profile. These are most likely to occur during a plan update process. Between plan update cycles, substantive changes to the core plan that are recommended by the Workgroup should be approved by the EMC. The public should also be afforded an opportunity to provide feedback.

Major changes to a plan participant's annex are the responsibility of the affected jurisdiction. Depending on a plan participant's approval process, such revisions may require approval by the jurisdiction's governing body.

Distribution of Revisions

Thurston County Emergency Management staff will maintain a master copy of the plan and distribute updates to all plan participants with adopted plans. Copies of revisions made to the plan and any correspondence from the state or FEMA will be shared with the plan participants. Any local agency that makes changes to the contents of its local annex should provide Thurston County Emergency Management a copy of updated annex and any supporting documentation that was used to revise its annex.

When possible, plan updates will be sent by email or by other electronic file sharing services. A current version of the plan will be available online at co.thurston.wa.us. Alternate plan formats may be requested through Thurston County Emergency Management.

Procedure to Add a Community to the Plan

All local governments and special districts were encouraged to participate in the regional hazard mitigation plan update process. Plan participants that attended Workgroup meetings have up to one year, following FEMA approval of the plan, to prepare and adopt an annex to the hazards mitigation plan through the region's planning framework.

The following steps outline the process that the region's tribes, local governments, and state colleges can follow to develop and adopt a hazard mitigation plan, if they are an active participant to the process.

1. Interested communities should contact Thurston County Emergency Management.
2. Thurston County Emergency Management will notify the EMC of the community's intent to join the regional plan. County staff will direct the community to resources for building a plan including a copy of current plan, the most current FEMA Local Mitigation Planning Handbook, online resources, and contact information for state and federal mitigation technical support staff, and the necessary templates and instructions for developing an annex.
3. The community is responsible for meeting all the federal plan requirements that are consistent with 44 CFR Section 201.6 (201.7 for tribes).
4. The community submits their draft plan to Thurston County Emergency Management for review to ensure conformance with the regional plan.
5. The community follows the steps described in the "Plan Review Process" and "Adoption Process" sections that follow.

The Plan Update Process

Hazard mitigation planning is a multi-step process that may take between one to two years to complete. Sufficient time must be allotted to educate plan participants about the purpose of hazard mitigation planning and the requirements for developing a plan. Multijurisdictional plans are costly to produce, local funding is scarce, and the availability of federal mitigation grants to update plans are highly competitive and often insufficient. It may take 12 months or more to secure funding to perform a plan update and local governments need to establish work programs and approve budgets prior to starting work on a plan.

To accommodate this need, the EMC and the Workgroup will use the following schedule to guide a future plan update:

1. In the second year after FEMA approves a plan, the EMC will coordinate with partners to apply for planning grants.
2. Assuming funds are secure by the third year, the plan partners will identify the lead staff, establish work programs, refine the scope of work, and approve budgets to develop their plans.
3. At the beginning of the fourth year, the EMC and the plan partners will initiate the planning process.
4. In the latter half of the fifth year, a draft plan will be available to the public, and submitted to the state and FEMA for review.
5. The plan partners will adopt the updated plan within one to two months following a FEMA review where no revisions are necessary.

State and Federal Hazard Mitigation Plan Review Process

Prior to adoption, jurisdictions must first submit their plans to Washington State Emergency Management Division (WAEMD) and FEMA for review to ensure compliance with the Disaster Mitigation Act planning requirements in 44 CFR Section 201.6. The review also provides an opportunity for the state and FEMA reviewers to offer feedback that supports the development of effective mitigation strategies (See Figure 5.3).

Each jurisdiction performs an internal review of their plan using FEMA's Local Mitigation Plan Review Checklist. If a community believes the plan satisfies all the planning requirements, the community submits the plan for the review.

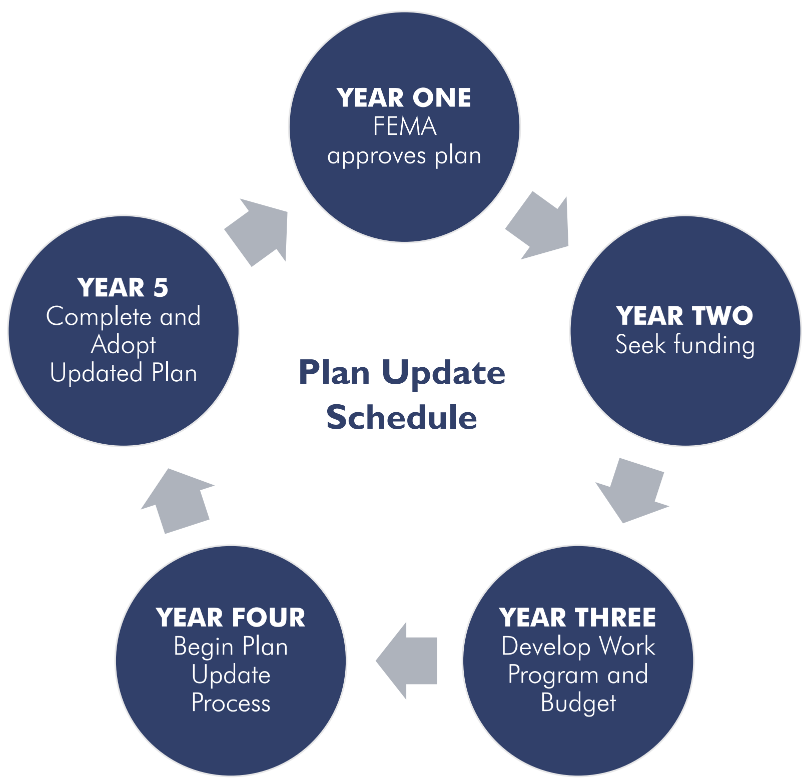
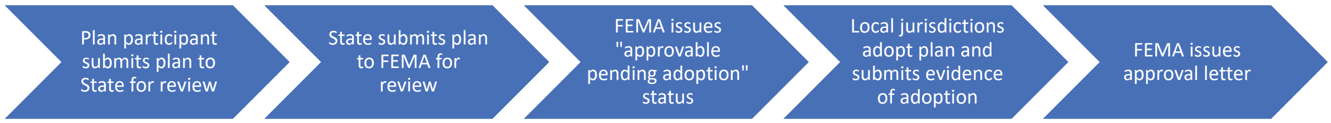


Figure 5.3 Hazard Mitigation Plan State and Federal Review Process and Approval



Washington State Review

- The State Hazard Mitigation Strategist has up to 30 days to review the plan and provide feedback.
- If no substantive revisions are required, WAEMD will forward the plan to FEMA Region X for review.

FEMA Review

- FEMA may take up to 45 days to review the plan and provide feedback.
- If no revisions are necessary, FEMA issues an "approvable pending adoption" status meaning that the plan is ready for federal approval.
- After a plan participant officially adopts the plan and provides FEMA evidence of adoption, FEMA will approve the Plan.

Unmet Requirements

- If WAEMD or FEMA identify unmet planning requirements, they notify the community and indicate what part of the plan requires additional process or documentation to satisfy the unresolved requirements.

Adoption Process

Adoption by a jurisdiction's governing body demonstrates the community's commitment to fulfilling the plan's mitigation goals, their mitigation strategies, and their public engagement activities. Adoption legitimizes the plan and authorizes designated individuals or departments to implement the plan's recommendations. Each participant will follow their established processes including adequate public notice for their governing body to adopt the plan. Through the multi-jurisdictional planning process, participants have one year to adopt the plan after receiving an "approvable pending adoption" notification from FEMA.

Adoption Requirements

All participants to the Hazards Mitigation Plan for the Thurston Region, or an update thereof, must adopt the core plan including chapters 1 through 6 and the appendices. In addition, each agency must adopt their annex. The core plan plus the jurisdiction's annex constitutes a complete plan.

Federal Approval and Plan Expiration

The final step for approval involves submitting evidence of adoption to WAEMD and FEMA. FEMA certifies the plan and issues an approval letter which includes the date of approval. The first jurisdiction to formally adopt the plan initiates the five-year approval period and sets the expiration date for all the plan participants' plans, regardless of when they adopt their plan. The approval letter is amended each time one or more communities submit evidence of adoption.

Continued Public Involvement

During the plan update process, the workgroup highlighted the importance of the Regional Hazard Mitigation Public Outreach Strategy initiative. This was the highest scoring action among the regional initiatives assessed through the benefit-cost review process. The action will continue countywide outreach and education activities to inform all sectors of the community about natural hazards and steps people and organizations can take to reduce their risks. Attention will focus on socially vulnerable populations who are at higher risk. The plan participants and the Emergency Management Council will continue engaging plan stakeholders, residents, property owners, and businesses about the risks the region faces from the hazards identified in this plan. The Workgroup and TCEM will explore opportunities to educate and involve the public about the region's mitigation strategy. Ongoing public outreach activities will occur regularly at the following annual activities:

- Summer Weather Hazards Webinar
- The Fall/Winter Weather Hazards Webinar
- Thurston County Fair
- Thurston County Emergency Preparedness Expo
- Thurston County Flood Bulletin
- Executive and Management Seminars

TCEM and the Workgroup will consider additional opportunities to promote and educate the public about hazard mitigation within existing emergency preparedness education and outreach programs. Additional activities could include:

- Developing a multijurisdictional online hazards information portal
- Conducting an annual short survey or series of polls
- Social media campaigns
- Attend other community events
- Share information through utility inserts and e-newsletters

Copies of the plan will be maintained online at Thurston County Emergency Management's website at co.thurston.wa.us/em and at Thurston Regional Planning Council's website at www.trpc.org/hazards.

Chapter 6

Plan Process and Development

Introduction

Developing the *Hazards Mitigation Plan for the Thurston Region* required dedicated funding, partner commitments, interagency coordination, research and data, stakeholder input, multiple meetings, and a variety of outreach activities. This plan's process was driven by staff, stakeholders, governing bodies, and members of the community. This chapter documents who was involved and how the plan was prepared. The information provides a record to show accountability on how decisions were made and to inform future plan updates.

Community, Jurisdiction, Plan Participant, and Partner

Throughout this chapter, the terms community, jurisdiction, plan participant, and partner generally refer to a local government municipality, tribe, special purpose district, or college that is involved in the Thurston County multijurisdictional hazard mitigation planning process with the intent to produce an annex to the region's Mitigation Plan.

Plan Overview

The Thurston Region's hazard mitigation plan (HMP) consists of a core plan and jurisdictional annexes (Figure 6.1):

1. Core plan – The Core plan is the foundational plan. It documents hazard information, risks, and strategies that cover the entire planning area. It provides the multijurisdictional planning framework for the plan's participants to develop a HMP.
2. Jurisdictional annexes – An annex is a participant's subplan to the Core Plan. An annex documents a jurisdiction's unique capabilities, planning process, risks, and mitigation actions.

Combined, the core plan and a jurisdiction's annex form a community's complete hazard mitigation plan. Both the Core Plan and the annexes are submitted to the Federal Emergency Management Agency (FEMA) for approval.

Process Overview

This plan and the process to develop it is unique to communities in Thurston County. The core plan and annexes were developed in parallel - the planning process convened the participating jurisdictions' representatives and stakeholders together to craft the core plan and to provide guidance to participants to prepared their annexes. Each jurisdiction assembled their own

Figure 6.1 Thurston Region Hazards Mitigation Plan Components

Together, the collection of the jurisdictional annexes and the core plan form the Thurston Region's multijurisdictional hazard mitigation plan.

planning team and developed an annex within the Core Plan's framework, the FEMA planning process, and their community's process to update their plan.

Every HMP must satisfy FEMA's local mitigation planning requirements. However a community prepares a plan, there are four basic steps and a series of prescribed tasks that are followed (see Figure 6.2).

Funding the Plan Update

In December 2019, Thurston County and Thurston Regional Planning Council (TRPC) jointly prepared and submitted a federal grant application on behalf of the region's hazard mitigation planning partners to fund the plan update. To strengthen the grant proposal and establish a mutual understanding in support of the plan update process, Thurston County and

Figure 6.2: FEMA Local Mitigation Planning Steps and Tasks[1]

1	**Organize the Planning Process**	Task 1: Determine the Planning Area Task 2: Build the Planning Team Task 3: Create an Outreach Strategy
2	**Assess Risks**	Task 4: Conduct a Risk Assessment
3	**Develop a Mitigation Strategy**	Task 5: Review Community Capabilities Task 6: Develop a Mitigation Strategy
4	**Adopt & Implement the Plan**	Task 7. Review and Adopt the Plan Task 8. Keep the Plan Current Task 9: Create a Safe and Resilent Community

[1]Adapted from the 2023 FEMA Local Mitigation Planning Handbook

the communities of Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, and Yelm each signed a Statement of Intent to Participate (See Appendix E). The statement outlines the responsibilities for participation and joinability for other interested communities that could participate in the plan updated after the grant proposal was submitted.

On May 1, 2021, Thurston County received a notice of award for a FEMA Pre-Disaster Mitigation grant totaling $166,611 (PDMC-PL-10-WA-2019-012). Thurston County supplied the minimum 25 percent non-federal share of $55,538 to fully fund the project. Additional non-federal financial support was provided through in-kind staff planning activities performed during the planning process by Thurston County and the local agency plan participants. On October 13, 2021, Thurston County and Washington State Military Department executed the agreement for the Pre-Disaster Mitigation grant.

Project Management

Thurston County Emergency Services managed the grant contract. On October 19, 2021 Thurston County contracted with Thurston Regional Planning Council (TRPC) to facilitate and manage the plan update process and produce the plan.

Organizing the Planning Process

Thurston County communities have a strong record of working together in a regional manner to improve the quality of life for the region's residents. The original HMP and its subsequent updates follow this tradition. On October 17, 2021, the Chair of the Emergency Management Council of Thurston County sent a letter to the leaders of 36 local organizations including tribes, the county, cities, town, special purpose districts, and colleges to participate in the region's HMP update (see Appendix D). Organizations were encouraged to participate in the Hazard Mitigation Planning Workgroup to develop a plan or to participate as stakeholders.

The Planning Area

Consistent with previous plans, all of Thurston County and its local governments that have land use authority or provide public services within the county are included in the planning area. The plan's partners encouraged participation among agencies that operate in Thurston County but have multi-county missions or service areas. Such agencies can produce a HMP that includes mitigation strategies for Thurston County in addition to strategies that address assets and vulnerabilities that are outside of Thurston County's border. There are several current and potential plan adopters and stakeholders to whom this exception applies to, such as:

- **Intercity Transit** – Intercity Transit's Public Transportation Benefit Area is located entirely within the county, however the agency provides express public transportation services to Pierce County. The agency's ridership includes passengers who live or work outside of Thurston County.
- **Thurston Public Utilities District #1** – The district provides water planning and utility services to residents in Thurston County. The agency also owns and operates water systems in five additional counties in the Puget Sound Region.
- **The Evergreen State College** – The college's main campus is located in Thurston County. A second campus is located in the City of Tacoma.
- **Educational Services District 113** – The Capital Region ESD 113 provides a variety of direct and technical support services to public school districts in Thurston, Grays Harbor, Lewis, Mason, and Pacific counties.
- **Timberland Regional Library** – The library district's administrative services are headquartered in the City of Tumwater, but the district owns (or leases) and operates branches and provides a range of library services throughout five counties in southwest Washington.
- **Puget Sound Energy** – Although the energy company is headquartered in Bellevue and provides energy services throughout parts of Washington, PSE is Thurston County's only electric and natural gas utility service provider. PSE is an active stakeholder in the Thurston Region's emergency management planning activities and programs.

Figure 6.3 Multijurisdictional Hazard Mitigation Planning Entities Relationship

The Multijurisdictional Planning Entities

Several entities performed key roles in leading and performing the four local mitigation planning steps to update the region's HMP. Each entity contributed specific tasks and functions that complement the multijurisdictional process (see Figure 6.3). The coordination of the efforts, taken as a whole, strived to achieve a thorough and equitable planning process.

Emergency Management Council (EMC) of Thurston County – Steering Committee

The EMC was established by a 1993 Interlocal agreement to coordinate local emergency management activities on behalf of the member organizations. The membership is comprised of the emergency managers from the region's tribes, county, and cities. The EMC continued its role to serve as the HMP's Steering Committee. During and after a plan update process, the members provide general direction and inform the communities' senior and elected officials about the region's mitigation planning activities.

EMC Meetings

The EMC typically meets monthly every fourth Thursday. During the COVID-19 pandemic, the EMC met virtually until March 2022. Since then their meetings have been convened in a hybrid format from the Thurston County Emergency Coordination Center.

Hazard mitigation planning is a standing item on the EMC's monthly agenda. Throughout the plan update process, TCEM and/or TRPC briefed the members on the HMP's development status. Key mitigation planning activities performed by the EMC included:

- Inviting communities and stakeholders to participate in the HMP update process.
- Providing general direction to TCEM and TRPC staff throughout the planning process.
- Approving the Regional Mitigation Initiatives, their benefit-cost review scores, and their ranking.
- Establishing the agendas, including hazard mitigation topics, for twice-yearly Executive Seminars for Senior and Elected Officials.

EMC membership and Alternate Representatives

Member	Representative, (Alternate)
City of Lacey	Ed Taylor, Chair, (Bracy DiLeonardo)
City of Olympia	Mike Buchanan, (Todd Carson)
City of Rainier	Tom Arnbrister
City of Tenino	Robert Auderer
City of Tumwater	Brian Hurley, Vice Chair, (Jon Kalar)
City of Yelm	Rob Carlson
Confederated Tribes of the Chehalis Reservation	Cal Bray
Nisqually Indian Tribe	Jeff Choke
Thurston County	Kyle Bustad, (Ben Miller-Todd)
Town of Bucoda	Steven Purcell

Thurston Regional Planning Council (TRPC) – Lead Entity

Thurston Regional Planning Council or TRPC is a 23-member public council of governments for Thurston County. It is the federally designated Metropolitan Planning Organization for the Thurston County Region and has over 50 years' experience in developing multijurisdictional plans. TRPC managed and coordinated the production of the HMP with the plan entities. This involved:

- Coordinating and facilitating the planning activities among the plan participants, technical partners, and other interested parties.
- Producing meeting agendas, materials, and recording notes for the Hazard Mitigation Planning Workgroup.
- Maintaining the project website and the online shared resource directory.
- Educating plan participants about the HMP process and its federal requirements.
- Devising and distributing plan process worksheets and annex templates.
- Coordinating the review and update of the plan's Goals and Policies, Regional Mitigation Strategy, and the Benefit-Cost Review process.
- Recruiting and managing a consultant team to analyze and report on hazard loss estimates and prepare hazard risk ratings.
- Researching, developing, and documenting the Core Plan's risk assessment.
- Leading regional public participation activities for the plan.
- Assembling all core planning documents, maps, and data tables.
- Providing technical assistance to plan participants on the development of their annexes.
- Coordinating the review of the draft plan with the state and FEMA to obtain federal approval.

Lead TRPC Staff

Staff	Position
Paul Brewster	Senior Planner
Casey Mauck	Associate Planner

Project Management Meetings

TRPC and Thurston County Emergency Management project team meetings typically occurred by web conference every other week on the second and fourth Wednesday each month. The meetings addressed project management needs, the planning process tasks and their timing, Hazard Mitigation Planning Workgroup agendas, and public engagement activities.

Thurston County Emergency Management (TCEM) – Project Sponsor

As the federal grant recipient to update the HMP, TCEM was the project's sponsor. TCEM staff performed a lead role in scheduling and coordinating meetings of the Emergency Management Council of Thurston County and the Executive Seminars. TCEM provided data and logistical support to the coordination of the plan's development. TCEM was also Thurston County's team lead for the development of the county's annex to the HMP.

Lead TCEM Staff

Staff	Position
Cherie Carey	Emergency Management Coordinator
Brandon Cheney	Emergency Management Coordinator
Emily Schoendorf	Emergency Management Coordinator

Hazard Mitigation Planning Workgroup (HMPW)

The Hazard Mitigation Planning Workgroup (HMPW) or workgroup, like in previous plans, served as the working body for the plan update process. The workgroup served in an advisory role to inform the multijurisdictional planning process and to guide the Core Plan's contents such as the hazard risk assessment, goals and policies, regional mitigation initiatives, and the plan maintenance process.

Each jurisdiction intending to develop an annex through the regional process appointed a representative to participate on the HMPW. The representatives were the lead members of their community's HMP team. Each plan participant formed a team to produce an annex. Each team is composed of the community's subject matter experts that provide the capabilities to produce and implement their HMP. Each community's planning team and their planning activities are documented in their annex.

Community stakeholders also participated in the workgroup to provide broader community perspectives and serve in an advisory role. Jurisdictional planning team members also frequented the workgroup's meetings. Stakeholders consisted of both local governments not producing an annex and private sector representatives. The minimum participation requirements of the workgroup members were as follows:

- Participate in the planning process including the HMPW meetings, public meetings or open houses, workshops, planning partner specific training sessions, or public review and comment periods.
- Provide support in the form of data sharing, mailing lists, meeting space, and public information materials to solicit public participation in the planning process.
- Conduct relevant jurisdiction-specific meetings to review and refine hazard mitigation capabilities, and a local risk assessment.
- Create and prioritize a mitigation strategy that will identify each project, the responsible entity for overseeing the project, funding options, and an estimated timeline for implementation.
- Formally adopt the core plan and the jurisdictional annex.

Hazard Mitigation Planning Workgroup Community Representatives and Stakeholder Members

County and City Members	Representatives
Thurston County	Cherie Carey, Emergency Management Coordinator Brandon Cheney, Emergency Management Coordinator Emily Schoendorf, Emergency Management Coordinator
Town of Bucoda	Mayor Steve Purcell (former) Mike Presswood, TCEM
City of Lacey	Ed Taylor, Emergency Management and Safety Coordinator
City of Olympia	Mike Buchanan, Assistant Fire Chief Susan Clark, Water Resources Engineering & Planning Supervisor
City of Rainier	Robert Shaw, Mayor Mike Presswood, TCEM
City of Tenino	Wayne Fournier, Mayor Mike Presswood, TCEM
City of Tumwater	Ericka Smith-Erickson, Housing and Land Use Planner Brad Medrud, Long Range Planning Manager
City of Yelm	Sara Williams, Assistant Planner Rob Carlson, Chief of Police
School District Members and Stakeholders	**Representatives**
Olympia School District	Wendy Couture, Custodial Supervisor & Safety/Risk Manager Frank Wilson, Director of Facilities
Tumwater School District	Mel Murray, Director of Facilities
Rochester School District	Ed Dowell, Director of Facilities
Educational Services District 113	Dan Beaudoin, Comprehensive School Safety Coordinator
Fire District Members and Stakeholders	**Representatives**
McLane-Black Lake Fire District 9	Leonard Johnson, Fire Chief
SE Thurston Fire Authority and Olympia Fire District #6	Brian Richardson, Captain
South Bay Fire District 8	Brian VanCamp, Fire Chief
West Thurston Regional Fire Authority	David Pethia, Commissioner Rob Smith, Fire Chief Robert Scott, Fire Chief (retired)
Special Purpose District Members and Stakeholders	**Representatives**
Intercity Transit	Jason Hanner, Safety Program Manager Emily Bergkamp, Interim General Manager
LOTT Clean Water Alliance	Julie Dufresne, Safety Manager
TCOMM 911	Wendy Hill, Director
Thurston PUD	Kim Gubbe, Director of Planning and Compliance
College Members and Stakeholders	**Representatives**
South Puget Sound Community College	Fred Creek, Director of Security
The Evergreen State College	Jackie LaVerne, Emergency Manager
Other Stakeholders	**Representatives**
Puget Sound Energy	Amy Tousley, Municipal Liaison Manager
Washington Department of Transportation	Lit Dudley, Emergency Manager

HMPW Meetings and Materials

All HMPW meetings were facilitated by TRPC and convened in a web conference format. All meetings were convened on the last Monday of the month and were open to the public. Online polls and facilitated breakout groups discussions were used to encourage member participation.

All meeting agendas and materials were generally provided to workgroup members at least one week prior to the meetings and were posted on TRPC's homepage at www.trpc.org. Following each meeting, a meeting video, materials and presentations, and the summary notes were published on the project website at https://www.trpc.org/1101/Fourth-Edition-Update.

Workgroup members and stakeholders received email notifications from TRPC throughout the plan update process about the availability of meeting materials, templates and worksheets, notices of funding opportunities, and other HMP resources. Workgroup members could access the project's mitigation planning resources through a shared online resource directory that was managed by TRPC. A list of the workgroups meeting activities is shown in Table 6.1.

Table 6.1 Hazard Mitigation Planning Workgroup Meeting Activities

Meeting	Date	Agenda Topics	Guest Presenters
1	02/28/2022	Overview of Hazard Mitigation Planning Process Roles and Responsibilities Schedule	
2	03/28/2022	Capability Self-Assessment Introduction to Public Outreach Strategy Ideation for Community Survey Consultant Recruitment Proposals Cost Share Time Tracking	
3	04/25/2022	Consultant Recruitment Update Capability Self-Assessment Results Draft Public Engagement Strategy Draft Community Survey Review	
4	05/23/2022	Hazard Mitigation Grant Program Call for Projects Community Survey Outreach Discussion Consultant Scope of Work	Matt Lebens, WAEMD
5	07/25/2022	Risk Assessment and Mitigation Strategy Development Road Map Data Collection and Coordination Community Survey Outreach Activities	Carol Baumann, Tetra Tech
6	09/26/2022	Geologic Hazards Community Hazard Resiliency Survey Results Risk Assessment and Data Coordination Update Hazard Scenarios & Profile Format Time Tracking Reminder	Tricia Sears, WADNR Kate Mickelson, WADNR Corina Allen, WADNR
7	10/24/2022	Wildfire Hazards & Wildfire Ready Neighbors Program Risk Assessment Requirements Plan Goals & Policies part 1	Jennifer Coe, DNR
8	11/28/2022	Flood Hazards & RiskMAP Lakes Study Goals & Policies part 2 Community Profile & Capability Assessment Meeting Schedule Update	Wendy Shaw, FEMA Region X
9	01/23/2023	Risk Assessment and Hazard Ratings Walkthrough	Rob Flaner, Tetra Tech
10	02/27/2023	Risk Assessment Update Annex Hazard Maps Online Hazard Mapping Tool Regional Mitigation Initiatives part 1 Strengths, Weaknesses, Obstacles, and Opportunities part 1 Schedule Update	
11	03/27/2023	Critical Facilities Risk Analysis & Hazard Risk Rating Results for Special Purpose Districts SWOO Assessment Results & Application to Mitigation Actions Jurisdictional Mitigation Ideation Workshop	Rob Flaner, Tetra Tech

Meeting	Date	Agenda Topics	Guest Presenters
12	4/24/2023	Regional Mitigation Initiatives part 2 Benefit-Cost Review Criteria & Mitigation Prioritization Process and Meeting Schedule Update	
13	5/22/2023	Regional Mitigation Initiatives Benefit-Cost Review Scores & Ranking Risk Assessment and Planning Process Templates Public Outreach Strategy Benefit-Cost Review Criteria & Mitigation Prioritization Process and Meeting Schedule Update	
14	6/26/2023	Jurisdictional Mitigation Initiatives Status Reporting Mitigation Action Community Survey and Outreach Strategy Schedule Update	
15	8/28/2023	Action Plan Regional Mitigation Initiatives Survey Results Risk Assessment Recap Model Annex Review and Plan Review Process Plan Monitoring and Maintenance Strategy	

Special HMPW Subcommittee Benefit-Cost Review Meeting

A voluntary subcommittee of the workgroup convened in person at TRPC's office and via a web conference on May 8, 2023 to conduct the Regional Mitigation Initiatives benefit-cost review (see Chapter 2: Mitigation Goals, Policies, and Initiatives). TRPC facilitated the subcommittee's review to evaluate, score, and rank all 12 initiatives. The results of this process were shared with the full HMPW during their May 22, 2022 meeting. The workgroup concurred the subcommittee's results and forwarded a recommendation to the EMC to approve the initiatives scores and ranking. The EMC members approved the workgroup's recommendation by email vote on May 25, 2023.

HMPW Benefit-Cost Review Subcommittee Members

HMPW Member	Representative
City of Olympia	Mike Buchanan Susan Clark
Thurston County	Cherie Carey Brandon Cheney
South Bay Fire District 8	Brian VanCamp
West Thurston Regional Fire Authority	David Pethia Rob Smith

Consultant Team – Tetra Tech

Tetra Tech was contracted by TRPC to develop hazard what-if scenarios to model hazard impacts and to perform GIS hazard exposure analysis in support of producing the risk assessment's hazard loss estimates and risk ratings for Thurston County communities (see Chapter 4: Risk Assessment). The consultant's products informed both the regional and jurisdictional mitigation strategies. The consultant team produced a mitigation catalog to guide plan participants through the mitigation selection process and supported the Strengths, Weaknesses, Obstacles, and Opportunities assessment questionnaire (see Chapter 3: Community Profile and Capability Assessment). The consultant project lead and GIS analyst both attended and presented their process and analysis at key workgroup meetings. The principals for Tetra Tech are shown below.

Tetra Tech Team Members

Tetra Tech Team Member	Title
Rob Flaner	Hazard Mitigation Program Manager
Carol Baumann	Senior GIS Analyst

Consultant Team Meetings

TRPC, Tetra Tech, and TCEM project team meetings typically occurred every second and fourth Thursday throughout the duration of the consultant's contract. All meetings were held by web conference and covered the risk assessment and mitigation strategy development process.

Technical Partners

Local, state, and federal government staff from a variety of agencies contributed data, guidance, and training to support the HMP update. In turn, TRPC provided technical assistance to the plan partners to support the development of their annexes. The following agencies provided TRPC and the plan partners technical support:

- Public Health – Seattle and King County (PHSKC)
- Thurston County Public Health and Social Services (TCPHSS)
- University of Washington Climate Impacts Group (UWCIG)
- Washington State Department of Ecology (WADOE)
- Washington State Department of Health (WADOH)
- Washington State Department of Natural Resources (WADNR)
- Washington State Military Department Emergency Management Division (WAEMD)
- Washington State Department of Transportation (WSDOT)
- Federal Emergency Management Agency (FEMA)
- United States Forest Service (USFS)
- National Oceanic and Atmospheric Administration National Weather Service (NOAA NWS)

Table 6.2 Technical Assistance Meetings, Training, and Plan Coordination Activities

Date	Activity	Participants
10/27/2021	Identifying Plausible Community Wildfire Disasters in Low Frequency Fire Regimes Webinar	Paul Brewster, TRPC USFS PNW Research Station
05/12/2022	Updated Local Mitigation Planning Policy Review Webinar	Paul Brewster, TRPC FEMA Presentation
07/27/2022	Thurston County Landslide Hazards	Paul Brewster, TRPC Casey Mauck, TRPC Kate Mickelson, WADNR
08/01/2022	Wildland-Urban Interface Map	Paul Brewster, TRPC Casey Mauck, TRPC Ashley Blazina, WADNR Ana Barros, WADNR Robert Scott, WTRFA David Pethia, WTRFA
08/04/2022	Wildland Fire Tour of WTRFA	Paul Brewster, TRPC Robert Scott, WTRFA Ana Barros, WADNR
08/23/2022	Geological Hazards Risks and Resources	Paul Brewster, TRPC Casey Mauck, TRPC Corina Allen, WADNR Tricia Sears, WADNR Kate Mickelson, WADNR
09/21/2022	Wildland Fire Hazard Risks and Resources	Paul Brewster, TRPC Jennifer Coe, WADNR
09/28/2022	Skookumchuck Dam Study to Examine Future Uses Webinar	Paul Brewster, TRPC Office of the Chehalis Basin TransAlta and other Partners
10/04/2022	Extreme Heat Health Impacts Incidents Data	Paul Brewster, TRPC Sue Poyner, Thurston County Public Health and Social Services Mary Ann O'Garro, Thurston County Public Health and Social Services
02/10/2023	Extreme Heat & Cold Events NWS Forecasts & Risk Warnings	Paul Brewster, TRPC Reid Woolcott, Warning Coordination Meteorologist, NOAA NWS
03/08/2023	Tumwater Mitigation Planning Support	Paul Brewster, TRPC Casey Mauck, TRPC Ericka Smith-Erickson, Tumwater Brad Medrud, Tumwater
03/20/2023	Intercity Transit Mitigation Planning Support	Paul Brewster, TRPC Casey Mauck, TRPC Jason Hanner, Intercity Transit Steve Swan, Intercity Transit

Date	Activity	Participants
04/19/2023	Thurston County Mitigation Initiatives Review	Paul Brewster, TRPC Brandon Cheney, TCEM Cherie Carey, TCEM
05/23/2023	Two-Day FEMA Region 10 Local Mitigation Planning Training	Paul Brewster, TRPC
05/24/2023	High Hazard Potential Dam Inventory in Thurston County	Paul Brewster, TRPC Jodi Gooding, WADOE
05/26/2023	High Hazard Potential Dams Emergency Action Plans	Paul Brewster, TRPC Charlotte Lattimore, WADOE
06/06/2023	HMP Review Process New FEMA HMP Policy Requirements	Paul Brewster, TRPC Kevin Zerbe, WAEMD
08/03/2023	Resilience Improvement Plans: Best Practices and Requirements	Paul Brewster, TRPC USDOT FHWA Webinar

Stakeholders

TRPC coordinated with local and regional stakeholders to collect data, to gain insights from subject matter experts to strengthen the HMP, to develop a public outreach strategy, and to identify and leverage mutual objectives whenever possible.

Stakeholder involvement was productive in shaping the plan. Thurston County's Racial Equity Program Manager provided guidance in the development of the plan's Outreach Strategy and helping TRPC identify opportunities for engaging the public in the 2022 Community Resiliency Survey.

A board member of the Thurston Climate Action Team (TCAT) and the chair of the Olympia Physicians for Social Responsibility Climate Task Force, other Olympia area physicians, TCAT staff, Thurston County Medic One, and Thurston County's Homeless Response Program Manager provided information and guidance to prepare the extreme heat hazard profile in the plan's risk assessment. The same stakeholders provided feedback to TRPC to develop the plan's proposed Extreme Heat Response and Illness Prevention Plan mitigation initiative.

The Thurston County Fire Chiefs Association was instrumental in informing the plan's Wildland Fire Risk Assessment and agreed to lead the Community Wildfire Protection Plan mitigation initiative. A team of fire chiefs met with TRPC staff on numerous occasions to provide guidance and review draft plan content.

Table 6.3 Stakeholder Meetings and Planning Coordination Activities

Date	Activity	Participants
10/27/2021	Thurston County Fire Chiefs Briefing on the HMP Update	Thurston County Fire Chiefs Association
03/11/2022	Pierce County Hazard Mitigation Plan - Special Purpose District Outreach Brainstorm	Paul Brewster, TRPC Casey Mauck, TRPC Debbie Bailey, Pierce County
04/13/2022	HMP Public Engagement Strategy and Race & Equity Inclusion	Paul Brewster, TRPC Casey Mauck, TRPC Cherie Carey, TCEM Nicole Miller, Thurston County, Racial Equity Program Manager Meghan Porter, Thurston County, Public Information Officer
05/17/2022	Thurston County Fire Commissioners Briefing on the HMP Update	Paul Brewster, TRPC Thurston County Fire Commissioners
08/05/2022	Educational Services District 113 Support and Resources to HMP Update	Paul Brewster, TRPC Casey Mauck, TRPC Dan Beaudoin, ESD 113 Scott Black, ESD 113
08/05/2022	Extreme Heat Hazards in HMP Update	Paul Brewster, TRPC Alyssa Woods, Tumwater Marisa Caughlan, TCAT Melinda Hughes, TCAT
10/21/2022	Fire Chiefs Strategy to Support Wildland Fire Hazard Risk Assessment & Mitigation	Paul Brewster, TRPC Brandon Cheney, TCEM Chief Steve Brooks, FD 3 Chief Brian VanCamp, FD 8 Chief Leonard Johnson, FD 9
10/31/2022	Hazards and Socially Vulnerable Populations & Hazardous Weather Task Force	Paul Brewster, TRPC Casey Mauck, TRPC Keylee Marineau, TCPHSS, Homeless Response Program Manager Jessica Olson, TCPHSS
12/27/2022	Wildland Fire Hazard Risk Rating - Chief's Feedback	Thurston County Fire Chiefs Association
02/22/2023	Community Wildfire Protection Plan Discussion	Thurston County Fire Chiefs Association
03/13/2023	Heat Response Strategy for Hazard Mitigation Discussion	Paul Brewster, TRPC Dr. Gordon Wheat, TCAT Dr. Rachel Wood, TCAT Melinda Hughes, TCAT
03/17/2023	Wildland Fire Hazard Risk Rating	Paul Brewster, TRPC Assistant Chief Michael Cerovski, FD3 Chief Brian VanCamp, FD 8 Chief Leonard Johnson, FD 9

Date	Activity	Participants
03/24/2023	Extreme Heat Incident Response Initiative Proposal	Paul Brewster, TRPC Dr. Gordon Wheat, TCAT Dr. Rachel Wood, TCAT Dr. Joseph Pellicer Melinda Hughes, TCAT
04/26/2023	Community Wildfire Protection Plan Initiative Proposal	Thurston County Fire Chiefs Association
05/10/2023	Extreme Heat Incident Response Initiative Discussion	Paul Brewster, TRPC Sue Poyner, TCPHSS
06/7/2023	SPSCC Stormwater Pond F - High Hazard Potential Dam Site Visit & Discussion	Paul Brewster, TRPC Fred Creek, SPSCC Director of Security Karl Shenkel, SPSCC Assistant Director of Facilities
07/13/2023	Thurston County Public Health and Extreme Heat Incident Response	Marc Daily, TRPC Paul Brewster, TRPC Dr. Jen Freiheit, TCPHSS David Bayne, Dr. Jen Freiheit, TCHPSS
09/20/2023	Nisqually Hydroelectric Project Dam Failure Vulnerabilities and Probabilities	Paul Brewster, TRPC Jayson Lelli, Tacoma Power Emergency Manager
10/13/201	Hazard Mitigation Plan Participant Identification	Paul Brewster, TRPC Cherie Carey, TCEM

Community Engagement Activity

Soliciting feedback from the public to make Thurston County communities more disaster resilient was central to updating the region's HMP. TCEM, TRPC, and the plan participants performed numerous outreach activities to raise public awareness about natural hazards and the actions that are identified in the plan participants' mitigation strategies. Throughout the planning process, TRPC and the plan participants engaged community leaders, stakeholders, and the public about the plan through the project website, email lists, social media, public meetings, surveys, an online open house, and attending community events.

A Hazard Mitigation Plan Community Outreach Strategy was developed in coordination with the HMPW and stakeholders (see outreach strategy in Appendix E). The strategy identified three community engagement goals.

Community Engagement Goals:

1. Build community support for hazard mitigation planning.
2. Increase public awareness about the region's known hazards and their impacts.
3. Create opportunities for people to share ideas to make Thurston County communities more disaster resilient.


Senior and elected officials divided into small groups to perform a transportation recovery exercise on June 6, 2022.

Engaging Leadership

Regional Executive Seminars

For nearly a decade, the EMC has sponsored twice annual Executive Seminars for Senior and Elected Officials. These events convene tribal, county, city, and special purpose district directors, department leaders, and elected representatives to promote awareness about Thurston County's various emergency management programs including preparedness, response, recovery, and mitigation. The events are well attended and provide attendees an opportunity to network with other leaders in the region.

Hazard mitigation planning is one of the EMC's chief work program priorities. The evening seminars provide a prime opportunity for the region's emergency managers, first responders, and planners to present information about the benefits of mitigation planning and to encourage audience members to provide leadership to their jurisdictions in the form of supporting and encouraging the development of HMP plans. The EMC, TCEM, and TRPC regularly provide mitigation planning updates at the Seminars.

Table 6.4 Executive Seminar for Senior and Elected Official Presentations

Date	Activity
12/13/2021	HMP Introduction and Planning Process Presentation
06/06/2022	HMP Status update and Regional Transportation Disaster Recovery Exercise
12/12/2022	Countywide Community Resiliency Survey Results Presentation
06/05/2023	Risk Assessment, Hazard Risk Ratings, and Regional Mitigation Initiatives Update Presentation Wildfire Trends

Local Leadership Activities

Each participant developing a plan engaged their community's governing body and/or subcommittees to inform their leaders about the progression of the plan and the actions included in their jurisdiction's mitigation strategy. Community leadership is most evident when a governing body adopts their HMP and when prioritizing and approving the implementation of their mitigation actions. Each jurisdiction's leadership engagement activities are documented in their annex.

Hazard Education and Outreach Activities

Education and outreach activities deliver important hazard mitigation and disaster resilience information to organizations and community members. Providing information to promote hazard awareness and increase risk reduction is a priority of the region's mitigation strategy.

Community leaders received a mitigation planning risk assessment briefing on June 5, 2023.

Fall/Winter and Summer Weather Hazards Seminars

Thurston County Emergency Management sponsors annual weather hazards seminars in the fall and summer. The seminars feature guest speakers from the National Weather Service, Olympic Region Clean Air Authority, Puget Sound Energy, Washington State Departments of Health and Natural Resources, the Sheriff's Office, fire districts, Thurston County Community Planning and Economic Development and Public Health and Social Services, TRPC, and others. Information is presented about weather trends, potential hazards, mitigation strategies, and preparedness to local government agencies and community partners.

TRPC presented information about wildland fire and extreme heat mitigation strategies at both the June 9, 2022 and May 31, 2023 Summer Weather Hazard Seminars. TCEM invited guest speakers to present winter weather hazard information at the October 2022 and 2023 seminars.

2023 Thurston County Preparedness Expo

The Emergency Management Council resumed sponsoring the Thurston County Preparedness Expo after a four-year pause from COVID-19 safety precautions. On September 23, 2023, over 500 people attended the half-day event at Peter G. Schmidt Elementary School in Tumwater to learn steps they can take to become more prepared for a variety of emergencies.

Preparedness Expo attendees could learn about hazards that could impact their home and community.

TRPC and TCEM staff hosted a hazard mitigation table with posters displaying information about natural hazards and mitigation activities. Expo visitors could interact with staff and use an interactive hazard mapping station to discover which natural hazards could potentially impact their homes and property. These in-person interactions created opportunities for staff to share information about the types of actions that local governments are pursuing through the HMP to reduce the impacts of hazards in the attendees' communities. Staff interacted with over 130 visitors and distributed bookmarks that included a QR code to the HMP project website.

Table 6.5 General Public Education and Outreach Activities

Date	Activity
06/09/2022	Summer Hazards Seminar
10/26/2022	Fall/Winter Hazards Seminar
05/31/2023	Summer Hazards Seminar
10/26/2023	Fall/Winter Hazards Seminar
09/23/2023	Thurston County Preparedness Expo
10/17/2023	Real Estate MLSA Group Presentation

2022 Multijurisdictional Pre-Plan Development Natural Hazards and Resiliency Survey

TRPC conducted an online survey in June-July 2022 to gather public input to inform the development of the multijurisdictional plan update. The survey included 12 questions about perceived risk and preferred mitigation activities. Eight additional questions sought demographic information from participants. The survey was available to the public from June 6 – July 31, 2022. The survey was available in English, Korean, Spanish, and Vietnamese.

2022 Survey Promotion and Outreach Activities

The survey was hosted on TRPC's website and promoted with a variety of outreach methods shown in 6. All the plan partners were encouraged to notify their constituents about the survey through their agency social media accounts, electronic newsletters, utility bills, email messages, and during in-person community events.

Table 6.6 2022 Natural Hazards and Resiliency Survey Outreach Activities

Method	Description	Dates
Video Survey Announcement	TCTV produced a one-minute video that aired on social media: https://youtu.be/bylVoF2oZJ8.	June - July
TRPC Webpage	A banner on the homepage directed users to the survey.	June 6 – July 31
Facebook	An advertisement for the survey was boosted throughout the region.	June 6 – July 31
Timberland Regional Library newsletter	A note about the survey was included in TRL's June digital newsletter.	June
South Thurston Economic Development Institute	Staff announced the survey and its purpose at the monthly meeting.	June 18
Swede Day	Staff handed out bookmarks with a QR code to the survey at the event and posted a large QR code on a WTRFA apparatus in the community parade.	June 18
Yelm Prairie Days	Staff handed out bookmarks with a QR code to the survey at the event.	June 25
Lacey Polynesian Festival	Staff handed out bookmarks with a QR code to the survey and provided iPads for guests to complete the survey onsite.	June 25
Scott Lake Community Annual Celebration	Staff handed out bookmarks with a QR code to the survey at the event.	June 25
Intercity Transit July Rider News	A note about the community survey was included in IT's July digital newsletter.	July
Timberland Regional Library Sandwich Boards	Sandwich boards were placed at the entries of all Timberland Regional Library locations in Thurston County. The board included a QR code to the survey and staff contact information.	July 8 – July 31
South Sound BBQ	Staff handed out bookmarks with a QR code to the survey and provided iPads for guests to complete the survey onsite.	July 9
Thurston Climate Mitigation Plan News Flash	The Thurston Climate Mitigation Plan Published and Emailed a News Flash to subscribers	July 20

This table does not include all activities conducted by plan partners.

Responses

668 people participated in the survey. There was one response to the Korean language version. There were no requests for paper versions of the survey. The survey results were presented at the September 2022 HMPW meeting and the December 12 Executive Seminar for Senior and Elected Officials. The survey participants' response results to perceived concern about hazards is referenced in the hazard profiles in Chapter 4. The majority of respondents rated strengthening critical facilities and essential services as the highest priority mitigation actions that local governments should pursue. Hazard warning systems and public education and outreach activities rated as the second and third highest priorities respectively. These responses were considered during the development of the Regional Mitigation Strategy. The ranking of the Regional Mitigation Initiatives in Chapter 2 reflects these priorities. The respondents' comments were shared with the plan participants. See Appendix E for a survey report that provides a complete summary of the results.

Plan participants like West Thurston Regional Fie Authority promoted the survey on social media.

2023 Multijurisdictional Hazard Risks and Action Plan Survey

TRPC hosted an online open house in tandem with an online multijurisdictional survey to gather feedback on the proposed regional and jurisdictional mitigation strategies. The EMC approved four objectives to guide the survey and its outreach activities:

Action Plan Survey Objectives

1. Increase public understanding of natural hazards that affect Thurston County communities.
2. Increase awareness of the plan participants' action plans.
3. Community members and interested parties will share their views about the proposed action plans.
4. Increase public support to carry out the Hazard Mitigation Plan through greater agreement and acceptance.

Online Open House

To support the first two objectives, TRPC hosted an online open house at www.trpc.org/hazards during and after the survey period. The open house presented information to inform potential survey respondents and community members in a scrollable story map format. The open house featured the following content:

1. An introduction to Hazard Mitigation Planning
   - A. Overview of basic mitigation concepts
   - B. The planning area and participating jurisdictions
   - C. The benefits of mitigation
2. Natural Hazards
   - A. What is risk?
   - B. Description of the hazard profiles
   - C. Community risk ratings

TRPC hosted an online open house story map to inform the public about the plan's proposed actions.

3. Proposed Actions to Make our Communities Stronger
   A. High level summary of the 12 Regional Mitigation Initiatives
4. Link to Surveys
   A. Regional Mitigation Action Survey
   B. Links to surveys for Thurston County, Olympia, Lacey, Tumwater, Olympia School District, The Evergreen State College, Thurston PUD, and West Thurston Regional Fire Authority

Online Survey

To support the third and fourth objectives, TRPC and the plan participants promoted the online survey that was available from July 24 to August 25, 2023. Respondents were encouraged to visit the online open house before taking the survey. The survey questions focused on the proposed regional and jurisdictional mitigation actions. Two survey questions, a request for an email address (for future information sharing), and four demographic questions were replicated in each jurisdiction's survey. The two survey questions prompted respondents for the following feedback:

1. *Based on your understanding of hazards and how they might impact you or your community, select the three actions that you would like to see prioritized highest.*
2. *Based on your understanding of hazards and how they might impact you or your community, what other actions do you suggest should be taken to minimize hazard impacts? Share as much detail as you can.*

2023 Survey Promotion and Outreach Activities

TCEM and TRPC co-hosted a booth at the Thurston County Fair daily from July 26-31 to promote the open house and survey. HMPW representatives assisted with hosting the event. A variety of informational brochures, booklets, and posters were available to audiences of all ages. Staff engaged fair visitors about emergency preparedness and hazard mitigation. Bookmarks and water bottles with custom hazard mitigation plan survey labels were offered to the fair visitors.

A similar effort to the 2022 pre-plan development survey was performed for the action plan survey. TRPC provided a baseline of regional and jurisdictional activities to encourage community engagement. The plan participants were advised to conduct parallel activities to increase community participation. Table 6.7 lists the outreach activities that were completed.

Table 6.7 2023 Hazard Risks and Action Plan Survey Outreach Activities

Method	Description	Dates
Video Survey Announcement	TCTV produced a second one-minute video that aired on social media: https://www.youtube.com/watch?v=9O2k8_hSEUk.	July - August
TRPC Webpage	A banner on the homepage directed users to the survey.	June 6 – July 31
Social Media	TRPC posted two ads on Facebook for the survey. It was boosted throughout the region. Plan participants shared and posted other social media announcements.	July 27-August 31
Timberland Regional Library newsletter	A note about the survey was included in TRL's July and August digital newsletters.	July - August
Thurston County Fair	HMPW members hosted a daily informational table with posters and materials at the Thurston County Fair. Fair goers were encouraged to take the survey.	July 26 – July 31
News Release	TRPC issued a news release to local media organizations. King 5 covered the Thurston County Fair activities and broadcast the story on July 28: https://www.king5.com/article/news/local/natural-disaster-prep-thurston-county/281-bae685f6-5a81-4b17-9b60-bc6355693d16	July 28
Yelm Night Out	TCEM staff hosted a children's activity table at the Yelm Police Department's Night Out. The survey was promoted to attendees.	August 1
Thurston County Friday Five	Thurston County published the News Release in the Thurston County Friday Five Email Newsletter	August 4
Intercity Transit July Rider News	A note about the community survey was included in IT's August digital newsletter.	August
Timberland Regional Library Sandwich Boards	Sandwich boards were placed at the entries of all Timberland Regional Library locations in Thurston County. The board included a QR code to the survey and staff contact information.	July 8 – July 31
Bookmarks	Staff distributed bookmarks at all community events. The bookmark included a QR code linking to the online open house and survey.	July 25-August 25.

This table does not include all activities conducted by plan partners.

Survey Response

Survey participation was low for both the regional and jurisdictional action plan surveys. 70 people responded to the Regional Hazard Risks and Action Plan Survey. Fewer respondents participated in the jurisdictional surveys. The low response rate is not statistically significant and does not offer a broad range of representation and community views. The percentage of respondents who selected their three highest priority initiatives is shown in Chapter 2 in the Regional Mitigation Strategy section. Despite the low survey response rate, the three most popular initiatives align with three of the top five regional initiatives ranked by the Benefit-Cost Review process. A copy of the survey results and the respondents' comments are included in Appendix E.

Final Draft Plan Public Review and Comment Process

The Hazard Mitigation Plan participants value the input of community members in shaping the Hazards Mitigation Plan for the Thurston Region. To ensure transparency and inclusivity, the final draft of the plan underwent a public

Visitors learned about natural hazards and preparedness at the 2023 Thurston County Fair. Photo courtesy of King 5 News.

review and comment period from November 3 to November 17, 2023. In addition, five jurisdiction ready annexes were publicized:

- Thurston County
- City of Olympia
- City of Tumwater
- The Thurston County Public Utilities District #1
- The Evergreen State College

Accessible Information Online

The Hazards Mitigation Plan in whole, including individual downloadable chapters, appendices, and annexes were made easily accessible online at www.trpc.org/hazards. This platform allowed community members to download or view any section of the plan at their convenience.

Interactive Exploration through Story Map

To enhance community engagement, an interactive online "Thurston County Natural Hazards" story map was presented. This map provided an option for community members to explore hazards specific to their area, fostering a deeper understanding of the risks and mitigation strategies outlined in the plan.

Multiple Avenues for Feedback

We wanted to hear from diverse voices in our community, and as such, we provided multiple channels for feedback. Community members and interested parties were encouraged to share their thoughts and suggestions through:

1. Online Form: A user-friendly online form was made available, allowing reviewers to specify the jurisdiction and sections of the plan to which their comments pertained.
2. Email: Comments could be submitted via email for those who preferred this mode of communication.
3. Mail: For those who preferred traditional mail, a mailing address was provided to facilitate their participation in the review process.

Empowering Community Input

Instructions accompanying the plan guided community members on how to effectively use these channels for providing feedback. We believe that by involving the community in this crucial phase, we enhance the plan's effectiveness and ensure it truly reflects the needs and perspectives of the Thurston Region.

Public Notification

TRPC notified the general public of the opportunity to comment on the public plan through social media, a press release, and email notification to plan partners and stakeholders. Jurisdictions with annexes also performed community outreach as documented in their annexes. For example, the City of Olympia published a notice on the city's official Facebook account, the city's fire department Facebook account, and in the November 2023 Water Resources e-newsletter.

Results

The Hazard Mitigation Plan participants express gratitude to all who participated in this public review process. Community insights contribute significantly to our collective efforts to create a resilient and safer Thurston Region. TRPC did not receive any public comments on the core plan. One comment each was submitted for the City of Olympia and City of Tumwater annexes. Copies of the comments were submitted to the community planning representatives for their response. Jurisdiction specific comments are documented in their respective annexes.

Additional Public Comment Periods

Other jurisdiction annexes are in the process of development as part of the Thurston Region's multijurisdictional hazard mitigation plan update process. Plan participants have up to one year to complete and adopt their plans from the date that the Federal Emergency Management Agency grants approval of the 4th Edition Hazards Mitigation Plan for the Thurston Region. As the annexes are completed, communities and constituents will be notified and afforded opportunities to comment on draft plans before they are adopted.

The following participants* annexes are in development and pending future public comment:

- Town of Bucoda
- City of Lacey
- City of Rainier
- City of Tenino
- City of Yelm
- Intercity Transit
- McLane Black Lake Fire District
- SE Thurston Fire Authority and East Olympia Fire District
- West Thurston Regional Fire Authority

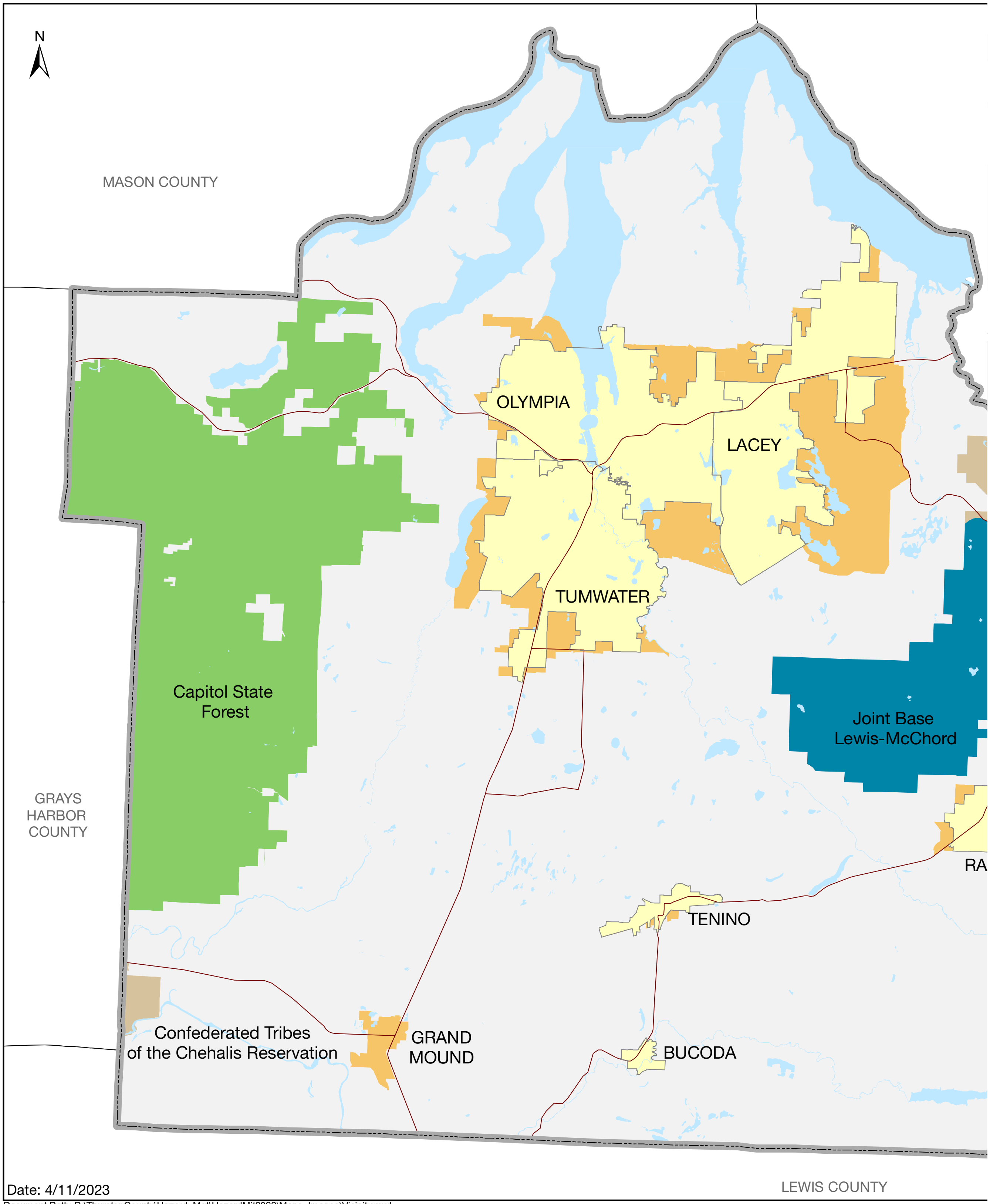
*Note: See Chapter 5: Keeping the Plan Current for details on the plan review and approval process. This chapter describes the multi-jurisdictional framework for Thurston County local governments to develop, maintain, and update a hazard mitigation plan.

Appendix A

Community Profile Maps and Tables

Contents

Map A1 Cities, Towns, Reservations and Public Lands of Thurston County



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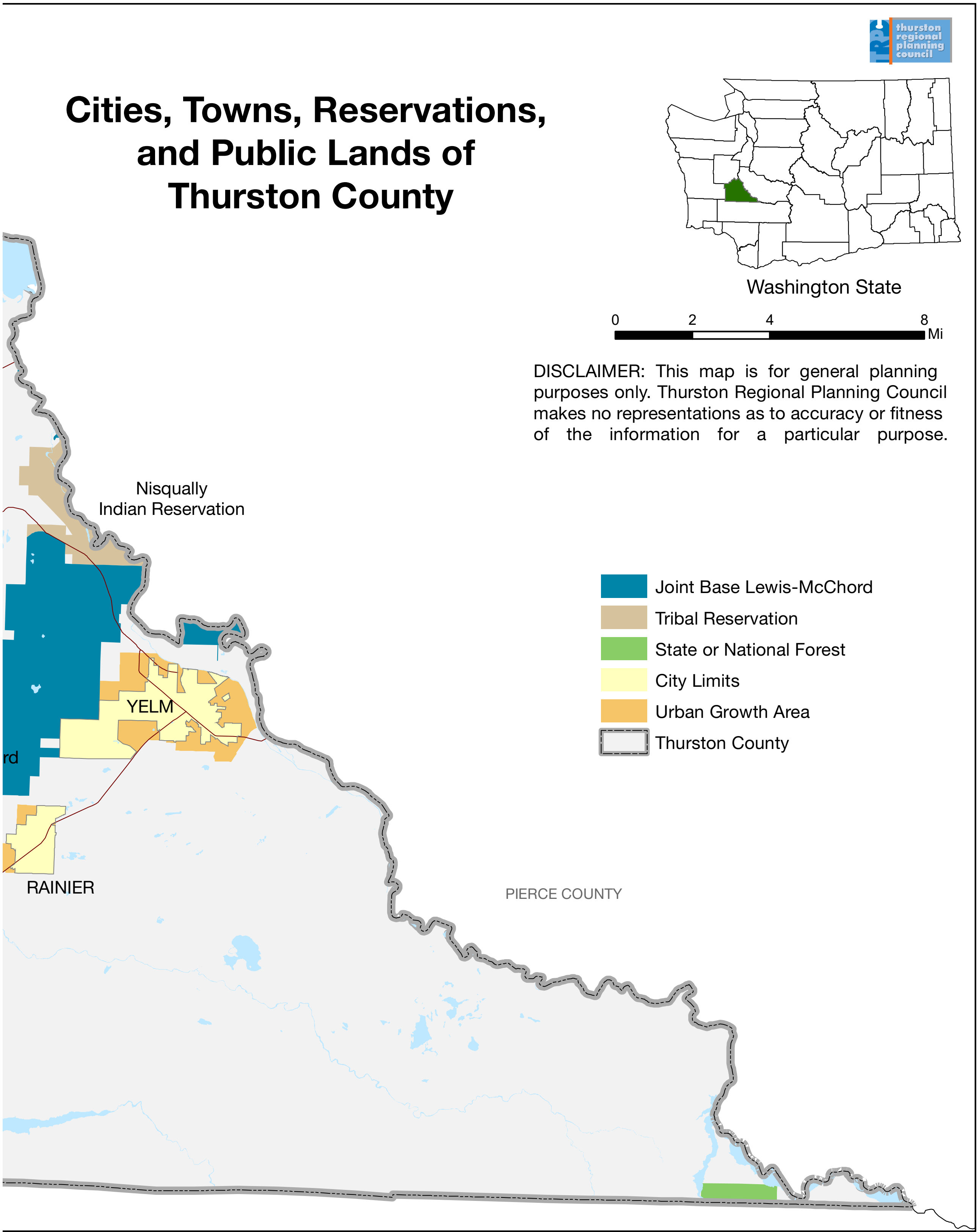
thurston regional planning council
Cities, Towns, Reservations, and Public Lands of Thurston County
Washington State
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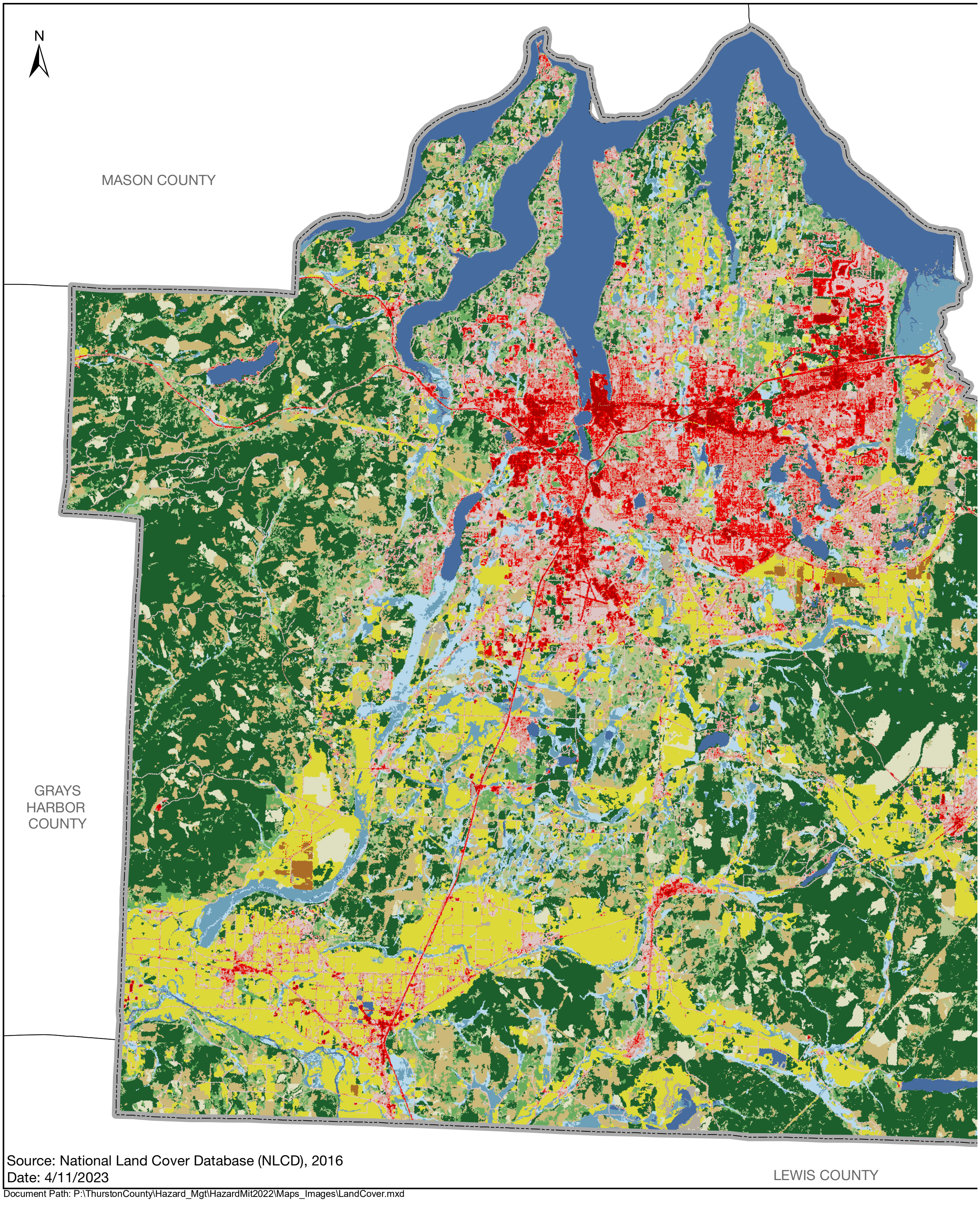
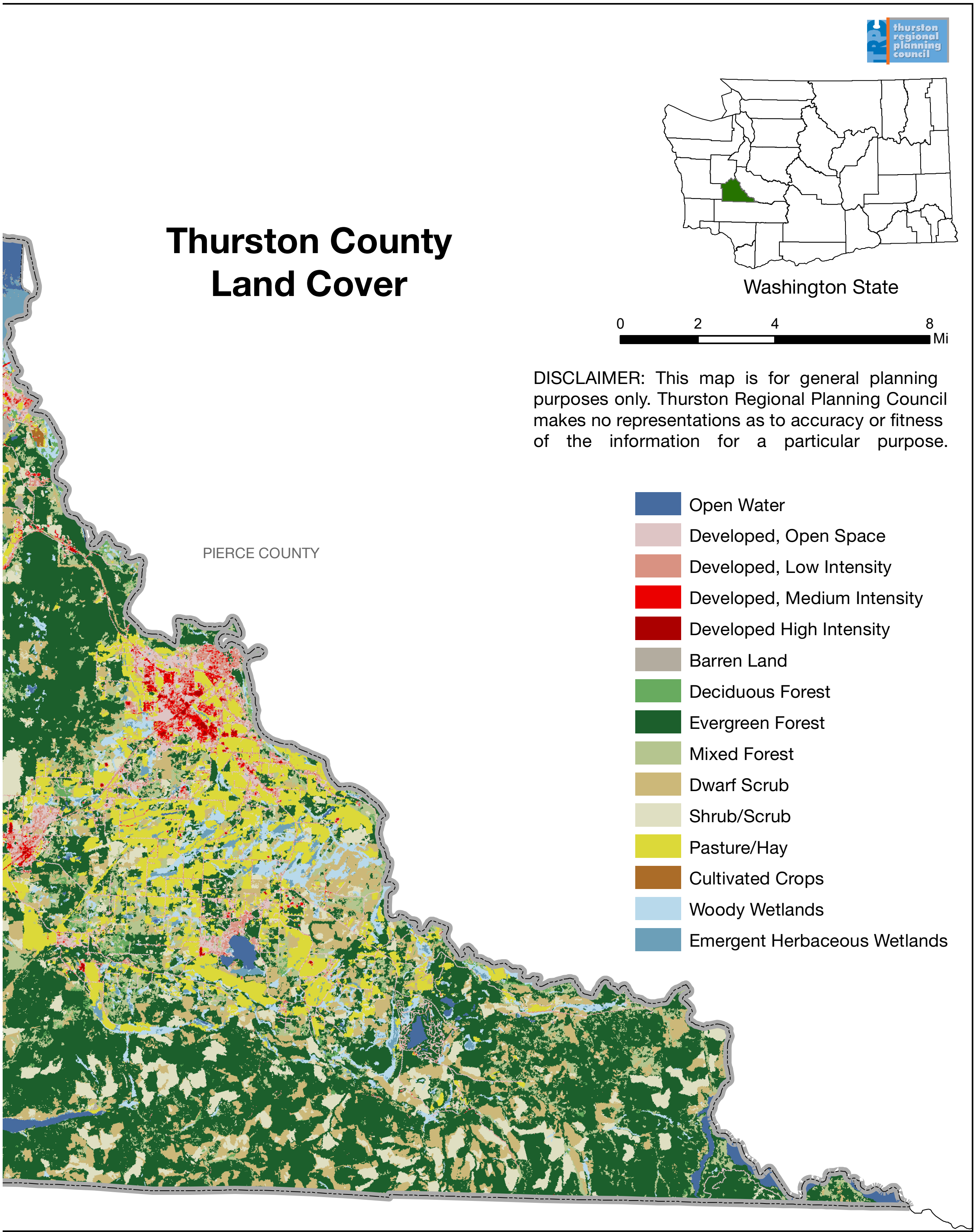
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Nisqually Indian Reservation
YELM
rd
RAINIER
PIERCE COUNTY
Joint Base Lewis-McChord
Tribal Reservation
State or National Forest
City Limits
Urban Growth Area
Thurston County

Map A2 Thurston County Land Cover, 2016




Thurston County
Land Cover
thurston regional planning council
Washington State
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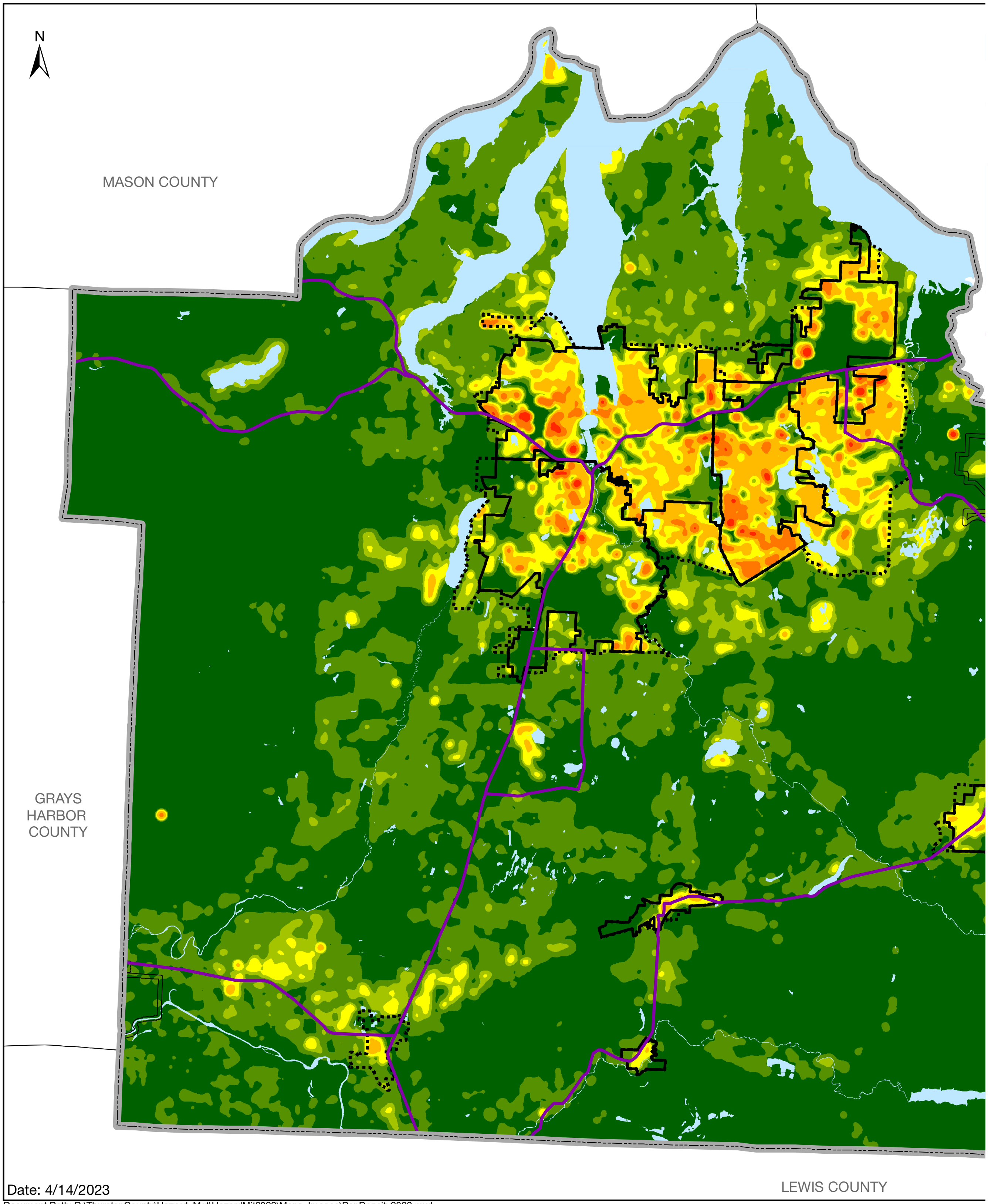
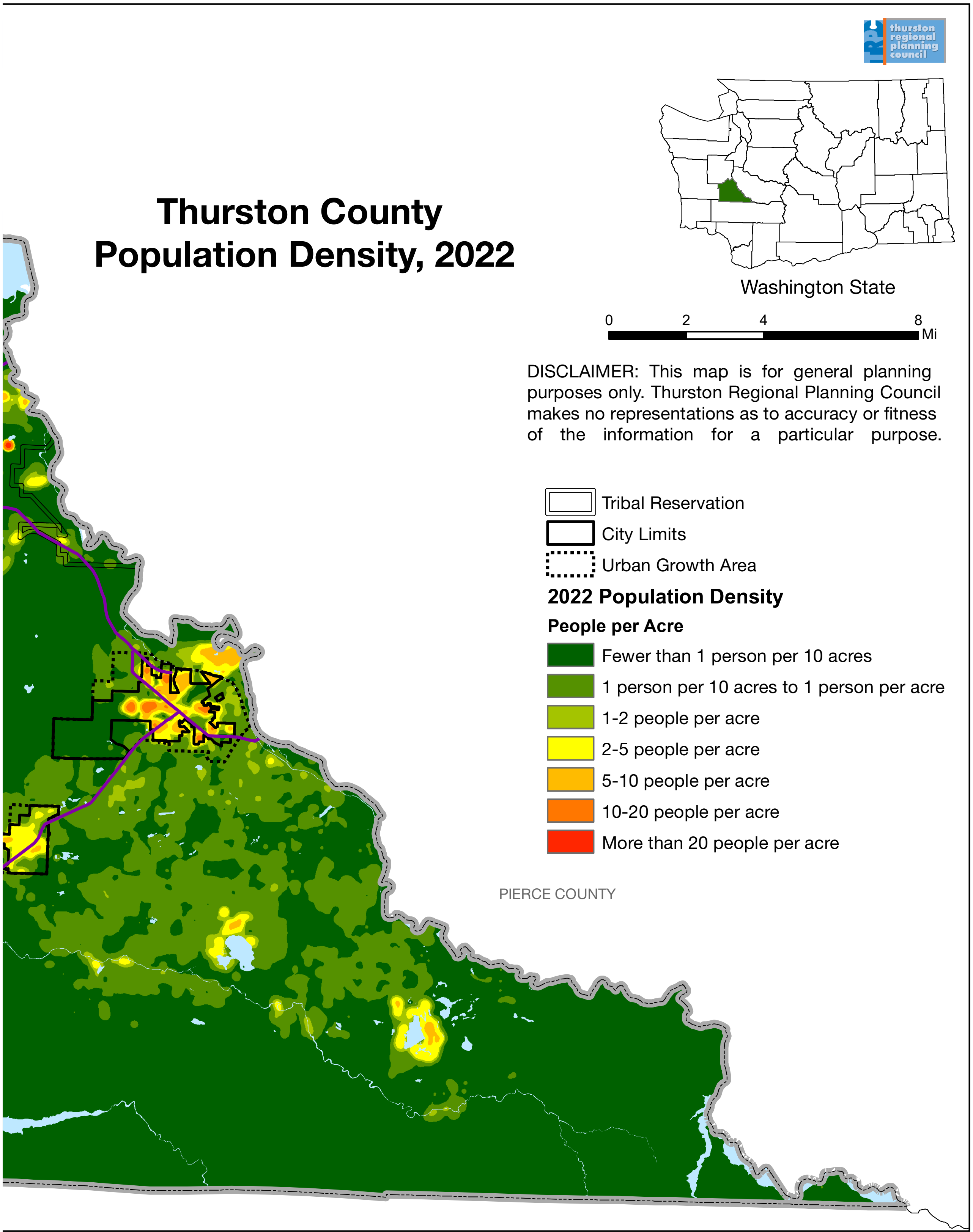
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
PIERCE COUNTY
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Dwarf Scrub
Shrub/Scrub
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emergent Herbaceous Wetlands

Map A3 Thurston County Population Density, 2022




thurston regional planning council
Thurston County
Population Density, 2022
Washington State
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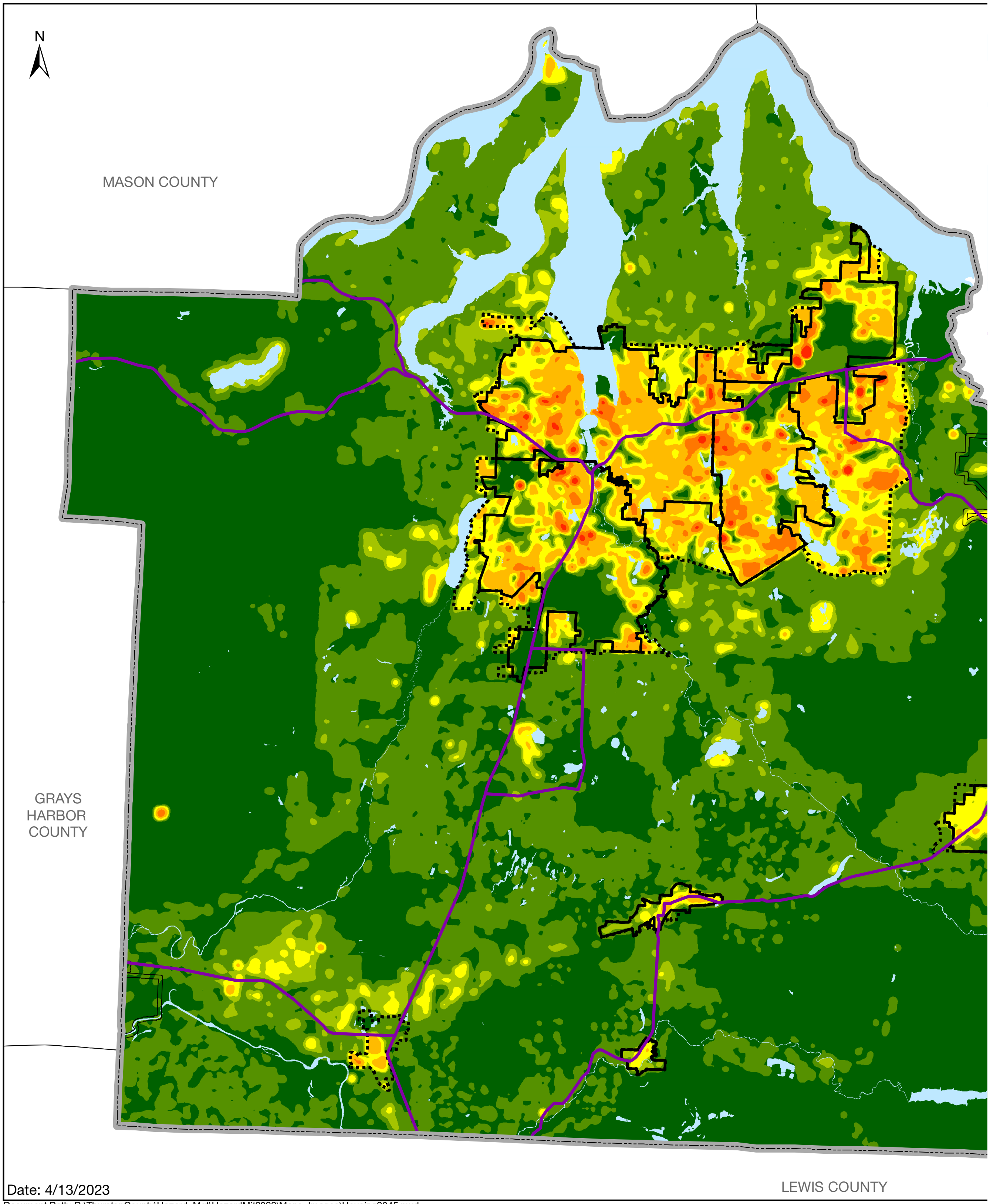
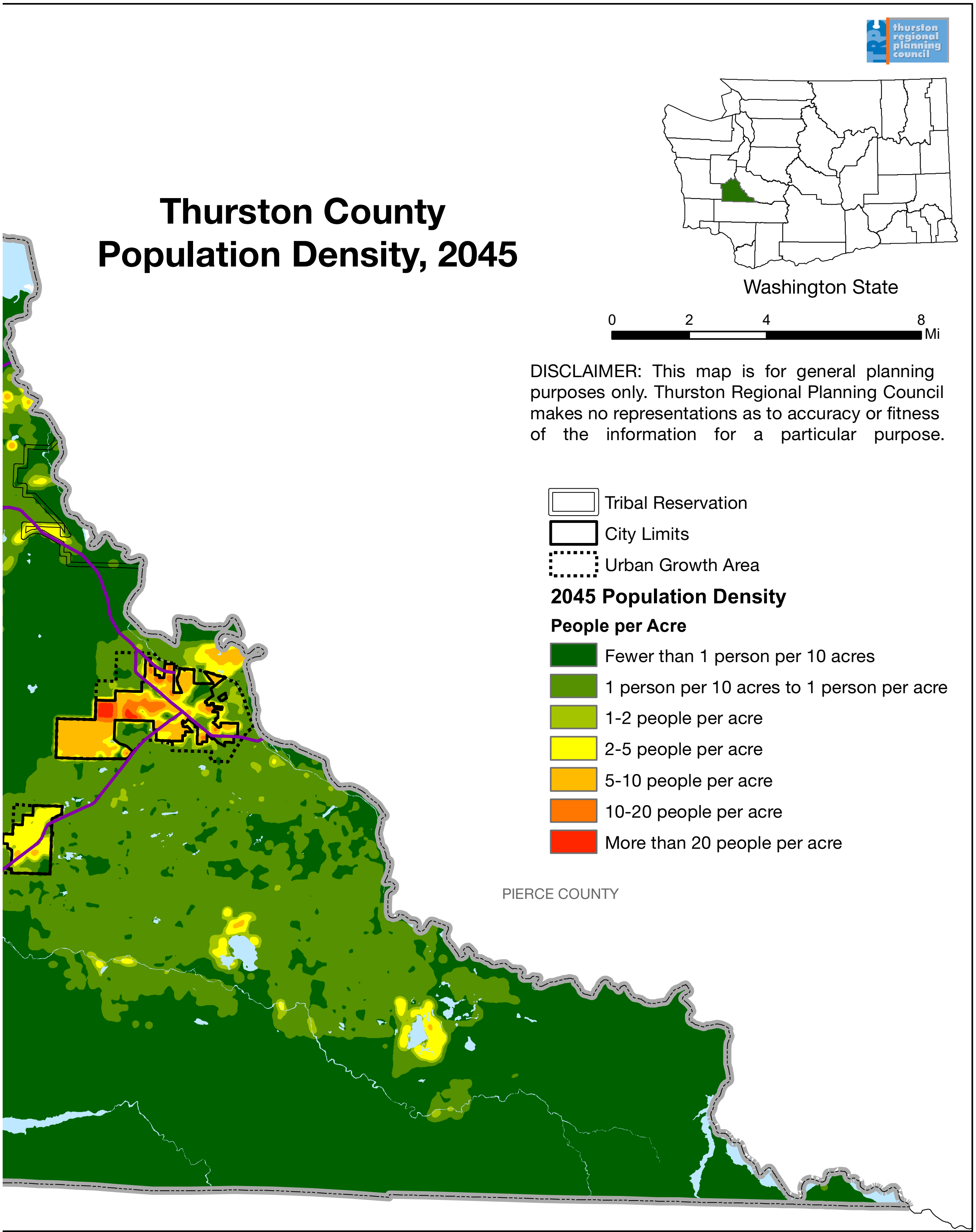
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Tribal Reservation
City Limits
Urban Growth Area
2022 Population Density
People per Acre
Fewer than 1 person per 10 acres
1 person per 10 acres to 1 person per acre
1-2 people per acre
2-5 people per acre
5-10 people per acre
10-20 people per acre
More than 20 people per acre
PIERCE COUNTY

Map A4 Thurston County Population Density, 2045





Thurston County
Population Density, 2045
thurston regional planning council
Washington State
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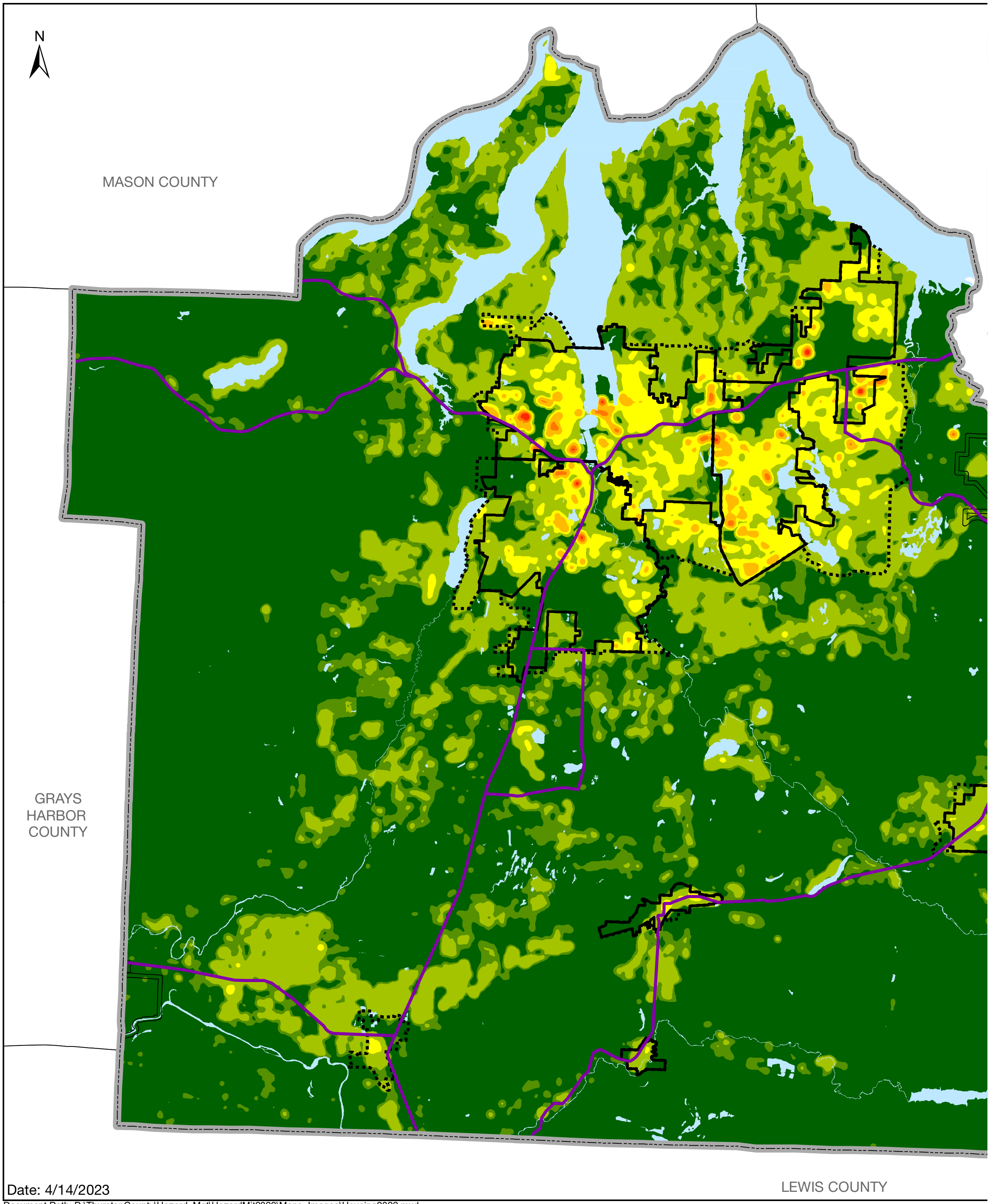
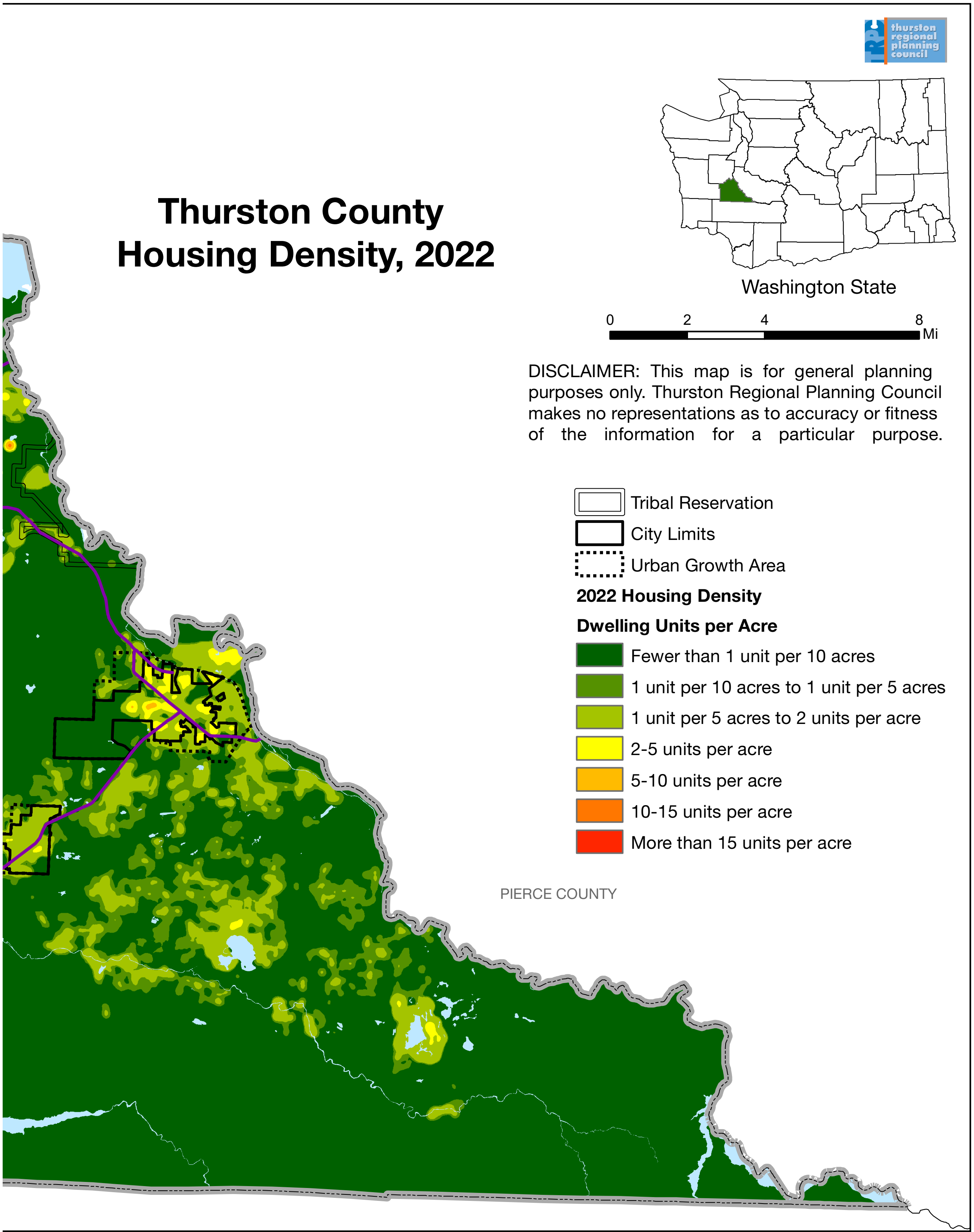
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Tribal Reservation
City Limits
Urban Growth Area
2045 Population Density
People per Acre
Fewer than 1 person per 10 acres
1 person per 10 acres to 1 person per acre
1-2 people per acre
2-5 people per acre
5-10 people per acre
10-20 people per acre
More than 20 people per acre
PIERCE COUNTY

Map A5 Thurston County Housing Density, 2022




Thurston County
Housing Density, 2022
thurston regional planning council
Washington State
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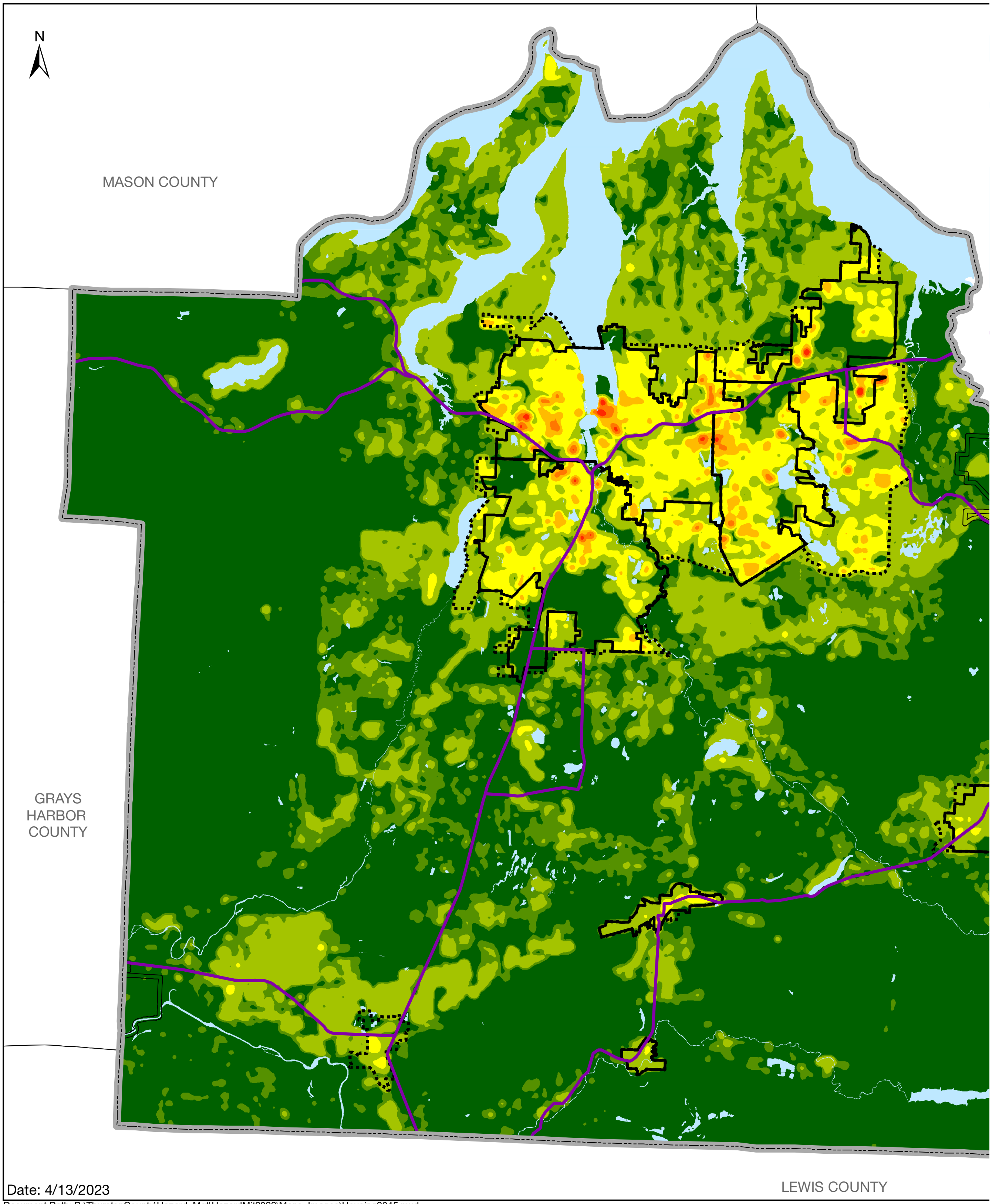
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Tribal Reservation
City Limits
Urban Growth Area
2022 Housing Density
Dwelling Units per Acre
Fewer than 1 unit per 10 acres
1 unit per 10 acres to 1 unit per 5 acres
1 unit per 5 acres to 2 units per acre
2-5 units per acre
5-10 units per acre
10-15 units per acre
More than 15 units per acre
PIERCE COUNTY

Map A6 Thurston County Housing Density, 2045



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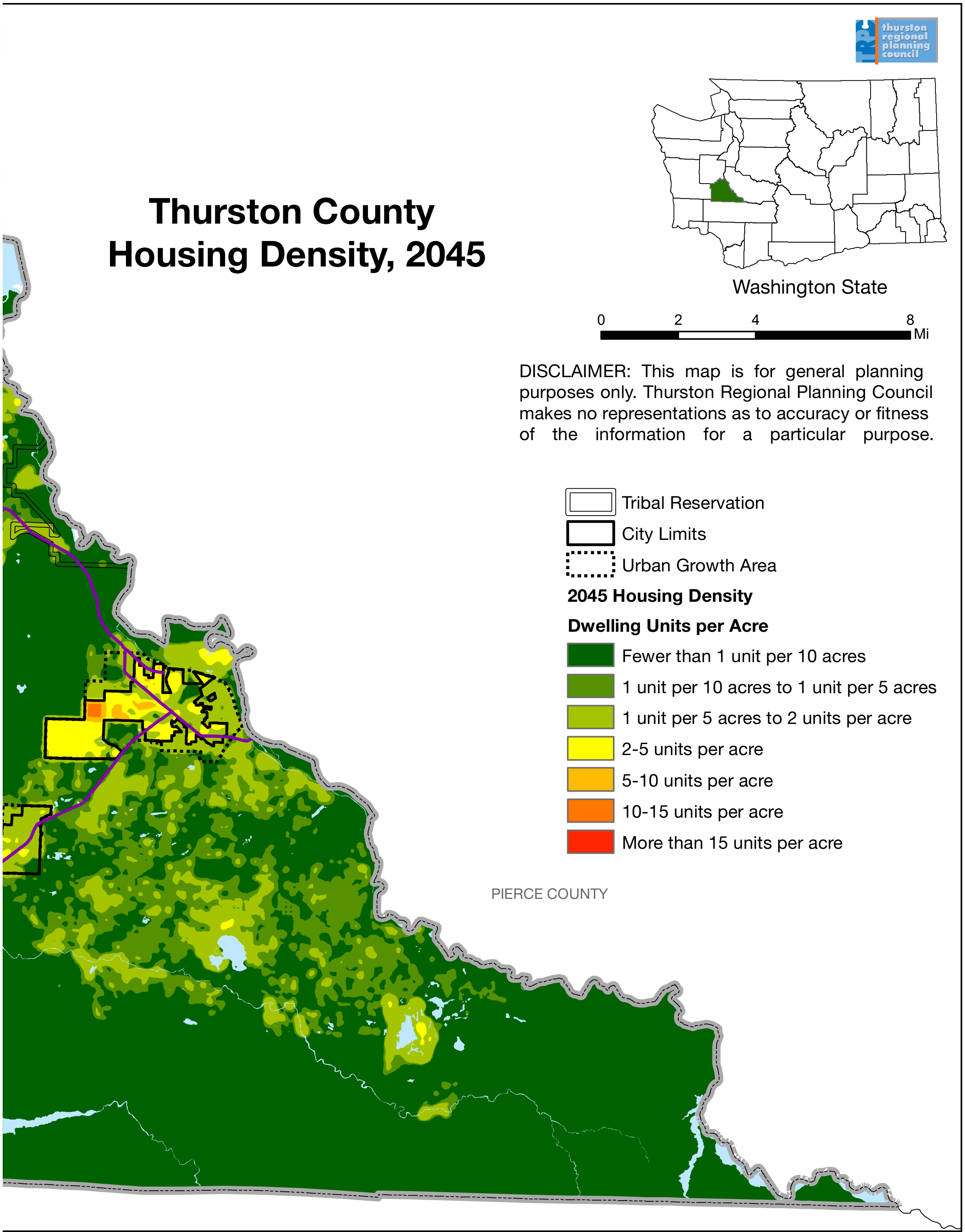
thurston regional planning council
Thurston County
Housing Density, 2045
Washington State
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2
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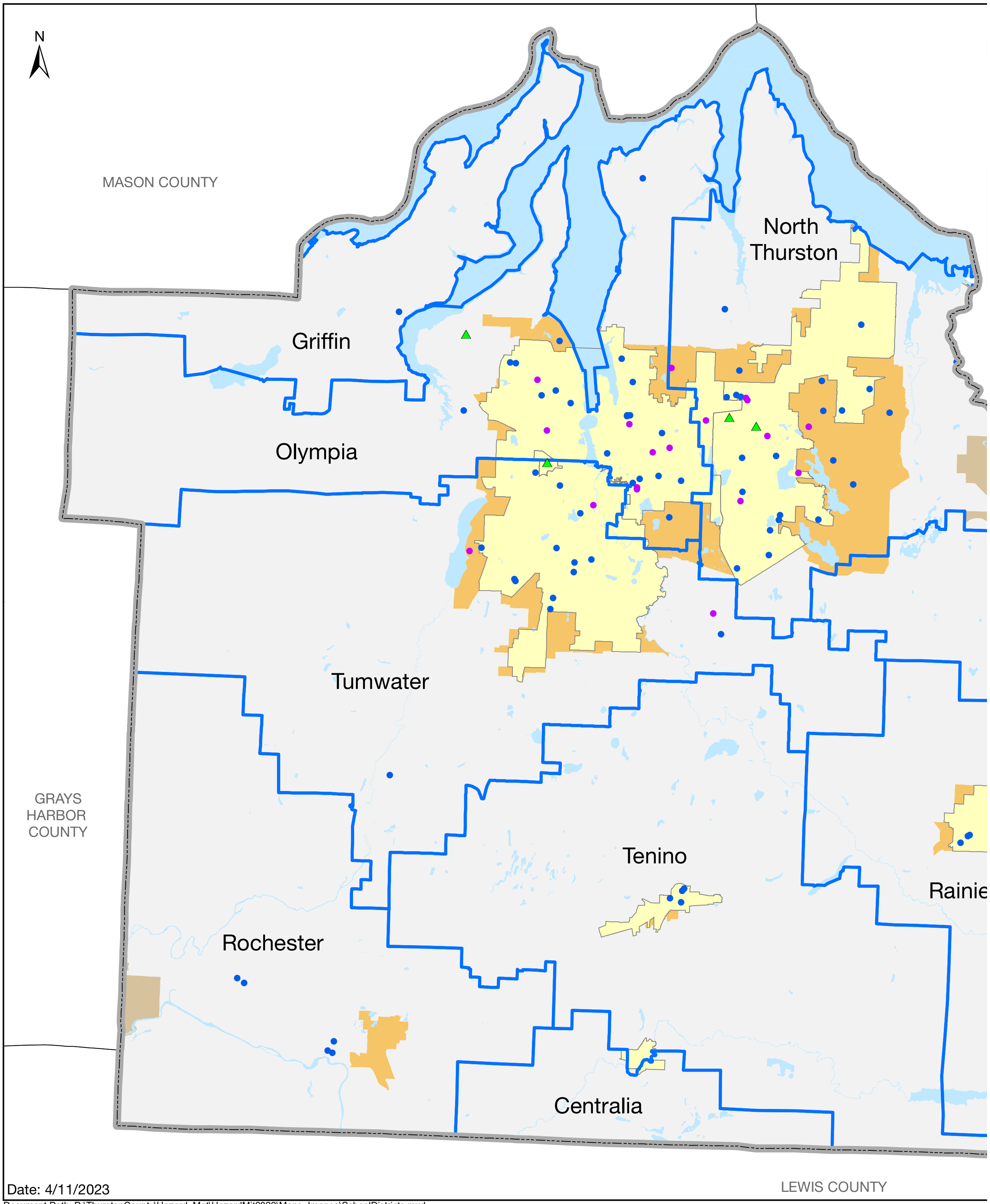
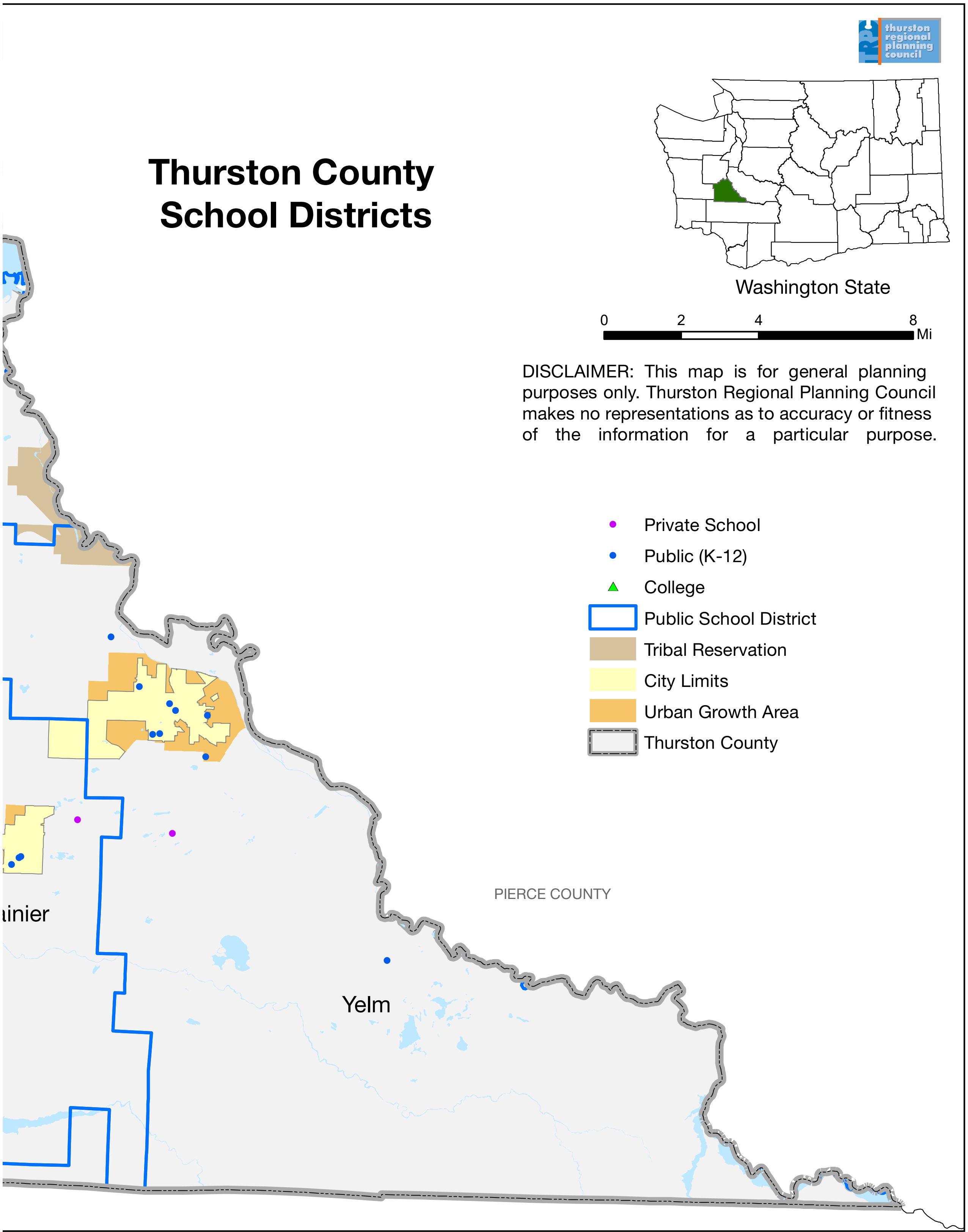
Mi
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Tribal Reservation
City Limits
Urban Growth Area
2045 Housing Density
Dwelling Units per Acre
Fewer than 1 unit per 10 acres
1 unit per 10 acres to 1 unit per 5 acres
1 unit per 5 acres to 2 units per acre
2-5 units per acre
5-10 units per acre
10-15 units per acre
More than 15 units per acre
PIERCE COUNTY

Map A7 Schools and School Districts, Thurston County, WA




Thurston County
School Districts
thurston regional planning council
Washington State
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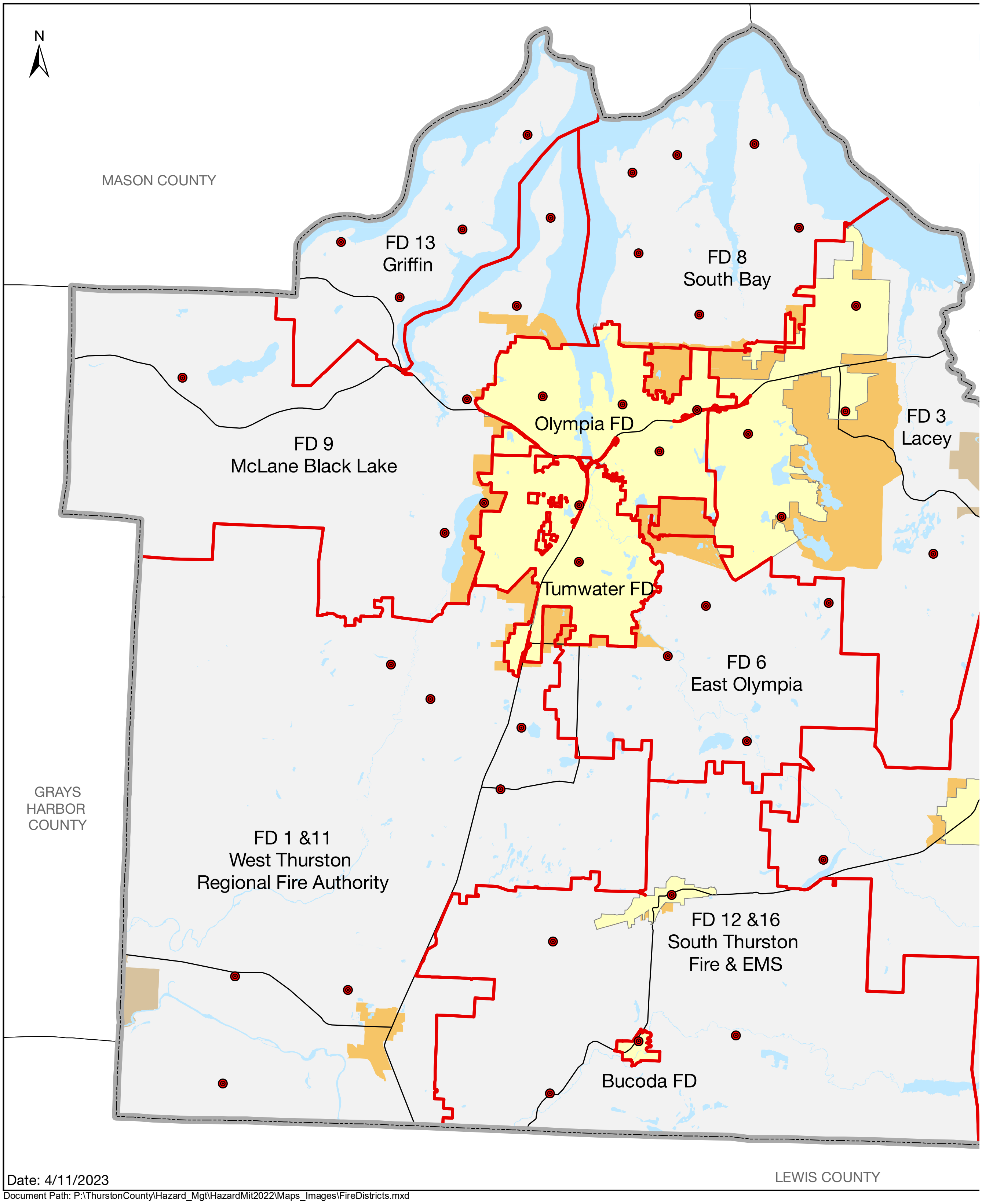
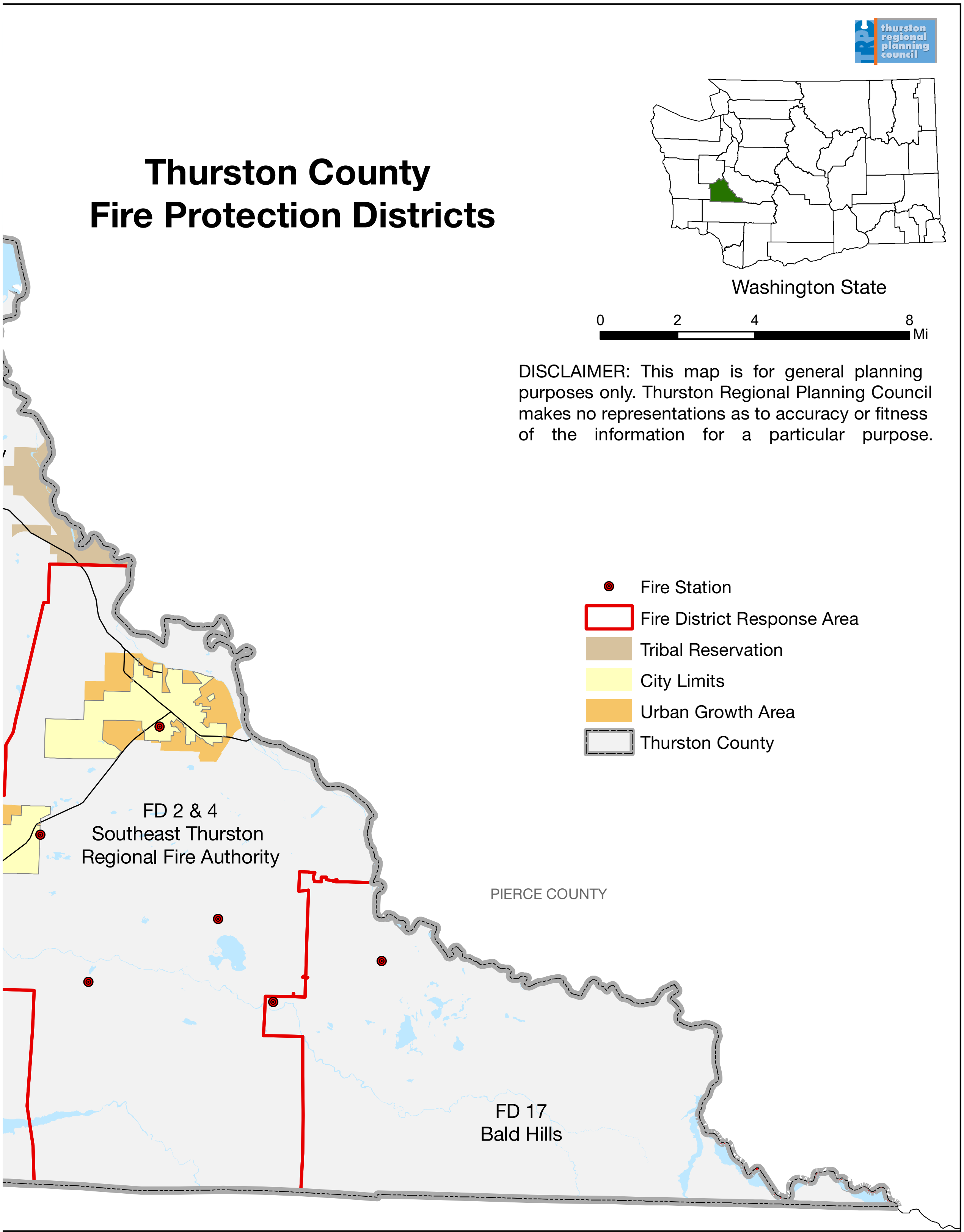
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Private School
Public (K-12)
College
Public School District
Tribal Reservation
City Limits
Urban Growth Area
Thurston County
PIERCE COUNTY
ainier
Yelm

Map A8 Thurston County Fire Protection Districts




thurston regional planning council
Thurston County
Fire Protection Districts
Washington State
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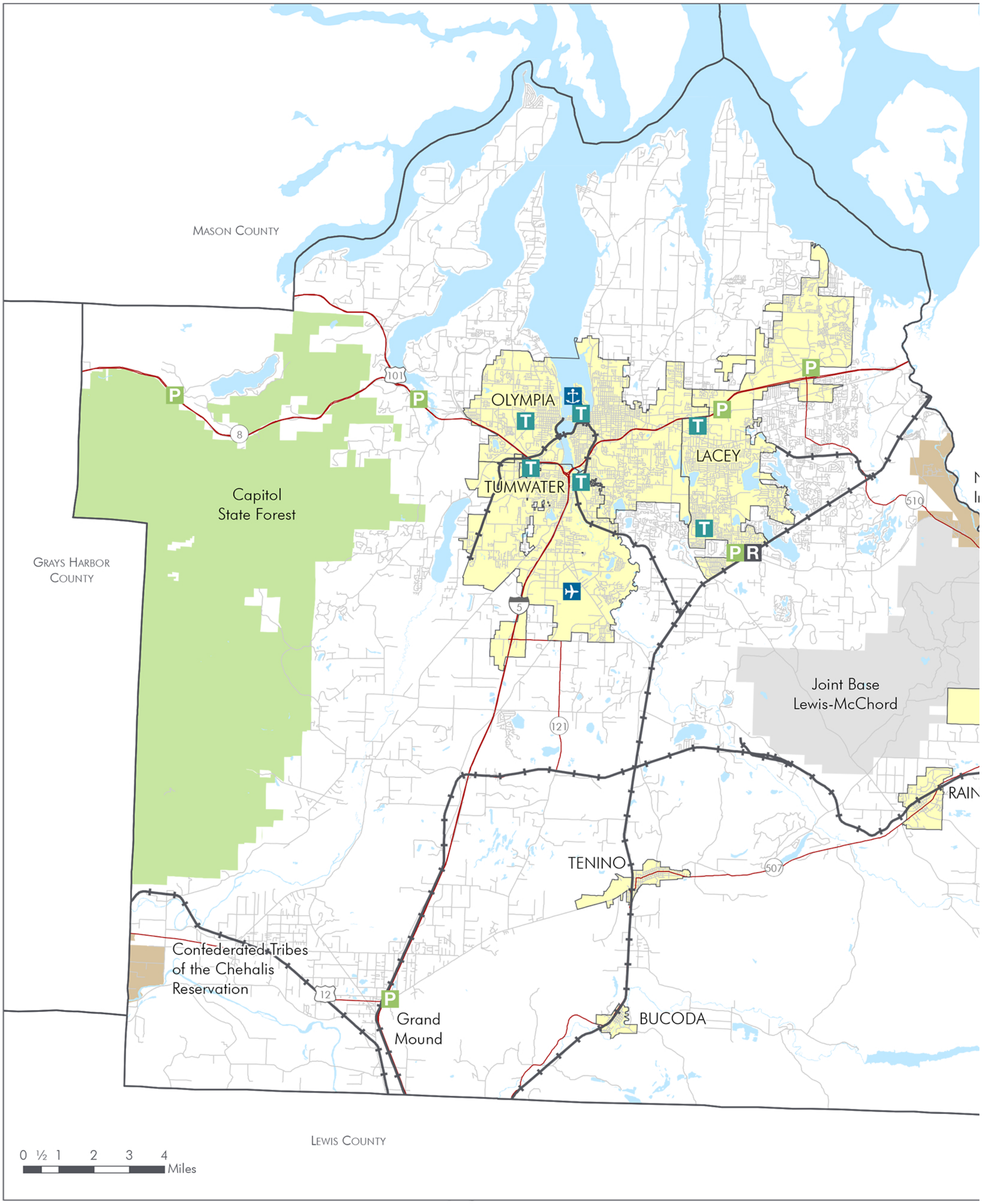
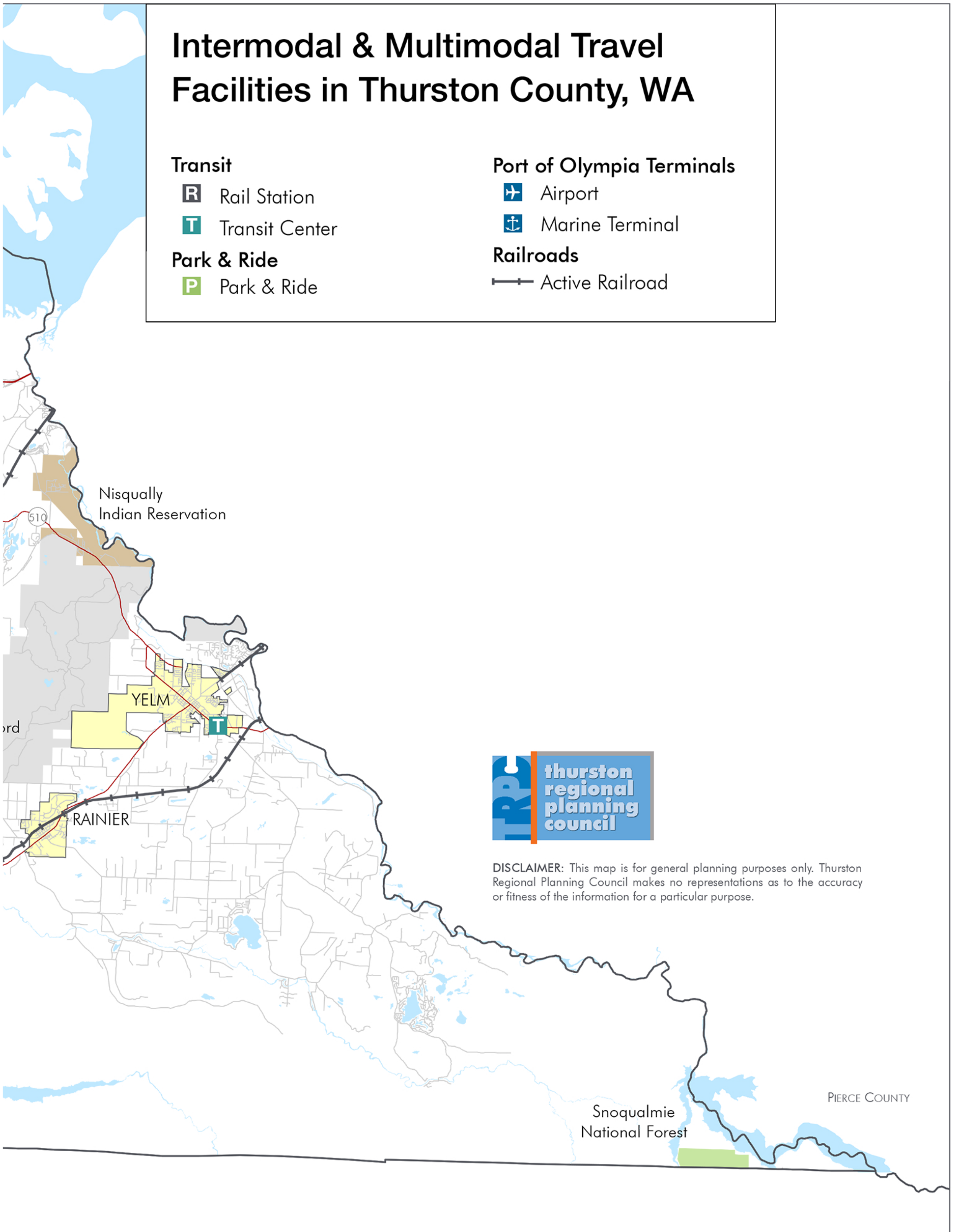
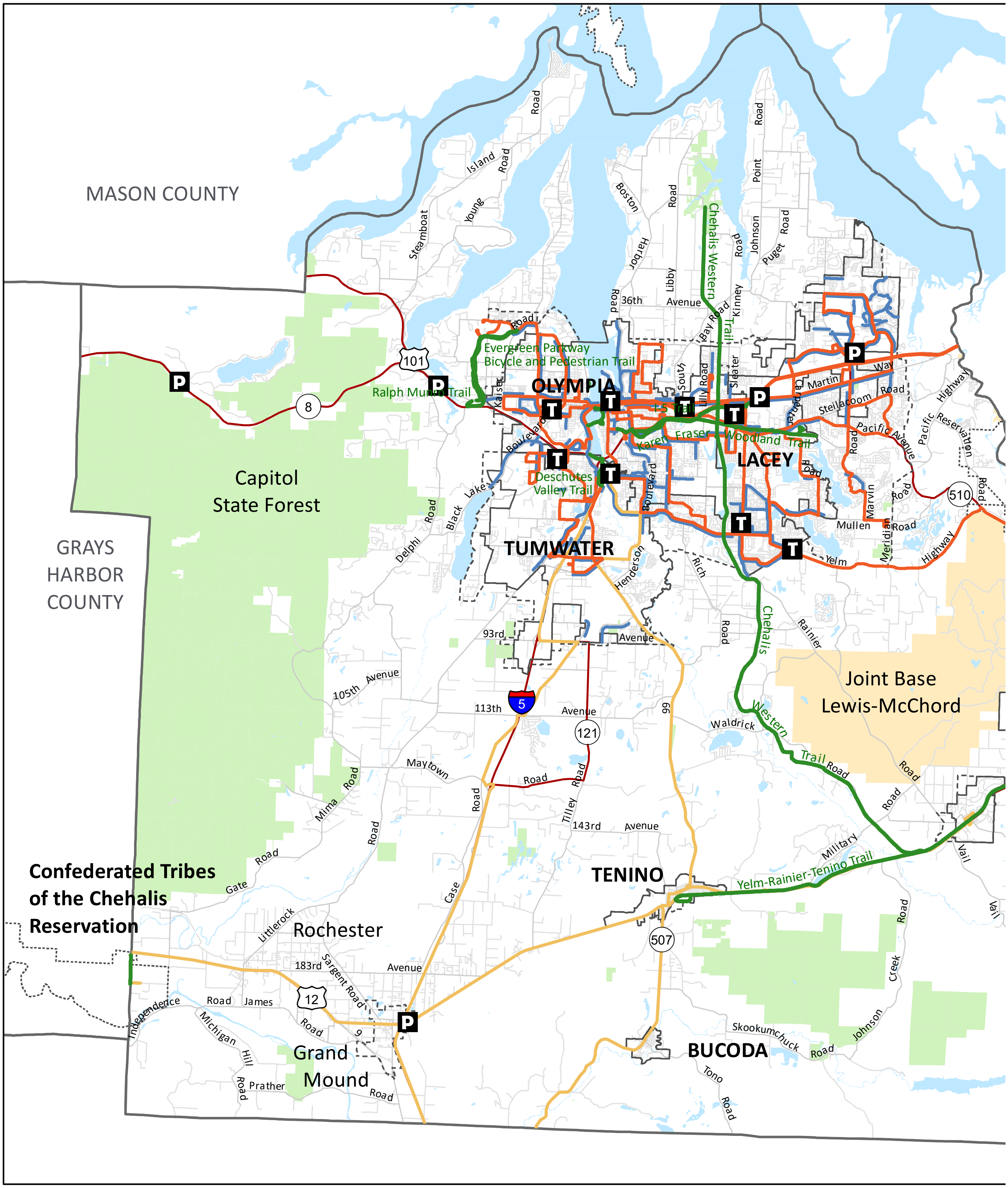
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Fire Station
Fire District Response Area
Tribal Reservation
City Limits
Urban Growth Area
Thurston County
FD 2 & 4
Southeast Thurston
Regional Fire Authority
PIERCE COUNTY
FD 17
Bald Hills

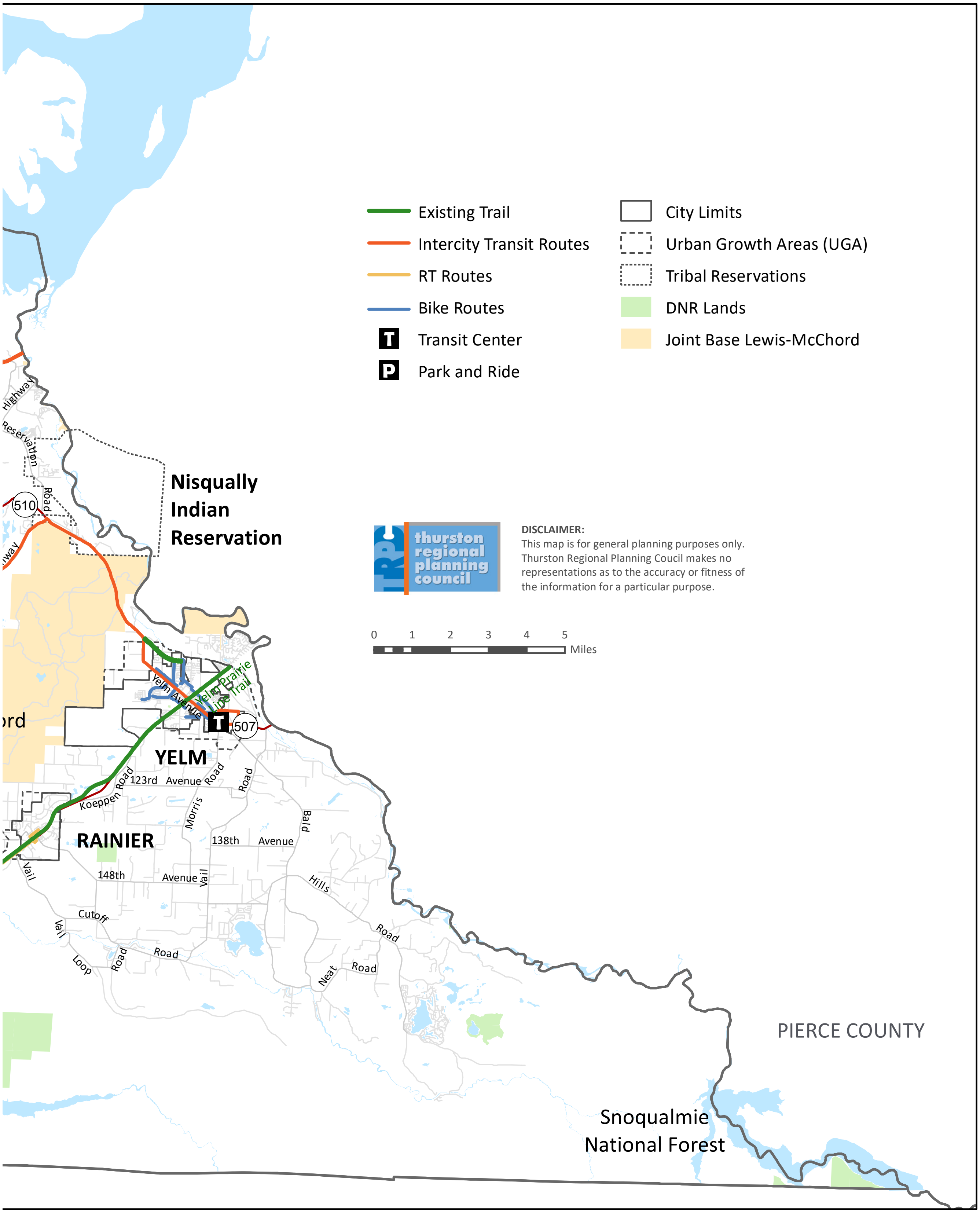
Map A9 Intermodal and Multimodal Transportation Facilities in Thurston County




Intermodal & Multimodal Travel Facilities in Thurston County, WA
Transit
Rail Station
Transit Center
Park & Ride
Park & Ride
Port of Olympia Terminals
Airport
Marine Terminal
Railroads
Active Railroad
Nisqually Indian Reservation
510
YELM
RAINIER
Snoqualmie National Forest
Pierce County
thurston regional planning council
DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to the accuracy or fitness of the information for a particular purpose.

Map A10 Multimodal Transportation Facilities in Thurston County





Existing Trail
Intercity Transit Routes
RT Routes
Bike Routes
Transit Center
Park and Ride
City Limits
Urban Growth Areas (UGA)
Tribal Reservations
DNR Lands
Joint Base Lewis-McChord
Nisqually Indian Reservation
YELM
RAINIER
PIERCE COUNTY
Snoqualmie National Forest
Yelm Prairie Line Trail
Yelm Avenue
123rd Avenue
138th Avenue
148th Avenue
Koeppen Road
Morris Road
Bald Hills Road
Neat Road
Vail Cutoff Road
Vail Loop Road
Reservation Road
507
510
thurston regional planning council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Coucil makes no representations as to the accuracy or fitness of the information for a particular purpose.
0 1 2 3 4 5 Miles

Table A1 Thurston County Land Area, 2021

JURISDICTION		Acres	Square Miles	Percent
Bucoda	City	379	0.6	0.1%
Lacey	City	11,367	17.8	2.3%
	UGA	9,923	15.5	2.0%
Olympia	City	12,858	20.1	2.6%
	UGA	3,913	6.1	0.8%
Rainier	City	1,109	1.7	0.2%
	UGA	316	0.5	0.1%
Tenino	City	916	1.4	0.2%
	UGA	70	0.1	0.0%
Tumwater	City	11,413	17.8	2.3%
	UGA	2,816	4.4	0.6%
Yelm	City	3,659	5.7	0.7%
	UGA	2,368	3.7	0.5%
Grand Mound	UGA	982	1.5	0.2%
Confederated Tribes of the Chehalis Reservation (1)		860	1.3	0.2%
Nisqually Indian Reservation (1)		2,147	3.4	0.4%
Rural Unincorporated County (2)		430,337	672.4	86.9%
Thurston County		**495,434**	**774.1**	**100.0%**

Source: TRPC
Notes: Area includes freshwater lakes and waterbodies. 1) Data are for Thurston County portion of reservations only. 2) "Rural Unincorporated County" is the area outside of city, UGA, and reservation boundaries.

Table A2 Land Cover and Impervious Area, Thurston County 2016

NOAA C-CAP Land Cover	2016 Acreage
High Intensity Developed	3,536
Medium Intensity Developed	10,936
Low Intensity Developed	29,779
Developed Open Space	18,106
Cultivated	6,300
Pasture/Hay	36,832
Grassland	39,718
Deciduous Forest	28,239
Evergreen Forest	140,562
Mixed Forest	50,195
Scrub/Shrub	69,406
Palustrine Forested Wetland	10,673
Palustrine Scrub/Shrub Wetland	8,236
Palustrine Emergent Wetland	8,175
Estuarine Emergent Wetland	205
Unconsolidated Shore	508
Bare Land	2,373
Water	6,394
Palustrine Aquatic Bed	334
Estuarine Aquatic Bed	2
Snow/Ice	2
Total	**470,511**

Source: NOAA C-CAP

Table A3 Population Estimates and Forecast, Thurston County Cities, Urban Growth Areas, and Reservations, 2010 to 2045

Jurisdiction	Census		TRPC		TRPC Forecast				
	2010	2020	2021	2022	2025	2030	2035	2040	2045
Bucoda	562	560	595	610	625	685	720	765	800
Lacey	42,393	42,830	54,850	58,180	56,550	57,820	58,970	59,890	60,670
UGA	33,170	33,380	37,330	34,770	41,480	44,550	47,050	49,850	52,770
Total	75,560	76,210	92,180	92,950	98,030	102,370	106,020	109,740	113,440
Olympia	46,478	46,780	55,960	56,370	58,840	62,980	66,960	69,760	72,040
UGA	11,840	11,910	12,510	12,620	13,270	13,390	13,730	14,610	15,610
Total	58,320	58,690	68,470	68,990	72,110	76,370	80,690	84,370	87,650
Rainier	1,794	1,825	2,440	2,510	2,350	2,570	2,725	3,075	3,165
UGA	110	110	125	125	115	120	130	135	160
Total	1,905	1,935	2,565	2,635	2,465	2,690	2,855	3,210	3,325
Tenino	1,695	1,700	2,010	2,030	2,050	2,310	2,565	2,750	2,790
UGA	15	15	15	15	15	15	15	15	45
Total	1,710	1,715	2,025	2,045	2,065	2,325	2,580	2,765	2,835
Tumwater	17,371	17,570	26,050	26,360	29,120	31,670	34,090	35,920	36,900
UGA	6,350	6,120	3,290	3,380	5,410	7,030	8,240	9,020	9,170
Total	23,720	23,690	29,340	29,740	34,530	38,700	42,330	44,940	46,070
Yelm	6,848	7,008	10,640	10,680	13,610	17,450	20,980	23,980	25,960
UGA	1,355	1,420	1,400	1,540	1,310	1,310	1,330	1,350	1,610
Total	8,205	8,430	12,040	12,220	14,920	18,760	22,310	25,330	27,570
Grand Mound UGA	1,345	1,370	1,220	1,255	1,870	2,270	2,505	2,665	2,745
Chehalis Reservation	64	70	50	50	65	65	65	65	65
Nisqually Reservation	575	595	610	610	855	870	885	905	930
Total Cities	117,141	118,273	152,545	156,740	163,140	175,500	187,010	196,140	202,310
Total UGAs[1]	54,180	54,310	55,900	53,700	63,480	68,690	73,010	77,650	82,110
Total Reservations[2]	639	665	660	660	920	930	950	970	990
Unincorporated County [3]	80,300	80,850	88,700	89,400	88,960	90,880	93,430	95,940	98,090
County Total	**252,264**	**254,100**	**256,800**	**260,100**	**264,000**	**267,400**	**272,700**	**276,900**	**281,700**

SOURCE: Thurston Regional Planning Council. Small Area Population Estimates and Population and Employment Forecast Work Program, 2022. NOTES: Estimates are for April 1 and reflect city limits on that date. A decrease in UGA population is likely due to annexation. Numbers may not add due to rounding. 1) Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth. 2) Reservations: Estimate is for Thurston County portion of reservation only. 3) Rural Unincorporated County is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table A4 Social Vulnerability Metrics by Thurston County Jurisdiction

Household Characteristics

Metric	Percent of Population or Households										
	Thurston County	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Yelm	Chehalis Reservation	Nisqually Reservation	Unincorporated County
Population over age 5 that speaks English less than "very well"	**4%**	1%	6%	5%	1%	2%	2%	2%	2%	1%	3%
Population with a disability	**14%**	21%	14%	15%	23%	15%	11%	13%	16%	22%	13%
Households with children and a single parent	**9%**	22%	10%	10%	15%	12%	12%	12%	24%	20%	8%
Population under 18	**21%**	25%	22%	19%	26%	26%	22%	32%	24%	29%	22%
Population 65 and over	**17%**	18%	18%	18%	13%	12%	12%	7%	13%	19%	19%

Housing & Transportation

Metric	Percent of Households or Population										
	Thurston County	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Yelm	Chehalis Reservation	Nisqually Reservation	Unincorporated County
Households without a vehicle	**5%**	2%	7%	8%	0%	2%	5%	5%	4%	7%	3%
Households in structures with 10+ units	**10%**	0%	14%	25%	0%	14%	10%	9%	0%	0%	2%
Households in manufactured homes	**11%**	18%	5%	4%	17%	14%	6%	4%	75%	4%	17%
Population in group quarters	**2%**	0%	3%	3%	0%	0%	1%	1%	4%	0%	1%
Households with more occupants than bedrooms	**2%**	7%	2%	1%	4%	1%	1%	3%	2%	9%	2%
Households that are renter-occupied	**33%**	27%	43%	52%	11%	43%	44%	32%	55%	14%	0%

Socioeconomic Status

Metric	Percent of Population or Households										
	Thurston County	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Yelm	Chehalis Reservation	Nisqually Reservation	Unincorporated County
Population 16 and over that is in the labor force and unemployed	**3%**	5%	3%	4%	3%	2%	5%	3%	6%	5%	3%
Population 25 and over without a high school diploma or GED	**6%**	10%	6%	5%	8%	6%	5%	7%	18%	13%	6%
Households that are cost-burdened (>30% of income spent on housing costs)	**32%**	17%	37%	38%	18%	38%	32%	35%	21%	17%	27%
Households that are severely cost-burdened (>50% of income spent on housing costs)	**14%**	9%	15%	18%	7%	19%	16%	13%	4%	15%	11%
Population without health insurance	**5%**	8%	5%	6%	4%	10%	5%	6%	20%	23%	5%
Population with income below 150% of poverty level	**17%**	34%	18%	22%	23%	29%	17%	18%	30%	20%	14%

Race and Ethnicity

Metric	Percent of Population										
	Thurston County	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Yelm	Chehalis Reservation	Nisqually Reservation	Unincorporated County
Population identifying as a Person of Color	**29%**	17%	40%	29%	21%	21%	27%	33%	75%	79%	26%
Population identifying as White/Non-Hispanic	**71%**	83%	60%	71%	79%	79%	73%	67%	25%	21%	74%
Population identifying as American Indian & Alaska Native*	**2%**	2%	1%	1%	1%	2%	1%	2%	64%	65%	2%
Population identifying as Asian*	**6%**	1%	9%	7%	2%	1%	5%	4%	0%	1%	5%
Population identifying as Black/African American*	**3%**	0%	6%	3%	1%	1%	3%	3%	2%	1%	2%
Population identifying as Native Hawaiian & Pacific Islander*	**1%**	1%	3%	1%	1%	0%	1%	2%	0%	1%	1%
Population identifying as Other Race*	**4%**	2%	5%	3%	3%	3%	2%	4%	2%	1%	3%
Population identifying as Two or More Races*	**12%**	8%	13%	11%	9%	11%	12%	14%	8%	7%	11%
Population identifying as Hispanic or Latino of Any Race	**10%**	7%	13%	9%	8%	8%	9%	12%	7%	11%	9%

**includes those identifying as Hispanic or Latinx*

Table A5 Thurston County Point-in-Time Homeless Count

	COUNTY POINT-IN-TIME COUNT			
	Sheltered	Transitional	Unsheltered	Total
2006	156	163	122	441
2007	249	143	187	579
2008	168	100	194	462
2009	323	203	219	745
2010	181	432	363	976
2011	95	204	267	566
2012	167	377	164	708
2013	113	321	230	664
2014	172	147	257	576
2015	158	155	163	476
2016	223	174	189	586
2017	242	166	171	579
2018	333	182	320	835
2019	236	170	394	800
2020	295	159	541	995
2022	266	49	346	661

Table A6 Students Experiencing Homelessness by Thurston County School District

	SCHOOL DISTRICT								
School Year	Griffin	North Thurston	Olympia	Rainier	Rochester	Tenino	Tumwater	Yelm	Total
2014-15	2	588	344	28	136	15	184	43	**1,340**
2015-16	5	616	148	35	111	22	135	44	**1,116**
2016-17	10	696	173	15	95	42	151	56	**1,238**
2017-18	8	713	204	21	108	43	175	90	**1,362**
2018-19	6	681	202	14	109	34	189	102	**1,337**
2019-20	2	655	138	19	101	30	172	150	**1,267**
2020-21	1	377	91	13	89	18	132	77	**798**
2021-22	7	480	156	0	81	26	132	154	**1,036**
2022-23	0	684	169	11	91	31	106	173	**1,265**

Table A7 Median Household Income by Thurston County Jurisdiction, 2017-2021

Household Income (In 2021 Inflation-Adjusted Dollars)	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Yelm	Thurston County	Chehalis Reservation	Nisqually Reservation	Washington State
Less than $10,000	0	994	1,603	36	19	218	196	4,605	11	15	122,237
$10,000 to $14,999	9	273	926	9	41	329	23	2,727	22	6	84,336
$15,000 to $19,999	16	923	918	45	73	342	22	3,824	13	4	83,289
$20,000 to $24,999	14	563	619	34	52	330	103	3,166	9	29	88,319
$25,000 to $29,999	0	635	1,423	12	29	333	8	3,642	6	4	93,924
$30,000 to $34,999	8	486	729	14	21	451	137	3,364	12	2	93,696
$35,000 to $39,999	5	714	884	9	42	416	65	3,538	9	21	96,944
$40,000 to $44,999	4	821	1,222	26	18	315	117	4,201	10	3	103,507
$45,000 to $49,999	17	865	847	52	29	324	122	3,904	9	5	94,566
$50,000 to $59,999	19	1,823	1,758	47	78	844	206	8,348	19	13	200,810
$60,000 to $74,999	29	2,388	2,143	62	78	781	263	11,260	18	25	278,463
$75,000 to $99,999	33	3,458	3,486	258	99	1,343	816	17,957	33	28	391,503
$100,000 to $124,999	21	2,780	2,634	134	44	1,249	468	14,564	16	22	316,297
$125,000 to $149,999	5	1,858	1,672	33	59	886	162	9,787	10	21	232,045
$150,000 to $199,999	6	1,653	1,726	115	30	1,031	349	10,954	12	14	287,746
$200,000 or more	0	750	1,597	14	13	538	109	8,715	4	9	364,159
Total Households	**186**	**20,984**	**24,187**	**900**	**725**	**9,730**	**3,166**	**114,556**	**213**	**221**	**2,931,841**
Median Income	**$62,778**	**$75,059**	**$67,975**	**$88,036**	**$55,202**	**$77,849**	**$83,027**	**$81,501**	**$52,292**	**$68,125**	**$82,400**

Table A8 Housing Estimates and Forecast, Thurston County Cities, Urban Growth Areas, and Reservations, 2010 to 2045

		Census Calibrated	TRPC			TRPC Forecast Most Recent Jurisdiction Boundaries				
Jurisdiction		2010	2020	2021	2022	2025	2030	2035	2040	2045
Bucoda	Total	245	241	250	255	280	315	335	355	375
Lacey	City	18,490	22,039	22,080	23,450	25,230	26,150	26,910	27,540	28,090
	UGA	13,250	14,565	14,550	13,640	17,180	18,820	20,040	21,330	22,640
	Total	31,740	36,604	36,630	37,090	42,410	44,970	46,950	48,870	50,730
Olympia	City	22,090	25,642	25,860	26,220	29,210	32,120	34,630	36,580	38,290
	UGA	4,870	5,093	5,060	5,060	5,510	5,690	5,890	6,290	6,740
	Total	26,960	30,735	30,920	31,280	34,720	37,810	40,520	42,870	45,030
Rainier	City	715	850	920	920	1,010	1,130	1,210	1,380	1,420
	UGA	50	54	50	50	55	60	60	65	75
	Total	765	904	970	970	1,065	1,190	1,270	1,445	1,495
Tenino	City	740	780	810	810	920	1,055	1,180	1,270	1,295
	UGA	5	5	5	5	5	5	5	5	15
	Total	745	785	815	815	925	1,060	1,185	1,275	1,310
Tumwater	City	8,060	10,847	11,260	11,710	13,270	14,720	15,980	16,940	17,510
	UGA	2,650	1,427	1,390	1,390	2,290	3,010	3,540	3,880	3,950
	Total	10,710	12,274	12,650	13,100	15,560	17,730	19,520	20,820	21,460
Yelm	City	2,520	3,455	3,350	3,550	5,310	7,090	8,690	10,070	10,960
	UGA	530	516	530	530	540	550	560	570	660
	Total	3,050	3,971	3,880	4,080	5,850	7,640	9,250	10,640	11,620
Grand Mound UGA	Total	375	424	450	470	510	600	675	720	735
Chehalis Reservation	Total	20	20	20	20	20	20	20	20	20
Nisqually Reservation	Total	190	220	255	255	315	315	320	325	330
Total Cities		52,870	63,854	64,530	66,910	75,230	82,580	88,930	94,130	97,940
Total UGAs (1)		21,730	22,084	22,030	21,140	26,090	28,730	30,770	32,870	34,830
Total Reservations (2)		210	240	280	280	330	340	340	350	350
Rural Unincorporated County (3)		33,380	35,260	35,890	36,070	37,370	39,050	40,480	41,710	42,680
Thurston County Total		**108,200**	**121,438**	**122,700**	**124,400**	**139,000**	**150,700**	**160,500**	**169,000**	**175,800**

SOURCE: Thurston Regional Planning Council. Small Area Population Estimates and Population and Employment Forecast, 2018.
NOTES: Estimates are for April 1 and reflect city limits on that date. A decrease in UGA dwellings is likely due to annexation. Numbers may not add due to rounding. 1) Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth. 2) Reservations: Estimate is for Thurston County portion of reservation only. 3) Rural Unincorporated County is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table A9 Housing Estimates by Type, Thurston County Cities, Urban Growth Areas, and Reservations, 2022

Jurisdiction		Single-family	Multifamily	Manufactured Home	Total
Bucoda	Total	205	5	45	255
Lacey	City	14,090	8,130	1,220	23,450
	UGA	10,380	2,100	1,160	13,640
	Total	24,470	10,230	2,380	37,090
Olympia	City	13,180	12,090	950	26,220
	UGA	3,710	1,270	80	5,060
	Total	16,890	13,360	1,030	31,280
Rainier	City	685	80	155	920
	UGA	40	0	10	50
	Total	725	80	165	970
Tenino	City	575	125	110	810
	UGA	5	0	0	5
	Total	580	125	110	815
Tumwater	City	6,770	4,180	760	11,710
	UGA	740	130	510	1,390
	Total	7,510	4,310	1,270	13,100
Yelm	City	2,610	840	130	3,570
	UGA	350	0	160	510
	Total	2,960	840	290	4,080
Grand Mound UGA	Total	230	85	155	470
Chehalis Reservation	Total	5	0	15	20
Nisqually Reservation	Total	225	25	10	255
Total Cities		38,110	25,450	3,370	66,930
Total UGAs (1)		15,450	3,590	2,070	21,120
Total Reservations (2)		230	20	20	280
Rural Unincorporated County (3)		27,480	730	7,860	36,070
Thurston County Total		**81,300**	**29,800**	**13,300**	**124,400**

SOURCE: Thurston Regional Planning Council Small Area Population Estimates.
NOTES: Estimates are for April 1 and reflect city limits on that date. A decrease in UGA dwellings is likely due to annexation. Numbers may not add due to rounding. 1) Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years' time to accommodate urban growth. 2) Reservations: Estimate is for Thurston County portion of reservation only. 3) Rural Unincorporated County is the portion of the unincorporated county that lies outside UGA and Reservation

Table A10 Residential Units Permitted, by Jurisdiction, 2017-2021

Jurisdiction		2017	2018	2019	2020	2021
Bucoda	**Total**	**0**	**0**	**0**	**1**	**2**
Lacey	City	171	1,025	259	174	750
	UGA	179	129	186	127	484
	Total	350	1,154	445	301	1,234
Olympia	City	134	547	180	288	325
	UGA	26	46	15	86	12
	Total	160	593	195	374	337
Rainier	City	14	24	22	44	2
	UGA	0	1	2	0	0
	Total	14	25	24	44	2
Tenino	City	0	6	2	36	0
	UGA	0	0	0	0	0
	Total	0	6	2	36	0
Tumwater	City	201	74	244	321	383
	UGA	7	10	7	5	3
	Total	208	84	251	326	386
Yelm	City	52	45	21	41	207
	UGA	0	1	3	2	0
	Total	52	46	24	43	207
Grand Mound UGA	Total	5	3	9	20	25
Chehalis Reservation	Total	0	1	0	0	0
Nisqually Reservation	Total	25	26	0	0	2
Total Cities		572	1,721	728	905	1,669
Total UGAs (1)		217	190	222	240	524
Total Reservations (2)		25	27	0	0	2
Rural Unincorporated County (3)		331	343	313	293	270
Total Single-Family		914	724	636	723	717
Total Multifamily		161	1,480	558	631	1,666
Total Manufactured Housing		70	77	69	84	82
Thurston County Total		**1,145**	**2,281**	**1,263**	**1,438**	**2,465**

SOURCE: Thurston Regional Planning Council. Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, Yelm and Thurston County building departments.
NOTES: Count of dwelling units permitted; may not reflect actual housing units built. Permits are reported for each calendar year for most recent jurisdiction boundaries. Excludes demolitions and reissued permits. 1) Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth. 2) Reservations: Estimate is for Thurston County portion of reservation only. 3) Rural Unincorporated County is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table A11 Population Estimate and Forecast by School District, 2020-2045

	TRPC Estimate				TRPC Forecast (Adopted 2018)				
District Name	**2020**	**2021**	**2022**	**2023**	**2025**	**2030**	**2035**	**2040**	**2045**
Centralia (1)	520	520	520	520	620	740	830	910	960
Griffin	6,490	6,500	6,540	6,540	6,570	6,660	6,820	6,980	7,120
North Thurston	111,180	113,060	114,210	116,350	120,940	126,170	130,640	134,780	138,580
Olympia	70,390	70,610	71,200	71,590	73,380	76,990	80,730	83,680	86,120
Rainier	6,000	6,110	6,210	6,250	6,820	8,860	10,930	13,140	14,570
Rochester (1)	14,750	14,690	14,780	14,770	15,660	16,300	16,860	17,320	17,660
Tenino	10,380	10,570	10,690	10,710	10,980	11,790	12,510	13,110	13,520
Tumwater	43,690	44,220	44,650	44,900	49,100	53,440	57,380	60,430	62,020
Yelm (1)	31,390	31,520	31,690	31,760	32,430	35,050	37,700	40,340	42,950

SOURCE: Thurston Regional Planning Council, Small Area Population Estimates and Population and Employment Forecast (2018 Update)
NOTES: Estimates are for April 1 of each year. Numbers may not add due to rounding. 1) Estimates are for Thurston County portion of districts only.

Table A12 Population Estimate and Forecast by Fire District, 2020-2045

	TRPC Estimate				TRPC Forecast (Adopted 2018)				
Fire District	**2020**	**2021**	**2022**	**2023**	**2025**	**2030**	**2035**	**2040**	**2045**
Bucoda	600	600	610	620	630	680	720	760	800
Olympia	55,380	55,960	56,370	56,900	58,840	62,980	66,960	69,760	72,040
Tumwater	25,570	26,050	26,360	26,710	29,120	31,670	34,090	35,920	36,900
1: Rochester	13,070	13,150	13,240	13,190	14,010	14,610	15,120	15,540	15,830
2: Yelm	23,060	23,130	23,230	23,290	25,200	29,250	33,090	36,430	38,940
3: Lacey	102,420	104,210	105,280	107,310	110,420	114,780	118,600	122,830	127,150
4: Rainier	6,210	6,340	6,440	6,490	6,280	6,710	7,090	7,620	7,880
6: East Olympia	11,820	11,870	11,940	11,900	11,980	12,240	12,590	13,000	13,380
8: South Bay	12,870	12,990	13,090	13,070	12,610	12,790	13,170	13,620	14,110
9: McLane Black Lake	15,100	14,700	14,930	14,870	17,570	18,560	19,330	20,070	20,420
11: Littlerock	10,180	10,090	10,150	10,170	10,920	11,930	13,000	13,740	14,110
12: South Thurston	7,120	7,270	7,310	7,320	7,390	7,850	8,280	8,610	8,800
13: Griffin	5,610	5,620	5,650	5,660	5,550	5,630	5,760	5,890	5,990
17: Bald Hills	4,660	4,700	4,760	4,770	4,270	4,400	4,550	4,720	4,850

SOURCE: Thurston Regional Planning Council, Small Area Population Estimates and Population and Employment Forecast
NOTES: Estimates are for April 1 of each year. Estimates are for April 1, 2020 Fire District tax boundaries

Appendix B

Capability Assessment Documentation

Contents

Hazard Mitigation Capability Self-Assessment Questionnaire

Each community has unique capabilities, including authorities, policies, programs, staff, funding, and other resources available to accomplish mitigation and reduce long-term vulnerability. By reviewing the existing capabilities in your jurisdiction, your planning team and the Hazard Mitigation Planning Workgroup can identify capabilities that currently reduce disaster losses or could be used to reduce losses in the future.

Please work with others in your organization if you are unsure how to answer any of the questions. This assessment includes 20 questions and should take approximately 30 minutes. If you have any questions, please contact Paul Brewster at 360-741-2526 or brewstp@trpc.org.

Questions

General Information

1. Please select your organization type.
    a. Tribe
    b. City or County
    c. School District or Education Partner
    d. Fire District
    e. Special Purpose Utility District
    f. Transit Agency
    g. Port
    h. College/University
    i. Other
2. Please list your name, position, organization, and email address.
    a. Open answer
3. Has your organization previously adopted a FEMA approved Hazard Mitigation Plan?
    a. Yes
    b. No

4. As part of the 4th Edition Hazard Mitigation Plan for the Thurston Region update process, is your organization planning to produce and adopt an annex to the Hazards Mitigation Plan for the Thurston Region?
    a. Yes
    b. No
    c. Maybe

Hazard Mitigation Capabilities

5. How do you rate your organization's leadership (elected officials and management) support for participating in the Hazard Mitigation Plan Update?
    a. Strongly supportive
    b. Supportive
    c. Somewhat supportive
    d. Isn't supportive
6. How do you rate your organization's familiarity with Hazard Mitigation Planning?
    a. Very familiar
    b. Familiar
    c. Somewhat familiar
    d. Unfamiliar
7. Does your jurisdiction periodically review its progress, opportunities, and challenges with implementing your adopted mitigation strategy?
    a. Yes
    b. No
    c. Not sure
8. Does your jurisdiction have any means to measure any changes to your organization's resiliency or vulnerability to any hazards? (e.g., rate of occurrence of destructive hazard events, tracking new development in vulnerable areas, the rate of occurrence of first responder incidents related to natural disasters)
    a. Yes – please describe
        i. Open answer
    b. No
    c. Not sure

9. Does your organization conduct any policy maker or public education or outreach to keep your community informed about hazards and how your community can continue to be involved in the mitigation planning process? (e.g., informational brochures, webpages, hazard preparedness presentations, community meetings or workshops)
   a. Yes – please describe
      i. Open answer
   b. No
   c. Not sure

10. CITIES & COUNTIES ONLY – Is there staff who can document how your jurisdiction is using any of the following regulatory acts to strengthen your community's hazard mitigation policies or strategies? If so, please include their name and email address.
    - State Environmental Policy Act (SEPA)
    - Building Code
    - Fire Code
    - Clean Air Act
    - Clean Water Act
    - Endangered Species Act (ESA)
    - Washington Floodplain Management Law (WAC 173-158, RCW 86.16)
    - Shoreline Management Act
    - Growth Management Act
    - Watershed Management Act
    - Critical Areas Ordinances
      a. Yes – include name and email
         i. Open answer
      b. No
      c. Not sure

11. CITIES & COUNTIES ONLY – Does your jurisdiction participate in the National Flood Insurance Program (NFIP)?
    a. Yes
    b. No
    c. Not sure

12. CITIES & COUNTIES ONLY – If yes to NFIP, is there staff who can document how your community maintains compliance with the NFIP (e.g. last community assistance visit, strategies to address repetitive losses and severe repetitive losses, etc.)? If so, please include their name and email address.
    a. Yes – include name and email
        i. Open answer
    b. No
    c. Not sure
13. CITIES & COUNTIES ONLY – Is there staff who can document how your jurisdiction regulates development in or near floodplains? If so, please include their name and email address.
    a. Yes – include name and email
        i. Open answer
    b. No
    c. Not sure
14. What other tools and opportunities come to mind that could support your organization's capability to perform hazard mitigation planning?
    a. Open answer
15. What obstacles does your organization encounter with implementing hazard mitigation programs, and projects? (Select all that apply)
    a. Limited community support
    b. Political barriers
    c. Lack of funding
    d. Lack of knowledge/expertise within the organization
    e. Lack of staff time
    f. Other (open answer)

Regional Planning Process

16. Is your organization able to provide TRPC information about your physical assets such as critical and capital facilities and building inventory in support of developing a risk assessment?
    a. Yes
    b. No
    c. Not sure

17. Please check all the expertise that you plan to include on your organization's planning team.
    a. Public information office/Communications
    b. Planning/Community development
    c. Fire services
    d. Police services
    e. Emergency management
    f. Stormwater management
    g. Building code enforcement
    h. Transportation (roads/bridges)
    i. Public works/Operations and Maintenance
    j. Other – please describe
        i. Open answer
18. What types of outreach activities could your organization perform to inform your public/constituents about the hazard mitigation plan update process? (Select all that apply)
    a. Council/Board/Commission meeting announcements
    b. Email notifications
    c. Social media posts
    d. Newspaper articles
    e. Radio announcements
    f. Television or internet videos
    g. Public events
    h. Utility insert
    i. Newsletter
    j. Other (open answer)

19. Please rate your perceived vulnerability to various hazards. This will help inform which hazards should be considered in the risk assessment.

Hazards/Threats	Low Vulnerability	Moderate Vulnerability	High Vulnerability
Civil Unrest			
Climate Change			
Critical shortage			
Cyber attack			
Dam Failure			
Disease			
Drought			
Earthquake			
Extreme heat			
Flooding			
Hazardous Materials Incident			
Landslide			
Severe storm/weather			
Space weather/Solar wind			
Terrorism			
Tsunami			
Volcanic			
Wildland fire			

20. Would your organization be interested in attending annual or semi-annual hazard mitigation meetings to build regional connections and discuss mitigation strategy progress?
    a. Yes
    b. No

Strengths, Weaknesses, Obstacles, and Opportunities (SWOO) Assessment Questions

A Strengths, Weaknesses, Obstacles, and Opportunities (SWOO) Assessment can assist communities with identifying both weaknesses and opportunities for strengthening resiliency through collaborative partnerships at the regional level and for each jurisdiction. Section I assesses regional risk management activities to support the development of the core Hazard Mitigation Plan. Section II assesses individual jurisdiction activities that can support annex development.

Rate each capability statement in sections I and II as a strength, weakness, not applicable, or don't know. For statements that are city and county regulatory functions, special purpose districts may select "not applicable."

Example responses for each statement

☐ *Strength* ☐ *Weakness* ☐ *Not applicable* ☐ *Don't Know*

A. What jurisdiction do you represent?

1. Regional Risk Reduction Partnerships and Activities

Emergency Management

1. Emergency management roles and responsibilities are clearly defined for agencies in the Thurston County region.
2. There is strong and ongoing emergency management collaboration and coordination between the tribes, cities, county, special purpose districts, neighboring jurisdictions, state, and federal agency partners.
3. All relevant stakeholders are actively engaged in strengthening the region's resiliency to natural and other technological hazards.

Hazard Mitigation Planning

4. Natural hazards are adequately mapped within the Thurston County region.
5. Planning partners are knowledgeable about hazards and their impacts.
6. Planning partners have an effective regional planning framework to share information, resources, and enhance hazard mitigation planning capabilities.
7. Planning partners are involved in implementing the countywide mitigation strategy to improve the region's resiliency to natural hazards.

Public Awareness and Information Accessibility

8. Thurston County residents have a good understanding of natural hazards and their risks to people, property, and the environment.
9. Thurston County residents know where to find information about hazards.
10. There is strong public support for hazard mitigation within Thurston County.
11. Appropriate and timely emergency warning systems are in place.

2. Jurisdiction Hazard Mitigation Activities

Hazard Mitigation Planning

12. Your jurisdiction is highly capable of assessing and mitigating risk from natural hazards.
13. Your jurisdiction has a policy framework to equitably prioritize mitigation actions that benefit your community's socially vulnerable populations.
14. Your jurisdiction has the capability to account for the effects of climate change, changes in population, and changes in land use patterns to assess your hazard risks.
15. Your jurisdiction has an effective mitigation strategy to address your highest risk hazards.
16. Your jurisdiction actively seeks funding and resources to implement your priority mitigation actions.

Land Use Regulations

17. Your jurisdiction enforces its building and public safety codes, ordinances, and standards to reduce hazard risks in your community.
18. Current land uses within identified hazard areas are appropriate for the risk posed by each hazard.
19. Areas that provide natural resource protection are identified and protected within your jurisdiction (e.g. zoning codes, critical areas ordinances, and Shoreline Master Program).

Flood Prevention Programs

20. Your jurisdiction currently has adopted policies, codes, and regulations that prevent development from occurring inside your special flood hazard areas.
21. Existing flood control systems are effective and well maintained.
22. There is a coordinated program to maintain drainage systems free of debris.
23. Your jurisdiction has an effective program to inform your residents about flood insurance.

Public Awareness and Information Accessibility

24. Your jurisdiction has an ongoing public outreach strategy to engage the public about efforts to reduce your jurisdiction's risks from natural hazards.

Strengths, Weaknesses, Obstacles, and Opportunities (SWOO) Assessment Results

Prepared by Thurston Regional Planning Council, March 31, 2023

Purpose

The Federal Emergency Management Administration (FEMA) requires local governments to assess their existing capabilities to understand how best they can support their hazard mitigation strategy. Each agency must also describe their ability to expand and improve the identified capabilities to achieve their mitigation objectives. The Strengths, Weaknesses, Obstacles, and Opportunities (SWOO) Assessment offers the Thurston Region Hazard Mitigation Workgroup planning partners a framework to evaluate their capabilities and identify potential actions to achieve mitigation goals in alignment with FEMA hazard mitigation planning requirements.

Responses

In March 2023, 13 agencies and stakeholders from the Thurston Hazard Mitigation Planning Workgroup responded to an online SWOO survey. Respondents were instructed to rate their familiarity with 25 emergency management and hazard mitigation planning activities/program statements as an area of "strength", "weakness", "not applicable", or "don't know." Special Purpose districts were advised they could respond "not applicable" to questions that were specific to municipal land use and regulatory roles and authorities.

Section 1 (statements 1-11) assessed countywide or multijurisdictional risk management activities to support the development of the core Hazard Mitigation Plan. Section 2 (statements 11-24) assessed individual jurisdiction capabilities to support mitigation actions and annex development. Statements 18-24 were specific to the county and cities.

Respondents

Emergency Dispatch TCOMM 911 **Fire Districts** FD 1 & 11 West Thurston Regional Fire Authority FD 6 & SE Thurston Fire Authority FD 8 South Bay Fire FD 9 McLane Black Lake Fire **Transit** Intercity Transit	**School Districts** Tumwater School District **Utility** Thurston PUD **Municipalities** City of Lacey City of Olympia (2 responses) City of Tumwater City of Yelm Thurston County (3 responses)

Results

A breakdown of the responses is shown for each statement on the pages that follow.

Key Findings for Section I, Regional Hazard Mitigation Capabilities

- More effort is needed to actively engage relevant stakeholders in hazard mitigation planning.
- Natural hazards are adequately mapped.
- Planning partners are knowledgeable about hazards and their impacts.
- Most planning partners believe there is an effective regional planning framework for hazard mitigation and are involved in implementing the countywide mitigation strategy.
- More effort is needed to improve residents' understanding of natural hazards and their risks and their means to access useful information.
- Most planning partners are uncertain if there is strong public support for hazard mitigation.
- More effort is needed to communicate how existing emergency warning systems are operated and evaluated.

Key Findings for Section II, Jurisdictional Hazard Mitigation Capabilities

- Most planning partners stated they are capable of assessing and mitigating their hazard risks.
- Only half of the partners have a policy framework to prioritize actions that benefit socially vulnerable populations.
- More effort is needed to account for the impacts of climate change for hazard risk assessments.
- Most partners are capable of accounting for changes in population and land use patterns to assess their jurisdiction's risks.
- Most partners believe they have an effective mitigation strategy for their highest risks and are actively seeking funding and resources to implement priority actions.
- Most municipal partners enforce building codes, ordinances, and standards and have appropriate land use designations to reduce their community's risks.
- More effort is needed to inform residents about flood insurance.
- More effort is needed to engage the public about efforts to reduce risks after plans are approved.

How to use the Results

Planning partners that rated statement with "weakness" or "don't know" should identify opportunities to strengthen their capabilities. A list of potential actions to support this effort is presented.

This assessment should be used in tandem with the "Mitigation Catalog" and FEMA's Mitigation Ideas handbook to consider a range of mitigation actions that can reduce risks and strengthen capabilities to support implementation of the jurisdictions' mitigation strategies.

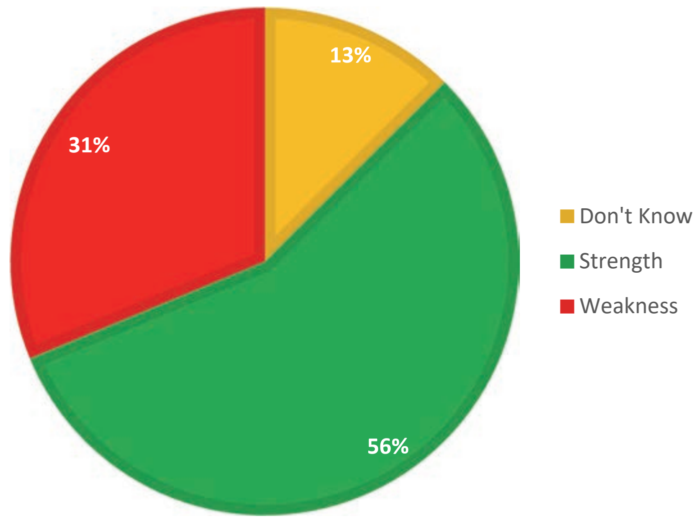
Section 1. Regional Hazard Mitigation Capability Assessment

1. Emergency management roles and responsibilities are clearly defined for agencies in the Thurston County region.

ASSESSMENT: The municipalities believe emergency management roles and responsibilities are clearly defined, however TCOMM 911 and the Fire Service agencies believe this area is a weakness.

Potential Actions

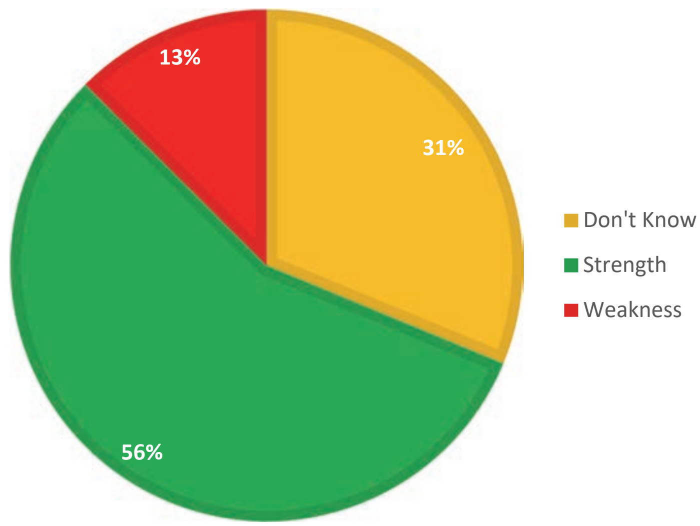
1. Broaden stakeholder involvement in updates to Comprehensive Emergency Management Plans.
2. Conduct training/exercises to build awareness among a broader set of planning partners.
3. Convene joint meetings between the Emergency Management Council, TCOMM 9-1-1 and Fire Chiefs Association and other emergency management partners to strengthen understanding of key roles and responsibilities.



TCOMM 911	Weakness
FD 1 & 11 West Thurston Regional Fire Authority	Weakness
FD 6 & SE Thurston Fire Authority	Weakness
FD 8 South Bay/LEPC	Weakness
FD 9 McLane Black Lake	Weakness
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Strength
Thurston County	Strength
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Don't Know

2. **There is strong and ongoing emergency management collaboration and coordination between the tribes, cities, county, special purpose districts, neighboring jurisdictions, state, and federal agency partners.**

ASSESSMENT: The majority of the respondents believe there is strong ongoing emergency management coordination and collaboration. Five partners responded they don't know, and two Fire Service partners believe this is a weakness.



Potential Actions

1. Create and provide routine orientations/ introductions for new staff/positions to become familiar with and network with emergency managers and emergency service providers.
2. Review and update websites to provide easier access to information, plans, and staff contact information.

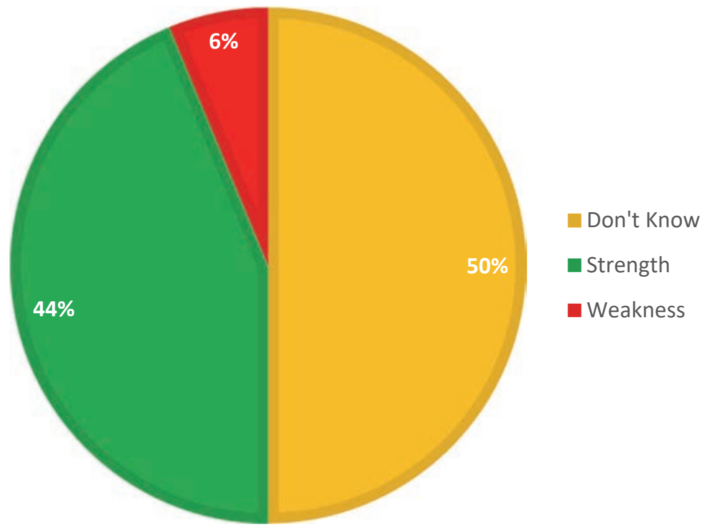
TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Don't Know
FD 6 & SE Thurston Fire Authority	Strength
FD 8 South Bay/LEPC	Weakness
FD 9 McLane Black Lake	Weakness
City of Lacey	Strength
City of Olympia	Don't Know
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Strength
Thurston County	Strength
Thurston County	Strength
Thurston County	Don't Know
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Strength

3. All relevant stakeholders are actively engaged in strengthening the region's resiliency to natural and other technological hazards.

ASSESSMENT: Half the partners responded they don't know if relevant stakeholders are actively engaged in strengthening the regions' resiliency to hazards.

Potential Actions

1. Convene an annual meeting of the Hazard Mitigation Planning Workgroup to review progress on countywide mitigation actions and share updates on local implementation efforts.
2. Perform direct outreach to stakeholders to solicit their feedback on risk assessment and mitigation strategy development.
3. Create webpage that reports on the implementation status of all jurisdictions' mitigation actions.
4. Periodically invite state and federal agency staff to present information about hazards. Thurston County Emergency Management regularly invites speakers to its winter and summer hazards seminar. The Emergency Management Council regularly invites speakers to its Executive Seminars.



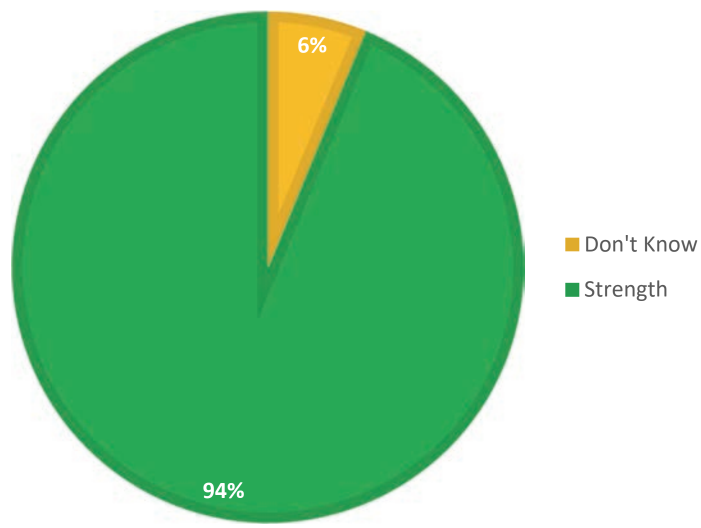
TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Don't Know
FD 8 South Bay/LEPC	Weakness
FD 9 McLane Black Lake	Don't Know
City of Lacey	Strength
City of Olympia	Don't Know
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Strength
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Strength
Tumwater School District	Don't Know
Intercity Transit	Don't Know
Thurston PUD	Strength

4. Natural hazards are adequately mapped within the Thurston County region.

ASSESSMENT: The majority of the plan partners believe natural hazards are adequately mapped.

Potential Actions

1. The Hazard Mitigation Planning Workgroup was briefed on the Washington Department of Natural Resources Landslide Hazard Mapping Program. Cities and the County can apply to this program to map and update landslide hazard information.
2. Continue seeking opportunities to map areas of the community that are at risk of wildland fire hazards.



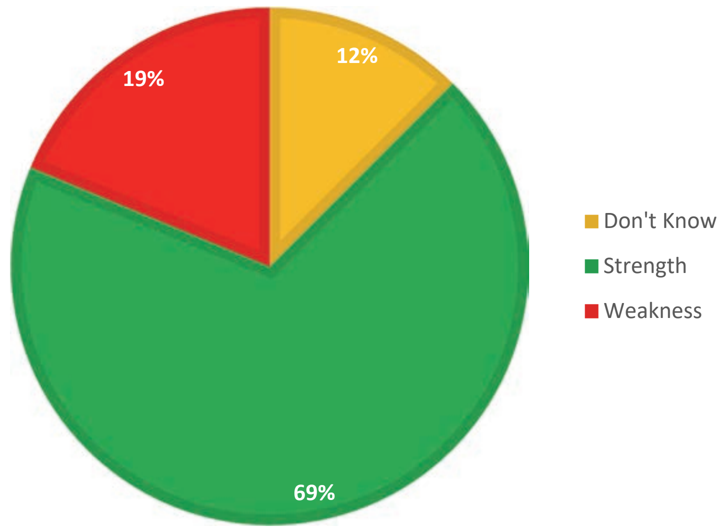
TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Strength
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Strength
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Strength
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Strength

5. **Planning partners are knowledgeable about hazards and their impacts.**

ASSESSMENT: The majority of the partners are knowledgeable about hazards and their impacts.

Potential Actions

Planning partners are encouraged to become familiar with the *Thurston Region Hazards Mitigation Plan* and the *Washington State Enhanced Hazard Mitigation Plan* for information about hazards and impacts that threaten Thurston County.



TCOMM 911	Weakness
FD 1 & 11 West Thurston Regional Fire Authority	Weakness
FD 6 & SE Thurston Fire Authority	Strength
FD 8 South Bay/LEPC	Don't Know
FD 9 McLane Black Lake	Don't Know
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Weakness
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Strength

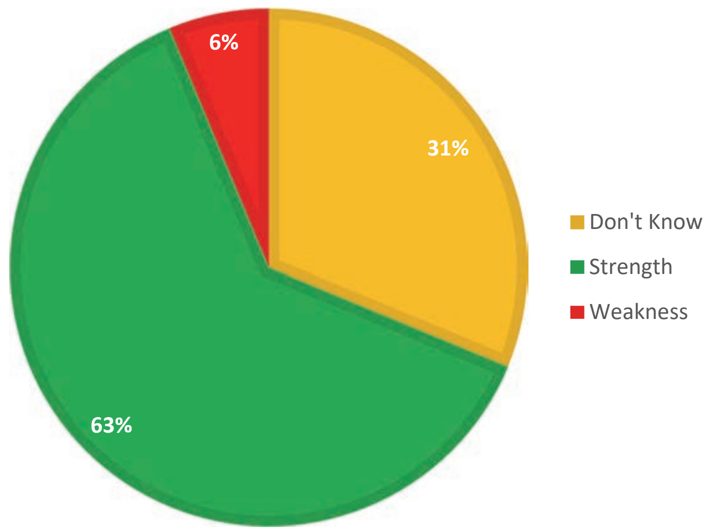
6. Planning partners have an effective regional planning framework to share information, resources, and enhance hazard mitigation planning capabilities.

ASSESSMENT: The majority of the partners believe there is an effective regional planning framework to support hazard mitigation planning.

The Thurston Region has convened a Hazard Mitigation Planning Workgroup to develop and update the region's plan since 2003. In 2022-2023, partners are updating the fourth edition.

Potential Actions

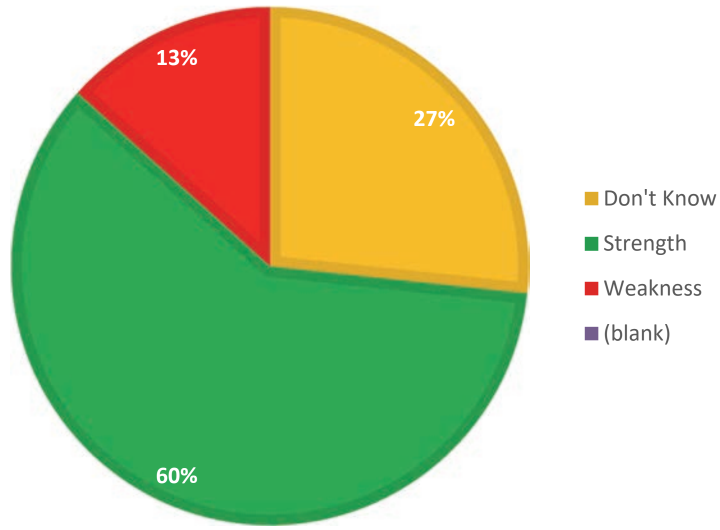
1. Identify other strategies to engage planning partners to update the region's plan and document it in the plan maintenance section.
2. Conduct an After-Action Review or postmortem at the end of the planning process to document what worked well and areas that can be improved.



TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Don't Know
FD 6 & SE Thurston Fire Authority	Don't Know
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Strength
City of Lacey	Strength
City of Olympia	Don't Know
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Strength
Thurston County	Strength
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Weakness
Intercity Transit	Strength
Thurston PUD	Strength

7. **Planning partners are involved in implementing the countywide mitigation strategy to improve the region's resiliency to natural hazards.**

ASSESSMENT: The majority of the partners believe there is strong involvement in implementing the countywide mitigation strategy, however there are six partners who are unfamiliar with the level of involvement or believe it needs work.



Potential Actions

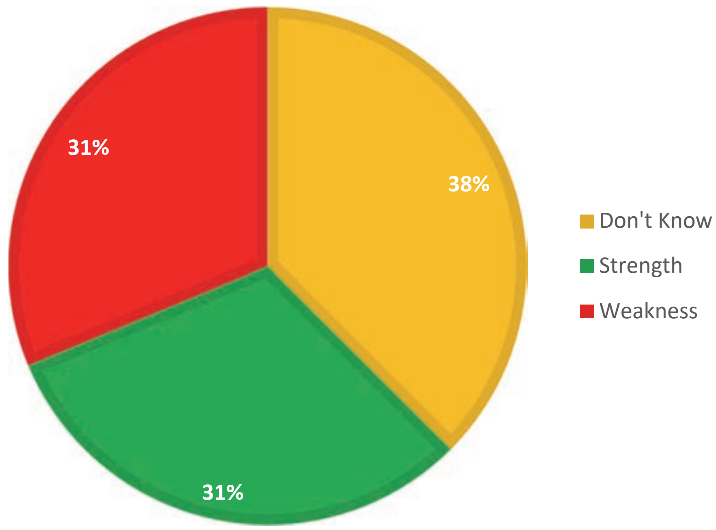
1. Convene an annual meeting of the Hazard Mitigation Planning Workgroup to monitor and report on progress on countywide mitigation actions.
2. Expand stakeholder involvement in shaping, implementing, and evaluating the countywide mitigation actions.

TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Don't Know
FD 8 South Bay/LEPC	Weakness
FD 9 McLane Black Lake	
City of Lacey	Strength
City of Olympia	Don't Know
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Weakness
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Don't Know
Intercity Transit	Strength
Thurston PUD	Strength

8. **Thurston County residents have a good understanding of natural hazards and their risks to people, property, and the environment.**

ASSESSMENT: Respondents are divided about residents' understanding of hazards and their risks to the community about one-third each as a weakness, strength, or don't know. In general, partners agree that public education and outreach is an area that can always be improved.

The Thurston County Emergency Management Council and other emergency services partners host an annual Emergency Preparedness Expo. Historically, these events were effective opportunities to inform the public about hazards and their risks. Covid 19 paused this well-attended event over the last three years. It is resuming to an in-person event in September 2023.



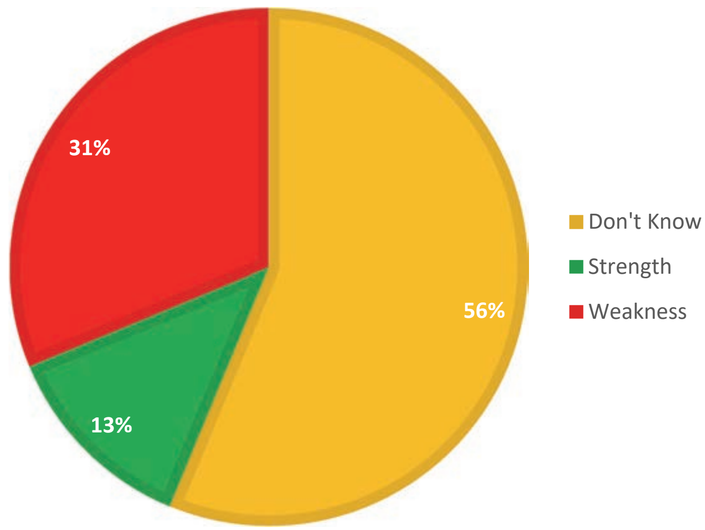
TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Don't Know
FD 8 South Bay/LEPC	Weakness
FD 9 McLane Black Lake	Don't Know
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Weakness
Thurston County	Weakness
Thurston County	Weakness
Thurston County	Weakness
Tumwater School District	Don't Know
Intercity Transit	Strength
Thurston PUD	Don't Know

Potential Actions

1. Using a variety of media and modes of communication, create an ongoing public education campaign about hazard risks and steps that residents and businesses can take to reduce their losses.
2. Make information about hazards and preparedness accessible at other non-emergency community events such as festivals and other community planning projects.
3. Partner with community outreach specialists and Public Information Officers to routinely promote hazard mitigation and preparedness information.

9. Thurston County residents know where to find information about hazards.

ASSESSMENT: The majority of partners don't know or believe more work is needed to improve residents' access to hazard information.



Potential Actions

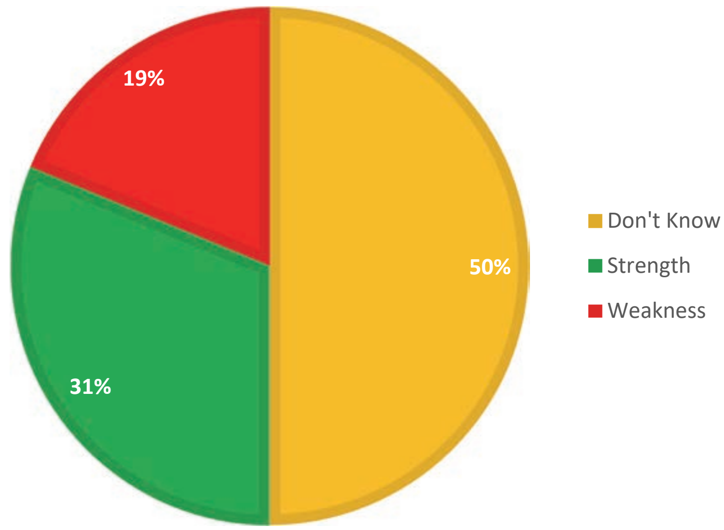
1. Create and maintain a one-stop countywide multi-hazard website to inform residents and businesses about their risks and steps they can take to reduce losses.
2. Attend community events, use existing newsletters, utility bill inserts, and other forms of messaging to educate community members about hazards.

[illegible]	[illegible]
FD 1 & 11 West Thurston Regional Fire Authority	Weakness
FD 6 & SE Thurston Fire Authority	Weakness
FD 8 South Bay/LEPC	Don't Know
FD 9 McLane Black Lake	Don't Know
City of Lacey	Don't Know
City of Olympia	Don't Know
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Weakness
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Weakness
Intercity Transit	Don't Know
Thurston PUD	Don't Know

10. There is strong public support for hazard mitigation within Thurston County.

ASSESSMENT: The majority of partners are uncertain about public support for hazard mitigation within the community.

In Summer 2022, TRPC conducted a multi-language countywide hazards and resiliency survey. It included 12 questions about perceived risk and preferred mitigation activities. Nearly 670 people participated in the survey and rated strengthening critical facilities and essential services as their highest priority, hazard notification systems as second, and education and outreach as third.



TCOMM 911	Don't Know
FD 1 & 11 West Thurston Regional Fire Authority	Weakness
FD 6 & SE Thurston Fire Authority	Don't Know
FD 8 South Bay/LEPC	Don't Know
FD 9 McLane Black Lake	Strength
City of Lacey	Don't Know
City of Olympia	Don't Know
City of Olympia	Don't Know
City of Tumwater	Don't Know
City of Yelm	Weakness
Thurston County	Strength
Thurston County	Strength
Thurston County	Weakness
Tumwater School District	Strength
Intercity Transit	Don't Know
Thurston PUD	Strength

Potential Actions

1. Periodically survey or poll residents and businesses about their perceived risks and support for mitigation actions that can make the community safer.
2. Invite neighborhood associations, community organizations, and interested stakeholders to participate in focus group to assess public preferences for mitigation strategies.

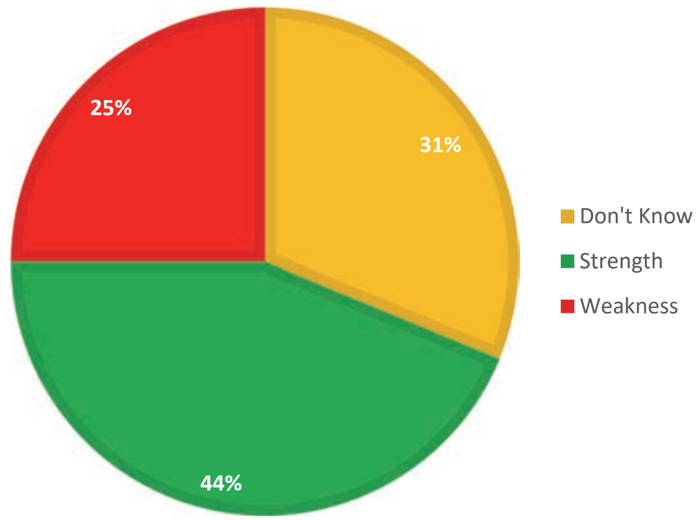
11. Appropriate and timely emergency warning systems are in place.

ASSESSMENT: Only seven partners reported that appropriate and timely warning systems are in place, five don't know, and four believe it needs improvement.

Thurston County currently uses the TC Alert System: https://www.thurstoncountywa.gov/alert-and-notification.

Potential Actions

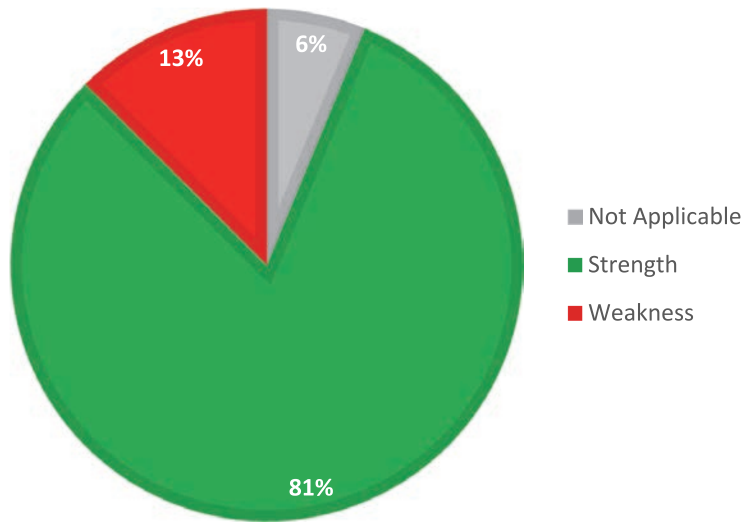
1. Expand public awareness of the subscriber alert system.
2. Conduct subscriber surveys to assess users' satisfaction with the alert notification system.
3. Regularly coordinate emergency managers and responders to assess the operation and effectiveness of the alert notification system.



[illegible]	[illegible]
FD 6 & SE Thurston Fire Authority	Don't Know
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Strength
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Weakness
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Don't Know
Tumwater School District	Weakness
Intercity Transit	Strength
Thurston PUD	Don't Know

Section 2 – Individual Agency Hazard Mitigation Planning Capability Assessment

12. Your jurisdiction is highly capable of assessing and mitigating risk from natural hazards.



ASSESSMENT: The majority of the partners rate their jurisdiction is capable of assessing and mitigating hazards.

Potential Actions

1. Assign and maintain a team of staff to develop the technical capacity to integrate hazard mitigation planning into plans, policies, and procedures.
2. Attend FEMA hazard mitigation planning training courses.
3. Prepare an annual presentation for boards, commissions, and councils.

Educate and engage planning commissions and similar formalized member appointed panels to formulate mitigation planning recommendations for policy makers.

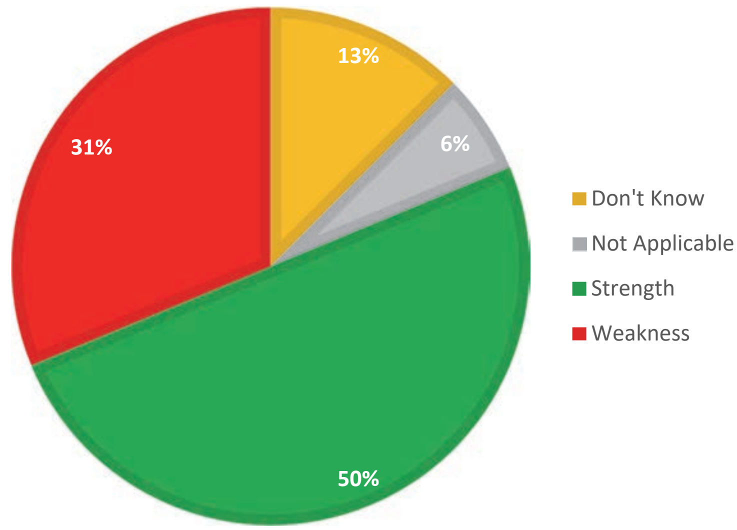
TCOMM 911	Not Applicable
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Strength
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Weakness
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Strength
Thurston County	Weakness
Thurston County	Strength
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Strength

13. **Your jurisdiction has a policy framework to equitably prioritize mitigation actions that benefit your community's socially vulnerable populations.**

ASSESSMENT: Most municipalities, transit, and utilities report they are capable of equitably prioritizing mitigation actions for socially vulnerable populations.

Both the Centers for Disease Control Social Vulnerability Index on Hazards and the Washington State Department of Health Washington Tracking Network provide useful mapping tools to understand community social and health vulnerabilities :

- https://www.atsdr.cdc.gov/placeandhealth/svi/index.html;
- https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/topic-list



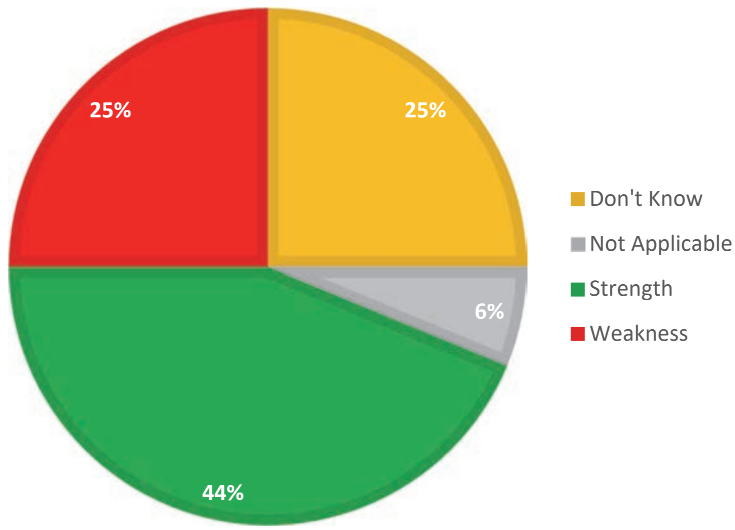
TCOMM 911	Not Applicable
FD 1 & 11 West Thurston Regional Fire Authority	Weakness
FD 6 & SE Thurston Fire Authority	Weakness
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Weakness
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Strength
Thurston County	Don't Know
Thurston County	Strength
Thurston County	Weakness
Tumwater School District	Weakness
Intercity Transit	Strength
Thurston PUD	Strength

14. Your jurisdiction has the capability to account for the effects of climate change to assess your hazard risks.

ASSESSMENT: There is variability in the planning partners' capabilities to account for the effects of climate change to assess hazard risks.

There are resources to assist communities understanding of the effects of climate change on Pacific Northwest communities:

- University of Washington Climate Impacts Group (UWCIG) Special Publications, including information on westside wildfires: https://cig.uw.edu/resources/special-reports/
- UW CIG Interactive Climate Mapping for a Resilient Washington – includes data and maps on climate forecast data: https://cig-wa-climate.nkn.uidaho.edu/
- TRPC's 2018 Climate Adaptation Plan and Vulnerability Assessment: https://www.trpc.org/580/Thurston-Climate-Adaptation-Plan



TCOMM 911	Not Applicable
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Strength
FD 8 South Bay/LEPC	Weakness
FD 9 McLane Black Lake	Weakness
City of Lacey	Don't Know
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Don't Know
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Weakness
Intercity Transit	Strength
Thurston PUD	Don't Know

Potential Actions

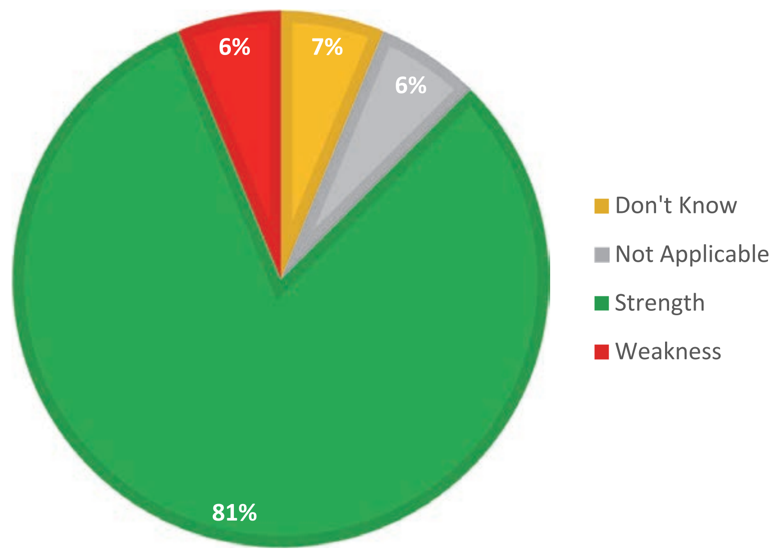
1. Offer training to staff to improve their knowledge and develop technical expertise to prepare for and respond to climate change impacts.
2. Factor climate impacts into the planning of operations and the coordination of disaster response and recovery activities among first-responders, including public health, law enforcement, fire service, and emergency medical services personnel.

15. **Your jurisdiction has the capability to account for the changes in population and land use patterns to assess your hazard risks.**

ASSESSMENT: The majority of partners have the capability to account for changes in population and land use patterns to assess risks.

TRPC summarizes US Census and American Community Survey data to assist communities in analyzing changes in population. For more information, visit: https://www.trpc.org/391/The-Profile-Thurston-County-Statistics-D

The Thurston County GeoData Center produces several map and data products to assist communities with evaluating land use: https://www.thurstoncountywa.gov/departments/geodata-center



TCOMM 911	Not Applicable
FD 1 & 11 West Thurston Regional Fire Authority	Strength
FD 6 & SE Thurston Fire Authority	Strength
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Strength
City of Lacey	Strength
City of Olympia	Don't Know
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Strength
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Weakness

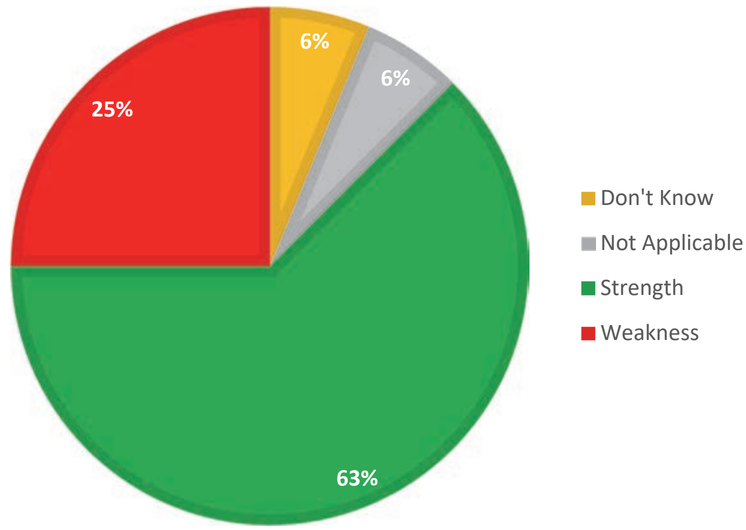
16. Your jurisdiction has an effective mitigation strategy to address your highest risk hazards.

ASSESSMENT: The majority of the partners responded that they have effective mitigation strategies.

Local governments are required to update their hazard mitigation plans every five years to assess changes in conditions, risks, and capabilities. The plan update process is the opportune time to evaluate a strategy for its effectiveness in bolstering resiliency and reducing potential losses.

Hazard Mitigation Workgroup Members have access to resources to help them consider a range of mitigation actions to formulate their strategy:

- FEMA Mitigation Ideas: https://www.fema.gov/sites/default/files/2020-06/fema-mitigation-ideas_02-13-2013.pdf
- Mitigation Catalog: https://app.box.com/s/x6kygopte9j495my850ifqawxgfi56z2/file/1169677344253



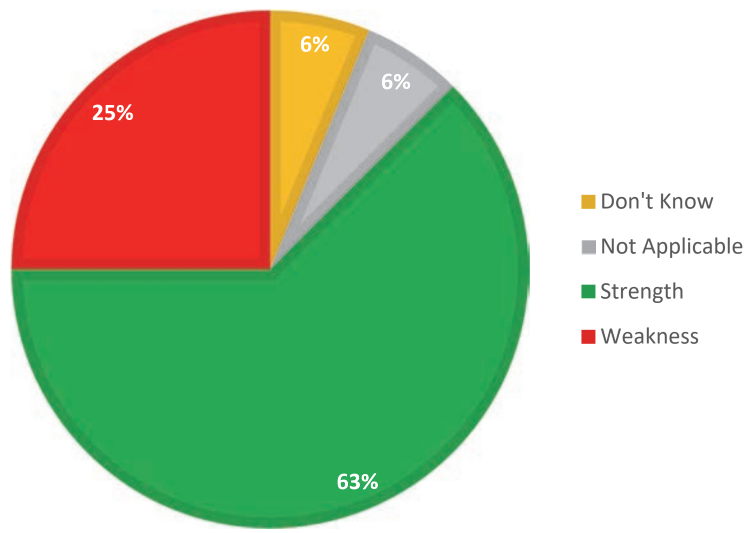
TCOMM 911	Not Applicable
FD 1 & 11 West Thurston Regional Fire Authority	Weakness
FD 6 & SE Thurston Fire Authority	Weakness
FD 8 South Bay/LEPC	Strength
FD 9 McLane Black Lake	Strength
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Weakness
Thurston County	Weakness
Thurston County	Don't Know
Thurston County	Strength
Tumwater School District	Strength
Intercity Transit	Strength
Thurston PUD	Strength

17. Your jurisdiction actively seeks funding and resources to implement your priority mitigation actions.

ASSESSMENT: The majority of the partners are capable of seeking funding and resources for mitigation actions.

Potential Actions

1. Convene a state or FEMA sponsored regional workshop for local governments to receive training and instruction on mitigation grant application development
2. Participate in federal grant programs training
3. Subscribe to FEMA Region X email messaging services and attend FEMA mitigation grant program webinars



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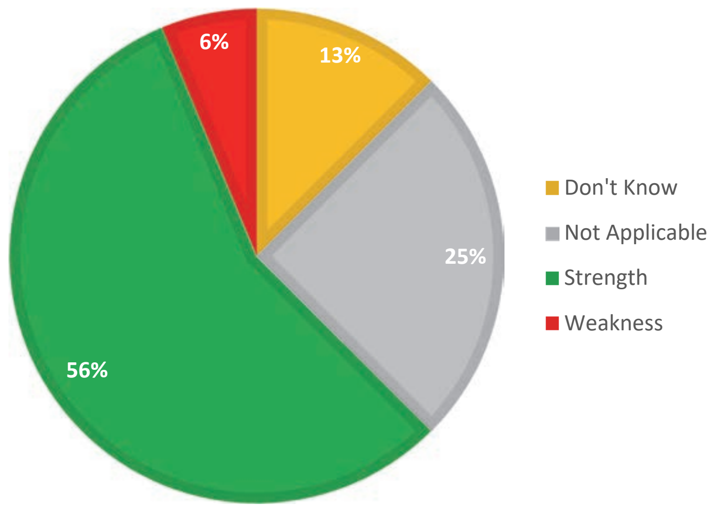
FD 8 South Bay/LEPC	Not Applicable
FD 9 McLane Black Lake	Strength
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Weakness
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Strength
Intercity Transit	Don't Know
Thurston PUD	Strength

18. **Your jurisdiction enforces its building and public safety codes, ordinances, and standards to reduce hazard risks in your community.**

ASSESSMENT: The majority of the planning partners have the capability to enforce building codes and other ordinances to reduce risks.

Potential Actions

1. Build and maintain an interdisciplinary hazard mitigation planning team with staff expertise from all organizational departments.
2. Conduct a systemic review of existing policies, codes, regulations, and procedures to ensure they don't interfere with implementation of hazard mitigation strategies.



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FD 6 & SE Thurston Fire Authority	Don't Know
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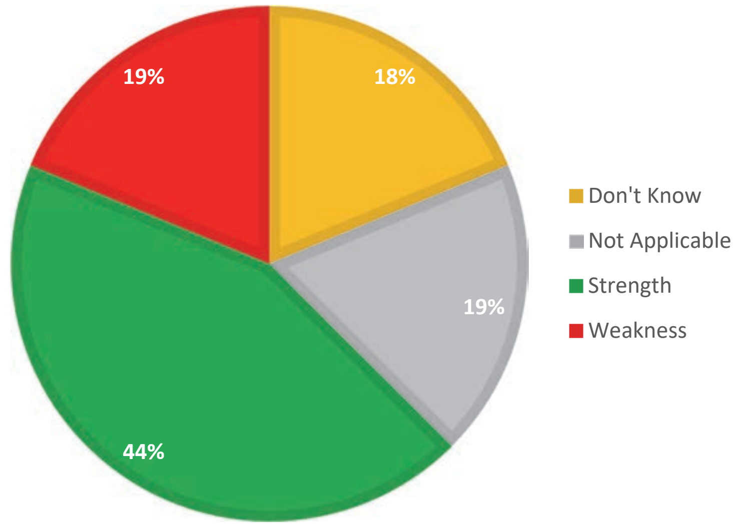
FD 9 McLane Black Lake	Not Applicable
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Don't Know
Thurston County	Strength
Thurston County	Strength
Thurston County	Strength
Tumwater School District	Not Applicable
Intercity Transit	Strength
Thurston PUD	Strength

19. Current land uses within identified hazard areas are appropriate for the risk posed by each hazard.

ASSESSMENT: The cities and county are the jurisdictions with land use authority. Most of the municipal planning partners rate their land uses are appropriate for the risks posed by each hazard.

Potential Actions

Review Comprehensive Plans and zoning code and consider revisions, where appropriate, to integrate policies and land use regulations that improve community resilience to natural hazards.



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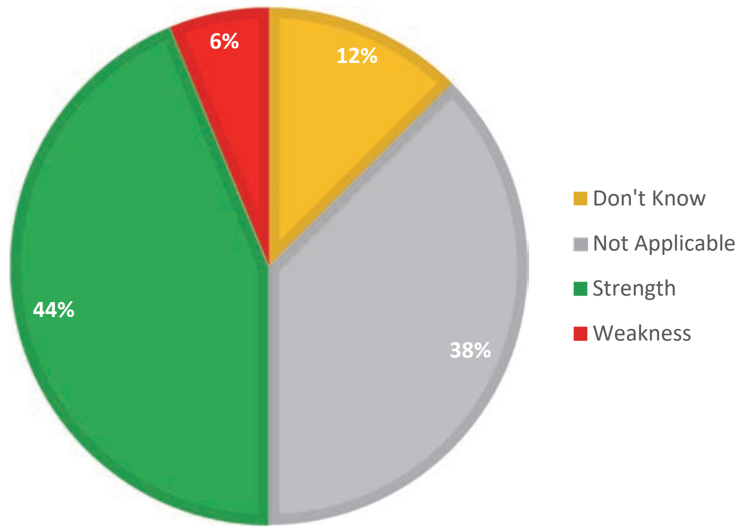
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Not Applicable
Intercity Transit	Strength
Thurston PUD	Strength

20. **Areas that provide natural resource protection are identified and protected within your jurisdiction (e.g. zoning codes, critical areas ordinances, and Shoreline Master Program).**

ASSESSMENT: The majority of municipal planning partners believe they have adequate codes and policies to protect natural resource areas.



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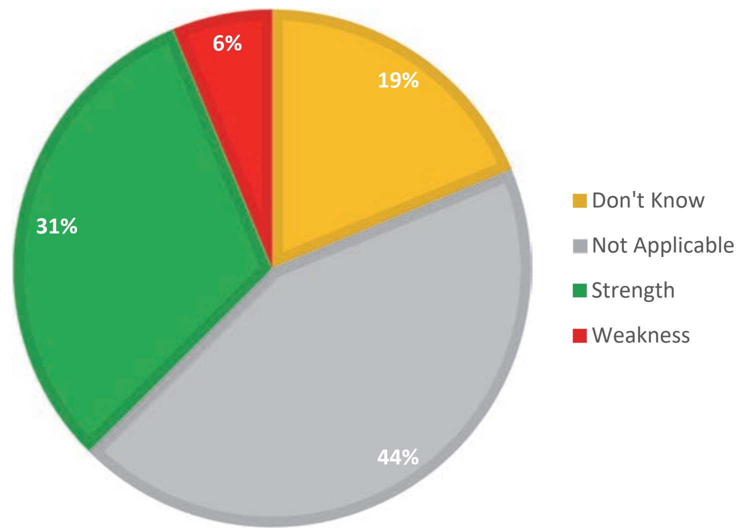
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Not Applicable
Intercity Transit	Not Applicable
Thurston PUD	Not Applicable

21. Your jurisdiction currently has adopted policies, codes, and regulations that prevent development from occurring inside your special flood hazard areas.

ASSESSMENT: Only four municipalities rank their special flood hazard area policies, codes, and regulations as sufficient to prevent development.

Potential Actions

1. Review and amend, as necessary, Comprehensive Plans, Critical Areas Ordinances, Zoning Codes, and Development Regulations to prevent flood losses and strengthen flood plain functions.
2. Develop a comprehensive flood management plan.
3. Participate in the National Flood Insurance Program Community Rating System.



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FD 1 & 11 West Thurston Regional Fire Authority	Strength
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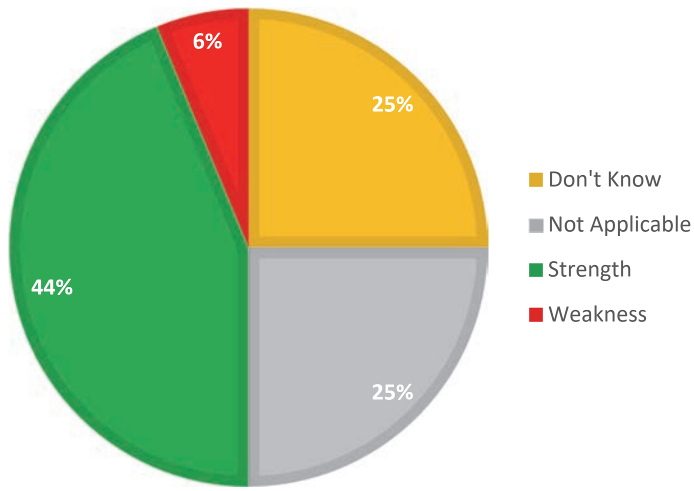
FD 9 McLane Black Lake	Don't Know
City of Lacey	Strength
City of Olympia	Not Applicable
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Don't Know
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Not Applicable
Intercity Transit	Not Applicable
Thurston PUD	Not Applicable

22. Existing flood control systems are effective and well maintained.

ASSESSMENT: The majority of municipal planning partners believe existing flood control systems are effective and well maintained, however other planning partners are unfamiliar with this.

Potential Actions

1. Produce an annual report about the state of flood control systems to increase public awareness about ongoing flood control activities.
2. Summarize flood system maintenance activities in an annual flood bulletin.



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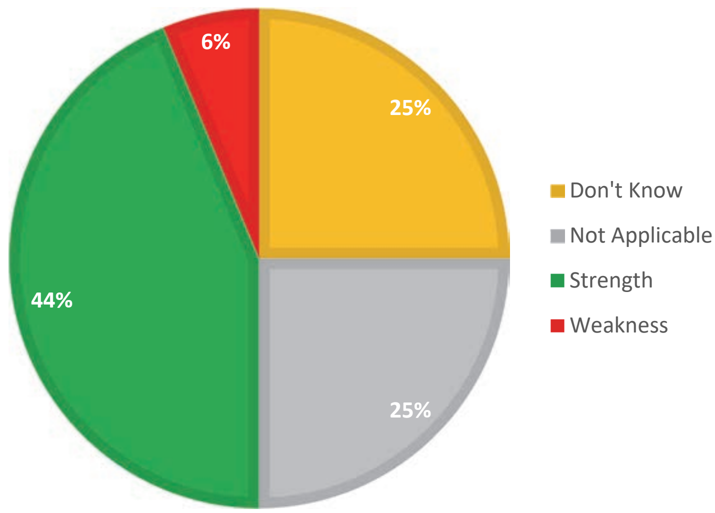
FD 8 South Bay/LEPC	Not Applicable
FD 9 McLane Black Lake	Don't Know
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Strength
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Don't Know
Intercity Transit	Strength
Thurston PUD	Not Applicable

23. There is a coordinated program to maintain drainage systems free of debris.

ASSESSMENT: Most of municipal plan partners believe they have programs to maintain drainage systems free of debris.

Potential Actions

Establish a program to monitor and maintain drainage systems to reduce flood impacts.



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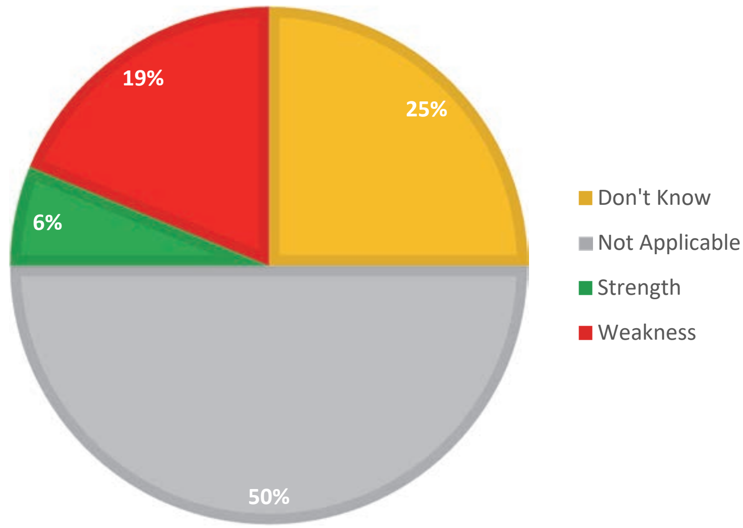
City of Lacey	Strength
City of Olympia	Strength
City of Olympia	Strength
City of Tumwater	Strength
City of Yelm	Strength
Thurston County	Don't Know
Thurston County	Strength
Thurston County	Weakness
Tumwater School District	Don't Know
Intercity Transit	Strength
Thurston PUD	Not Applicable

24. Your jurisdiction has an effective program to inform your residents about flood insurance.

ASSESSMENT: Most plan partners are unaware of their flood insurance information programs or believe their current programs may be inadequate.

Potential Actions

1. Create a website to inform residents about the benefits of National Flood Insurance.
2. Host community events or workshops to inform residents in flood prone neighborhoods how to acquire flood insurance.



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City of Olympia	Strength
City of Tumwater	Don't Know
City of Yelm	Not Applicable
Thurston County	Weakness
Thurston County	Don't Know
Thurston County	Weakness
Tumwater School District	Not Applicable
Intercity Transit	Not Applicable
Thurston PUD	Not Applicable

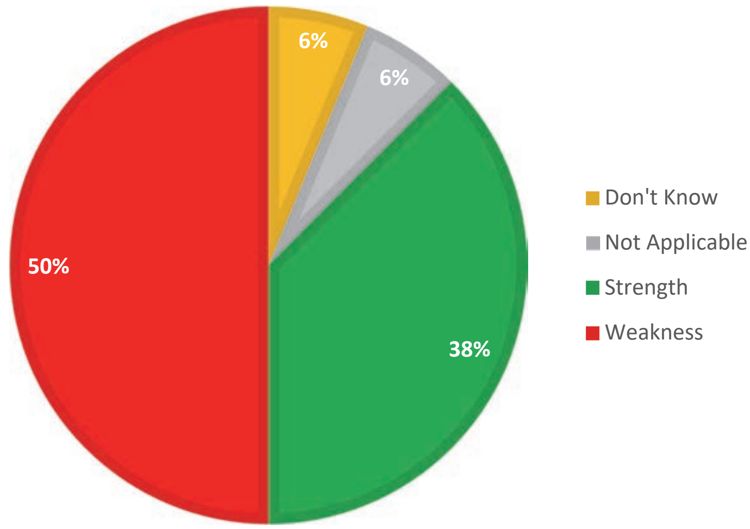
25. Your jurisdiction has an ongoing public outreach strategy to engage the public about efforts to reduce your jurisdiction's risks from natural hazards.

ASSESSMENT: Eight plan partners rate ongoing public outreach strategies to reduce risks from natural hazards as a weakness.

FEMA requires that local governments describe a process for the community to participate in plan maintenance after the plan is approved.

Potential Actions

1. Establish a community-based mitigation plan advisory committee.
2. Create a webpage with links to the plan/annex, staff contact information, and an online comment submission form.
3. Publish an annual report on the status of the hazard mitigation strategy and create a social media campaign to highlight major accomplishments.
4. Host an annual online meeting to present implementation outcomes and offer a question-and-answer session.
5. Conduct mini polls to solicit public feedback on the plan.



TCOMM 911	Not Applicable
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City of Tumwater	Don't Know
City of Yelm	Weakness
Thurston County	Strength
Thurston County	Weakness
Thurston County	Weakness
Tumwater School District	Weakness
Intercity Transit	Strength
Thurston PUD	Weakness

Hazard Mitigation Catalog

Thurston County Hazard Mitigation Plan

Catalog of Risk Reduction Measures

Risk is defined as being a function of the:

- Hazard
- Exposure
- Vulnerability and
- Capability

Risk can be reduced through mitigation by manipulating the hazard, reducing exposure to the hazard, reducing the vulnerability and/or increasing capability. And, where mitigation is not yet possible, the risk can be reduced through preparation, response or/and recovery. This list is not meant to be exhaustive, but to inspire thought.

Risk Reduction Measures	Hazard Category			
	Dam Failure			
	Manipulate Hazard	Reduce Exposure	Reduce Vulnerability	Increase Capability
Personal Scale	None	1. Relocate out of Dam Failure Inundation areas.	1. Elevate your home to appropriate leveles 2. Flood-proof your home to appropriate levels.	1. Educate your self on risk reduction to the dam failure hazard. 2. Learn the evacuation routes for a dam failure event. 3. Educate yourself on early warning procedures.
Corporate Scale	1. Remove Dams 2. Remove levees 3. Strengthen Dams/levees	1. Replace earthen dams with harden structures	1. Flood proof facilities within Dam Failure/Inundation areas	1. Educate your employees on the propbable impacts of a dam failure. 2. Develop a COOP
Government Scale	1. Remove Dams 2. Remove levees 3. Strengthen Dams/levees	1. Replace earthen dams with harden structures 2. Relocate critical facilities out of Dam Failure/Inundation areas. 3. Promote open space land use in designated Dam Failure/Inundation areas.	1. Adopt Higher regulatory floodplain standards in mapped Dam Failure/Inundation areas. 2. Retrofit critical facilities within Dam Failure/Inundation areas. 3. Consider low density land uses within identified Dam Failure/Inundation areas.	1. Create scenario based Dam Failure/Inundation area maps. 2. Enhance Emergency Operations Plan to include a dam failure component. 3. Institute monthly communications checks with dam operators. 4. Inform the public on risk reduction techniques 5. Adopt real-estate disclosure requirements for the re-sale of property located within Dam Failure/Inundation areas. 6. Establish early warning systems downstream of high hazard dams.

Risk Reduction Measures	Hazard Category: Earthquake			
	Manipulate Hazard	**Reduce Exposure**	**Reduce Vulnerability**	**Increase Capability**
Personal scale	None	1. Locate outside of hazard area (off soft soils)	1. Retrofit structure (anchor house structure to foundation) 2. Secure household items that can cause injury or damage such as water heaters, bookcases, and other appliances 3. Build to higher design	1. Practice "drop, cover and hold" 2. Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72 hr self-sufficiency during an event 3. Increase capability by having cash reserves for reconstruction 4. Become informed on the hazard and risk reduction alternatives available 5. Develop a post-disater action plan for your household.
Corporate scale	None	1. Locate/relocate mission critical functions outside hazard area where possible.	1. Build redundancy for critical functions/facilities 2. Retrofit critical buildings/areas housing mission critical functions.	1. Adopt higher standard for new construction -- Consider "performance based design' when building new structures 2. Increase capability by having cash reserves for reconstruction 3. Inform your employes on the possible impacts of earthquake and how to deal with them at your work facility 4. Develop a Continuity of Operations Plan (COOP)
Government	None	1. Locate critical facilities or functions outside of hazard area where possible	1. Harden infrastructure 2. Provide redundancy for critical functions 3. Implement higher regulatory standards 4. Adopt the International Building Code	1. Produce more accurate hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas: tax incentives, information 4. Include retrofitting/replacement of critical system elements in Capital Improvments Plan (CIP) 5. Develop strategy to take advantage of post disaster opportunities 6. Warehouse critical infrastructure components such as pipe, power line, and road repair material 7. Develop and adopt a Continuity of Operations Plan (COOP) 8. Initiate triggers guiding improvements such as: (< 50% substantial damage/improvements) 9. Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. 10. Develop a post disaster action plan that includes a grant funding and debris removal components

Risk Reduction Measures	Hazard Category: Flood			
	Manipulate Hazard	Reduce Exposure	Reduce Vulnerability	Increase Capability
Personal scale	1. Clear stormwater drains and culverts	1.Locate outside of hazard area 2. Elevate utilities above BFE 3. Institute low impact development techniques on property	1. Retrofit structure (elevate house above BFE) 2. Elevate items with house above BFE 3. Build new homes above BFE 4. Floodproof non-residential structures	1. Comply with National Flood Insurance Program (NFIP) 2. Buy flood insurance 3. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72 hr self-sufficiency during and after an event
Corporate scale	1. Clear stormwater drains and culverts	1. Locate business critical facilities or functions outside hazard area 2. Institute low impact development techniques on property	1. Build redundancy for critical functions/ retrofit critical buildings 2. Provide flood-proofing measures when new critical infrastructure must be located in floodplains	1. Increase capability by having cash reserves for reconstruction 2. Suport and implement hazard disclosure for the sale/re-sale of property in identified risk zones 3. Solicit 'cost-sharing" through partnerships with private sector stake holders on projects with multiple benefits
Government	1. Clear stormwater drains and culverts 2. Dredging, levee construction, providing retention areas… 3. Structural flood control: levee's, dams, channelization, revetments 4. Construct regional stormwater control facilites	1. Locate/re-locate critical facilities outside of hazard area 2. Acquire or relocate identified repetitive loss properties 3. Promote open space uses in identified high hazard areas via techniques such as: PUD's, easements, setbacks, greenways, sensitive area tracks 4. Adopt land development criteria such as PUD's, Density transfers, clustering 5. Institute low impact development techniques on property 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff	1. Strengthen existing infrastructure 2. Provide redundancy for critical functions and infrastructure 3. Adopt appropriate regulatory standards such as cumulative substantial improvement/damage, freeboard, lower substantial damage threshold, compensatory storage 4. Stormwater management regulations and master planning 5. Adopt "no-adverse impact" floodplain management policies that strive to not increase the flood risk on down-stream communities	1. Produce more accurate flood hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, information, enforcement of the NFIP) 4. Incorporate retrofitting/replacement of critical system elements in CIP 5. Develop strategy to take advantage of post disaster opportunities 6. Warehouse critical infrastructure components 7. Develop and adopt a Continuity of Operations Plan (COOP) 8. Join Community Rating System (CRS) program 9. Maintain existing data as well as gather new data needed to define risks and vulnerability 10. Training for staff and decision-makers in floodplain management

Risk Reduction Measures	Hazard Category: Flooding			
	Manipulate Hazard	Reduce Exposure	Reduce Vulnerability	Increase Capability
Government				11. Create a building and elevation inventory of structures in the floodplain 12. Develop and implement a public information strategy 13. Charge a hazard mitigation fee on all new permits to create a hazard mitigation funding source for initiatives or grant cost share requirments 14. Develop a Flood Task Force 15. Participate in the Flood Control Districts Basin Opportunity fund program 16. Integrate floodplain mangement policies into other planning mechanisms within the planning area

Risk Reduction Measures	Hazard Category			
	Landslide/Avalanche			
	Manipulate Hazard	**Reduce Exposure**	**Reduce Vulnerability**	**Increase Capability**
Personal scale	1. Stabilize slope (de-water, armor toe) 2. Reduce weight on top of slope 3.) Minimize vegetation removal and the addition of impervious surfaces	1. Locate structures outside of hazard area (off unstable land and away from slide-run out area)	1. Retrofit homes on steep slopes	1. Institute warning system and develop evacuation plan 2. Increase capability by having cash reserves for reconstruction 3. Educate yourself on risk reduction techniques for landslide hazards
Corporate scale	1. Stabilize slope (de-water, armor toe) 2. Reduce weight on top of slope 3.) Minimize vegetation removal and the addition of impervious surfaces	1. Locate structures outside of hazard area (off unstable land and away from slide-run out area)	1. Retrofit at risk facilities	1. Institute warning system and develop evacuation plan 2. Increase capability by having cash reserves for reconstruction 3. Develop a COOP 4. Educate your employees on the potential exposure to landslide hazards and your emergency response protocol
Government	1. Stabilize slope (de-water, armor toe) 2. Reduce weight on top of slope 3.) Minimize vegetation removal and the addition of impervious surfaces	1. Acquire properties located in high risk landslide areas 2. Adopt land use policies that prohibit the placement of habitable structures in high risk landslide areas	1. Adopt higher regulatory standards for new development within unstable slope areas 2. Armor/retrofit critical infrastructure from the impact of landslides	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas: better land controls, tax incentives, information 4. Develop strategy to take advantage of post-disaster opportunities 5. Warehouse critical infrastructure components 6. Develop and adopt a Continuity of Operations Plan (COOP) 7. Educate the public on the landslide hazard and appropriate risk reduction alternatives

Risk Reduction Measures	Hazard Category			
	Tsunami/Seiche			
	Manipulate Hazard	Reduce Exposure	Reduce Vulnerability	Increase Capability
Personal scale	None	1. Locate outside of hazard area	1. Apply personal property mitigation techniques to your home such as anchoring your foundation and foundation openings to allow flow though.	1. Develop and practice a household evacuation plan. 2. Support/Create a Tsunami Working Group 3. Educate your self on the risk exposure from the Tsunami hazard and ways to minimize that risk.
Corporate scale	None	1. Locate structure or mission critical functions outside of hazard area whenever possible	1. Mitigate personnel property for the imapcts of Tsunami	1. Develop and practice a corporate evacuation plan 2. Support/Create a Tsunami Working Group 3. Educate your employees on the risk exposure from the Tsunami hazard and ways to minimize that risk
Government	1. Build wave abatement structures (e.g. the "Jacks" looking structure designed by the Japanese)	1. Locate structure or functions outside of hazard area whenever possible. 2. Strengthen infrastructure for Tsunami impacts 3. Relocate identified critical facilities located in Tsunami high hazard areas	1. Adopt Higher regulatory standards that will provide higher levels of protection to structures built in a Tsunami Inundation area 2. Utilize Tsunami mapping once available, to guide development away from high risk areas through land use planning 3. Construct local vertical evacuation structures	1. Create a probabilistic Tsunami/Seiche map for the planning area 2. Provide incentives to guide development away from hazard areas 3. Develop a tsunami warning and response system 4. Provide residents with tsunami inundation maps 5. Join NOAA's Tsunami Ready program 6. Develop and communicate evacuation routes 7. Enhance the public information program to include risk reduction options for the tsunami hazard

Risk Reduction Measures	Hazard Category			
	Severe Storm/Weather			
	Hazard	Exposure	Vulnerability	Capability
Personal scale	None	None	1. Insulate house 2. Provide redundant heat and power 3. Insulate structure 4. Plant appropriate trees near home and power lines ("Right tree, right place" National Arbor Day Foundation Program)	1. Trim or remove trees that could effect power lines 2. Promote 72 hour self-sufficiency 3. Obtain a NOAA wether radio 4. Obtain an emergency generator
Corporate Scale	None	None	1. Relocate critical infrastructure, such as power lines, underground 2. Reinforce or relocate critical infrastructure such as powerlines so that it meets performance expectations. 3. Install tree wire	1. Trim or remove trees that could affect power lines 2. Create redundancy 3. Equip your facilities with a NOAA weather radio 4. Equip vital facilites with emergency power sources
Government	None	None	1. Strengthen infrastructure (such a locating utilities under ground) 2. Trimming trees back from power lines 3. Designate snow routes and strengthen critical road sections and bridges	1. Support programs such as "Tree Watch" that proactively manage problem areas by use of selective removal of hazardous trees, tree replacement, etc 2. Establish and enforce building codes that require all roofs to withstand snow loads 3. Improve communication alternatives 4. Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors 5. Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines 6. Establish formal mutual aid agreements 7. Provide NOAA weather radios to the public

Risk Reduction Measures	Hazard Category			
	Volcano/Lahar/Ashfall			
	Manipulate Hazard	**Reduce Exposure**	**Reduce Vulnerability**	**Increase Capability**
Personal scale	None	1. Relocate outside of hazard area, such as lahar zones	None	1. Develop and practice a household evacuation plan
Corporate scale	None	1. Locate mission critical functions outside of hazard area, such as lahar zones whenever possible	1. Build redundancy for critical facilities and functions	1. Develop and practice an employee evacuation plan
Government	1. Lava flow diversion structures (only limited success experienced)	1. Locate critical facilities and functions outside of hazard area, such as lahar zones, whenever possible	1. Build redundancy for critical facilities and functions	1. Public outreach, awareness 2. Support detailed wind/ashfall studies 3. Install a volcano warning system similar to that for Mt. Rainier

Risk Reduction Measures	Hazard Category			
	Wildfire			
	Hazard	Exposure	Vulnerability	Capability
Personal scale	Clear potential fuels on property: dry, overgrown underbrush, diseased trees	1. Create and maintain defensible space around structures 2. Reduce exposure --Locate outside of hazard area 3. Mow regularly	1. Create and maintain defensible space around structures, provide water on site. 2. Use fire-retardant building materials 3. Create defensible spaces around your home	1. Employ "Firewise" techniques to safegard your home 2. Identify alternative water supplies for fire fighting 3. Install/replace roofing material with non-combustible roofing materials
Corporate scale	Clear potential fuels on property: dry underbrush, diseased trees	1. Create and maintain defensible space around structures and infrastructure 2. Reduce exposure -- Locate outside of hazard area	1. Create and maintain defensible space around structures and infrastructure, provide water on site 2. Use fire-retardant building materials	1. Support "Firewise" community initiatives 2. Create /establish stored water supplies to be utilized for fire fighting
Government	1. Clear fuels (dry underbrush, diseased trees) on land that can trigger and maintain wildfires 2. Implement "Best Management Practices" on public lands	1. Create and maintain defensible space around structures and infrastructure 2. Reduce exposure -- Locate outside of hazard area 3. Enhance building code to include use of fire resitant materials in high hazard areas	1. Create and maintain defensible space around structures and infrastructure 2. Use fire-retardant building materials 3. Higher regulatory standards 4. Biomass reclamation initiatives	1. Establish/improve public outreach and education efforts 2. Possible Weapons of Mass Destruction (WMD) funds available to enhance fire capability in High Risk areas 3. Identify and create emergency vehicle access in high hazard areas 4. Seek alternative water supplies in urban wildland interface areas 5. Become a "Firewise" community 6. Utilize academia to study impacts/solutions to wildfire risk 7. Establish/maintain mutual aid agreements between Fire Service Agencies 8. Create/implement wildfire protection plans

Appendix C

Risk Assessment Ratings Calculation Tables

Content

Dam Failure Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Va
Bucoda	610	245	237	$63,726,655	230	571	93.7%	$37,907,781	
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0	
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.0%	$0	
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0	
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%	$0	
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%	$0	
Unincorporated	143,760	53,104	51,429	$24,765,596,428	636	1,719	1.2%	$149,534,795	
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**866**	**2,291**	**0.8%**	**$187,442,576**	

Jurisdiction	Acres of Inundation Area	Number of Structures in Skookumchuck Dam Inundation Area (2)						
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Bucoda	260	222	6	0	0	0	2	0
Lacey	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated	16,839	615	15	3	0	1	2	0
Total	**17,100**	**837**	**21**	**3**	**0**	**1**	**4**	**0**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Va
Bucoda	610	245	237	$63,726,655	0	0	0.0%	$0	
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0	
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.0%	$0	
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0	
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%	$0	
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%	$0	
Unincorporated	143,760	53,104	51,429	$24,765,596,428	796	2,116	1.5%	$143,783,309	
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**796**	**2,116**	**0.7%**	**$143,783,309**	

Jurisdiction	Acres of Inundation Area	Number of Structures in Alder and LaGrande Dams Inundation Area (2)						
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Bucoda	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated	7,788	757	34	1	0	0	0	4
Total	**7,788**	**757**	**34**	**1**	**0**	**0**	**0**	**4**

Jurisdiction	MUNICIPAL RISK SCORES AND RATINGS Dam Failure (S							
	Probability		Impact on People				Impact on Pr	
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)
Bucoda	Low	1	93.67%	High	3	9	94.06%	High
Lacey	Low	1	0.00%	None	0	0	0.00%	None
Olympia	Low	1	0.00%	None	0	0	0.00%	None
Rainier	Low	1	0.00%	None	0	0	0.00%	None
Tenino	Low	1	0.00%	None	0	0	0.00%	None
Tumwater	Low	1	0.00%	None	0	0	0.00%	None
Yelm	Low	1	0.00%	None	0	0	0.00%	None
Unincorporated	Low	1	2.67%	Low	1	3	1.86%	Low
Total	Low	1	1.47%	Low	1	3	0.71%	Low

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.

Skookumchuck Dam (3)										
			Economic Impact							
lue Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
$22,032,603	$59,940,384	94.1%	7,248	169	12	230	$28,330,608	$18,079,019	$46,409,627	72.8%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$84,005,388	$233,540,183	0.9%	14,362	20	0	566	$53,433,544	$31,212,504	$84,646,048	0.3%
$106,037,991	**$293,480,567**	**0.4%**	**21,610**	**188**	**12**	**796**	**$81,764,152**	**$49,291,523**	**$131,055,675**	**0.2%**

Total
230
0
0
0
0
0
0
636
866

Dam Failure Alder and LaGrande Dams on Nisqually River (3)										
			Economic Impact							
lue Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$84,128,736	$227,912,044	0.9%	33,115	31	2	567	$54,674,990	$88,257,261	$142,932,250	0.6%
$84,128,736	**$227,912,044**	**0.3%**	**33,115**	**31**	**2**	**567**	**$54,674,990**	**$88,257,261**	**$142,932,250**	**0.2%**

Total
0
0
0
0
0
0
0
796
796

kookumchuck, Alder and LaGrande Dams)							
perty		Impact on Economy				Risk	
Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
3	6	72.83%	High	3	3	**18**	**Medium**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.92%	Low	1	1	**6**	**Low**
1	2	0.37%	Low	1	1	**6**	**Low**

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

Dam Failure Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

Jurisdiction	SPECIAL PURPOSE DISTRICTS RISK SCORE						
	Probability		Impact on People				
East Olympia Fire District	Low	1	0.00%	None	0	0	0.00%
Intercity Transit	Low	1	0.00%	None	0	0	0.00%
Lacey Fire District	Low	1	0.94%	Low	1	3	0.00%
McLane Black Lake Fire District	Low	1	0.00%	None	0	0	0.00%
Olympia School District	Low	1	0.00%	None	0	0	0.00%
SE Thurston Fire Authority	Low	1	4.09%	Low	1	3	0.00%
South Bay Fire District	Low	1	0.00%	None	0	0	0.00%
The Evergreen State College	Low	1	0.00%	None	0	0	0.00%
Thurston PUD	Low	1	0.76%	Low	1	3	3.85%
West Thurston Regional Fire Authority	Low	1	3.04%	Low	1	3	0.00%

	Special Purpose District Critical Facilities Loss Detail						
Jurisdiction	Critical Facilities	Facilities in Dam Failure	% in Hazard	Total Valuation	Structure Value	% Loss of Affected Facilities	% Total Valu Damage
East Olympia Fire District	6	0	0.00%	$4,995,000	0	0%	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0	0%	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0	0%	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0	0%	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0	0%	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0	0%	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0	0%	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0	0%	0.00%
Thuston PUD	104	4	3.85%	$157,995,117	$3,598,933	0%	0.00%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0	0%	0.00

S AND RATINGS Dam Failure (Skookumchuck, Alder and LaGrande Dams)									
Impact on Property				Impact on Economy				Risk Ranking Score	Hazard Risk Rating
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**3**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**3**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	Low	1	2	0.71%	Low	1	1	**6**	**Low**
	None	0	0	0.00%	None	0	0	**3**	**Low**

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Dam Failure Hazard Scenario, by Watershed, Risk Assessment Results and Risk Ratings

					Skookumchuck Dam (3)												
					Estimated Exposure							Economic Impact					
Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Co Dam (
Bucoda	610	245	237	$63,726,655	230	571	93.7%	$37,907,781	$22,032,603	$59,940,384	94.1%	7,248	169	12	230	$28,330,608	$18,07
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Black River	17,289	6,519	6,185	$2,801,171,662	168	453	2.6%	$37,643,405	$21,550,167	$59,193,572	2.1%	3,755	6	0	148	$9,719,312	$5,91
Unincorporated Budd Inlet	10,480	3,844	3,749	$1,752,014,029	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Chehalis River	12,148	4,575	4,346	$1,999,992,610	86	238	2.0%	$23,947,418	$14,843,629	$38,791,047	1.9%	1,725	3	0	68	$2,617,327	$1,36
Unincorporated Deschutes Mountain Zone	196	70	70	$14,876,117	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Deschutes River Lower	13,775	5,007	4,928	$2,548,777,015	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Deschutes River Middle	7,380	2,666	2,640	$975,938,911	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Eld Inlet	11,505	4,253	4,116	$2,786,155,643	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Henderson Inlet	26,843	9,837	9,603	$4,424,313,689	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Mcallister Creek	18,142	6,855	6,490	$3,712,893,851	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Nisqually	15,285	5,593	5,468	$1,945,195,946	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Nisqually Reach	4,702	1,697	1,682	$895,133,285	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Skookumchuck River	1,618	593	579	$201,544,596	382	1,029	63.6%	$87,943,971	$47,611,593	$135,555,564	67.3%	8,881	10	0	350	$41,096,905	$23,93
Unincorporated Totten Inlet	4,377	1,581	1,566	$701,366,142	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated West Capitol Forest	20	14	7	$6,222,931	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**866**	**2,291**	**0.8%**	**$187,442,576**	**$106,037,991**	**$293,480,567**	**0.4%**	**21,610**	**188**	**12**	**796**	**$81,764,152**	**$49,29**

Jurisdiction	Acres of Inundation Area	Number of Structures in Skookumchuck Dam Inundation Area (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	260	222	6	0	0	0	2	0	230
Lacey	0	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0	0
Unincorporated Black River	5,093	162	4	1	0	1	0	0	168
Unincorporated Budd Inlet	0	0	0	0	0	0	0	0	0
Unincorporated Chehalis River	4,734	85	1	0	0	0	0	0	86
Unincorporated Deschutes Mountain Zone	0	0	0	0	0	0	0	0	0
Unincorporated Deschutes River Lower	0	0	0	0	0	0	0	0	0
Unincorporated Deschutes River Middle	0	0	0	0	0	0	0	0	0
Unincorporated Eld Inlet	0	0	0	0	0	0	0	0	0
Unincorporated Henderson Inlet	0	0	0	0	0	0	0	0	0
Unincorporated Mcallister Creek	0	0	0	0	0	0	0	0	0
Unincorporated Nisqually	0	0	0	0	0	0	0	0	0
Unincorporated Nisqually Reach	0	0	0	0	0	0	0	0	0
Unincorporated Skookumchuck River	7,012	368	10	2	0	0	2	0	382
Unincorporated Totten Inlet	0	0	0	0	0	0	0	0	0
Unincorporated West Capitol Forest	0	0	0	0	0	0	0	0	0
Total	**17,099**	**837**	**21**	**3**	**0**	**1**	**4**	**0**	**866**

					Dam Failure Alder and LaGrande Dams on Nisqually River (3)												
					Estimated Exposure							Economic Impact					
Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Co Dam (
Bucoda	610	245	237	$63,726,655	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Black River	17,289	6,519	6,185	$2,801,171,662	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Budd Inlet	10,480	3,844	3,749	$1,752,014,029	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Chehalis River	12,148	4,575	4,346	$1,999,992,610	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Deschutes Mountain Zone	196	70	70	$14,876,117	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Deschutes River Lower	13,775	5,007	4,928	$2,548,777,015	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Deschutes River Middle	7,380	2,666	2,640	$975,938,911	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Eld Inlet	11,505	4,253	4,116	$2,786,155,643	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Henderson Inlet	26,843	9,837	9,603	$4,424,313,689	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Mcallister Creek	18,142	6,855	6,490	$3,712,893,851	211	506	2.8%	$39,827,218	$26,271,871	$66,099,090	1.8%	9,272	9	0	175	$12,028,498	$37,06
Unincorporated Nisqually	15,285	5,593	5,468	$1,945,195,946	585	1,610	10.5%	$103,956,090	$57,856,864	$161,812,955	8.3%	23,843	22	2	392	$42,646,492	$51,18
Unincorporated Nisqually Reach	4,702	1,697	1,682	$895,133,285	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Skookumchuck River	1,618	593	579	$201,544,596	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated Totten Inlet	4,377	1,581	1,566	$701,366,142	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Unincorporated West Capitol Forest	20	14	7	$6,222,931	0	0	0.0%	$0	$0	$0	0.0%	0	0	0	0	$0	$
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**796**	**2,116**	**0.7%**	**$143,783,309**	**$84,128,736**	**$227,912,044**	**0.3%**	**33,115**	**31**	**2**	**567**	**$54,674,990**	**$88,25**

Jurisdiction	Acres of Inundation Area	Number of Structures in Alder and LaGrande Dam Inundation Area (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	0	0
Lacey	0	0	0	0	0	0	0	0	0
Olympia	0	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0	0
Unincorporated Black River	0	0	0	0	0	0	0	0	0
Unincorporated Budd Inlet	0	0	0	0	0	0	0	0	0
Unincorporated Chehalis River	0	0	0	0	0	0	0	0	0
Unincorporated Deschutes Mountain Zone	0	0	0	0	0	0	0	0	0
Unincorporated Deschutes River Lower	0	0	0	0	0	0	0	0	0
Unincorporated Deschutes River Middle	0	0	0	0	0	0	0	0	0
Unincorporated Eld Inlet	0	0	0	0	0	0	0	0	0
Unincorporated Henderson Inlet	0	0	0	0	0	0	0	0	0
Unincorporated Mcallister Creek	2,427	181	29	1	0	0	0	0	211
Unincorporated Nisqually	5,361	576	5	0	0	0	0	4	585
Unincorporated Nisqually Reach	0	0	0	0	0	0	0	0	0
Unincorporated Skookumchuck River	0	0	0	0	0	0	0	0	0
Unincorporated Totten Inlet	0	0	0	0	0	0	0	0	0
Unincorporated West Capitol Forest	0	0	0	0	0	0	0	0	0
Total	**7,788**	**757**	**34**	**1**	**0**	**0**	**0**	**4**	**796**

	RISK SCORES AND RATINGS Dam Failure (Skookumchuck, Alder and LaGrande Dams)															
	Probability		Impact on People				Impact on Property				Impact on Economy				Risk	
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	Low	1	93.67%	High	3	9	94.06%	High	3	6	72.83%	High	3	3	**18**	**Medium**
Lacey	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Olympia	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Rainier	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Tenino	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Tumwater	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Yelm	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Black River	Low	1	2.62%	Low	1	3	2.11%	Low	1	2	0.56%	Low	1	1	**6**	**Low**
Unincorporated Budd Inlet	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Chehalis River	Low	1	1.96%	Low	1	3	1.94%	Low	1	2	0.20%	Low	1	1	**6**	**Low**
Unincorporated Deschutes Mountain Zone	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Deschutes River Lower	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Deschutes River Middle	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Eld Inlet	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Henderson Inlet	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Mcallister Creek	Low	1	2.79%	Low	1	3	1.78%	Low	1	2	1.32%	Low	1	1	**6**	**Low**
Unincorporated Nisqually	Low	1	10.53%	Medium	2	6	8.32%	Low	1	2	4.82%	Low	1	1	**9**	**Low**
Unincorporated Nisqually Reach	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated Skookumchuck River	Low	1	63.56%	High	3	9	67.26%	High	3	6	32.27%	High	3	3	**18**	**Medium**
Unincorporated Totten Inlet	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Unincorporated West Capitol Forest	Low	1	0.00%	None	0	0	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
Total	Low	1	1.47%	Low	1	3	0.71%	Low	1	2	0.37%	Low	1	1	**6**	**Low**

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated population.
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

ntents in $ aged 6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
79,019	$46,409,627	72.8%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
4,053	$15,633,365	0.6%
0	$0	0.0%
5,145	$3,982,472	0.2%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
33,306	$65,030,211	32.3%
0	$0	0.0%
0	$0	0.0%
91,523	**$131,055,675**	**0.2%**

ntents in $ aged 6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
58,049	$49,096,547	1.3%
39,211	$93,835,703	4.8%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
0	$0	0.0%
57,261	**$142,932,250**	**0.2%**

Earthquake Cascadia M9.3 Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Exposure						
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Numbe Displa Househol
Bucoda	610	100%	245	$63,726,655	100%	16.79	40
Lacey	58,180	100%	18,985	$17,357,526,547	100%	272.95	1,57
Olympia	56,370	100%	18,242	$19,116,213,011	100%	474.69	2,01
Rainier	2,510	100%	875	$393,003,023	100%	11.36	14
Tenino	2,030	100%	751	$404,778,123	100%	22.72	13
Tumwater	26,360	100%	9,513	$9,362,171,728	100%	198.35	811
Yelm	10,680	100%	3,139	$2,077,637,133	100%	44.59	68
Unincorporated	143,760	100%	53,104	$24,765,596,428	100%	315.83	655
TOTAL	**300,500**	100%	**104,854**	**$73,540,652,648**	100%	**1,357.28**	**5,18**

	RISK RANKIN						
Jurisdiction	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Tota Expos
Bucoda	Medium	2	100.00%	High	3	9	100.0
Lacey	Medium	2	100.00%	High	3	9	100.0
Olympia	Medium	2	100.00%	High	3	9	100.0
Rainier	Medium	2	100.00%	High	3	9	100.0
Tenino	Medium	2	100.00%	High	3	9	100.0
Tumwater	Medium	2	100.00%	High	3	9	100.0
Yelm	Medium	2	100.00%	High	3	9	100.0
Unincorporated	Medium	2	100.00%	High	3	9	100.0
TOTAL	Medium	2	100.00%	High	3	9	100.0

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.1.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.1.

Economic Impact - Cascadia M9.3 Scenario					
er of ced lds (3)	**People Requiring Short-Term Shelter (3)**	**Value Structure in $ Damaged (4)**	**Value Contents in $ Damaged (4)**	**Total Value (Structure and Contents in $) Damaged (4)**	**% of Total Value Damaged**
	24	$6,483,618	$2,086,159	$8,569,777	13.4%
2	877	$652,953,041	$294,139,558	$947,092,599	5.5%
0	1,096	$1,120,596,938	$456,206,118	$1,576,803,056	8.2%
	8	$8,703,252	$3,693,126	$12,396,378	3.2%
	7	$12,441,838	$6,159,193	$18,601,032	4.6%
1	406	$682,594,027	$314,297,626	$996,891,653	10.6%
	43	$32,826,674	$17,612,336	$50,439,009	2.4%
5	369	$984,579,057	$357,753,068	$1,342,332,124	5.4%
32	**2,830**	**$3,501,178,444**	**$1,451,947,183**	**$4,953,125,627**	6.7%

IG-Earthquake - Cascadia Scenario M9.3 Scenario									
Impact on Property				**Impact on Economy**				**Risk**	
l Value sed	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**	**% of Total Value Damaged**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**	**Risk Ranking Score**	**Hazard Risk Rating**
0%	High	3	6	13.45%	High	3	3	**36**	**High**
0%	High	3	6	5.46%	Medium	2	2	**34**	**High**
0%	High	3	6	8.25%	Medium	2	2	**34**	**High**
0%	High	3	6	3.15%	Low	1	1	**32**	**Medium**
0%	High	3	6	4.60%	Low	1	1	**32**	**Medium**
0%	High	3	6	10.65%	High	3	3	**36**	**High**
0%	High	3	6	2.43%	Low	1	1	**32**	**Medium**
0%	High	3	6	5.42%	Medium	2	2	**34**	**High**
0%	High	3	6	6.74%	Medium	2	2	**34**	**High**

Earthquake Cascadia M9.3 Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	Special Purpose Di						
Jurisdiction	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Tota Expos
East Olympia Fire District	Medium	2	100.00%	High	3	9	100.0
Intercity Transit	Medium	2	100.00%	High	3	9	100.0
Lacey Fire District	Medium	2	100.00%	High	3	9	100.0
McLane Black Lake Fire District	Medium	2	100.00%	High	3	9	100.0
Olympia School District	Medium	2	100.00%	High	3	9	100.0
SE Thurston Fire Authority	Medium	2	100.00%	High	3	9	100.0
South Bay Fire District	Medium	2	100.00%	High	3	9	100.0
The Evergreen State College	Medium	2	100.00%	High	3	9	100.0
Thuston PUD	Medium	2	100.00%	High	3	9	100.0
West Thurston Regional Fire Authority	Medium	2	100.00%	High	3	9	100.0

istrict Risk Ranking - Cascadia Scenario M9.3 Scenario									
Impact on Property				Functional Downtime					
l Value sed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Days until 50% Functionality	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**
0%	High	3	6	7	Low	1	1	**32**	**Medium**
0%	High	3	6	14	Low	1	1	**32**	**Medium**

Earthquake Nisqually M7.2 Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Exposure					
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Numbe Displa Househol
Bucoda	610	100%	245	$63,726,655	100%	1.67	2
Lacey	58,180	100%	18,985	$17,357,526,547	100%	36.22	152
Olympia	56,370	100%	18,242	$19,116,213,011	100%	61.57	185
Rainier	2,510	100%	875	$393,003,023	100%	1.25	1
Tenino	2,030	100%	751	$404,778,123	100%	2.05	0
Tumwater	26,360	100%	9,513	$9,362,171,728	100%	24.70	68
Yelm	10,680	100%	3,139	$2,077,637,133	100%	5.70	4
Unincorporated	143,760	100%	53,104	$24,765,596,428	100%	29.64	30
TOTAL	**300,500**	100%	**104,854**	**$73,540,652,648**	100%	**162.80**	**443**

Jurisdiction	RISK RANK						
	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Tota Expos
Bucoda	Medium	2	100.00%	High	3	9	100.0
Lacey	Medium	2	100.00%	High	3	9	100.0
Olympia	Medium	2	100.00%	High	3	9	100.0
Rainier	Medium	2	100.00%	High	3	9	100.0
Tenino	Medium	2	100.00%	High	3	9	100.0
Tumwater	Medium	2	100.00%	High	3	9	100.0
Yelm	Medium	2	100.00%	High	3	9	100.0
Unincorporated	Medium	2	100.00%	High	3	9	100.0
TOTAL	Medium	2	100.00%	High	3	9	100.0

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.1.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.1.

Economic Impact - Nisqually Fault M7.2 Scenario					
er of ced lds (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
	1	$1,135,105	$1,396,488	$2,531,594	4.0%
2	85	$146,583,916	$165,638,440	$312,222,356	1.8%
5	97	$198,776,101	$234,573,117	$433,349,219	2.3%
	0	$1,829,173	$2,062,368	$3,891,541	1.0%
	0	$2,200,024	$2,631,481	$4,831,505	1.2%
	35	$109,742,430	$133,975,231	$243,717,661	2.6%
	3	$10,756,046	$11,772,790	$22,528,836	1.1%
	17	$161,594,486	$177,886,479	$339,480,964	1.4%
3	**237**	**$632,617,281**	**$729,936,394**	**1,362,553,675**	1.9%

ING-Earthquake - Nisqually Fault M7.2 Scenario

Impact on Property				Impact on Economy				Risk	
l Value sed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0%	High	3	6	3.97%	Low	1	1	**32**	**Medium**
0%	High	3	6	1.80%	Low	1	1	**32**	**Medium**
0%	High	3	6	2.27%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.99%	Low	1	1	**32**	**Medium**
0%	High	3	6	1.19%	Low	1	1	**32**	**Medium**
0%	High	3	6	2.60%	Low	1	1	**32**	**Medium**
0%	High	3	6	1.08%	Low	1	1	**32**	**Medium**
0%	High	3	6	1.37%	Low	1	1	**32**	**Medium**
0%	High	3	6	1.85%	Low	1	1	**32**	**Medium**

Earthquake Nisqually M7.2 Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	Special Purpose						
Jurisdiction	**Probability**		**Impact on People**				
	Probability (High, Medium, Low, None)	**Probability Factor (3,2,1,0)**	**% Population Exposed**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**	**% of Tota Expos**
East Olympia Fire District	Medium	2	100.00%	High	3	9	100.0
Intercity Transit	Medium	2	100.00%	High	3	9	100.0
Lacey Fire District	Medium	2	100.00%	High	3	9	100.0
McLane Black Lake Fire District	Medium	2	100.00%	High	3	9	100.0
Olympia School District	Medium	2	100.00%	High	3	9	100.0
SE Thurston Fire Authority	Medium	2	100.00%	High	3	9	100.0
South Bay Fire District	Medium	2	100.00%	High	3	9	100.0
The Evergreen State College	Medium	2	100.00%	High	3	9	100.0
Thuston PUD	Medium	2	100.00%	High	3	9	100.0
West Thurston Regional Fire Authority	Medium	2	100.00%	High	3	9	200.0

District Risk Ranking - Nisqually Fault M7.2 Scenario									
Impact on Property				Funtional Downtime					
l Value sed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Days until 50% Functionality	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Ris Ranking Score	Hazard Risk Rating
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	3	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**

Earthquake Seattle Fault Zone M7.2 Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Exposure						
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Numbe Displa Househol
Bucoda	610	100%	245	$63,726,655	100%	0.22	0
Lacey	58,180	100%	18,985	$17,357,526,547	100%	12.18	38
Olympia	56,370	100%	18,242	$19,116,213,011	100%	20.12	47
Rainier	2,510	100%	875	$393,003,023	100%	0.24	0
Tenino	2,030	100%	751	$404,778,123	100%	0.40	0
Tumwater	26,360	100%	9,513	$9,362,171,728	100%	6.59	15
Yelm	10,680	100%	3,139	$2,077,637,133	100%	1.31	1
Unincorporated	143,760	100%	53,104	$24,765,596,428	100%	9.07	9
TOTAL	**300,500**	100%	**104,854**	**$73,540,652,648**	100%	**50.13**	**111**

Jurisdiction	RISK RANKING-Ea						
	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Tota Expo
Bucoda	Medium	2	100.00%	High	3	9	100.0
Lacey	Medium	2	100.00%	High	3	9	100.0
Olympia	Medium	2	100.00%	High	3	9	100.0
Rainier	Medium	2	100.00%	High	3	9	100.0
Tenino	Medium	2	100.00%	High	3	9	100.0
Tumwater	Medium	2	100.00%	High	3	9	100.0
Yelm	Medium	2	100.00%	High	3	9	100.0
Unincorporated	Medium	2	100.00%	High	3	9	100.0
TOTAL	Medium	2	100.00%	High	3	9	100.0

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 5.1.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 5.1.

Economic Impact - Seattle Fault Zone - Southern M7.2 Scenario					
er of ced lds (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
	0	$38,530	$23,758	$62,288	0.1%
	21	$20,699,242	$13,927,947	$34,627,190	0.2%
	26	$48,840,580	$27,970,420	$76,811,000	0.4%
	0	$106,093	$67,599	$173,692	0.0%
	0	$85,319	$66,855	$152,174	0.0%
	8	$16,949,031	$10,225,500	$27,174,530	0.3%
	1	$769,636	$558,440	$1,328,075	0.1%
	5	$29,791,008	$15,264,168	$45,055,176	0.2%
l	**61**	**$117,279,439**	**$68,104,686**	**185,384,126**	0.3%

rthquake - Seattle Fault Zone - Southern M7.2 Scenario									
Impact on Property				**Impact on Economy**				**Risk**	
l Value sed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0%	High	3	6	0.10%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.20%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.40%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.04%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.04%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.29%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.06%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.18%	Low	1	1	**32**	**Medium**
0%	High	3	6	0.25%	Low	1	1	**32**	**Medium**

Earthquake Seattle Fault Zone M7.2 Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	Special Purpose District						
Jurisdiction	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Tota Expos
East Olympia Fire District	Medium	2	100.00%	High	3	9	100.0
Intercity Transit	Medium	2	100.00%	High	3	9	100.0
Lacey Fire District	Medium	2	100.00%	High	3	9	100.0
McLane Black Lake Fire District	Medium	2	100.00%	High	3	9	100.0
Olympia School District	Medium	2	100.00%	High	3	9	100.0
SE Thurston Fire Authority	Medium	2	100.00%	High	3	9	100.0
South Bay Fire District	Medium	2	100.00%	High	3	9	100.0
The Evergreen State College	Medium	2	100.00%	High	3	9	100.0
Thuston PUD	Medium	2	100.00%	High	3	9	100.0
West Thurston Regional Fire Authority	Medium	2	200.00%	High	3	9	200.0

Risk Ranking - Seattle Fault Zone - Southern M7.2 Scenario

Impact on Property				Functional Downtime					
l Value sed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Days until 50% Functionality	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**
0%	High	3	6	1	Low	1	1	**32**	**Medium**

50-Year Flood Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)
Bucoda	610	245	237	$63,726,655	113	288	47.26%	$14,842,523	$7,447,025
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.00%	$0	$0
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.00%	$0	$0
Rainier	2,510	875	814	$393,003,023	0	0	0.00%	$0	$0
Tenino	2,030	751	651	$404,778,123	1	3	0.15%	$111,427	$55,714
Tumwater	26,360	9,513	8,408	$9,362,171,728	5	16	0.06%	$851,244	$425,622
Yelm	10,680	3,139	2,827	$2,077,637,133	19	53	0.50%	$4,330,605	$3,013,885
Unincorporated	143,760	53,104	51,429	$24,765,596,428	515	1,319	0.92%	$106,013,033	$67,289,493
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**653**	**1,679**	**0.56%**	**$126,148,832**	**$78,231,739**

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	165	112	1	0	0	0	0	0	113
Lacey	2	0	0	0	0	0	0	0	0
Olympia	6	0	0	0	0	0	0	0	0
Rainier	0	0	0	0	0	0	0	0	0
Tenino	50	1	0	0	0	0	0	0	1
Tumwater	630	5	0	0	0	0	0	0	5
Yelm	234	14	2	2	0	1	0	0	19
Unincorporated	16,976	472	37	3	0	0	1	2	515
Total	**18,063**	**604**	**40**	**5**	**0**	**1**	**1**	**2**	**653**

MUNICIPAL RISK SCORE AND RATINC

	Probability		Impact on People				Impact on Property		
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor
Bucoda	High	3	47.26%	High	3	9	34.98%	High	3
Lacey	High	3	0.00%	None	0	0	0.00%	None	0
Olympia	High	3	0.00%	None	0	0	0.00%	None	0
Rainier	High	3	0.00%	None	0	0	0.00%	None	0
Tenino	High	3	0.15%	Low	1	3	0.04%	Low	1
Tumwater	High	3	0.06%	Low	1	3	0.01%	Low	1
Yelm	High	3	0.50%	Low	1	3	0.35%	Low	1
Unincorporated	High	3	0.92%	Low	1	3	0.70%	Low	1
Total	High	3	0.56%	Low	1	3	0.28%	Low	1

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Divisior

(2) Values based off of 2022 tax assessor data provided by Thurston County

(3) Percent of residential buildings exposed multiplied by the Estimated Population

(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatior

(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1

		Economic Impact							
lue (Structure and tents in $) Exposed (2)	**% of Total Value Exposed**	**Structure Debris (Tons) (4)**	**Displaced Population (5)**	**People Requiring Short-Term Shelter (5)**	**Buildings Impacted (6)**	**Value Structure in $ Damaged (6)**	**Value Contents in $ Damaged (6)**	**Total Value (Structure and Contents in $) Damaged (6)**	**% of Total Value Damaged**
$22,289,549	34.98%	400	143	2	110	$123,924	$86,399	$210,323	0.3%
$0	0.00%	0	0	0	0	$0	$0	$0	0.0%
$0	0.00%	0	0	0	0	$0	$0	$0	0.0%
$0	0.00%	0	0	0	0	$0	$0	$0	0.0%
$167,141	0.04%	60	0	0	1	$30,450	$17,164	$47,614	0.0%
$1,276,866	0.01%	608	0	0	5	$0	$0	$0	0.0%
$7,344,489	0.35%	336	1	0	14	$11,938	$4,793	$16,731	0.0%
$173,302,527	0.70%	7,471	24	0	513	$7,249,832	$8,084,559	$15,334,391	0.1%
$204,380,571	**0.28%**	**8,876**	**168**	**2**	**643**	**$7,416,145**	**$8,192,915**	**$15,609,060**	**0.0%**

G 50-yr Flood

	Impact on Economy				Risk	
Veighted Impact Factor	**% of Total Value Damaged**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**	**Risk Ranking Score**	**Hazard Risk Rating**
6	0.33%	Low	1	1	**48**	**High**
0	0.00%	None	0	0	**0**	**Low**
0	0.00%	None	0	0	**0**	**Low**
0	0.00%	None	0	0	**0**	**Low**
2	0.01%	Low	1	1	**18**	**Medium**
2	0.00%	None	0	0	**15**	**Low**
2	0.00%	None	0	0	**15**	**Low**
2	0.06%	Low	1	1	**18**	**Medium**
2	0.02%	Low	1	1	**18**	**Medium**

50-Year Flood Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

Jurisdiction	SPECIAL PURPOSE D							
	Probability		Impact on People					
East Olympia Fire District	High	3	0.07%	Low	1	3	0.00%	
Intercity Transit	High	3	0.00%	None	0	0	0.00%	
Lacey Fire District	High	3	0.81%	Low	1	3	0.00%	
McLane Black Lake Fire District	High	3	0.00%	None	0	0	0.00%	
Olympia School District	High	3	0.00%	None	0	0	0.00%	
SE Thurston Fire Authority	High	3	0.71%	Low	1	3	0.00%	
South Bay Fire District	High	3	0.00%	None	0	0	0.00%	
The Evergreen State College	High	3	0.00%	None	0	0	0.00%	
Thuston PUD	High	3	0.56%	Low	1	3	1.00%	
West Thurston Regional Fire Authority	High	3	0.94%	Low	1	3	0.00%	

Jurisdiction	Special Purpose District Critical Facility Loss Detail						
	Critical Facilities	Facilities in 50yr Flood	% in Hazard	Total Valuation	Structure Value	% Modeled Loss	% Total Value Damage
	6	0	0.00%	$4,995,000	0	0	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0	0	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0	0	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0	0	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0	0	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0	0	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0	0	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0	0	0.00%
Thuston PUD	104	1	0.96%	$157,995,117	$1,076,176	0.78	0.53%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0	0	0.00%

DISTRICT RISK SCORES AND RATINGS 50-yr Flood								
Impact on Property			**Impact on Economy**				**Risk Ranking Score**	**Hazard Risk Rating**
None	0	0	0.00%	None	0	0	**9**	**Low**
None	0	0	0.00%	None	0	0	**0**	**Low**
None	0	0	0.00%	None	0	0	**9**	**Low**
None	0	0	0.00%	None	0	0	**0**	**Low**
None	0	0	0.00%	None	0	0	**0**	**Low**
None	0	0	0.00%	None	0	0	**9**	**Low**
None	0	0	0.00%	None	0	0	**0**	**Low**
None	0	0	0.00%	None	0	0	**0**	**Low**
Low	1	2	0.53%	Low	1	1	**18**	**Medium**
None	0	0	0.00%	None	0	0	**9**	**Low**

50-Year Flood Hazard Scenario, by Watershed, Risk Assessment Results and Risk Rating

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Con Expo (2)
Bucoda	610	245	237	$63,726,655	113	288	47.3%	$14,842,523	$7,447
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0	$0
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.0%	$0	$0
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	$0
Tenino	2,030	751	651	$404,778,123	1	3	0.2%	$111,427	$55,7
Tumwater	26,360	9,513	8,408	$9,362,171,728	5	16	0.1%	$851,244	$425,
Yelm	10,680	3,139	2,827	$2,077,637,133	19	53	0.5%	$4,330,605	$3,013
Unincorporated Black River	17,289	6,519	6,185	$2,801,171,662	49	134	0.8%	$9,702,050	$5,099
Unincorporated Budd Inlet	10,480	3,844	3,749	$1,752,014,029	0	0	0.0%	$0	$0
Unincorporated Chehalis River	12,148	4,575	4,346	$1,999,992,610	31	87	0.7%	$5,461,093	$2,730
Unincorporated Deschutes Mountain Zone	196	70	70	$14,876,117	0	0	0.0%	$0	$0
Unincorporated Deschutes River Lower	13,775	5,007	4,928	$2,548,777,015	2	6	0.0%	$1,752,521	$876,
Unincorporated Deschutes River Middle	7,380	2,666	2,640	$975,938,911	27	75	1.0%	$3,630,259	$1,815
Unincorporated Eld Inlet	11,505	4,253	4,116	$2,786,155,643	0	0	0.0%	$0	$0
Unincorporated Henderson Inlet	26,843	9,837	9,603	$4,424,313,689	0	0	0.0%	$0	$0
Unincorporated Mcallister Creek	18,142	6,855	6,490	$3,712,893,851	180	422	2.3%	$33,507,636	$23,37
Unincorporated Nisqually	15,285	5,593	5,468	$1,945,195,946	163	439	2.9%	$40,657,499	$26,24
Unincorporated Nisqually Reach	4,702	1,697	1,682	$895,133,285	0	0	0.0%	$0	$0
Unincorporated Skookumchuck River	1,618	593	579	$201,544,596	63	157	9.7%	$11,301,975	$7,153
Unincorporated Totten Inlet	4,377	1,581	1,566	$701,366,142	0	0	0.0%	$0	$0
Unincorporated West Capitol Forest	20	14	7	$6,222,931	0	0	0.0%	$0	$0
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**653**	**1,679**	**0.6%**	**$126,148,832**	**$78,23**

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Tot
Bucoda	165	112	1	0	0	0	0	0	
Lacey	2	0	0	0	0	0	0	0	
Olympia	6	0	0	0	0	0	0	0	
Rainier	0	0	0	0	0	0	0	0	
Tenino	50	1	0	0	0	0	0	0	
Tumwater	630	5	0	0	0	0	0	0	
Yelm	234	14	2	2	0	1	0	0	
Unincorporated Black River	3,805	48	1	0	0	0	0	0	
Unincorporated Budd Inlet	24	0	0	0	0	0	0	0	
Unincorporated Chehalis River	3,725	31	0	0	0	0	0	0	
Unincorporated Deschutes Mountain Zone	174	0	0	0	0	0	0	0	
Unincorporated Deschutes River Lower	823	2	0	0	0	0	0	0	
Unincorporated Deschutes River Middle	873	27	0	0	0	0	0	0	
Unincorporated Eld Inlet	0	0	0	0	0	0	0	0	
Unincorporated Henderson Inlet	4	0	0	0	0	0	0	0	
Unincorporated Mcallister Creek	1,495	151	27	2	0	0	0	0	
Unincorporated Nisqually	3,683	157	4	0	0	0	0	2	
Unincorporated Nisqually Reach	0	0	0	0	0	0	0	0	
Unincorporated Skookumchuck River	2,369	56	5	1	0	0	1	0	
Unincorporated Totten Inlet	0	0	0	0	0	0	0	0	
Unincorporated West Capitol Forest	0	0	0	0	0	0	0	0	
Total	**18,063**	**604**	**40**	**5**	**0**	**1**	**1**	**2**	

RISK SCORE AND RATING 50-yr

Jurisdiction	Probability		Impact on People				Impact on Property		
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact I
Bucoda	High	3	47.26%	High	3	9	34.98%	High	3
Lacey	High	3	0.00%	None	0	0	0.00%	None	0
Olympia	High	3	0.00%	None	0	0	0.00%	None	0
Rainier	High	3	0.00%	None	0	0	0.00%	None	0
Tenino	High	3	0.15%	Low	1	3	0.04%	Low	1
Tumwater	High	3	0.06%	Low	1	3	0.01%	Low	1
Yelm	High	3	0.50%	Low	1	3	0.35%	Low	1
Unincorporated Black River	High	3	0.78%	Low	1	3	0.53%	Low	1
Unincorporated Budd Inlet	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated Chehalis River	High	3	0.71%	Low	1	3	0.41%	Low	1
Unincorporated Deschutes Mountain Zone	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated Deschutes River Lower	High	3	0.04%	Low	1	3	0.10%	Low	1
Unincorporated Deschutes River Middle	High	3	1.02%	Low	1	3	0.56%	Low	1
Unincorporated Eld Inlet	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated Henderson Inlet	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated Mcallister Creek	High	3	2.33%	Low	1	3	1.53%	Low	1
Unincorporated Nisqually	High	3	2.87%	Low	1	3	3.44%	Low	1
Unincorporated Nisqually Reach	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated Skookumchuck River	High	3	9.67%	Low	1	3	9.16%	Low	1
Unincorporated Totten Inlet	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated West Capitol Forest	High	3	0.00%	None	0	0	0.00%	None	0
Total	High	3	0.56%	Low	1	3	0.28%	Low	1

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division

(2) Values based off of 2022 tax assessor data provided by Thurston County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.

(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.

			Economic Impact							
tents in $ sed)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
,025	$22,289,549	35.0%	400	143	2	110	$123,924	$86,399	$210,323	0.3%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
714	$167,141	0.0%	60	0	0	1	$30,450	$17,164	$47,614	0.0%
622	$1,276,866	0.0%	608	0	0	5	$0	$0	$0	0.0%
,885	$7,344,489	0.4%	336	1	0	14	$11,938	$4,793	$16,731	0.0%
,775	$14,801,825	0.5%	711	2	0	48	$231,621	$144,698	$376,318	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
,547	$8,191,640	0.4%	450	1	0	31	$41,705	$26,614	$68,319	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
260	$2,628,781	0.1%	29	0	0	2	$0	$0	$0	0.0%
,130	$5,445,389	0.6%	392	2	0	27	$195,780	$99,742	$295,522	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
3,474	$56,881,111	1.5%	2,611	8	0	181	$2,193,805	$4,706,613	$6,900,417	0.2%
1,260	$66,898,759	3.4%	2,365	8	0	161	$3,914,916	$2,505,866	$6,420,781	0.3%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
,048	$18,455,023	9.2%	914	3	0	63	$672,007	$601,027	$1,273,033	0.6%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
1,739	**$204,380,571**	**0.3%**	**8,876**	**168**	**2**	**643**	**$7,416,145**	**$8,192,915**	**$15,609,060**	**0.0%**

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Flood

		Impact on Economy				Risk	
Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	6	0.33%	Low	1	1	**48**	**High**
	0	0.00%	None	0	0	**0**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.01%	Low	1	1	**18**	**Medium**
	2	0.00%	None	0	0	**15**	**Low**
	2	0.00%	None	0	0	**15**	**Low**
	2	0.01%	Low	1	1	**18**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.00%	None	0	0	**15**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.00%	None	0	0	**15**	**Low**
	2	0.03%	Low	1	1	**18**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.19%	Low	1	1	**18**	**Medium**
	2	0.33%	Low	1	1	**18**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.63%	Low	1	1	**18**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.02%	Low	1	1	**18**	**Medium**

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

100-Year Flood Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Va
Bucoda	610	245	237	$63,726,655	128	324	53.2%	$18,387,102	
Lacey	58,180	18,985	17,637	$17,357,526,547	1	3	0.0%	$308,553	
Olympia	56,370	18,242	16,257	$19,116,213,011	77	118	0.2%	$129,687,028	
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	
Tenino	2,030	751	651	$404,778,123	1	3	0.2%	$111,427	
Tumwater	26,360	9,513	8,408	$9,362,171,728	16	28	0.1%	$57,077,072	
Yelm	10,680	3,139	2,827	$2,077,637,133	17	60	0.6%	$4,448,895	
Unincorporated	143,760	53,104	51,429	$24,765,596,428	908	2,376	1.7%	$194,459,365	
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**1,148**	**2,913**	**1.0%**	**$404,479,441**	

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)						
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Bucoda	173	126	2	0	0	0	0	0
Lacey	605	1	0	0	0	0	0	0
Olympia	946	34	41	2	0	0	0	0
Rainier	1	0	0	0	0	0	0	0
Tenino	51	1	0	0	0	0	0	0
Tumwater	924	9	7	0	0	0	0	0
Yelm	141	16	0	1	0	0	0	0
Unincorporated	33,651	850	50	4	0	0	2	2
Total	**36,492**	**1,037**	**100**	**7**	**0**	**0**	**2**	**2**

	RISK RANKING-100-yr							
	Probability		Impact on People				Impact on Pr	
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)
Bucoda	High	3	53.16%	High	3	9	44.57%	High
Lacey	High	3	0.01%	None	0	0	0.00%	None
Olympia	High	3	0.21%	Low	1	3	1.17%	Low
Rainier	High	3	0.00%	None	0	0	0.00%	None
Tenino	High	3	0.15%	Low	1	3	0.04%	Low
Tumwater	High	3	0.11%	Low	1	3	1.21%	Low
Yelm	High	3	0.57%	Low	1	3	0.37%	Low
Unincorporated	High	3	1.65%	Low	1	3	1.25%	Low
Total	High	3	0.97%	Low	1	3	0.93%	Low

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated population.
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

			Economic Impact							
alue Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
$10,017,487	$28,404,589	44.6%	458	174	6	121	$223,241	$177,927	$401,168	0.6%
$154,276	$462,829	0.0%	143	0	0	1	$0	$0	$0	0.0%
$93,302,235	$222,989,262	1.2%	1,833	2	1	52	$2,656,715	$5,873,652	$8,530,367	0.0%
$0	$0	0.0%	1	0	0	0	$0	$0	$0	0.0%
$55,714	$167,141	0.0%	63	0	0	1	$37,083	$20,770	$57,853	0.0%
$56,345,143	$113,422,215	1.2%	738	0	0	12	$42,427	$81,452	$123,878	0.0%
$3,174,175	$7,623,070	0.4%	369	2	0	18	$16,783	$6,123	$22,906	0.0%
$115,945,962	$310,405,327	1.3%	11,867	79	16	680	$12,928,749	$13,865,202	$26,793,951	0.1%
$278,994,992	**$683,474,433**	**0.9%**	**15,472**	**257**	**23**	**885**	**$15,904,998**	**$20,025,126**	**$35,930,123**	**0.0%**

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operty		Impact on Economy				Risk	
Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
3	6	0.63%	Low	1	1	**48**	**High**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.04%	Low	1	1	**18**	**Medium**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.01%	Low	1	1	**18**	**Medium**
1	2	0.00%	None	0	0	**15**	**Low**
1	2	0.00%	None	0	0	**15**	**Low**
1	2	0.11%	Low	1	1	**18**	**Medium**
1	2	0.05%	Low	1	1	**18**	**Medium**

100-Year Flood Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	SPECIAL PURPOSE						
	Probability		Impact on People				
Jurisdiction	**Probability (High, Medium, Low, None)**	**Probability Factor (3,2,1,0)**	**% Population Exposed**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighted Impact Factor**	**% of Total Va Exposed**
East Olympia Fire District	High	3	0.77%	Low	1	3	0.00%
Intercity Transit	High	3	0.00%	None	0	0	0.00%
Lacey Fire District	High	3	1.01%	Low	1	3	0.00%
McLane Black Lake Fire District	High	3	0.82%	Low	1	3	0.00%
Olympia School District	High	3	0.50%	Low	1	3	0.00%
SE Thurston Fire Authority	High	3	0.78%	Low	1	3	0.00%
South Bay Fire District	High	3	0.64%	Low	1	3	0.00%
The Evergreen State College	High	3	0.00%	None	0	0	0.00%
Thuston PUD	High	3	0.97%	Low	1	3	1.00%
West Thurston Regional Fire Authority	High	3	2.68%	Low	1	3	0.00%

Special Purpose District Critical Facility Loss Detail							
Jurisdiction	**Critical Facilities**	**Facilities in 100yr Flood**	**% in Hazard**	**Total Valuation**	**Structure Value**	**% Modeled Loss**	**% Total Va Damage**
East Olympia Fire District	6	0	0.00%	$4,995,000	0	0.00%	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0	0.00%	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0	0.00%	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0	0.00%	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0	0.00%	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0	0.00%	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0	0.00%	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0	0.00%	0.00%
Thuston PUD	104	1	0.96%	$157,995,117	$1,076,176	1.43%	0.01%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0	0.00%	0.00%

DISTRICT RISK SCORES AND RATINGS-100-yr Flood										
Impact on Property				Impact on Economy				Risk		
alue	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	None	0	0	0.00%	None	0	0	9	Low
	None	0	0	0.00%	None	0	0	0	Low
	None	0	0	0.00%	None	0	0	9	Low
	None	0	0	0.00%	None	0	0	9	Low
	None	0	0	0.00%	None	0	0	9	Low
	None	0	0	0.00%	None	0	0	9	Low
	None	0	0	0.00%	None	0	0	9	Low
	None	0	0	0.00%	None	0	0	0	Low
	Low	1	2	0.01%	None	0	0	15	Low
	None	0	0	0.00%	None	0	0	9	Low

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100-Year Flood Hazard Scenario, by Watershed, Risk Assessment Results and Risk Rating

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents i[n $] Exposed (2)
Bucoda	610	245	237	$63,726,655	128	324	53.2%	$18,387,102	$10,017,487
Lacey	58,180	18,985	17,637	$17,357,526,547	1	3	0.0%	$308,553	$154,276
Olympia	56,370	18,242	16,257	$19,116,213,011	77	118	0.2%	$129,687,028	$93,302,235
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	$0
Tenino	2,030	751	651	$404,778,123	1	3	0.2%	$111,427	$55,714
Tumwater	26,360	9,513	8,408	$9,362,171,728	16	28	0.1%	$57,077,072	$56,345,143
Yelm	10,680	3,139	2,827	$2,077,637,133	17	60	0.6%	$4,448,895	$3,174,175
Unincorporated Black River	17,289	6,519	6,185	$2,801,171,662	145	394	2.3%	$28,686,084	$15,314,794
Unincorporated Budd Inlet	10,480	3,844	3,749	$1,752,014,029	37	98	0.9%	$8,875,966	$4,776,461
Unincorporated Chehalis River	12,148	4,575	4,346	$1,999,992,610	78	218	1.8%	$15,218,742	$7,609,371
Unincorporated Deschutes Mountain Zone	196	70	70	$14,876,117	0	0	0.0%	$0	$0
Unincorporated Deschutes River Lower	13,775	5,007	4,928	$2,548,777,015	41	115	0.8%	$11,114,482	$5,557,241
Unincorporated Deschutes River Middle	7,380	2,666	2,640	$975,938,911	74	207	2.8%	$11,874,516	$5,937,258
Unincorporated Eld Inlet	11,505	4,253	4,116	$2,786,155,643	30	84	0.7%	$7,583,791	$3,791,895
Unincorporated Henderson Inlet	26,843	9,837	9,603	$4,424,313,689	17	48	0.2%	$5,409,105	$2,704,552
Unincorporated Mcallister Creek	18,142	6,855	6,490	$3,712,893,851	209	498	2.7%	$40,240,177	$27,334,470
Unincorporated Nisqually	15,285	5,593	5,468	$1,945,195,946	178	475	3.1%	$43,790,725	$28,380,005
Unincorporated Nisqually Reach	4,702	1,697	1,682	$895,133,285	8	11	0.2%	$3,118,918	$2,826,584
Unincorporated Skookumchuck River	1,618	593	579	$201,544,596	82	204	12.6%	$17,233,677	$11,056,739
Unincorporated Totten Inlet	4,377	1,581	1,566	$701,366,142	9	25	0.6%	$1,313,182	$656,591
Unincorporated West Capitol Forest	20	14	7	$6,222,931	0	0	0.0%	$0	$0
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**1,148**	**2,913**	**1.0%**	**$404,479,441**	**$278,994,992**

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	173	126	2	0	0	0	0	0	
Lacey	605	1	0	0	0	0	0	0	
Olympia	946	34	41	2	0	0	0	0	
Rainier	1	0	0	0	0	0	0	0	
Tenino	51	1	0	0	0	0	0	0	
Tumwater	924	9	7	0	0	0	0	0	
Yelm	141	16	0	1	0	0	0	0	
Unincorporated Black River	8,354	141	4	0	0	0	0	0	
Unincorporated Budd Inlet	817	35	1	0	0	0	1	0	
Unincorporated Chehalis River	4,663	78	0	0	0	0	0	0	
Unincorporated Deschutes Mountain Zone	279	0	0	0	0	0	0	0	
Unincorporated Deschutes River Lower	1,960	41	0	0	0	0	0	0	
Unincorporated Deschutes River Middle	2,677	74	0	0	0	0	0	0	
Unincorporated Eld Inlet	400	30	0	0	0	0	0	0	
Unincorporated Henderson Inlet	1,034	17	0	0	0	0	0	0	
Unincorporated Mcallister Creek	2,359	178	29	2	0	0	0	0	
Unincorporated Nisqually	5,565	170	6	0	0	0	0	2	
Unincorporated Nisqually Reach	24	4	4	0	0	0	0	0	
Unincorporated Skookumchuck River	4,720	73	6	2	0	0	1	0	
Unincorporated Totten Inlet	798	9	0	0	0	0	0	0	
Unincorporated West Capitol Forest	0	0	0	0	0	0	0	0	
Total	**36,492**	**1,037**	**100**	**7**	**0**	**0**	**2**	**2**	

	RISK RANKING-100-yr Flood								
	Probability		Impact on People				Impact on Property		
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor
Bucoda	High	3	53.16%	High	3	9	44.57%	High	3
Lacey	High	3	0.01%	None	0	0	0.00%	None	0
Olympia	High	3	0.21%	Low	1	3	1.17%	Low	1
Rainier	High	3	0.00%	None	0	0	0.00%	None	0
Tenino	High	3	0.15%	Low	1	3	0.04%	Low	1
Tumwater	High	3	0.11%	Low	1	3	1.21%	Low	1
Yelm	High	3	0.57%	Low	1	3	0.37%	Low	1
Unincorporated Black River	High	3	2.28%	Low	1	3	1.57%	Low	1
Unincorporated Budd Inlet	High	3	0.93%	Low	1	3	0.78%	Low	1
Unincorporated Chehalis River	High	3	1.79%	Low	1	3	1.14%	Low	1
Unincorporated Deschutes Mountain Zone	High	3	0.00%	None	0	0	0.00%	None	0
Unincorporated Deschutes River Lower	High	3	0.83%	Low	1	3	0.65%	Low	1
Unincorporated Deschutes River Middle	High	3	2.80%	Low	1	3	1.83%	Low	1
Unincorporated Eld Inlet	High	3	0.73%	Low	1	3	0.41%	Low	1
Unincorporated Henderson Inlet	High	3	0.18%	Low	1	3	0.18%	Low	1
Unincorporated Mcallister Creek	High	3	2.74%	Low	1	3	1.82%	Low	1
Unincorporated Nisqually	High	3	3.11%	Low	1	3	3.71%	Low	1
Unincorporated Nisqually Reach	High	3	0.24%	Low	1	3	0.66%	Low	1
Unincorporated Skookumchuck River	High	3	12.61%	Medium	2	6	14.04%	Medium	2
Unincorporated Totten Inlet	High	3	0.57%	Low	1	3	0.28%	Low	1
Unincorporated West Capitol Forest	High	3	0.00%	None	0	0	0.00%	None	0
Total	High	3	0.97%	Low	1	3	0.93%	Low	1

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division

(2) Values based off of 2022 tax assessor data provided by Thurston County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.

(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.

			Economic Impact							
n $	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
	$28,404,589	44.6%	458	174	6	121	$223,241	$177,927	$401,168	0.6%
	$462,829	0.0%	143	0	0	1	$0	$0	$0	0.0%
	$222,989,262	1.2%	1,833	2	1	52	$2,348,593	$5,538,602	$7,887,195	0.0%
	$0	0.0%	1	0	0	0	$0	$0	$0	0.0%
	$167,141	0.0%	63	0	0	1	$37,083	$20,770	$57,853	0.0%
	$113,422,215	1.2%	738	0	0	12	$42,427	$81,452	$123,879	0.0%
	$7,623,070	0.4%	369	2	0	18	$16,783	$6,123	$22,906	0.0%
	$44,000,878	1.6%	2,231	21	4	92	$1,091,187	$623,253	$1,714,440	0.1%
	$13,652,427	0.8%	409	1	0	33	$1,195,842	$1,030,984	$2,226,826	0.1%
	$22,828,113	1.1%	980	3	0	35	$84,726	$52,943	$137,669	0.0%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
	$16,671,724	0.7%	450	1	0	30	$159,946	$78,904	$238,850	0.0%
	$17,811,774	1.8%	865	3	1	51	$507,635	$268,531	$776,166	0.1%
	$11,375,686	0.4%	310	2	0	12	$457,481	$219,465	$676,946	0.0%
	$8,113,657	0.2%	176	1	0	8	$144,292	$71,909	$216,201	0.0%
	$67,574,647	1.8%	2,660	17	4	185	$3,040,067	$6,248,661	$9,288,728	0.3%
	$72,170,731	3.7%	2,280	20	6	160	$4,839,658	$3,360,704	$8,200,362	0.4%
	$5,945,501	0.7%	112	0	0	6	$365,244	$1,040,603	$1,405,847	0.2%
	$28,290,416	14.0%	1,188	7	1	58	$951,711	$1,078,239	$2,029,950	1.0%
	$1,969,774	0.3%	205	3	0	10	$399,082	$126,057	$525,139	0.1%
	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
	$683,474,433	**0.9%**	**15,472**	**257**	**23**	**885**	**$15,904,998**	**$20,025,127**	**$35,930,125**	**0.0%**

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		Impact on Economy				Risk	
.	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	6	0.63%	Low	1	1	**48**	**High**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.04%	Low	1	1	**18**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.01%	Low	1	1	**18**	**Medium**
	2	0.00%	None	0	0	**15**	**Low**
	2	0.00%	None	0	0	**15**	**Low**
	2	0.06%	Low	1	1	**18**	**Medium**
	2	0.13%	Low	1	1	**18**	**Medium**
	2	0.01%	None	0	0	**15**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.01%	None	0	0	**15**	**Low**
	2	0.08%	Low	1	1	**18**	**Medium**
	2	0.02%	Low	1	1	**18**	**Medium**
	2	0.00%	None	0	0	**15**	**Low**
	2	0.25%	Low	1	1	**18**	**Medium**
	2	0.42%	Low	1	1	**18**	**Medium**
	2	0.16%	Low	1	1	**18**	**Medium**
	4	1.01%	Low	1	1	**33**	**High**
	2	0.07%	Low	1	1	**18**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.05%	Low	1	1	**18**	**Medium**

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

500-Year Flood Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Conte Expose (2)
Bucoda	610	245	237	$63,726,655	145	363	59.5%	$21,114,868	$11,744,(
Lacey	58,180	18,985	17,637	$17,357,526,547	1	3	0.0%	$308,553	$154,27
Olympia	56,370	18,242	16,257	$19,116,213,011	125	128	0.2%	$263,263,151	$192,563,
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	$0
Tenino	2,030	751	651	$404,778,123	1	3	0.2%	$111,427	$55,71
Tumwater	26,360	9,513	8,408	$9,362,171,728	23	34	0.1%	$68,792,391	$67,540,4
Yelm	10,680	3,139	2,827	$2,077,637,133	29	98	0.9%	$11,494,798	$9,129,0
Unincorporated	143,760	53,104	51,429	$24,765,596,428	1,069	2,809	2.0%	$232,973,507	$137,604,
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**1,393**	**3,440**	**1.1%**	**$598,058,696**	**$418,792,**

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	184	141	3	0	0	0	1	0	
Lacey	607	1	0	0	0	0	0	0	
Olympia	999	37	86	2	0	0	0	0	
Rainier	1	0	0	0	0	0	0	0	
Tenino	57	1	0	0	0	0	0	0	
Tumwater	1,143	11	12	0	0	0	0	0	
Yelm	149	26	2	1	0	0	0	0	
Unincorporated	35,937	1,005	54	5	0	1	2	2	
Total	**39,077**	**1,222**	**157**	**8**	**0**	**1**	**3**	**2**	

	RISK RANKING-500-yr Flood								
	Probability		Impact on People				Impact on Property		
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Fa
Bucoda	Medium	2	59.49%	High	3	9	51.56%	High	3
Lacey	Medium	2	0.01%	None	0	0	0.00%	None	0
Olympia	Medium	2	0.23%	Low	1	3	2.38%	Low	1
Rainier	Medium	2	0.00%	None	0	0	0.00%	None	0
Tenino	Medium	2	0.15%	Low	1	3	0.04%	Low	1
Tumwater	Medium	2	0.13%	Low	1	3	1.46%	Low	1
Yelm	Medium	2	0.92%	Low	1	3	0.99%	Low	1
Unincorporated	Medium	2	1.95%	Low	1	3	1.50%	Low	1
Total	Medium	2	1.14%	Low	1	3	1.38%	Low	1

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Divisic
(2) Values based off of 2022 tax assessor data provided by Thurston County
(3) Percent of residential buildings exposed multiplied by the Estimated Populatio
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatic
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1

			Economic Impact							
nts in $ d	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
069	$32,858,936	51.6%	731	203	10	141	$1,351,160	$1,449,167	$2,800,327	4.4%
76	$462,829	0.0%	216	0	0	1	$0	$0	$0	0.0%
,667	$455,826,818	2.4%	1,840	18	0	74	$2,900,374	$6,684,489	$9,584,864	0.1%
	$0	0.0%	1	0	0	0	$0	$0	$0	0.0%
4	$167,141	0.0%	148	0	0	1	$53,044	$29,308	$82,352	0.0%
491	$136,332,881	1.5%	995	10	0	20	$54,419	$2,027,259	$2,081,678	0.0%
033	$20,623,831	1.0%	441	11	0	29	$64,075	$56,956	$121,031	0.0%
,905	$370,578,413	1.5%	12,211	191	27	695	$13,564,185	$16,220,072	$29,784,256	0.1%
,155	**$1,016,850,850**	**1.4%**	**16,583**	**434**	**37**	**961**	**$17,987,258**	**$26,467,250**	**$44,454,508**	**0.1%**

145
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		Impact on Economy				Risk	
actor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	6	4.39%	Low	1	1	**32**	**Medium**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.05%	Low	1	1	**12**	**Low**
	0	0.00%	None	0	0	**0**	**Low**
	2	0.02%	Low	1	1	**12**	**Low**
	2	0.02%	Low	1	1	**12**	**Low**
	2	0.01%	None	0	0	**10**	**Low**
	2	0.12%	Low	1	1	**12**	**Low**
	2	0.06%	Low	1	1	**12**	**Low**

500-Year Flood Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	SPECIAL PURPOSE						
	Probability		Impact on People				
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Expose
East Olympia Fire District	Medium	2	0.82%	Low	1	3	0.00%
Intercity Transit	Medium	2	0.00%	None	0	0	0.00%
Lacey Fire District	Medium	2	1.09%	Low	1	3	0.00%
McLane Black Lake Fire District	Medium	2	0.86%	Low	1	3	0.00%
Olympia School District	Medium	2	0.51%	Low	1	3	0.00%
SE Thurston Fire Authority	Medium	2	0.98%	Low	1	3	0.00%
South Bay Fire District	Medium	2	0.64%	Low	1	3	0.00%
The Evergreen State College	Medium	2	0.00%	None	0	0	0.00%
Thuston PUD	Medium	2	0.02%	Low	1	3	1.00%
West Thurston Regional Fire Authority	Medium	2	3.41%	Low	1	3	0.00%

	Special Purpose District Critical Facility Loss Detail						
Jurisdiction	Critical Facilities	Facilities in 500yr Flood	% in Hazard	Total Valuation	Structure Value	% Modeled Loss	% Total V Damag
East Olympia Fire District	6	0	0.00%	$4,995,000	0	0.00%	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0	0.00%	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0	0.00%	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0	0.00%	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0	0.00%	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0	0.00%	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0	0.00%	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0	0.00%	0.00%
Thuston PUD	104	1	0.96%	$157,995,117	$1,076,176	7.13%	0.05%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0	0.00%	0.00%

DISTRICT RISK SCORES AND RATINGS 500-yr Flood

Impact on Property				Impact on Economy				Risk	
Value d	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
.	None	0	0	0.00%	None	0	0	**6**	**Low**
.	None	0	0	0.00%	None	0	0	**0**	**Low**
.	None	0	0	0.00%	None	0	0	**6**	**Low**
.	None	0	0	0.00%	None	0	0	**6**	**Low**
.	None	0	0	0.00%	None	0	0	**6**	**Low**
.	None	0	0	0.00%	None	0	0	**6**	**Low**
.	None	0	0	0.00%	None	0	0	**6**	**Low**
.	None	0	0	0.00%	None	0	0	**0**	**Low**
.	Low	1	2	0.05%	Low	1	1	**12**	**Low**
.	None	0	0	0.00%	None	0	0	**6**	**Low**

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500-Year Flood Hazard Scenario, by Watershed, Risk Assessment Results and Risk Rating

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Co... Exp...
Bucoda	610	245	237	$63,726,655	145	363	59.5%	$21,114,868	$11,7
Lacey	58,180	18,985	17,637	$17,357,526,547	1	3	0.0%	$308,553	$15
Olympia	56,370	18,242	16,257	$19,116,213,011	125	128	0.2%	$263,263,151	$192,
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0	
Tenino	2,030	751	651	$404,778,123	1	3	0.2%	$111,427	$55
Tumwater	26,360	9,513	8,408	$9,362,171,728	23	34	0.1%	$68,792,391	$67,5
Yelm	10,680	3,139	2,827	$2,077,637,133	29	98	0.9%	$11,494,798	$9,1
Unincorporated Black River	17,289	6,519	6,185	$2,801,171,662	176	475	2.7%	$38,448,198	$21,9
Unincorporated Budd Inlet	10,480	3,844	3,749	$1,752,014,029	42	103	1.0%	$10,369,746	$5,7
Unincorporated Chehalis River	12,148	4,575	4,346	$1,999,992,610	110	307	2.5%	$22,343,981	$11,1
Unincorporated Deschutes Mountain Zone	196	70	70	$14,876,117	7	20	10.0%	$748,718	$37
Unincorporated Deschutes River Lower	13,775	5,007	4,928	$2,548,777,015	42	117	0.9%	$11,233,268	$5,6
Unincorporated Deschutes River Middle	7,380	2,666	2,640	$975,938,911	92	257	3.5%	$15,229,152	$7,6
Unincorporated Eld Inlet	11,505	4,253	4,116	$2,786,155,643	30	84	0.7%	$7,583,791	$3,7
Unincorporated Henderson Inlet	26,843	9,837	9,603	$4,424,313,689	17	48	0.2%	$5,409,105	$2,7
Unincorporated Mcallister Creek	18,142	6,855	6,490	$3,712,893,851	231	559	3.1%	$44,986,223	$29,7
Unincorporated Nisqually	15,285	5,593	5,468	$1,945,195,946	195	520	3.4%	$48,108,402	$30,9
Unincorporated Nisqually Reach	4,702	1,697	1,682	$895,133,285	8	11	0.2%	$3,118,918	$2,8
Unincorporated Skookumchuck River	1,618	593	579	$201,544,596	110	282	17.4%	$24,080,825	$14,4
Unincorporated Totten Inlet	4,377	1,581	1,566	$701,366,142	9	25	0.6%	$1,313,182	$65
Unincorporated West Capitol Forest	20	14	7	$6,222,931	0	0	0.0%	$0	
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**1,393**	**3,440**	**1.1%**	**$598,058,696**	**$418,**

Jurisdiction	Acres of Floodplain	Number of Structures in Floodplain (2)							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	T
Bucoda	184	141	3	0	0	0	1	0	
Lacey	607	1	0	0	0	0	0	0	
Olympia	999	37	86	2	0	0	0	0	
Rainier	1	0	0	0	0	0	0	0	
Tenino	57	1	0	0	0	0	0	0	
Tumwater	1,143	11	12	0	0	0	0	0	
Yelm	149	26	2	1	0	0	0	0	
Unincorporated Black River	8,855	170	4	1	0	1	0	0	
Unincorporated Budd Inlet	924	37	4	0	0	0	1	0	
Unincorporated Chehalis River	5,059	110	0	0	0	0	0	0	
Unincorporated Deschutes Mountain Zone	319	7	0	0	0	0	0	0	
Unincorporated Deschutes River Lower	2,083	42	0	0	0	0	0	0	
Unincorporated Deschutes River Middle	2,916	92	0	0	0	0	0	0	
Unincorporated Eld Inlet	400	30	0	0	0	0	0	0	
Unincorporated Henderson Inlet	1,034	17	0	0	0	0	0	0	
Unincorporated Mcallister Creek	2,514	200	29	2	0	0	0	0	
Unincorporated Nisqually	5,946	186	7	0	0	0	0	2	
Unincorporated Nisqually Reach	24	4	4	0	0	0	0	0	
Unincorporated Skookumchuck River	5,066	101	6	2	0	0	1	0	
Unincorporated Totten Inlet	798	9	0	0	0	0	0	0	
Unincorporated West Capitol Forest	0	0	0	0	0	0	0	0	
Total	**39,077**	**1,222**	**157**	**8**	**0**	**1**	**3**	**2**	

	RISK SCORES AND RATINGS 50...								
	Probability		Impact on People				Impact on Property		
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impac...
Bucoda	High	3	59.49%	High	3	9	51.56%	High	
Lacey	High	3	0.01%	None	0	0	0.00%	None	
Olympia	High	3	0.23%	Low	1	3	2.38%	Low	
Rainier	High	3	0.00%	None	0	0	0.00%	None	
Tenino	High	3	0.15%	Low	1	3	0.04%	Low	
Tumwater	High	3	0.13%	Low	1	3	1.46%	Low	
Yelm	High	3	0.92%	Low	1	3	0.99%	Low	
Unincorporated Black River	High	3	2.75%	Low	1	3	2.16%	Low	
Unincorporated Budd Inlet	High	3	0.99%	Low	1	3	0.92%	Low	
Unincorporated Chehalis River	High	3	2.53%	Low	1	3	1.68%	Low	
Unincorporated Deschutes Mountain Zone	High	3	10.00%	Medium	2	6	7.55%	Low	
Unincorporated Deschutes River Lower	High	3	0.85%	Low	1	3	0.66%	Low	
Unincorporated Deschutes River Middle	High	3	3.48%	Low	1	3	2.34%	Low	
Unincorporated Eld Inlet	High	3	0.73%	Low	1	3	0.41%	Low	
Unincorporated Henderson Inlet	High	3	0.18%	Low	1	3	0.18%	Low	
Unincorporated Mcallister Creek	High	3	3.08%	Low	1	3	2.01%	Low	
Unincorporated Nisqually	High	3	3.40%	Low	1	3	4.06%	Low	
Unincorporated Nisqually Reach	High	3	0.24%	Low	1	3	0.66%	Low	
Unincorporated Skookumchuck River	High	3	17.44%	Medium	2	6	19.13%	Medium	
Unincorporated Totten Inlet	High	3	0.57%	Low	1	3	0.28%	Low	
Unincorporated West Capitol Forest	High	3	0.00%	None	0	0	0.00%	None	
Total	High	3	1.14%	Low	1	3	1.38%	Low	

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.

			Economic Impact							
ontents in $ posed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
744,069	$32,858,936	51.6%	731	203	10	141	$1,351,160	$1,449,167	$2,800,327	4.4%
54,276	$462,829	0.0%	216	0	0	1	$0	$0	$0	0.0%
563,667	$455,826,818	2.4%	1,840	18	0	74	$2,900,374	$6,684,489	$9,584,863	0.1%
$0	$0	0.0%	1	0	0	0			$0	0.0%
5,714	$167,141	0.0%	148	0	0	1	$53,044	$29,308	$82,352	0.0%
540,491	$136,332,881	1.5%	995	10	0	20	$54,419	$2,027,259	$2,081,678	0.0%
29,033	$20,623,831	1.0%	441	11	0	29	$64,075	$56,956	$121,031	0.0%
952,563	$60,400,760	2.2%	2,244	68	8	118	$2,340,154	$1,580,843	$3,920,997	0.1%
72,951	$16,142,697	0.9%	427	2	0	42	$1,205,144	$1,054,726	$2,259,870	0.1%
171,991	$33,515,972	1.7%	1,001	7	0	101	$1,065,079	$555,707	$1,620,786	0.1%
74,359	$1,123,077	7.5%	1	0	0	2	$0	$0	$0	0.0%
16,634	$16,849,902	0.7%	462	3	0	33	$111,789	$48,845	$160,634	0.0%
14,576	$22,843,728	2.3%	896	7	1	65	$543,687	$293,050	$836,737	0.1%
91,895	$11,375,686	0.4%	357	4	0	16	$462,902	$222,166	$685,068	0.0%
04,552	$8,113,657	0.2%	199	3	0	8	$129,823	$65,104	$194,927	0.0%
707,492	$74,693,715	2.0%	2,720	36	9	87	$2,643,714	$6,546,451	$9,190,165	0.2%
934,404	$79,042,806	4.1%	2,302	39	8	130	$3,158,175	$3,682,381	$6,840,556	0.4%
26,584	$5,945,501	0.7%	144	4	0	6	$374,333	$1,042,546	$1,416,879	0.2%
480,314	$38,561,139	19.1%	1,243	12	1	78	$1,134,603	$1,007,894	$2,142,497	1.1%
56,591	$1,969,774	0.3%	216	6	0	9	$394,783	$120,357	$515,140	0.1%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
792,155	**$1,016,850,850**	**1.4%**	**16,583**	**433**	**37**	**961**	**$17,987,258**	**$26,467,249**	**$44,454,507**	**0.1%**

Total
145
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92
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195
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0-yr Flood

y		Impact on Economy				Risk	
t Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
3	6	4.39%	Low	1	1	**48**	**High**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.05%	Low	1	1	**18**	**Medium**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.02%	Low	1	1	**18**	**Medium**
1	2	0.02%	Low	1	1	**18**	**Medium**
1	2	0.01%	None	0	0	**15**	**Low**
1	2	0.14%	Low	1	1	**18**	**Medium**
1	2	0.13%	Low	1	1	**18**	**Medium**
1	2	0.08%	Low	1	1	**18**	**Medium**
1	2	0.00%	None	0	0	**24**	**Medium**
1	2	0.01%	None	0	0	**15**	**Low**
1	2	0.09%	Low	1	1	**18**	**Medium**
1	2	0.02%	Low	1	1	**18**	**Medium**
1	2	0.00%	None	0	0	**15**	**Low**
1	2	0.25%	Low	1	1	**18**	**Medium**
1	2	0.35%	Low	1	1	**18**	**Medium**
1	2	0.16%	Low	1	1	**18**	**Medium**
2	4	1.06%	Low	1	1	**33**	**High**
1	2	0.07%	Low	1	1	**18**	**Medium**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.06%	Low	1	1	**18**	**Medium**

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated populatio
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

High Groundwater Flood Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Exposure				
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)
Bucoda	610	245	237	$63,726,655	0	0	0.0%	$0	$0
Lacey	58,180	18,985	17,637	$17,357,526,547	61	201	0.3%	$7,613,500	$3,806,750
Olympia	56,370	18,242	16,257	$19,116,213,011	1	0	0.0%	$402,355	$402,355
Rainier	2,510	875	814	$393,003,023	1	3	0.1%	$57,945	$28,972
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0	$0
Tumwater	26,360	9,513	8,408	$9,362,171,728	9	19	0.1%	$2,220,600	$1,610,965
Yelm	10,680	3,139	2,827	$2,077,637,133	2	8	0.1%	$433,821	$216,910
Unincorporated Black River	17,289	6,519	6,185	$2,801,171,662	25	70	0.4%	$6,688,064	$3,344,032
Unincorporated Budd Inlet	10,480	3,844	3,749	$1,752,014,029	1	3	0.0%	$99,334	$49,667
Unincorporated Chehalis River	12,148	4,575	4,346	$1,999,992,610	8	22	0.2%	$2,163,541	$1,081,770
Unincorporated Deschutes Mountain Zone	196	70	70	$14,876,117	0	0	0.0%	$0	$0
Unincorporated Deschutes River Lower	13,775	5,007	4,928	$2,548,777,015	1	3	0.0%	$197,518	$98,759
Unincorporated Deschutes River Middle	7,380	2,666	2,640	$975,938,911	1	3	0.0%	$239,395	$119,698
Unincorporated Eld Inlet	11,505	4,253	4,116	$2,786,155,643	5	14	0.1%	$1,992,846	$996,423
Unincorporated Henderson Inlet	26,843	9,837	9,603	$4,424,313,689	1	3	0.0%	$128,357	$64,178
Unincorporated Mcallister Creek	18,142	6,855	6,490	$3,712,893,851	13	36	0.2%	$2,908,337	$1,454,169
Unincorporated Nisqually	15,285	5,593	5,468	$1,945,195,946	15	42	0.3%	$4,717,672	$2,358,836
Unincorporated Nisqually Reach	4,702	1,697	1,682	$895,133,285	0	0	0.0%	$0	$0
Unincorporated Skookumchuck River	1,618	593	579	$201,544,596	0	0	0.0%	$0	$0
Unincorporated Totten Inlet	4,377	1,581	1,566	$701,366,142	1	3	0.1%	$656,889	$328,444
Unincorporated West Capitol Forest	20	14	7	$6,222,931	0	0	0.0%	$0	$0
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**145**	**429**	**0.1%**	**$30,520,173**	**$15,961,929**

Jurisdiction	Number of Structures in High Ground Water Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Bucoda	0	0	0	0	0	0	0	0
Lacey	61	0	0	0	0	0	0	61
Olympia	0	1	0	0	0	0	0	1
Rainier	1	0	0	0	0	0	0	1
Tenino	0	0	0	0	0	0	0	0
Tumwater	6	2	1	0	0	0	0	9
Yelm	2	0	0	0	0	0	0	2
Unincorporated Black River	25	0	0	0	0	0	0	25
Unincorporated Budd Inlet	1	0	0	0	0	0	0	1
Unincorporated Chehalis River	8	0	0	0	0	0	0	8
Unincorporated Deschutes Mountain Zone	0	0	0	0	0	0	0	0
Unincorporated Deschutes River Lower	1	0	0	0	0	0	0	1
Unincorporated Deschutes River Middle	1	0	0	0	0	0	0	1
Unincorporated Eld Inlet	5	0	0	0	0	0	0	5
Unincorporated Henderson Inlet	1	0	0	0	0	0	0	1
Unincorporated Mcallister Creek	13	0	0	0	0	0	0	13
Unincorporated Nisqually	15	0	0	0	0	0	0	15
Unincorporated Nisqually Reach	0	0	0	0	0	0	0	0
Unincorporated Skookumchuck River	0	0	0	0	0	0	0	0
Unincorporated Totten Inlet	1	0	0	0	0	0	0	1
Unincorporated West Capitol Forest	0	0	0	0	0	0	0	0
Total	**141**	**3**	**1**	**0**	**0**	**0**	**0**	**145**

	RISK RANKING-High Ground Water								
	Probability		Impact on People				Impact on Property		
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor
Bucoda	Medium	2	0.00%	None	0	0	0.00%	None	0
Lacey	Medium	2	0.35%	Low	1	3	0.07%	Low	1
Olympia	Medium	2	0.00%	None	0	0	0.00%	None	0
Rainier	Medium	2	0.12%	Low	1	3	0.02%	Low	1
Tenino	Medium	2	0.00%	None	0	0	0.00%	None	0
Tumwater	Medium	2	0.07%	Low	1	3	0.04%	Low	1
Yelm	Medium	2	0.07%	Low	1	3	0.03%	Low	1
Unincorporated Black River	Medium	2	0.40%	Low	1	3	0.36%	Low	1
Unincorporated Budd Inlet	Medium	2	0.03%	Low	1	3	0.01%	None	0
Unincorporated Chehalis River	Medium	2	0.18%	Low	1	3	0.16%	Low	1
Unincorporated Deschutes Mountain Zone	Medium	2	0.00%	None	0	0	0.00%	None	0
Unincorporated Deschutes River Lower	Medium	2	0.02%	Low	1	3	0.01%	Low	1
Unincorporated Deschutes River Middle	Medium	2	0.04%	Low	1	3	0.04%	Low	1
Unincorporated Eld Inlet	Medium	2	0.12%	Low	1	3	0.11%	Low	1
Unincorporated Henderson Inlet	Medium	2	0.01%	Low	1	3	0.00%	None	0
Unincorporated Mcallister Creek	Medium	2	0.20%	Low	1	3	0.12%	Low	1
Unincorporated Nisqually	Medium	2	0.27%	Low	1	3	0.36%	Low	1
Unincorporated Nisqually Reach	Medium	2	0.00%	None	0	0	0.00%	None	0
Unincorporated Skookumchuck River	Medium	2	0.00%	None	0	0	0.00%	None	0
Unincorporated Totten Inlet	Medium	2	0.06%	Low	1	3	0.14%	Low	1
Unincorporated West Capitol Forest	Medium	2	0.00%	None	0	0	0.00%	None	0
Total	Medium	2	0.14%	Low	1	3	0.06%	Low	1

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division

(2) Values based off of 2022 tax assessor data provided by Thurston County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.

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alue (Structure and ntents in $) Exposed (2)	% of Total Value Exposed
$0	0.0%
$11,420,250	0.1%
$804,710	0.0%
$86,917	0.0%
$0	0.0%
$3,831,565	0.0%
$650,731	0.0%
$10,032,097	0.4%
$149,001	0.0%
$3,245,311	0.2%
$0	0.0%
$296,277	0.0%
$359,093	0.0%
$2,989,269	0.1%
$192,535	0.0%
$4,362,506	0.1%
$7,076,508	0.4%
$0	0.0%
$0	0.0%
$985,333	0.1%
$0	0.0%
$46,482,102	**0.1%**

	Impact on Economy				Risk	
Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0	0.00%	None	0	0	**0**	**Low**
2	0.02%	Low	1	1	**12**	**Low**
0	0.00%	None	0	0	**0**	**Low**
2	0.01%	None	0	0	**10**	**Low**
0	0.00%	None	0	0	**0**	**Low**
2	0.01%	Low	1	1	**12**	**Low**
2	0.01%	None	0	0	**10**	**Low**
2	0.09%	Low	1	1	**12**	**Low**
0	0.00%	None	0	0	**6**	**Low**
2	0.04%	Low	1	1	**12**	**Low**
0	0.00%	None	0	0	**0**	**Low**
2	0.00%	None	0	0	**10**	**Low**
2	0.01%	None	0	0	**10**	**Low**
2	0.03%	Low	1	1	**12**	**Low**
0	0.00%	None	0	0	**6**	**Low**
2	0.03%	Low	1	1	**12**	**Low**
2	0.09%	Low	1	1	**12**	**Low**
0	0.00%	None	0	0	**0**	**Low**
0	0.00%	None	0	0	**0**	**Low**
2	0.04%	Low	1	1	**12**	**Low**
0	0.00%	None	0	0	**0**	**Low**
2	0.02%	Low	1	1	**12**	**Low**

High Groundwater Flood Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	SPECIAL PURPOSE						
	Probability		Impact on People				
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Expose
East Olympia Fire District	Medium	2	0.09%	Low	1	3	0.00%
Intercity Transit	Medium	2	0.00%	None	0	0	0.00%
Lacey Fire District	Medium	2	0.23%	Low	1	3	0.00%
McLane Black Lake Fire District	Medium	2	0.07%	Low	1	3	0.00%
Olympia School District	Medium	2	0.01%	Low	1	3	0.00%
SE Thurston Fire Authority	Medium	2	0.21%	Low	1	3	0.00%
South Bay Fire District	Medium	2	0.02%	Low	1	3	0.00%
The Evergreen State College	Medium	2	0.00%	None	0	0	0.00%
Thuston PUD	Medium	2	0.14%	Low	1	3	0.00%
West Thurston Regional Fire Authority	Medium	2	0.28%	Low	1	3	0.00%

Jurisdiction	Special Purpose District Critical Facilities Loss Detail					
	Critical Facilities	Facilities in HGW	% in Hazard	Total Valuation	Exposed Value	% Total Damage
East Olympia Fire District	6	0	0.00%	$4,995,000	0.00	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0.00	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0.00	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0.00	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0.00	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0.00	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0.00	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0.00	0.00%
Thuston PUD	104	0	0.00%	$157,995,117	0.00	0.00%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0.00	0.00%

E DISTRICT RISK SCORES AND RATINGS - HGW Flood

Impact on Property				Impact on Economy				Risk	
Value d	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	0	Low
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	0	Low
	None	0	0	0.00%	None	0	0	6	Low
	None	0	0	0.00%	None	0	0	6	Low

Landslide Hazard - Municipal Risk Assessment Results and Risk Rating

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Washington DNR I			
					Estima			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structu Exposed
Bucoda	610	245	237	$63,726,655	0	0	0.0%	$0
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0
Olympia	56,370	18,242	16,257	$19,116,213,011	647	1,789	3.2%	$243,001,
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%	$0
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%	$0
Unincorporated	143,760	53,104	51,429	$24,765,596,428	595	1,658	1.2%	$164,241,
Total	**300,500**	**104,854**	**98,260**	**73,540,652,648**	**1,242**	**3,447**	**1.1%**	**$407,242,**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Slope greater			
					Estima			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structu Exposed
Bucoda	610	245	237	$63,726,655	0	0	0.0%	$0
Lacey	58,180	18,985	17,637	$17,357,526,547	20	66	0.1%	$6,171,9
Olympia	56,370	18,242	16,257	$19,116,213,011	224	645	1.1%	$215,666,
Rainier	2,510	875	814	$393,003,023	4	12	0.5%	$988,96
Tenino	2,030	751	651	$404,778,123	1	3	0.2%	$258,06
Tumwater	26,360	9,513	8,408	$9,362,171,728	74	223	0.8%	$28,959,9
Yelm	10,680	3,139	2,827	$2,077,637,133	3	11	0.1%	$843,14
Unincorporated	143,760	53,104	51,429	$24,765,596,428	482	1,325	0.9%	$117,559,
Total	**300,500**	**104,854**	**98,260**	**73,540,652,648**	**808**	**2,285**	**0.8%**	**$370,448,**

	RISK RANKING- Landslide Hazards (WA DNR Landsl							
	Probability		Impact on People					
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (H Medium, Low
Bucoda	High	3	0.00%	None	0	0	0.00%	None
Lacey	High	3	0.11%	Low	1	3	0.05%	Low
Olympia	High	3	4.32%	Low	1	3	4.06%	Low
Rainier	High	3	0.49%	Low	1	3	0.38%	Low
Tenino	High	3	0.15%	Low	1	3	0.10%	Low
Tumwater	High	3	0.84%	Low	1	3	0.49%	Low
Yelm	High	3	0.11%	Low	1	3	0.06%	Low
Unincorporated	High	3	2.07%	Low	1	3	1.72%	Low
Total	High	3	1.91%	Low	1	3	1.71%	Low

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division

(2) Values based off of 2022 tax assessor data provided by Thurston County.

(3) Washington DNR Landslide Compilation & Slope greater than 40 Percent.

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

Landslide Compilation (3)												
ated Exposure				Number of Structures exposed to WA DNR Landslides (2)								
ure in $ (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
	$0	$0	0.0%	0	0	0	0	0	0	0	0
	$0	$0	0.0%	0	0	0	0	0	0	0	0
062	$166,129,145	$409,130,207	2.1%	516	131	0	0	0	0	0	647
	$0	$0	0.0%	0	0	0	0	0	0	0	0
	$0	$0	0.0%	0	0	0	0	0	0	0	0
	$0	$0	0.0%	0	0	0	0	0	0	0	0
	$0	$0	0.0%	0	0	0	0	0	0	0	0
720	$82,691,568	$246,933,289	1.0%	593	2	0	0	0	0	0	595
782	**$248,820,713**	**$656,063,496**	**0.9%**	**1,109**	**133**	**0**	**0**	**0**	**0**	**0**	**1,242**

than 40 Percent (3)											
ated Exposure				Number of Structures exposed to Slope greater than 40 Percent (2)							
ure in $ (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
	$0	$0	0.0%	0	0	0	0	0	0	0	0
40	$3,085,970	$9,257,909	0.1%	20	0	0	0	0	0	0	20
668	$150,673,011	$366,339,679	1.9%	186	35	0	0	0	3	0	224
2	$494,481	$1,483,443	0.4%	4	0	0	0	0	0	0	4
4	$129,032	$387,095	0.1%	1	0	0	0	0	0	0	1
019	$17,374,214	$46,334,133	0.5%	71	3	0	0	0	0	0	74
7	$421,573	$1,264,720	0.1%	3	0	0	0	0	0	0	3
963	$62,244,601	$179,804,564	0.7%	474	8	0	0	0	0	0	482
662	**$234,422,883**	**$604,871,545**	**0.8%**	**759**	**46**	**0**	**0**	**0**	**3**	**0**	**808**

ide Compilations & Slope greater than 40 Percent)								
Impact on Property			Impact on Economy					
igh, , None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	0	0	0.00%	None	0	0	**0**	**Low**
	1	2	0.01%	Low	1	1	**18**	**Medium**
	1	2	1.01%	Low	1	1	**18**	**Medium**
	1	2	0.09%	Low	1	1	**18**	**Medium**
	1	2	0.02%	Low	1	1	**18**	**Medium**
	1	2	0.12%	Low	1	1	**18**	**Medium**
	1	2	0.02%	Low	1	1	**18**	**Medium**
	1	2	0.43%	Low	1	1	**18**	**Medium**
	1	2	0.43%	Low	1	1	**18**	**Medium**

Landslide Hazard - Special Purpose Districts Risk Assessment Results and Risk Rating

	SPECIAL PURPOSE DISTRICT RISK SCORES AND RATINGS						
	Probability		Impact on People				
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of T Value E
East Olympia Fire District	High	3	0.31%	Low	1	3	0.0
Intercity Transit	High	3	0.00%	None	0	0	0.0
Lacey Fire District	High	3	0.18%	Low	1	3	11.0
McLane Black Lake Fire District	High	3	4.03%	Low	1	3	0.0
Olympia School District	High	3	0.00%	None	0	0	0.0
SE Thurston Fire Authority	High	3	0.25%	Low	1	3	0.0
South Bay Fire District	High	3	2.94%	Low	1	3	0.0
The Evergreen State College	High	3	0.00%	None	0	0	0.0
Thuston PUD	High	3	1.15%	Low	1	3	0.0
West Thurston Regional Fire Authority	High	3	0.09%	Low	1	3	0.0

Jurisdiction	Special Purpose District Critical Facilities Detail					
	Critical Facilities	Facilities in Tsunami	% in Hazard	Total Valuation	Exposed Value	% Total Damage
East Olympia Fire District	6	0	0.00%	$4,995,000	0	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0	0.00%
SE Thurston Fire Authority	6	1	16.67%	$5,967,300	$167,531	0.70%
South Bay Fire District	3	0	0.00%	$4,245,296	0	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0	0.00%
Thuston PUD	104	0	0.00%	$157,995,117	0	0.00%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0	0.00%

Landslide Hazards (WA DNR Landslide Compilations & Slope greater than 40 Percent)									
Impact on Property				Impact on Economy					
Total xposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0%	None	0	0	0.00%	None	0	0	**9**	**Low**
0%	None	0	0	0.00%	None	0	0	**0**	**Low**
0%	Medium	2	4	0.00%	None	0	0	**21**	**Medium**
0%	None	0	0	0.00%	None	0	0	**9**	**Low**
0%	None	0	0	0.00%	None	0	0	**0**	**Low**
0%	None	0	0	0.70%	Low	1	1	**12**	**Low**
0%	None	0	0	0.00%	None	0	0	**9**	**Low**
0%	None	0	0	0.00%	None	0	0	**0**	**Low**
0%	None	0	0	0.00%	None	0	0	**9**	**Low**
0%	None	0	0	0.00%	None	0	0	**9**	**Low**

Sea Level Rise Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Estimated Building Exposure			
					Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)
Bucoda	610	245	237	$63,726,655	0	0	0.0%	$0
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%	$0
Olympia	56,370	18,242	16,257	$19,116,213,011	122	114	0.2%	$322,608,575
Rainier	2,510	875	814	$393,003,023	0	0	0.0%	$0
Tenino	2,030	751	651	$404,778,123	0	0	0.0%	$0
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%	$0
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%	$0
Unincorporated	143,760	53,104	51,429	$24,765,596,428	154	375	0.3%	$43,850,493
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**276**	**489**	**0.2%**	**$366,459,068**

Jurisdiction	Acres of Inundation Area	Number of Structures in Inundation Area (2)						
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Bucoda	0	0	0	0	0	0	0	0
Lacey	5	0	0	0	0	0	0	0
Olympia	197	33	83	3	0	0	3	0
Rainier	0	0	0	0	0	0	0	0
Tenino	0	0	0	0	0	0	0	0
Tumwater	0	0	0	0	0	0	0	0
Yelm	0	0	0	0	0	0	0	0
Unincorporated	2,122	134	19	0	0	0	1	0
Total	**2,324**	**167**	**102**	**3**	**0**	**0**	**4**	**0**

	RISK RANKING-Sea Lev							
	Probability		Impact on People				Impact on Pr	
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High, Medium, Low, None)
Bucoda	Low	1	0.00%	None	0	0	0.00%	None
Lacey	High	3	0.00%	None	0	0	0.00%	None
Olympia	High	3	0.20%	Low	1	3	2.91%	Low
Rainier	Low	1	0.00%	None	0	0	0.00%	None
Tenino	Low	1	0.00%	None	0	0	0.00%	None
Tumwater	Low	1	0.00%	None	0	0	0.00%	None
Yelm	Low	1	0.00%	None	0	0	0.00%	None
Unincorporated	High	3	0.26%	Low	1	3	0.29%	Low
Total	High	3	0.16%	Low	1	3	0.85%	Low

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated population.
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

			Economic Impact							
lue Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$233,915,577	$556,524,151	2.9%	538	0	0	122	$8,729,964	$21,883,034	$30,612,998	0.2%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$0	$0	0.0%	0	0	0	0	$0	$0	$0	0.0%
$27,355,301	$71,205,795	0.3%	1,837	1	0	154	$5,222,311	$4,790,130	$10,012,441	0.0%
$261,270,878	**$627,729,946**	**0.9%**	**2,375**	**1**	**0**	**276**	**$13,952,275**	**$26,673,163**	**$40,625,439**	**0.1%**

Total
0
0
122
0
0
0
0
154
276

vel Rise

perty		Impact on Economy				Risk	
Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.16%	Low	1	1	**18**	**Medium**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
0	0	0.00%	None	0	0	**0**	**Low**
1	2	0.04%	Low	1	1	**18**	**Medium**
1	2	0.06%	Low	1	1	**18**	**Medium**

Sea Level Rise Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdictions	SPECIAL PURPOSE DIS						
	Probability		Impact on People				
East Olympia Fire District	Low	1	0.00%	None	0	0	0.00%
Intercity Transit	High	3	0.00%	None	0	0	0.00%
Lacey Fire District	High	3	0.01%	None	0	0	0.00%
McLane Black Lake Fire District	High	3	0.69%	Low	1	3	0.00%
Olympia School District	High	3	0.45%	Low	1	3	0.00%
SE Thurston Fire Authority	Low	1	0.00%	None	0	0	0.00%
South Bay Fire District	High	3	1.00%	Low	1	3	0.00%
The Evergreen State College	High	3	0.00%	None	0	0	0.00%
Thuston PUD	High	3	0.16%	Low	1	3	0.00%
West Thurston Regional Fire Authority	Low	1	0.00%	None	0	0	0.00%

Jurisdictions	Special Purpose District Critical Facilities Loss Detail					
	Critical Facilities	Facilities inSea Level Rise	% in Hazard	Total Valuation	Total Damaged	% Total Damage
East Olympia Fire District	6	0	0.00%	$4,995,000	0.00%	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0.00%	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0.00%	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0.00%	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0.00%	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0.00%	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0.00%	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0.00%	0.00%
Thuston PUD	104	0	0.00%	$157,995,117	0.00%	0.00%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0.00%	0.00%

STRICT RISK SCORES AND RATINGS Sea Level Rise										
Impact on Property				**Impact on Economy**				**Risk Ranking Score**	**Hazard Risk Rating**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**9**	**Low**
	None	0	0	0.00%	None	0	0	**9**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**9**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**9**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**

Severe Weather Hazard - Municipal and Special Purpose Districts Risk Assessment Results and R

Jurisdiction	MUNICIPAL RISK SCORE						
	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	mpact Facto	Weighted Impact Factor	% of Total Value Exposed
Bucoda	High	3	5.00%	Low	1	3	5.00%
Lacey	High	3	5.00%	Low	1	3	5.00%
Olympia	High	3	5.00%	Low	1	3	5.00%
Rainier	High	3	5.00%	Low	1	3	5.00%
Tenino	High	3	5.00%	Low	1	3	5.00%
Tumwater	High	3	5.00%	Low	1	3	5.00%
Yelm	High	3	5.00%	Low	1	3	5.00%
Unincorporated	High	3	5.00%	Low	1	3	5.00%
Total	High	3	5.00%	Low	1	3	5.00%

Jurisdiction	SPECIAL PURPOSE DISTRICT RIS						
	Probability		Impact on People				
East Olympia Fire District	High	3	5.00%	Low	1	3	5.00%
Intercity Transit	High	3	5.00%	Low	1	3	5.00%
Lacey Fire District	High	3	5.00%	Low	1	3	5.00%
McLane Black Lake Fire District	High	3	5.00%	Low	1	3	5.00%
Olympia School District	High	3	5.00%	Low	1	3	5.00%
SE Thurston Fire Authority	High	3	5.00%	Low	1	3	5.00%
South Bay Fire District	High	3	5.00%	Low	1	3	5.00%
The Evergreen State College	High	3	5.00%	Low	1	3	5.00%
Thuston PUD	High	3	5.00%	Low	1	3	5.00%
West Thurston Regional Fire Authority	High	3	5.00%	Low	1	3	5.00%

isk Rating

ES AND RATINGS SEVERE WEATHER HAZARDS

Impact on Property			Impact on Economy				Risk	
Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**

SK SCORES AND RATINGS SEVERE WEATHER HAZARDS

Impact on Property			Impact on Economy				Risk	
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**
Low	1	2	1.00%	Low	1	1	**18**	**Medium**

Tsunami Cascadia M9.3 Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Buildings Exposed (2)	Population Exposed (3)	% of Populatio Exposed
Bucoda	610	245	237	$63,726,655	0	0	0.0%
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.0%
Olympia	56,370	18,242	16,257	$19,116,213,011	35	52	0.1%
Rainier	2,510	875	814	$393,003,023	0	0	0.0%
Tenino	2,030	751	651	$404,778,123	0	0	0.0%
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.0%
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.0%
Unincorporated	143,760	53,104	51,429	$24,765,596,428	49	109	0.1%
Total	**300,500**	**104,854**	**98,260**	**$73,540,652,648**	**84**	**161**	**0.1%**

Jurisdiction	Number of Structures in Tsunami Inundation Area (2)						
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education
Bucoda	0	0	0	0	0	0	
Lacey	0	0	0	0	0	0	
Olympia	15	18	2	0	0	0	
Rainier	0	0	0	0	0	0	
Tenino	0	0	0	0	0	0	
Tumwater	0	0	0	0	0	0	
Yelm	0	0	0	0	0	0	
Unincorporated	39	10	0	0	0	0	
Total	**54**	**28**	**2**	**0**	**0**	**0**	

Jurisdiction	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Valu Exposed
Bucoda	Low	1	0.00%	None	0	0	0.00%
Lacey	Medium	2	0.00%	None	0	0	0.00%
Olympia	Medium	2	0.09%	Low	1	3	0.38%
Rainier	Low	1	0.00%	None	0	0	0.00%
Tenino	Low	1	0.00%	None	0	0	0.00%
Tumwater	Low	1	0.00%	None	0	0	0.00%
Yelm	Low	1	0.00%	None	0	0	0.00%
Unincorporated	Medium	2	0.08%	Low	1	3	0.09%
Total	Medium	2	0.05%	Low	1	3	0.13%

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 5.1, and adjusted to reflect the estimated population.
(6) Calculated using a user-defined (UDF) analysis in Hazus 5.1.

	Estimated Exposure			
n	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
	$0	$0	$0	0.0%
	$0	$0	$0	0.0%
	$38,825,561	$33,870,770	$72,696,331	0.4%
	$0	$0	$0	0.0%
	$0	$0	$0	0.0%
	$0	$0	$0	0.0%
	$0	$0	$0	0.0%
	$12,742,393	$9,473,317	$22,215,710	0.1%
	$51,567,954	**$43,344,088**	**$94,912,042**	**0.1%**

	Total
0	0
0	0
0	35
0	0
0	0
0	0
0	0
0	49
0	**84**

RISK RANKING-Tsunami

Impact on Property				Impact on Economy				Risk	
ue	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	Low	1	2	0.10%	Low	1	1	**12**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	Low	1	2	0.02%	Low	1	1	**12**	**Low**
	Low	1	2	0.03%	Low	1	1	**12**	**Low**

Tsunami Cascadia M9.3 Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Ratings

	SPECIAL PURPOSE DISTR						
Jurisdiction	Probability		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Val Exposed
East Olympia Fire District	Low	1	0.00%	None	0	0	0.00%
Intercity Transit	Medium	2	0.00%	None	0	0	0.00%
Lacey Fire District	Medium	2	0.00%	None	0	0	0.00%
McLane Black Lake Fire District	Medium	2	0.45%	Low	1	3	0.00%
Olympia School District	Medium	2	0.19%	Low	1	3	0.00%
SE Thurston Fire Authority	Low	1	0.00%	None	0	0	0.00%
South Bay Fire District	Medium	2	0.17%	Low	1	3	0.00%
The Evergreen State College	Medium	2	0.00%	None	0	0	0.00%
Thuston PUD	Medium	2	0.05%	Low	1	3	0.00%
West Thurston Regional Fire Authority	Low	1	0.00%	None	0	0	0.00%

	Special Purpose District Critical Facility Loss Detail					
Jurisdiction	Critical Facilities	Facilities in Tsunami	% in Hazard	Total Valuation	Exposed Value	% Total Damage
East Olympia Fire District	6	0	0.00%	$4,995,000	0.00	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0.00	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0.00	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0.00	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0.00	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0.00	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0.00	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0.00	0.00%
Thuston PUD	104	0	0.00%	$157,995,117	0.00	0.00%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0.00	0.00%

RICTS RISK SCORES AND RATINGS TSUNAMI HAZARDS

Impact on Property				Impact on Economy				Risk	
ue	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**6**	**Low**
	None	0	0	0.00%	None	0	0	**6**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**6**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**
	None	0	0	0.00%	None	0	0	**6**	**Low**
	None	0	0	0.00%	None	0	0	**0**	**Low**

Mount Rainier Case I Lahar Hazard Scenario - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Volcano Lahar Inundat			
					Estimated Expo			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure Exposed (2)
Bucoda	610	245	237	$63,726,655	0	0	0.00%	0
Lacey	58,180	18,985	17,637	$17,357,526,547	0	0	0.00%	0
Olympia	56,370	18,242	16,257	$19,116,213,011	0	0	0.00%	0
Rainier	2,510	875	814	$393,003,023	0	0	0.00%	0
Tenino	2,030	751	651	$404,778,123	0	0	0.00%	0
Tumwater	26,360	9,513	8,408	$9,362,171,728	0	0	0.00%	0
Yelm	10,680	3,139	2,827	$2,077,637,133	0	0	0.00%	0
Unincorporated	143,760	53,104	51,429	$24,765,596,428	857	2,284	1.59%	163,656,517
Total	**300,500**	**104,854**	**98,260**	**73,540,652,648**	**857**	**2,284**	**0.76%**	**163,656,517**

	RISK RANKING - Volcano Lahar I							
	Probability		Impact on People				Impact	
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (High Medium, Low, N
Bucoda	Low	1	0.00%	None	0	0	0.00%	None
Lacey	Low	1	0.00%	None	0	0	0.00%	None
Olympia	Low	1	0.00%	None	0	0	0.00%	None
Rainier	Low	1	0.00%	None	0	0	0.00%	None
Tenino	Low	1	0.00%	None	0	0	0.00%	None
Tumwater	Low	1	0.00%	None	0	0	0.00%	None
Yelm	Low	1	0.00%	None	0	0	0.00%	None
Unincorporated	Low	1	1.59%	Low	1	3	1.04%	Low
Total	Low	1	0.76%	Low	1	3	0.35%	Low

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Volcano Lahar Hazard data provided by USGS.
(4) Percent of residential buildings exposed multiplied by the Estimated Population.

ion Area (3)											
sure				Number of Structures in Hazard Area (2)							
in $	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
	0	0	0.00%	0	0	0	0	0	0	0	0
	0	0	0.00%	0	0	0	0	0	0	0	0
	0	0	0.00%	0	0	0	0	0	0	0	0
	0	0	0.00%	0	0	0	0	0	0	0	0
	0	0	0.00%	0	0	0	0	0	0	0	0
	0	0	0.00%	0	0	0	0	0	0	0	0
	0	0	0.00%	0	0	0	0	0	0	0	0
	94,432,130	258,088,648	1.04%	817	35	1	0	0	0	4	857
	94,432,130	**258,088,648**	**0.35%**	**817**	**35**	**1**	**0**	**0**	**0**	**4**	**857**

Inundation Area (3)									
on Property			Impact on Economy						
, one)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	0	0	0.00%	None	0	0	**0**	**Low**
	0	0	0.00%	None	0	0	**0**	**Low**
	0	0	0.00%	None	0	0	**0**	**Low**
	0	0	0.00%	None	0	0	**0**	**Low**
	0	0	0.00%	None	0	0	**0**	**Low**
	0	0	0.00%	None	0	0	**0**	**Low**
	0	0	0.00%	None	0	0	**0**	**Low**
	1	2	0.26%	Low	1	1	**6**	**Low**
	1	2	0.09%	Low	1	1	**6**	**Low**

Mount Rainier Case I Lahar Hazard Scenario - Special Purpose Districts Risk Assessment Results and Risk Rat

	SPECIAL PURPOSE DISTRIC					
Jurisdiction	**Probability**		**Impact on People**			
	Probability (High, Medium, Low, None)	**Probability Factor (3,2,1,0)**	**% Population Exposed**	**Impact (High, Medium, Low, None)**	**Impact Factor**	**Weighte Impact Fa**
East Olympia	Low	1	0.00%	None	0	0
Intercity Transit	Low	1	0.00%	None	0	0
Lacey Fire District	Low	1	1.01%	Low	1	3
McLane Black Lake Fire District	Low	1	0.00%	None	0	0
Olympia School District	Low	1	0.00%	None	0	0
SE Thurston Fire Authority	Low	1	4.43%	Low	1	3
South Bay Fire District	Low	1	0.00%	None	0	0
The Evergreen State College	Low	1	0.00%	None	0	0
Thuston PUD	Low	1	0.76%	Low	1	3
West Thurston Regional Fire Authority	Low	1	0.00%	None	0	0

Jurisdiction	Special Purpose District Critical Facilities Detail					
	Critical Facilities	**Facilities in Tsunami**	**% in Hazard**	**Total Valuation**	**Exposed Value**	**% Tota Damag**
East Olympia Fire District	6	0	0.00%	$4,995,000	0	0.00%
Intercity Transit	9	0	0.00%	$84,647,258	0	0.00%
Lacey Fire District	9	0	0.00%	$66,350,723	0	0.00%
McLane Black Lake Fire District	7	0	0.00%	$9,451,467	0	0.00%
Olympia School District	22	0	0.00%	$237,434,380	0	0.00%
SE Thurston Fire Authority	6	0	0.00%	$5,967,300	0	0.00%
South Bay Fire District	3	0	0.00%	$4,245,296	0	0.00%
The Evergreen State College	31	0	0.00%	$633,990,605	0	0.00%
Thuston PUD	104	1	0.96%	$157,995,117	$468,751	0.07%
West Thurston Regional Fire Authority	6	0	0.00%	$8,619,586	0	0.00%

ings

T RISK SCORES AND RATINGS Volcano Lahar Inundation Area

	Impact on Property				Impact on Economy				Risk	
d ctor	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**3**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**3**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	1.00%	Low	1	2	0.07%	Low	1	1	**6**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**

l e

Wildland-Urban Interface Hazard - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Washington		
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed
Bucoda	610	245	237	$63,726,655	224	561	92.0%
Lacey	58,180	18,985	17,637	$17,357,526,547	4,342	12,951	22.3%
Olympia	56,370	18,242	16,257	$19,116,213,011	3,444	10,142	18.0%
Rainier	2,510	875	814	$393,003,023	517	1,437	57.2%
Tenino	2,030	751	651	$404,778,123	693	1,868	92.0%
Tumwater	26,360	9,513	8,408	$9,362,171,728	4,142	11,431	43.4%
Yelm	10,680	3,139	2,827	$2,077,637,133	2,744	9,226	86.4%
Unincorporated	143,760	53,104	51,429	$24,765,596,428	18,524	49,279	34.3%
Total	**300,500**	**104,854**	**98,260**	**73,540,652,648**	**34,630**	**96,894**	**32.2%**

	RISK SCORE AND RATING WILD						
Jurisdiction	Probability (5)		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed
Bucoda	Low	1	91.98%	High	3	9	91.94%
Lacey	Low	1	22.26%	Medium	2	6	34.40%
Olympia	Low	1	17.99%	Medium	2	6	25.04%
Rainier	Low	1	57.25%	High	3	9	61.00%
Tenino	Low	1	92.01%	High	3	9	94.55%
Tumwater	Low	1	43.36%	High	3	9	36.59%
Yelm	Low	1	86.38%	High	3	9	88.39%
Unincorporated	Medium	2	34.28%	High	3	9	36.79%
Total	Medium	2	32.24%	High	3	9	35.10%

Notes:

(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division

(2) Values based off of 2022 tax assessor data provided by Thurston County.

(3) Wildland Urban Interface and Intermix data provided by Washington DNR.

(4) Percent of residential buildings exposed multiplied by the Estimated Population.

(5) Probability is based on 2008-2022 Washington DNR Wildfire Data for Thurston County. Probability is assigned as follows: High, 20+acre fires in this period; Medium, 5-10 acre fires in this period; low 0-1 acr

n DNR Wildland Urban Interface (3)											
Estimated Exposure				Number of Structures in Wildland Urban Interface (2)							
ue Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
$37,150,528	$21,438,267	$58,588,795	91.9%	218	4	0	0	0	2	0	224
3,322,957,920	$2,648,459,432	$5,971,417,351	34.4%	3,926	347	19	0	5	1	44	4,342
2,669,027,331	$2,117,031,646	$4,786,058,977	25.0%	2,925	507	2	0	5	1	4	3,444
$141,499,831	$98,246,273	$239,746,104	61.0%	466	42	0	0	2	1	6	517
$220,337,015	$162,363,873	$382,700,888	94.5%	599	72	0	1	7	5	9	693
1,930,103,308	$1,495,341,610	$3,425,444,918	36.6%	3,646	433	48	1	1	6	7	4,142
1,089,473,790	$746,942,304	$1,836,416,094	88.4%	2,442	262	10	1	13	5	11	2,744
5,653,973,894	$3,458,460,282	$9,112,434,176	36.8%	17,629	669	94	4	32	24	72	18,524
15,064,523,615	**$10,748,283,687**	**$25,812,807,303**	**35.1%**	**31,851**	**2,336**	**173**	**7**	**65**	**45**	**153**	**34,630**

DFIRE HAZARD (Wildland Urban Interface)								
Impact on Property			Impact on Economy				Risk	
mpact (High, dium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
High	3	6	22.98%	High	3	3	**18**	**Medium**
High	3	6	8.60%	Medium	2	2	**14**	**Low**
High	3	6	6.26%	Medium	2	2	**14**	**Low**
High	3	6	15.25%	High	3	3	**18**	**Medium**
High	3	6	23.64%	High	3	3	**18**	**Medium**
High	3	6	9.15%	Medium	2	2	**17**	**Medium**
High	3	6	22.10%	High	3	3	**18**	**Medium**
High	3	6	9.20%	Medium	2	2	**34**	**High**
High	3	6	8.78%	Medium	2	2	**34**	**High**

e fires.

Wildland-Urban Interface Hazard - Special Purpose Districts Risk Assessment Results and Risk Ratings

	SPECIAL PURPOSE DISTRICTS R					
	Probability (5)		Impact on People			
Jurisdiction	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Facto
East Olympia Fire District	Low	1	37.06%	High	3	9
Intercity Transit	Low	1	0.00%	None	0	0
Lacey Fire District	Low	1	39.99%	High	3	9
McLane Black Lake Fire District	Medium	2	25.14%	High	3	9
Olympia School District	Low	1	22.98%	Medium	2	6
SE Thurston Fire Authority	High	3	46.75%	High	3	9
South Bay Fire District	Low	1	17.61%	Medium	2	6
The Evergreen State College	Medium	2	0.00%	None	0	0
Thuston PUD	Medium	2	32.24%	High	3	9
West Thurston Regional Fire Authority	High	3	26.40%	High	3	9

	Special Purpose District Critical Facilities Detail					
Jurisdiction	Critical Facilities	Facilities in Interface	% in Hazard	Total Valuation	Exposed Value	% Total Damage
East Olympia Fire District	6	3	50.00%	$4,995,000	$4,475,000	22.40%
Intercity Transit	9	0	0.00%	$84,647,258	$0	0.00%
Lacey Fire District	9	1	11.11%	$66,350,723	$2	0.00%
McLane Black Lake Fire District	7	2	28.57%	$9,451,467	$4,464,625	11.81%
Olympia School District	22	5	22.73%	$237,434,380	$42,744,026	4.50%
SE Thurston Fire Authority	6	2	33.33%	$5,967,300	$3,093,609	12.96%
South Bay Fire District	3	1	33.33%	$4,245,296	$3,255,552	19.17%
The Evergreen State College	31	31	100.00%	$633,990,605	$633,990,605	25.00%
Thuston PUD	104	27	25.96%	$157,995,117	$65,365,922	10.34%
West Thurston Regional Fire Authority	6	4	66.67%	$8,619,586	$5,667,603	16.44%

RISK SCORES AND RATINGS Wildfire Hazards (Wildland-Urban Interface)										
	Impact on Property				Impact on Economy					
or	% of Total Value Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	0.00%	None	0	0	22.40%	High	3	3	**12**	**Low**
	0.00%	None	0	0	0.00%	None	0	0	**0**	**Low**
	50.00%	High	3	6	0.00%	None	0	0	**15**	**Low**
	100.00%	High	3	6	11.81%	High	3	3	**36**	**High**
	24.00%	Medium	2	4	4.50%	Low	1	1	**11**	**Low**
	33.00%	High	3	6	12.96%	High	3	3	**54**	**High**
	100.00%	High	3	6	19.17%	High	3	3	**15**	**Low**
	100.00%	High	3	6	25.00%	High	3	3	**18**	**Medium**
	0.00%	None	0	0	10.34%	High	3	3	**24**	**Medium**
	67.00%	High	3	6	16.44%	High	3	3	**54**	**High**

Wildland-Urban Intermix Hazard - Municipal Risk Assessment Results and Risk Ratings

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)	Washington DNR			
					Estin			
					Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure Exposed (2
Bucoda	610	245	237	$63,726,655	21	49	8.0%	$3,281,434
Lacey	58,180	18,985	17,637	$17,357,526,547	2,007	6,469	11.1%	$1,065,524,8
Olympia	56,370	18,242	16,257	$19,116,213,011	1,427	4,757	8.4%	$503,348,67
Rainier	2,510	875	814	$393,003,023	358	1,073	42.8%	$99,644,900
Tenino	2,030	751	651	$404,778,123	58	162	8.0%	$13,972,990
Tumwater	26,360	9,513	8,408	$9,362,171,728	1,162	3,499	13.3%	$479,581,10
Yelm	10,680	3,139	2,827	$2,077,637,133	395	1,454	13.6%	$157,412,98
Unincorporated	143,760	53,104	51,429	$24,765,596,428	29,967	81,849	56.9%	$8,817,191,0
Total	**300,500**	**104,854**	**98,260**	**73,540,652,648**	**35,395**	**99,313**	**33.0%**	**$11,139,957,9**

	RISK SCORES AND RATINGS WILD							
Jurisdiction	Probability (5)		Impact on People				I	
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Exposed	Impact (Hig Medium, Low, N
Bucoda	Low	1	8.02%	Low	1	3	8.06%	Low
Lacey	Low	1	11.12%	Medium	2	6	9.85%	Low
Olympia	Low	1	8.44%	Low	1	3	4.11%	Low
Rainier	Low	1	42.75%	High	3	9	39.00%	High
Tenino	Low	1	7.99%	Low	1	3	5.45%	Low
Tumwater	Low	1	13.27%	Medium	2	6	8.08%	Low
Yelm	Low	1	13.62%	Medium	2	6	11.61%	Medium
Unincorporated	Medium	2	56.93%	High	3	9	55.10%	High
Total	Medium	2	33.05%	High	3	9	23.55%	Medium

Notes:
(1)2022 population from State of Washington, Office of Financial Management, Forecasting and Research Division
(2) Values based off of 2022 tax assessor data provided by Thurston County.
(3) Wildland Urban Interface and Intermix data provided by Washington DNR.
(4) Percent of residential buildings exposed multiplied by the Estimated Population.
(5) Probability is based on 2008-2022 Washington DNR Wildfire Data for Thurston County. Probability is assigned as follows: High, 20+acre fires in this period; Medium, 5-10 acre fires in this period; low 0-1 acre fires.

Wildland Urban Intermix (3)												
nated Exposure				Number of Structures in Wildland Urban Intermix (2)								
e in $)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
	$1,856,426	$5,137,860	8.1%	19	2	0	0	0	0	0	21
69	$644,078,438	$1,709,603,307	9.8%	1,961	38	1	0	3	2	2	2,007
9	$282,480,846	$785,829,525	4.1%	1,372	52	0	0	1	0	2	1,427
0	$53,612,019	$153,256,919	39.0%	348	7	1	0	1	1	0	358
0	$8,104,245	$22,077,234	5.5%	52	4	0	0	0	2	0	58
5	$277,069,037	$756,650,143	8.1%	1,116	41	2	0	3	0	0	1,162
7	$83,808,052	$241,221,039	11.6%	385	5	4	0	1	0	0	395
21	$4,829,411,313	$13,646,602,334	55.1%	29,281	557	24	1	37	28	39	29,967
084	**$6,180,420,377**	**$17,320,378,361**	**23.6%**	**34,534**	**706**	**32**	**1**	**46**	**33**	**43**	**35,395**

FIRE HAZARD (Wildland-Urban Intermix)								
mpact on Property			Impact on Economy				Risk	
h, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
	1	2	2.02%	Low	1	1	**6**	**Low**
	1	2	2.46%	Low	1	1	**9**	**Low**
	1	2	1.03%	Low	1	1	**6**	**Low**
	3	6	9.75%	Medium	2	2	**17**	**Medium**
	1	2	1.36%	Low	1	1	**6**	**Low**
	1	2	2.02%	Low	1	1	**9**	**Low**
	2	4	2.90%	Low	1	1	**11**	**Low**
	3	6	13.78%	High	3	3	**36**	**High**
	2	4	5.89%	Medium	2	2	**30**	**Medium**

Wildland-Urban Intermix Hazard - Special Purpose Districts Risk Assessment Results and Risk Ratings

	SPECIAL PURPOSE DISTRICT RIS						
Jurisdiction	Probability (5)		Impact on People				
	Probability (High, Medium, Low, None)	Probability Factor (3,2,1,0)	% Population Exposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of ' Value E
East Olympia	Low	1		None	0	0	33.0
Intercity Transit	Low	1	17.99%	Medium	2	6	0.00
Lacey Fire District	Low	1	11.12%	Medium	2	6	50.0
McLane Black Lake Fire District	Medium	2	20.00%	Medium	2	6	71.0
Olympia School District	Low	1	87.44%	High	3	9	10.0
SE Thurston Fire Authority	High	3	20.00%	Medium	2	6	67.0
South Bay Fire District	Low	1	20.00%	Medium	2	6	100.0
The Evergreen State College	Medium	2	100.00%	High	3	9	0.00
Thuston PUD	Medium	2	33.05%	High	3	9	75.0
West Thurston Regional Fire Authority	High	3	20.00%	Medium	2	6	33.0

Jurisdiction	Special Purpose District Critical Facilities Detail					
	Critical Facilities	Facilities in Interface	% in Hazard	Total Valuation	Exposed Value	% Total Damage
East Olympia Fire District	6	2	33.33%	$4,995,000	$520,000	2.60%
Intercity Transit	9	0	0.00%	$84,647,258	$0	0.00%
Lacey Fire District	9	4	44.44%	$66,350,723	$15,650,721	5.90%
McLane Black Lake Fire District	7	5	71.43%	$9,451,467	$4,986,842	13.19%
Olympia School District	22	2	9.09%	$237,434,380	$5,584,020	0.59%
SE Thurston Fire Authority	6	4	66.67%	$5,967,300	$2,873,691	12.04%
South Bay Fire District	3	4	133.33%	$4,245,296	$989,744	5.83%
The Evergreen State College	31	0	0.00%	$633,990,605	$0	0.00%
Thuston PUD	104	75	72.12%	$157,995,117	$91,302,380	14.45%
West Thurston Regional Fire Authority	6	3	50.00%	$8,619,586	$2,951,983	8.56%

SK SCORES AND RATINGS Wildfire Hazards (Wildland-Urban Intermix)									
Impact on Property				Impact on Economy				Risk	
Total xposed	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	% of Total Value Damaged	Impact (High, Medium, Low, None)	Impact Factor	Weighted Impact Factor	Risk Ranking Score	Hazard Risk Rating
00%	High	3	6	2.60%	Low	1	1	**7**	**Low**
0%	None	0	0	0.00%	None	0	0	**6**	**Low**
00%	High	3	6	5.90%	Medium	2	2	**14**	**Low**
00%	High	3	6	13.19%	High	3	3	**30**	**Medium**
00%	Medium	2	4	0.59%	Low	1	1	**14**	**Low**
00%	High	3	6	12.04%	High	3	3	**45**	**High**
00%	High	3	6	5.83%	Medium	2	2	**14**	**Low**
0%	None	0	0	0.00%	None	0	0	**18**	**Medium**
00%	High	3	6	14.45%	High	3	3	**36**	**High**
00%	High	3	6	8.56%	Medium	2	2	**42**	**High**

Appendix D
Annual Progress Report Template

Contents

Natural Hazards Mitigation Plan for the Thurston Region Annual Progress Report Template

Reporting Period: *insert date range for reporting period*

Background

The Natural Hazards Mitigation Plan for the Thurston Region assists communities in Thurston County with reducing the impacts of natural hazards by identifying resources, information, and strategies for risk reduction. The plan can be viewed on-line at:

https//:www.trpc.org/hazards

Summary Overview of the Plan's Progress: The performance period for the Hazards Mitigation Plan is anticipated to become effective by approximately January 1, 2024, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before October 1, 2029. As of this reporting period, the performance period for this plan is considered __% complete. The plan has targeted 12 regional multi-hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- ___ out of ___ initiatives (___%) reported ongoing action toward completion.
- ___ out of ___ initiatives (___%) were reported as being complete.
- ___ out of ___ initiatives (___%) reported no action taken.

Purpose

This report provides an annual update on the implementation of the action plan identified in the Hazards Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the plan responsive to the needs and capabilities of Thurston County communities. This report discusses the following:

- Any natural hazard events that have occurred within the last year.
- Changes in risk exposure within the planning area.
- Mitigation success stories.
- Review of the action plan including both regional and jurisdictional mitigation initiatives.
- Changes in capabilities that could impact plan implementation.
- Recommendations for changes/enhancement.

The Hazard Mitigation Planning Workgroup

The Hazard Mitigation Planning Workgroup (HMPW), made up of plan participant representatives and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on <insert date> It was determined through the plan's development process that the FPC will remain in service to oversee maintenance of the plan. At a minimum, the HMPW will provide review and oversight on the development of the annual progress report. Workgroup membership will be maintained by Thurston County Emergency Management and will be documented in the progress reports. For this reporting period, the HMPW membership is shown in Table 1.

TABLE 1 HAZARD MITIGATION PLANNING WORKGROUP MEMBERS		
Name	Title	Affilation

Hazard Events within the Planning Area

During the reporting period, there were ___ hazard events in the planning area that had a measurable impact on community assets. A summary of these events is as follows:

(Describe relevant hazard event(s) in the planning area that changed the probability of occurrence of the hazard(s) as presented in the HMPW).

Changes in Risk Exposure in the Planning Area

(Describe relevant hazard event(s) in the planning area that impacted assets and may require the plan participants to consider if there needs to be changes to the way risk is assessed within the planning area).

Mitigation Success Stories

(Insert brief overview of mitigation accomplishments achieved during the reporting period.)

Review of the Action Plan

Table 2 reviews the regional mitigation initiatives (also known as the action plan) and summarizes the status of each initiative. Reviewers of this report should refer to Chapter 2 in the Hazards Mitigation Plan for descriptions and details of each regional mitigation initiative. Jurisdictional initiatives are in each jurisdiction's respective annex.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2 ACTION PLAN MATRIX				
Action Taken? (YES or NO)	Timeline	Priority	Status	Status (X, O, ✓)
Insert ID#, Title, brief description, timeline and leads. Provide a succint description of any accomplishments for the reporting period.				

Completion status legend:

✓ = Project Completed

O = Action ongoing toward completion

X = No progress at this time

Changes That May Impact Implementation of the Plan

(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development.)

Recommendations for Changes or Enhancements

Based on the review of this report by the HMPW, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Annual Report Questions to Consider

Risk

1. *Should any hazards be added or removed from the Risk Assessment?*
2. *Are there any new data sources available to support the plan's Risk Assessment?*
3. *Are there any new critical facilities, infrastructure, or high value assets that need to be added to the critical facilities list?*
4. *Have there been any changes in development that create or reduce risks?*

Capabilities

5. *Have the plan participants adopted new policies, plans, or programs that can support the mitigation strategy?*
6. *Have any parts of the plan been incorporated into other planning mechanisms or work programs?*
7. *Are there different or new education and outreach programs and resources available for mitigation activities?*
8. *Has National Flood Insurance Program participation changed in the participating jurisdictions?*

Actions

9. *Are there new mitigation projects to consider?*
10. *Should mitigation actions be revised or removed from the plan?*
11. *Are there new funding sources to consider?*

Public review notice: *The contents of this report are subject to public disclosure. Copies of the report are provided to the Thurston County Emergency Management Council. Any questions or comments regarding the contents of this report should be directed to:*

Hazard Mitigation and Recovery Coordinator
9521 Tilley Road Southwest
Olympia, WA 98512
Phone: (360) 867-2800

Appendix E
Plan Process Documentation

Contents

NATURAL HAZARDS MITIGATION PLAN UPDATE (4th EDITION, 2022)
STATEMENT OF INTENT TO PARTICIPATE
FOR THE
THURSTON COUNTY, WASHINGTON REGION

PURPOSE: The purpose of this Statement of Intent (SOI) is to provide a mutual understanding in support of the signatory local governments, school districts, special purpose districts, colleges and universities, and other organizations that will be working in cooperation to complete an update to the multi-jurisdictional "Natural Hazards Mitigation Plan for the Thurston Region." This SOI serves as the "partners' agreement."

BACKGROUND AND FEDERAL POLICY: The Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Program (HMGP) are federally funded programs managed by the Washington Military Department's Emergency Management Division (State EMD). It provides grant funds for hazard mitigation plans and projects that reduce casualties and damage to structures in future disasters. The PDM program is authorized by Section 203 Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP grant program, made available following Presidential Disaster Declarations, is funded by the Federal Emergency Management Agency (FEMA), and authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

Cities, towns, counties, tribes, ports, school districts, and other special purpose local governments are required to adopt a FEMA- approved mitigation plan developed under 44 CFR Part 201 as a condition of receiving federal grant funds for mitigation plans or projects. Plans must be updated every five years in order to remain eligible for federal mitigation assistance. The current "Natural Hazards Mitigation Plan for the Thurston Region" (3rd edition) expires on August 2, 2022.

ROLES AND EXPECTATIONS: Consistent with the region's previous planning framework, the Thurston County Emergency Management Council will serve as the Steering Committee to direct the development of the plan. A multi-jurisdictional Hazard Mitigation Planning Workgroup composed of designees from each of the participating partners, will build the plan.

For the Hazard Mitigation Plan update process, signatory participation is defined as:

1. Designating a lead point of contact to represent the partner agency's interests on the regional Hazard Mitigation Plan Workgroup
2. Participating in the planning process including the Hazard Mitigation Plan Workgroup meetings, public meetings or open houses, workshops, planning partner specific training sessions, or public review and comment periods.
3. Providing reasonable support in the form of data, mailing lists, meeting space, and public information materials to solicit public participation in the planning process.
4. Conducting relevant jurisdiction specific meetings to review and refine its hazard mitigation capabilities, local risk assessment, and prioritizing a mitigation strategy.
5. Creating and prioritizing a mitigation strategy that will identify each project, the responsible entity for overseeing the project, how it will be financed, and an estimated implementation timeline.
6. Formally adopting the regional plan and a jurisdiction-specific mitigation strategy.

JOINABILITY: It is expected that there will be interested parties not currently included in this SOI that will request inclusion later. Other jurisdictions may be included in the regional plan update considering that they actively participate in all of the roles and expectations as outlined above.

AGREEMENT:

Whereas, the Federal Disaster Mitigation Act of 2000 requires that for all disasters declared on or after November 1, 2004, local and tribal government applicants must have an approved local mitigation plan in accordance with 44 CFR 201.6 prior to receipt of Hazard Mitigation Grant Program project funding; and

Whereas, Thurston County residents, businesses, and local governments are subject to frequent impacts from the destructive effects of flooding, winter storms, landslides, earthquakes, wildland fires, and other natural hazards that has resulted in 22 Presidential Disaster Declarations since 1965; and

Whereas, a multi-jurisdictional mitigation plan represents the commitment of jurisdictions to reduce risks from multiple hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards, and is in the public interest to proceed with the multi-jurisdictional grant application and planning process in a timely manner; and

Whereas, an open public involvement process is essential to the development of an effective plan, and the process will be coordinated with affected jurisdictions, agencies, businesses, academia and other private and non-profit interests in the county to ensure a comprehensive approach to mitigating the effects of natural disasters; and

Whereas, the plan shall include documentation of the planning process, and a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses, sufficient to enable each jurisdiction to identify and prioritize appropriate mitigation actions, a detailed mitigation strategy that provides the blueprint for reducing the potential losses identified in the risk assessment, a five year cycle for plan maintenance, and documentation of formal adoption by each participating jurisdiction; and

Whereas, the signatories agree to the best of their abilities and within the limits of their resources to work cooperatively on the project; and

Now, Therefore, this SOI is established to create a framework for coordinating efforts related to successfully completing the work funded under a Pre-Disaster Mitigation or Hazard Mitigation Grant Program grant or other relevant source of funding.

SIGNATORIES:

The undersigned individuals hereby commit to this SOI on behalf of their respective agencies. This SOI may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. Each Party has signed this two-page SOI. The original signature pages are on file at the Thurston Regional Planning Council: 2424 Heritage Ct. SW, Suite A, Olympia, WA 98502-6031, Phone: (360) 956-7575.

Signature 11/21/19 *Date*

John Hutchings, County Commissioner
Thurston County, Washington

AGREEMENT:

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Alan Carr 11/26/19

Signature *Date*

Alan Carr, Mayor
Town of Bucoda

Natural Hazards Mitigation Plan Update Statement of Intent to Participate Page 2 of 2

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Signature — *Date* 12/2/2019

Scott Spence, City Manager
City of Lacey

Natural Hazards Mitigation Plan Update Statement of Intent to Participate Page 2 of 2

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Signature [signature] 11/18/19
Date

Jay Burney, Interim City Manager
City of Olympia

AGREEMENT:

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Charmayne Garrison 12-3-19

Charmayne S. Garrison *Date*
City Administrator
City of Rainier

Natural Hazards Mitigation Plan Update Statement of Intent to Participate Page 2 of 2

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Robert Swain 11-26-19

Signature *Date*

Robert Swain, Chief of Police
Tenino Police Department

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Scott A. LaVielle — 11/25/19

Signature — *Date*

Scott A. LaVielle, Fire Chief/Emergency Services Director
City of Tumwater Fire Department

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[signature] *Signature*	11-25-19 *Date*
Mayor Title	City of Yelm Organization

Natural Hazards Mitigation Plan Update Statement of Intent to Participate Page 2 of 2

From: Todd Stancil
To: Purcell, Steve; Ryder, Andy; Selby, Cheryl; Shaw, Robert; Fournier, Wayne; Kmet, Pete; Foster, JW; Menser, Tye; Cox, Carolyn; Downing, Joe; Olsen, Russell; mkarras@griffinschool.us; sclifthorne@osd.wednet.edu; Gretchen Maliska; Sprouffske, Jerry; grodeheaver@rochester.wednet.edu; schiewek@tenino.k12.wa.us; melisaa.beard@tumwater.k12.wa.us; Edwards, Donna; Pickernell, Harry; Frank III, William; calvin.dahl@westhurstonfire.org; jsprouffske@setfa.org; O"Callahan, John; Kelling, Rick; putnadm@comcast.net; mhutchins@griffinfd.org; thefaithwk@aol.com; gzvirzdys@southbayfire.com; bhall@trl.org; president@evergreen.edu; tstokes@spscc.edu; olyurbanagrarian@gmail.com
Cc: Town of Bucoda; Spence, Scott; Burney, Jay; Justice, Tami; kcanup@cityoftenino.org; Doan, John; Michael Grayum; Chavez, Ramiro; Freeman-Manzanares, Ann; Strub, Mike; Gibboney, Sam; Weidenfeller, John; Woods, Greg; Patrick Murphy; Clemens,Deb; Bahr,Byron; Fry, Kim; endicottc@tenino.k12.wa.us; sean.dotson@tumwater.k12.wa.us; Wharton,Brian; Gleason, Jesse; Hutcheson, Rita; andrewschaffran@tcfd12.org; Brooks, Steve; ljohnson@mclanefire.org; coreyrux@griffinfd.org; Gregory, Mark; VanCamp, Brian; Heywood, Cheryl; Ward, William; mmattes@spscc.edu; Sarah Moorehead; Marc Daily; mhardie@ci.lacey.wa; Knouff, Patrick; jhutchings@cityoftenino.org; bhurley@ci.tumwate.wa.us; Todd Stancil; kurt.hardin@co.thurston.wa.us; Bergkamp, Emily; steven.besaw@lottwater.org; Jennief@portolympia.com; Oosterman, Linda; mdahl@nthurston.k12.wa.us; glaslg@rainier.wednet.edu; edowell@rochester.wednet.edu; williamsb@tenino.k12.wa.edu; Murray, Mel; Paul Brewster; mike.presswood@co.thurston.wa.us; etalylor@ci.lacey.wa.us; Knouff, Patrick; mike.presswood@co.thurston.wa.us; Matlock, Mike; Colt, Cody; sandy.eccker@co.thurston.wa.us; Burnham, Mike; Kim Gubbe; erin.m.brewster@evergreen.edu; Schelling, Sarah; Medrud, Brad; Landon Hawes; Nevin, Cherie; bwilson@thurstonpud.org; Ginther, David; Casey Mauck
Subject: Hazard Mitigation Plan for the Thurston Region
Date: Monday, October 18, 2021 2:27:38 PM

External Email Use caution before clicking links, opening attachments, or replying.

Dear Community Leader,

On behalf of the Thurston County Emergency Management Council, I invite your community to participate in the update to the Fourth Edition *Hazards Mitigation Plan for the Thurston Region*. Storms, flooding, fires, earthquakes, landslides, volcanic activity, and the effects of climate change will impact our communities. Thurston County has received 24 Presidential Disaster Declarations since 1965, with the latest declaration issued for the 2020 Nisqually River flood event. In 2021, we witnessed international headline events for severe rainstorms and wildfires that were more severe and destructive than any in recent recorded history.

Our region's hazard mitigation plan is a multi-jurisdictional risk assessment and strategy that identifies and prioritizes sustained measures, that if enacted, will help our communities reduce losses. States, local governments, and tribes must also perform hazard mitigation planning, adopt federally approved plans, and update them every five-years as a precondition for receiving funding from multiple federal mitigation assistance grant programs. These programs can help our communities implement projects that make us safer and more disaster resilient. A 2017 Report from the National Institute of Building Sciences estimates that for every federal mitigation grant dollar invested, four dollars will be saved in loss prevention.

The current plan is due for an update by August 2022. Thurston County Emergency Management and Thurston Regional Planning Council (TRPC) secured a FEMA Pre-Disaster Mitigation grant to update our region's plan. The plan update process is expected to launch in November 2021 and take approximately 12 to 15 months to complete.

Organizations that elect to participate in the process should appoint a lead and alternate staff representative to participate in a multi-agency planning workgroup. Now is also a good time to consider key staff and stakeholders who can provide multidisciplinary subject matter expertise and important voices to identify hazard reduction strategies within your community.

To confirm your organization's commitment to the plan update process or to learn more, please contact **Paul Brewster**, Senior Planner at TRPC, and share who will represent your organization in the plan update process: brewstp@trpc.org or 360-741-2526.

Sincerely,

Todd Stancil, Police Chief
Chair, Thurston County Emergency Management Council
360.458.5701
www.yelmwa.gov

City of Yelm
est. 1924
WASHINGTON

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The current plan is due for an update by August 2022. Thurston County Emergency Management and Thurston Regional Planning Council (TRPC) secured a FEMA Pre-Disaster Mitigation grant to update our region's plan. The plan update process is expected to launch in November 2021 and take approximately 12 to 15 months to complete.

Organizations that elect to participate in the process should appoint a lead and alternate staff representative to participate in a multi-agency planning workgroup. Now is also a good time to consider key staff and stakeholders who can provide multidisciplinary subject matter expertise and important voices to identify hazard reduction strategies within your community.

To confirm your organization's commitment to the plan update process or to learn more, please contact Paul Brewster, Senior Planner at TRPC, and share who will represent your organization in the plan update process: brewstp@trpc.org or 360-741-2526.

Sincerely,

Todd Stancil

Todd Stancil
City of Yelm Police Chief
Chair, Thurston County Emergency Management Council

- **Hazards Home**
- **Fourth Edition Update**
- **Plan Documents**

Home › Plans & Projects › Environment › Hazards Mitigation Plan › Fourth Edition Update

COMING SOON: 4th Edition of the Hazards Mitigation Plan for the Thurston Region

Hazard Mitigation Workgroup

The Hazard Mitigation workgroup will be meeting regularly throughout 2022-2023 to help identify potential mitigation stakeholders, share ideas and resources, and review the draft plan. Meetings will be held over Zoom and are open to the public.

Hazard Mitigation Planning Participants

Get Involved

- Watch or attend a Workgroup meeting
- Send in Public Comment
- Read the results of the Communitywide Survey

Meeting Materials

- June 26, 2023
- May 22, 2023
- April 24, 2023
- March 27, 2023
- February 27, 2023
- January 23, 2023
- November 28, 2022
- October 24, 2022
- September 26, 2022
- July 25, 2022
- May 23, 2022
- April 25, 2022
- March 28, 2022
- February 28, 2022

Partner Resources

- Local Mitigation Planning Policy Guide (FEMA)
- The Role of Local Leadership (FEMA)
- Integrating Hazard Mitigation Tools Into Local Planning (FEMA)
- Building Community Resilience with Nature-Based Solutions (FEMA)
- Local Mitigation Planning Handbook (FEMA)
- Local Mitigation Plan Review Tool (FEMA)
- National Risk Index Map (FEMA)


¿Cómo podemos hacer que las comunidades del condado de Thurston sean más resistentes a las catástrofes?
Chúng ta có thể làm gì để các cộng đồng Quận Thurston trở nên kiên cường hơn trước thảm họa?
어떻게 하면 Thurston 카운티 지역 사회의 재해 복구 능력을 높일 수 있습니까?
www.trpc.org/HAZARDS
thurston regional planning council
How can we make Thurston County communities more disaster resilient?
Take the Survey!

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HOMEPAGE

Thurston County wants to be prepared for natural disasters. Here's how to help

BY TY VINSON

JULY 11, 2022 5:00 AM

Sea level rise is expected to cause more frequent and widespread flooding in Olympia's downtown. BY AMELIA DICKSON

Only have a minute? Listen instead
Powered by Trinity Audio
00:00 1.0x 02:54

If you live in the South Sound, you probably already know of the likelihood for natural disasters to strike. Thurston County is at risk of earthquakes, floods, tsunamis, wildfires and volcanic hazards.

The Thurston Regional Planning Council is starting to draft the county's fourth edition of its Hazards Mitigation Plan, so when disaster strikes, residents across the region will be prepared.

Tumwater City Planner Brad Medrud gave a presentation to Tumwater City Council on June 28 to lay out the city's role in the county planning process.

"We have a lot of opportunities for natural disasters in our community," Medrud said. "The purpose of mitigation is to identify and implement actions that eliminate long-term risks to life and property before they occur."

He said some of the planning simply includes determining where buildings can and can't be built in the future in regards to floodplains. Building codes have to be up to date to ensure buildings can withstand earthquakes or other natural disasters. Tumwater, as well as other cities in the county, have specific sections in the plan that lay out mitigation.

For example, if data were to show a vital area or building would suffer from major flooding in a disaster event, mitigation could include elevating or removing those structures so they take on less. And this type of planning can regulate future development in those areas.

More than 20 local jurisdictions, including cities, school districts, LOTT and other special districts are involved in updating the mitigation plan. They're required by law to update their plan every five years to maintain eligibility for federal grant programs to fund mitigation, Medrud said.

The previous plan, published in 2017, included a community profile of Thurston County, different hazards risk assessments, strategies on how to implement mitigation efforts and more. Medrud said the county doesn't expect much to change in regards to strategies and implementation.

City spokesperson Ann Cook said if anything, they may find that will be additional hazards or the risk level of others may change.

The 2017 plan says the region's planning partners have made steady progress toward fulfilling mitigation goals so far. But the original plan had a goal fulfillment date of 2025, which is now right around the corner.

"Although the original plan sets a goal fulfillment date of 2025, most of the plan objectives will require continuous efforts throughout the region," it reads.

A community survey is available for residents of Thurston County and any jurisdictions within it. It asks people what hazards they're concerned about and how they want their city and county to take action to reduce losses. It can be found on the TRPC's website until July 31.


TY VINSON
360-357-0201

Conversation

HAZARDS
MITIGATION PLAN
FOR THE THURSTON REGION

Thurston County Communities
Natural Hazards and Resiliency Survey

Results

Prepared by Thurston Regional Planning Council

Natural Hazard Mitigation Plan for the Thurston Region, 4th Edition Update

September 2022

Acknowledgements

Thurston County would like to thank and acknowledge the Washington Military Department's Emergency Management Division and the Federal Emergency Management Agency (FEMA) for its financial support of CFDA No. 97.047 for this project. This publication does not constitute an endorsement by FEMA or reflect FEMA's views or policies.

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Contents

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Thurston County Communities Natural Hazards and Resiliency Survey – Results

Project Overview

Over 20 local governments in Thurston County including municipalities, special purpose districts, and colleges are partnering with Thurston Regional Planning Council (TRPC) to update the Hazards Mitigation Plan for the Thurston Region. The planning process identifies and assesses communities' risks and vulnerabilities to natural hazards and prioritizes mitigation strategies to reduce these risks. It is critical to engage the public throughout the planning process to understand what risks community members are most concerned about, and the types of actions they want to be implemented to improve public safety.

Survey Purpose

Plan partners selected an online survey format to conduct the first round of public input to inform the multi-jurisdictional plan update. The survey included 12 questions about perceived risk and preferred mitigation activities. Eight additional questions sought demographic information from participants. The survey was available to the public from June 6 – July 31, 2022. The survey was available in English, Korean, Spanish, and Vietnamese. The full survey can be found in **Appendix C: Community Survey**.

Survey Promotion and Outreach Activities

The survey was hosted on TRPC's website and promoted with a variety of outreach methods shown Table 1. All the plan partners were encouraged to notify their constituents about the survey through their agency social media accounts, electronic newsletters, utility bills, email messages, and during in-person community events. Additional outreach activities performed by project partners may not be show in Table 1.

Table 1. Summary of outreach methods used to promote the survey

Method	Description	Timing
TRPC Webpage	A graphic on the website homepage directed to the survey link.	June 6 – July 31
Facebook	An advertisement for the survey was boosted throughout the region.	June 6 – July 31
Timberland Regional Library newsletter	A note about the community survey was included in TRL's June digital newsletter.	June
South Thurston Economic Development Institute	Staff gave an announcement at the meeting.	June 18
Swede Day	Staff handed out bookmarks with a QR code to the survey at the event and posted a large QR code on a fire engine in the parade.	June 18
Yelm Prairie Days	Staff handed out bookmarks with a QR code to the survey at the event.	June 25
Lacey PolyFest	Staff handed out bookmarks with a QR code to the survey and provided iPads for guests to complete the survey onsite.	June 25
Scott Lake Community Annual Celebration	Staff handed out bookmarks with a QR code to the survey at the event.	June 25

Hazards Mitigation Plan for the Thurston Region – 4th Edition Update
Thurston County Communities Natural Hazards and Resiliency Survey Results

Method	Description	Timing
Intercity Transit July Rider News	A note about the community survey was included in IT's July digital newsletter.	July
Timberland Regional Library Sandwich Boards	Sandwich boards were put in the entries of all Timberland Regional Library locations in Thurston County. The board included a QR code to the survey and staff contact information.	July 8 – July 31
South Sound BBQ	Staff handed out bookmarks with a QR code to the survey and provided iPads for guests to complete the survey onsite.	July 9

This table does not include all activities conducted by plan partners.

Total Responses

668 people participated in the survey. There was one response to the Korean language version. There were no requests for paper versions of the survey.

Who took the survey?

- The highest response rates came from the communities of Olympia, Unincorporated Thurston County, and Lacey respectively (see Table 2).
- Homeowners are over-represented in the survey compared to the respondents who rent.
- 89% of survey respondents are white, and with every other race under-represented compared to the proportion of the county population they make up.
- One out of ten respondents indicated they have a disability.
- 61% of respondents have a household income of $75,000 or more.

*Table 2. Total Responses by Area of Residence**

Community	Responses
Bucoda	9
Lacey	96
Olympia	187
Rainier	7
Tenino	7
Tumwater	55
Yelm	16
Unincorporated Thurston County	188
Outside Thurston County	9
No Response	100
Total Responses	668

*As indicated by respondents

Hazards Mitigation Plan for the Thurston Region – 4th Edition Update
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Results - Hazard Awareness

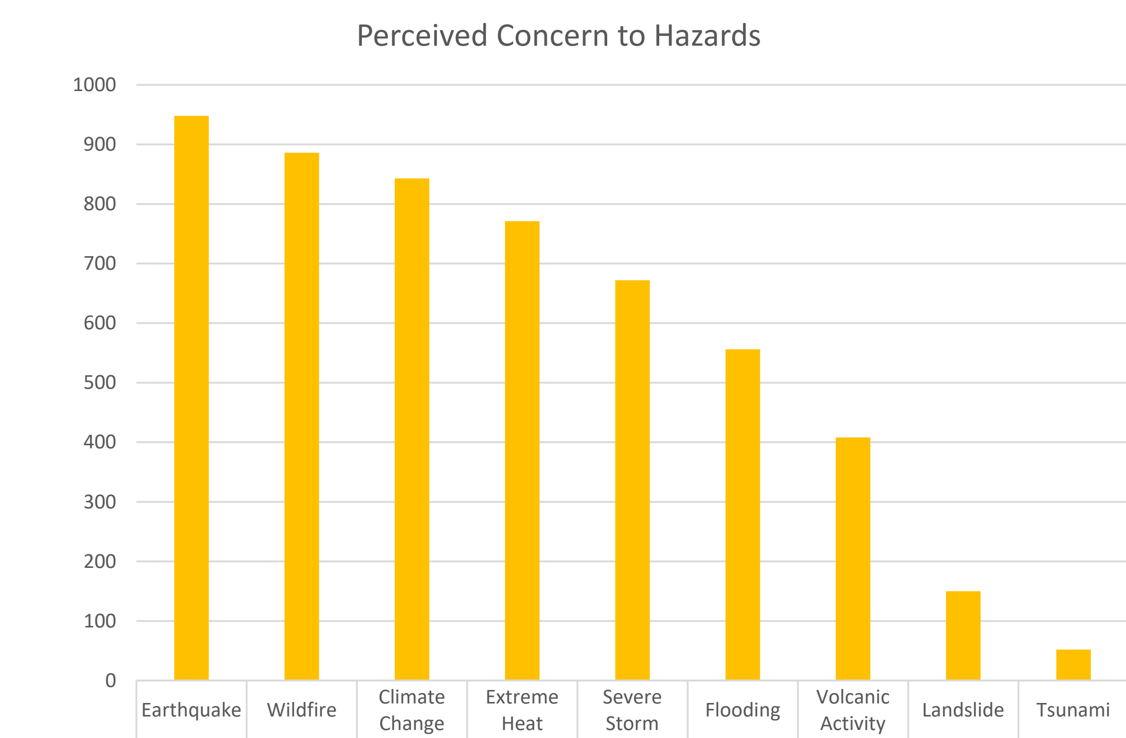
Question 1. How concerned are you about the effects of the following natural hazards impacting your community?

Respondents' level of concern for natural hazards varies based on the community they live in. The following figures rank the level of concern for each Thurston County municipality. All responses are weighted as follows: +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" are neutral and don't add or subtract from the total.

Countywide

Collectively, respondents throughout Thurston County are most concerned about earthquake with wildfire and climate change following closely. Extreme heat, severe storm, and flooding were of moderate concern while volcanic activity, landslide, and tsunami were ranked the lowest. It is important to note, during the survey period an extended heat wave occurred, which may have influenced the high rating for the extreme heat hazard.

Figure 1. Perceived concern to natural hazards in Thurston County.



	Earthquake	Wildfire	Climate Change	Extreme Heat	Severe Storm	Flooding	Volcanic Activity	Landslide	Tsunami
Total Concern	948	886	843	771	672	556	408	150	52

Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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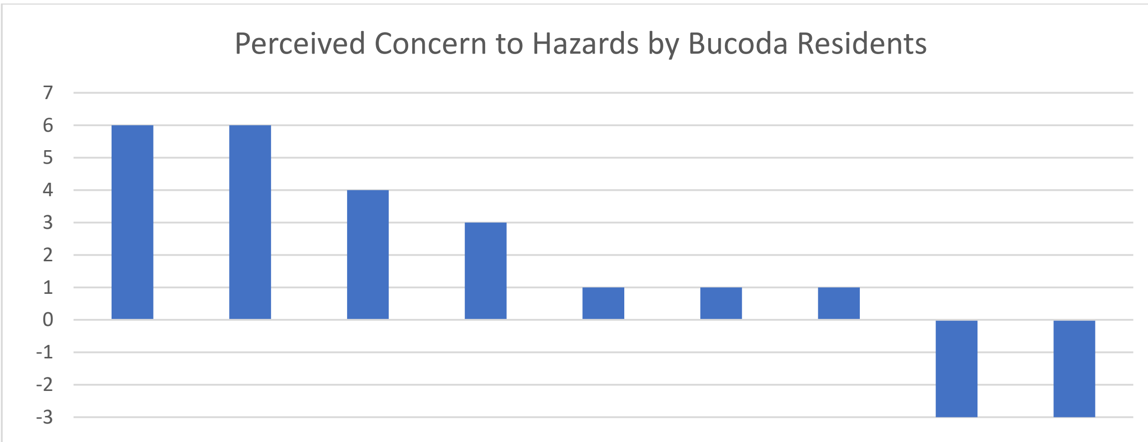
Bucoda

Respondents in Bucoda are most concerned about landslides and tsunamis, with flooding and earthquakes following close behind. Wildfire and extreme heat are the only hazards where respondents "not concerned" responses outweighed respondents who do exhibit concern. With only three respondents from Bucoda, the sample size is too low for the results to represent the whole community.

Figure 2. Perceived concern to natural hazards in Thurston County by residents of Bucoda.



	Landslide	Tsunami	Flooding	Earthquake	Climate Change	Severe Storm	Volcanic Activity	Wildfire	Extreme Heat
■	6	6	4	3	1	1	1	-3	-3

Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total

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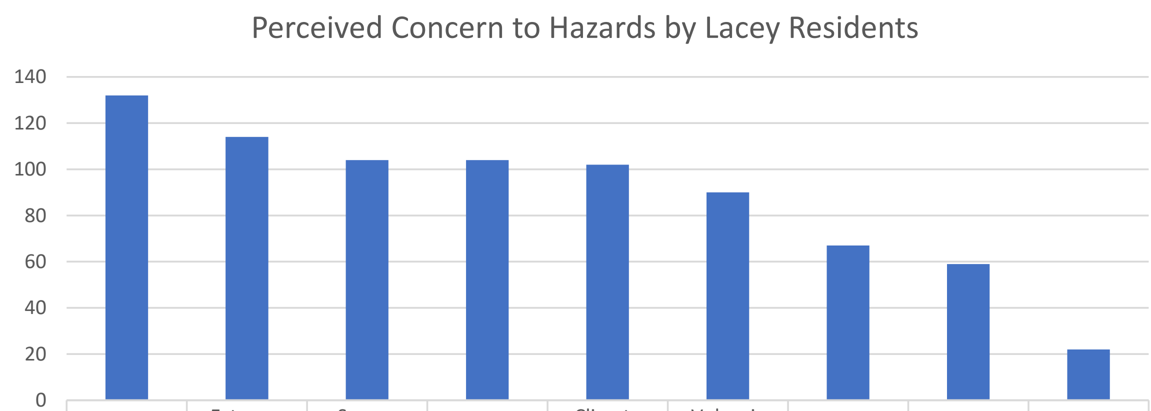
Lacey

Respondents in Lacey rank earthquake as the highest hazard of concern, similar to the countywide response, but rank extreme heat and severe storm higher than climate change and wildfire. Tsunamis and landslides were the hazards of lowest concern.

Figure 3. Perceived concern to natural hazards in Thurston County by residents of Lacey.



	Earthquake	Extreme Heat	Severe Storm	Wildfire	Climate Change	Volcanic Activity	Flooding	Tsunami	Landslide
■	132	114	104	104	102	90	67	59	22

Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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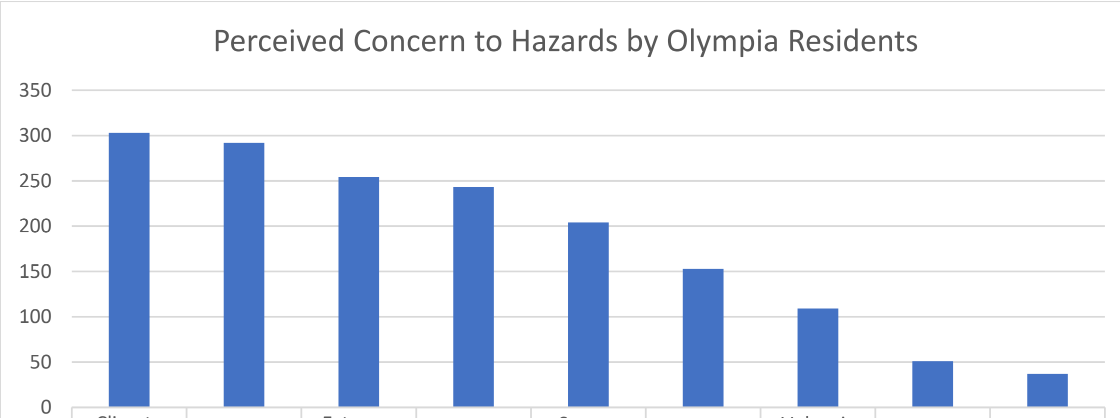
Olympia

Residents of Olympia are most concerned about climate change, with earthquake and extreme heat following close behind. Like other communities, landslides and tsunamis ranked lowest.

Figure 4. Perceived concern to natural hazards in Thurston County by residents of Olympia.



	Climate Change	Earthquake	Extreme Heat	Wildfire	Severe Storm	Flooding	Volcanic Activity	Landslide	Tsunami
■	303	292	254	243	204	153	109	51	37

Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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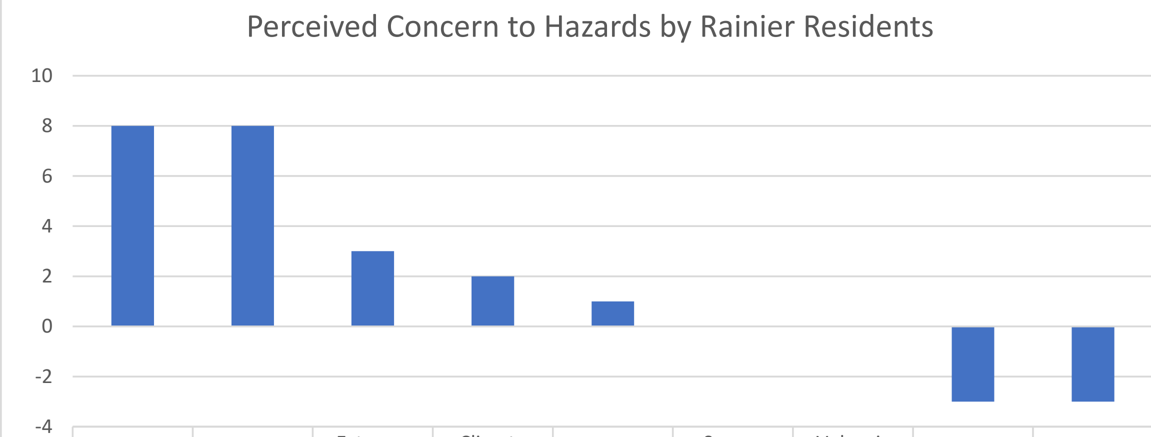
Rainier

Respondents in Rainier are most concerned about earthquake and wildfire. Landslides and tsunamis are the only hazards where respondents indicated "not concerned" outweighed respondents who exhibited concern. Portions of Rainier are affected by high groundwater flooding but is not included in the 100-year and 500-year Flood Insurance Rate Map. As such, respondents did not rate flooding as a high concern. With only 7 respondents from Rainier, the sample size is too low for the results to represent the whole community.

Figure 5. Perceived concern to natural hazards in Thurston County by residents of Rainier.



	Earthquake	Wildfire	Extreme Heat	Climate Change	Flooding	Severe Storm	Volcanic Activity	Landslide	Tsunami
■	8	8	3	2	1	0	0	-3	-3

Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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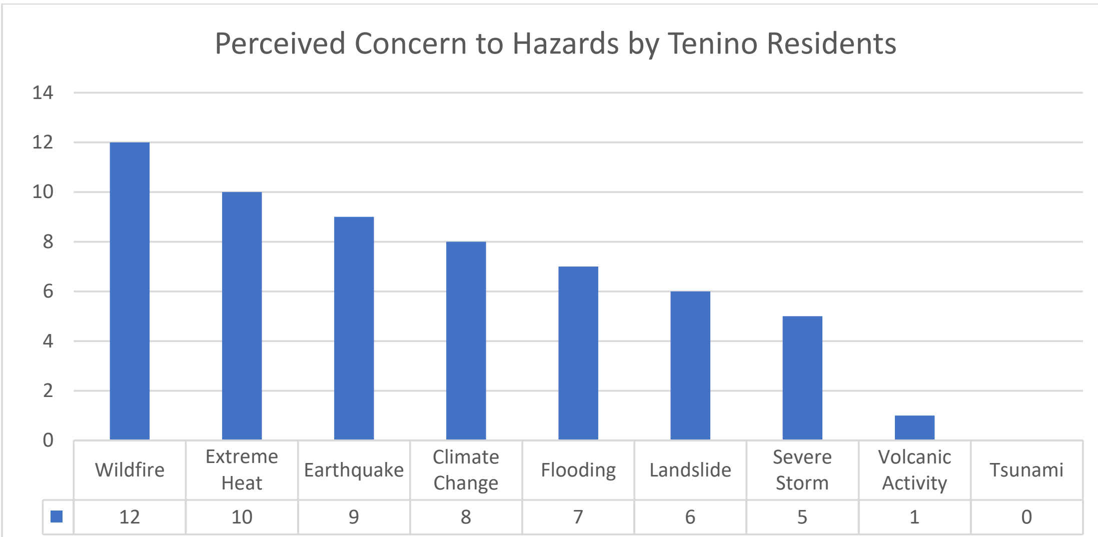
Tenino

Respondents in Tenino are most concerned about wildfire and extreme heat, with volcanic activity and tsunami rating low. Tenino's rural location and forested areas may contribute to the high rating of wildfire as a hazard of concern. With only seven respondents from Tenino, the sample size is too low for the results to represent the community.

Figure 6. Perceived concern to natural hazards in Thurston County by residents of Tenino.



Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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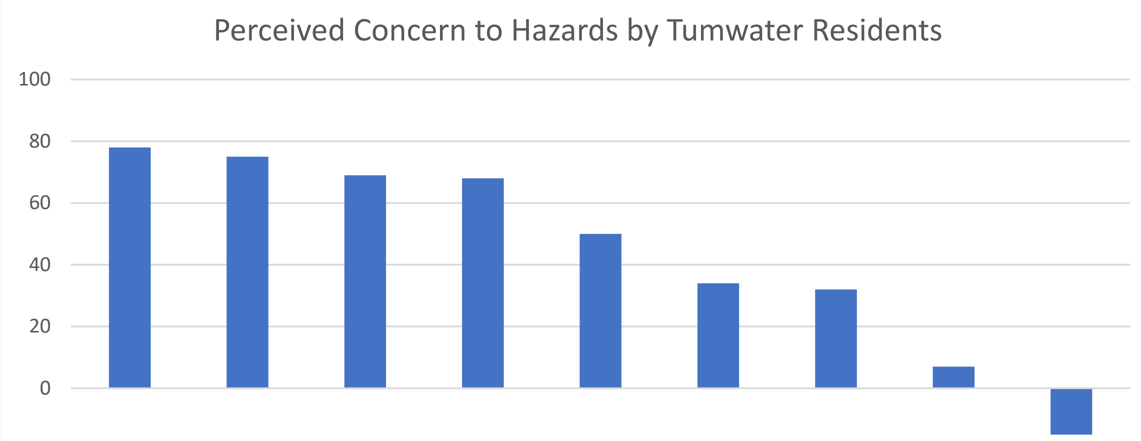
Tumwater

Respondents in Tumwater are most concerned about earthquakes and climate change, with wildfire and extreme heat closely behind. Landslide and tsunami garnered the lowest concern.

Figure 7. Perceived concern to natural hazards in Thurston County by residents of Tumwater.



	Earthquake	Climate Change	Wildfire	Extreme Heat	Severe Storm	Flooding	Volcanic Activity	Landslide	Tsunami
■	78	75	69	68	50	34	32	7	-15

Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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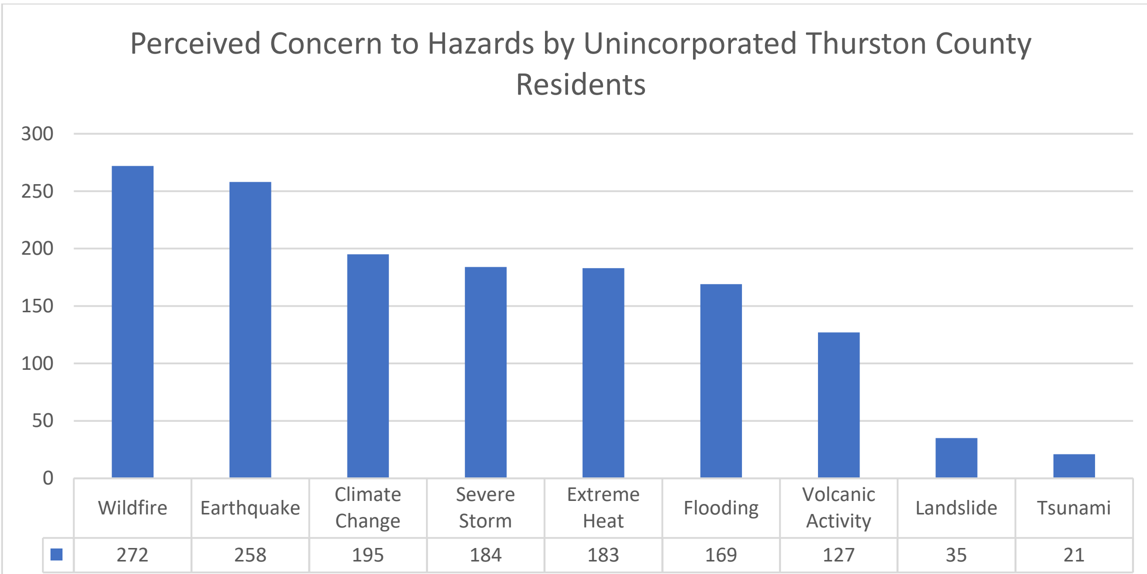
Unincorporated Thurston County

Unincorporated Thurston County respondents' hazards of concerns almost exactly match the collective countywide ranking, with wildfire and earthquake topping the list while landslide and tsunami fell to the bottom. Notably, flooding is the most prevalent hazard in Thurston County, but it ranked 6th by respondents.

Figure 8. Perceived concern to natural hazards in Thurston County by residents of Unincorporated Thurston County.



Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

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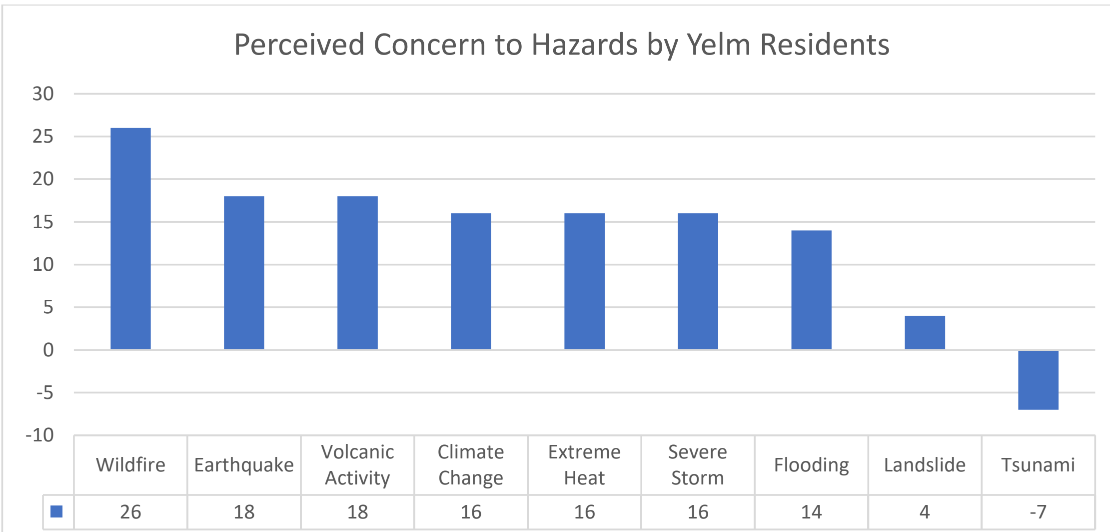
Yelm

Respondents in Yelm are most concerned about wildfire. Earthquake, volcanic activity, climate change, extreme heat, and severe storm follow closely behind. Yelm's proximity to Mount Rainier may contribute to the higher rating of volcanic activity. However, with only 16 respondents from Yelm, the sample size is insufficient to represent the whole community.

Figure 9. Perceived concern to natural hazards in Thurston County by residents of Yelm.



Responses are weighted +2 for "Very Concerned", +1 for "Somewhat Concerned", and -1 for "Not Concerned". Responses of "No Opinion" did not add or subtract from the total.

Hazards Mitigation Plan for the Thurston Region – 4th Edition Update
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Results – Community Vulnerability

The survey included six open-ended questions about vulnerabilities and solicited possible solutions to reduce problems within the planning area.

Question 2. Are there are any other hazards not listed above that you are concerned about?

142 respondents elected to respond to this question. The most common hazards of concern included:

- Disease or Epidemic (17 responses)
- Infrastructure Failure (14 responses)
- Drought (13 responses)

Several responses were focused around social or political issues that are unrelated to natural hazards including:

- Criminal Activity or Civil Unrest (18 responses)
- Political Ideologies (14 responses)
- Development (7 responses)
- Homelessness (4 responses)

Questions 3 through 7 sought additional details about areas of vulnerability in the region:

- *Question 3. Are you aware of any areas within the greater Thurston County region that are vulnerable to natural hazards?*
- *Question 4. Where in the region is this vulnerability located? Please describe with landmarks, cross-streets, or any other identifier?*
- *Question 5. What is the vulnerability?*
- *Question 6. Who does this vulnerability affect?*
- *Question 7.What possible solutions do you see to the problem you described above?*

260 respondents answered questions 3 through 7 and offered feedback about specific vulnerabilities in the region. Most responses reiterated general concerns about flooding, earthquake, and wildfire risks throughout the region, with special mention given to rural or forested areas and areas bordering waterbodies. Many respondents called attention to the section of I-5 that crosses the Nisqually Delta, and the risk that sea level rise poses to all areas bordering the South Puget Sound.

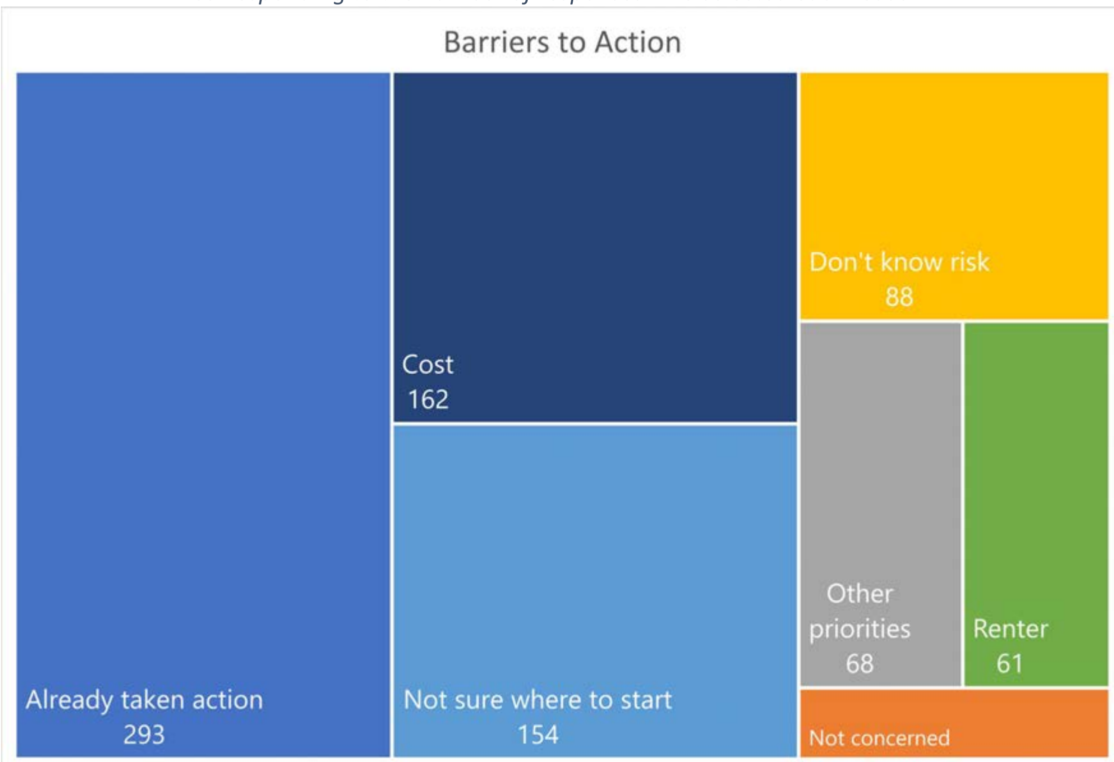
Full responses are sorted by jurisdiction, and a list of regional responses, can be found in **Appendix A: Specific Vulnerabilities by Geographic Area.** Some responses for Unincorporated Thurston County are relevant to portions of Bucoda, Rainier, Tenino, and Yelm .

Results – Barriers to Hazard Preparedness

Q8. What barriers prevent you from taking steps to achieve greater personal preparedness for natural disasters, or to reduce your household's risks from the impacts of hazards? Please select all that apply.

Over 290 respondents indicated they have already taken action to reduce their personal risks to hazard impacts. Cost and not knowing where to start were nearly evenly divided as factors preventing people from taking action to reduce their risks. A lack of concern, and renter status, were the least commonly indicated barriers. Figure 10 shows the breakdown of barriers to action.

Figure 10. Barriers to taking actions to reduce personal risks to hazards, with the shape size corresponding to the number of responses who selected each reason.



Q9. How do you currently receive information about hazards in your community? How would you prefer to receive information? Choose all that apply.

Respondents rank local or regional news as the method they most commonly already use to receive information about hazards, and the method they most commonly prefer to use. This is closely followed by local or state government, and other methods. Thurston County Community Alerts was a method that roughly one-third of respondents already use, and 113 respondents indicated that they prefer it. Neighborhood groups and church or faith-based organizations rated lowest of methods that people both currently and prefer to use to receive hazard information.

When respondents completed the survey, they were automatically redirected to the Thurston County Community Alerts registration page. Figure 11 shows respondents' preferences for methods of receiving hazard information.

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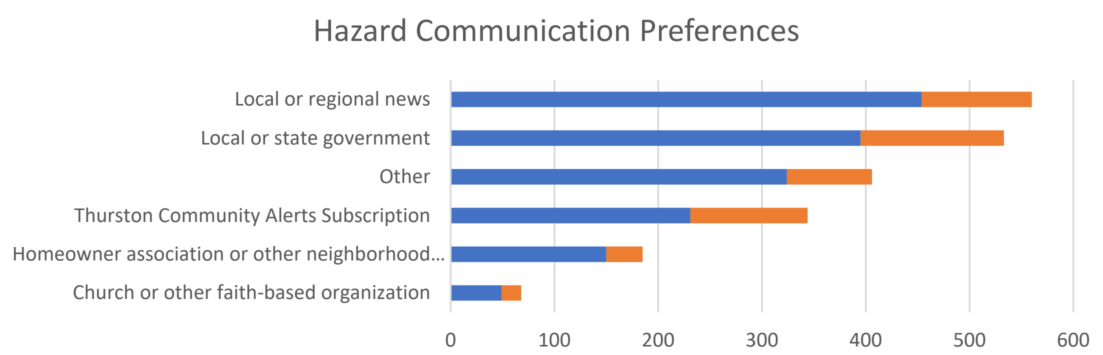
Figure 11. Communication methods that respondents currently use and prefer to use to receive information about hazards.



	Church or other faith-based organization	Homeowner association or other neighborhood groups	Thurston Community Alerts Subscription	Other	Local or state government	Local or regional news
Currently Use	49	150	231	324	395	454
Prefer to Use	19	35	113	82	138	106

Currently Use   Prefer to Use

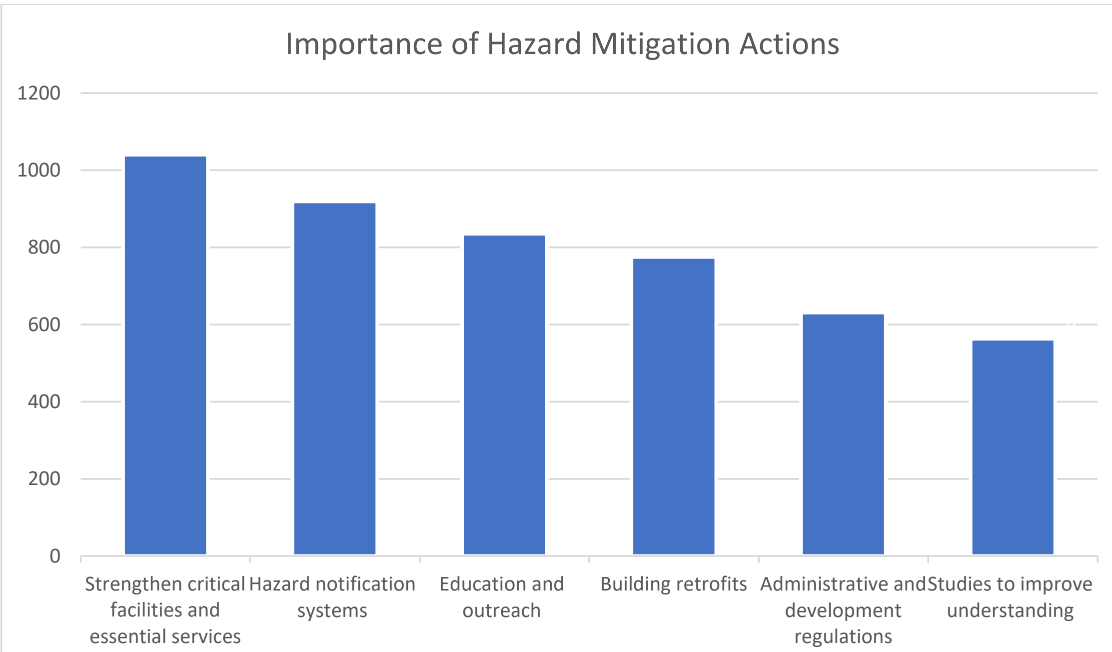
Hazards Mitigation Plan for the Thurston Region – 4th Edition Update
Thurston County Communities Natural Hazards and Resiliency Survey Results

Results – Hazard Reduction Activities

Q11. How important is it to you for local governments to focus on the following hazard reduction activities?

Community members were asked to rank, by level of importance, various categories of hazard mitigation actions that local agencies could focus on. Strengthening critical facilities and essential services topped the list, with hazard notification systems and education and outreach activities following. Administrative and development regulations, and studies to improve understanding, rated lowest. Figure 12 shows the ranking of mitigation actions by type.

Figure 12. Importance of local government hazard mitigation actions



Responses are weighted +2 for "Very Important", +1 for "Somewhat Important", and -1 for "Not Important". Responses of "No Opinion" did not add or subtract from the total.

There are no significant differences in responses regarding hazard mitigation activities by income level. Respondents of every income category except $14,999 or lower rated strengthening critical facilities and essential services highest, and most income categories rated studies to improve understanding as the action of lowest importance. Respondents earning less than $14,999 in household income rated hazard notification systems as the action of highest importance. Respondents with household incomes of $34,999 or lower rated administrative and development regulations slightly lower than studies to improve understanding. Figure 13 shows the importance of mitigation actions based on respondents' annual household income.

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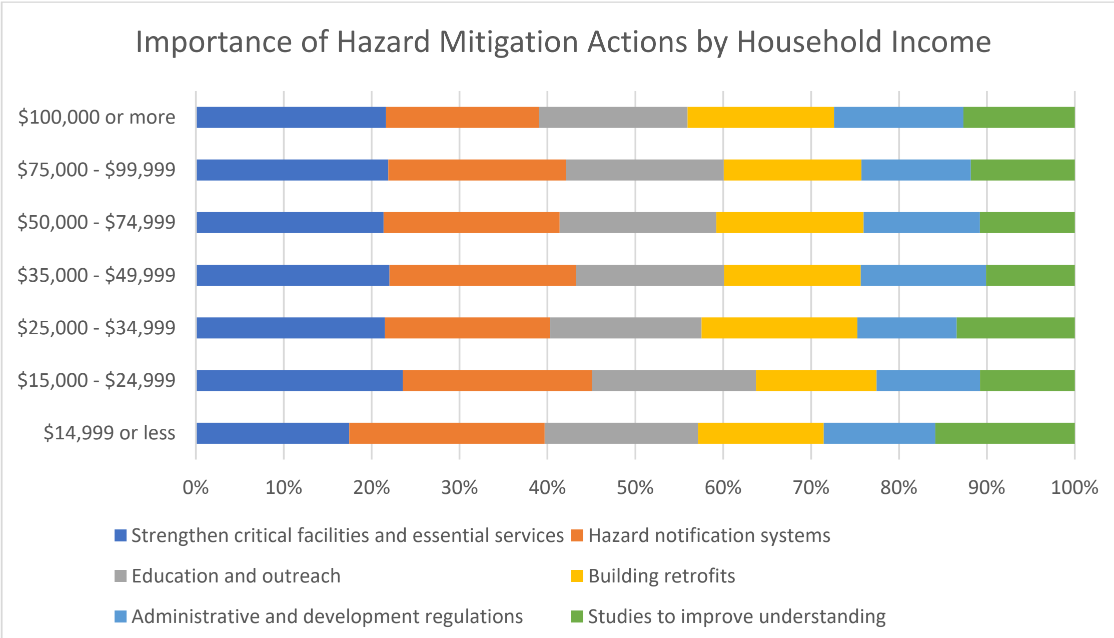
Figure 13. Importance of hazard mitigation actions by household income



Responses are weighted +2 for "Very Important", +1 for "Somewhat Important", and -1 for "Not Important". Responses of "No Opinion" did not add or subtract from the total.

Q11. Is there anything else you would like to share about improving disaster resiliency in your community?
169 respondents chose to provide additional feedback. Full responses can be seen in **Appendix B: Additional Notes**. Common themes include additional opportunities for education, training, or other means to understand and prepare for household risks. Many responses focused on preparedness, rather than hazard mitigation, and a need for better evacuation planning, notification systems, and communication in general between governments and residents.

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Thurston County Communities Natural Hazards and Resiliency Survey Results

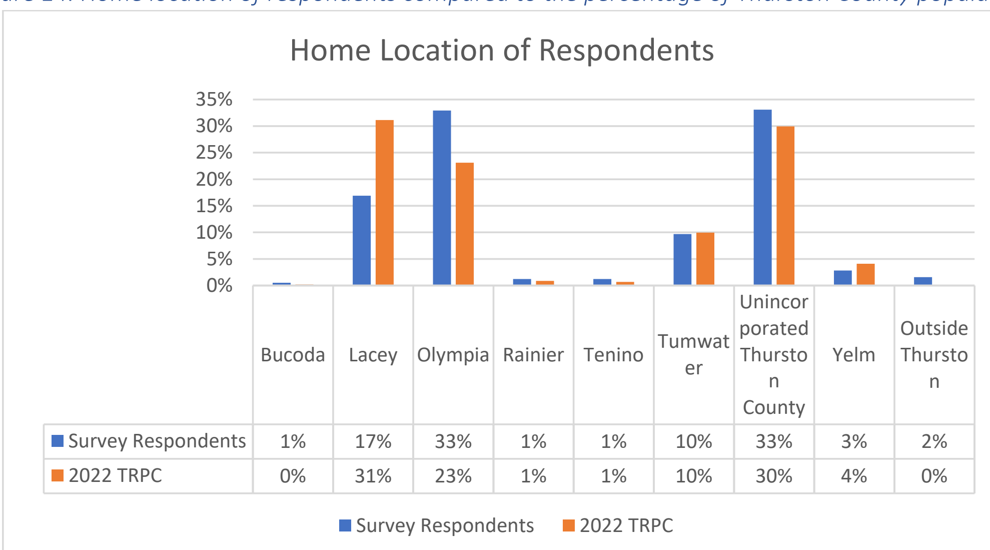
Results – Demographics

Respondents were asked to voluntarily share information about themselves. The section summarizes the respondents' demographic information.

Q13. Where do you live?

Most survey respondents reside in Olympia or Unincorporated Thurston County, which includes the communities of Rochester and Grand Mound. The communities of Bucoda, Rainier, Tenino, Tumwater, Unincorporated Thurston County, and Yelm had proportions of survey respondents that closely matched the percentage of residents from each community in the county total. Olympia's survey respondents significantly outweighed the percentage of county residents, while Lacey had a significantly lower percentage of respondents than their proportion of county residents.

Figure 14. Home location of respondents compared to the percentage of Thurston County population.



	Bucoda	Lacey	Olympia	Rainier	Tenino	Tumwater	Unincorporated Thurston County	Yelm	Outside Thurston
Survey Respondents	1%	17%	33%	1%	1%	10%	33%	3%	2%
2022 TRPC	0%	31%	23%	1%	1%	10%	30%	4%	0%

Source: TRPC 2022 Population Estimates.

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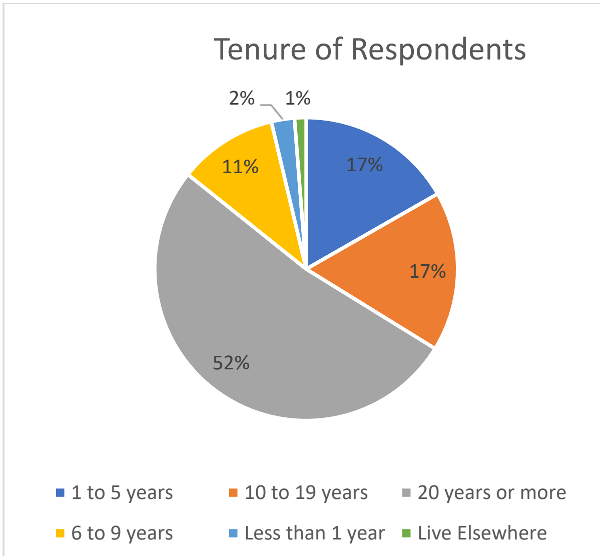
Q14. How long have you lived in the Thurston County area?

Most survey respondents have resided in Thurston County at least 20 years, while only small percentages of respondents have resided in the county for less than one year.

Figure 15. Length of time respondents have resided in Thurston County.



Q15. What is your current housing situation?

The majority of respondents own homes, rather than renting or other arrangements. Renters are underrepresented in the survey. Hazard mitigation priorities may be greatly affected by housing status, as renters may have less ability to retrofit their homes or conduct other personal preparedness activities. Figure 16 shows respondents stated housing status compared to actual population estimates.

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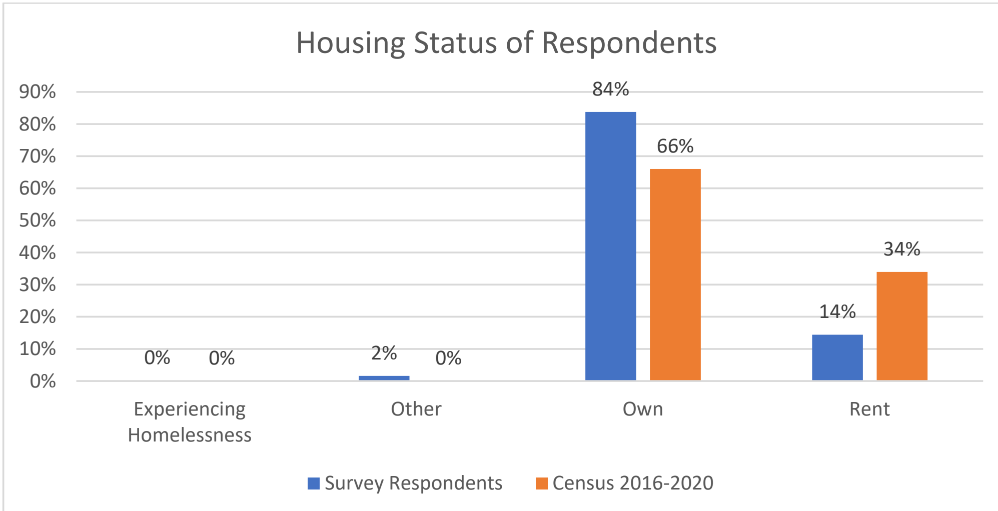
Figure 16. Respondents' housing status compared to Thurston County's population.

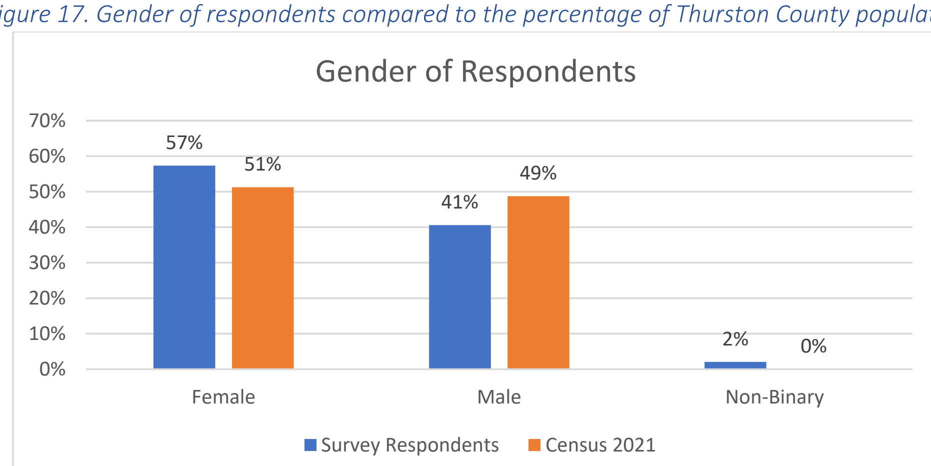


Source: US Census Bureau ACS 5-year Estimates, 2016-2020.

Q16. What is your gender?

Women are slightly overrepresented in survey results, while men are slightly underrepresented. Two percent of survey respondents indicated their gender as non-binary. There are no reliable estimates of the population that self-reports as non-binary residents, as the U.S. Census does not collect this data.

Figure 17. Gender of respondents compared to the percentage of Thurston County population



Source: Washington State Office of Financial Management, Postcensal Estimates 2021.

Q 17. What is your age range?

Adults ranging from 40-84 years are overrepresented in the survey results, while youth and adults over 85 are underrepresented. Respondents of ages 25-39 were slightly underrepresented, though the proportion of survey respondents is close to the percentage of the populations' age ranges overall.

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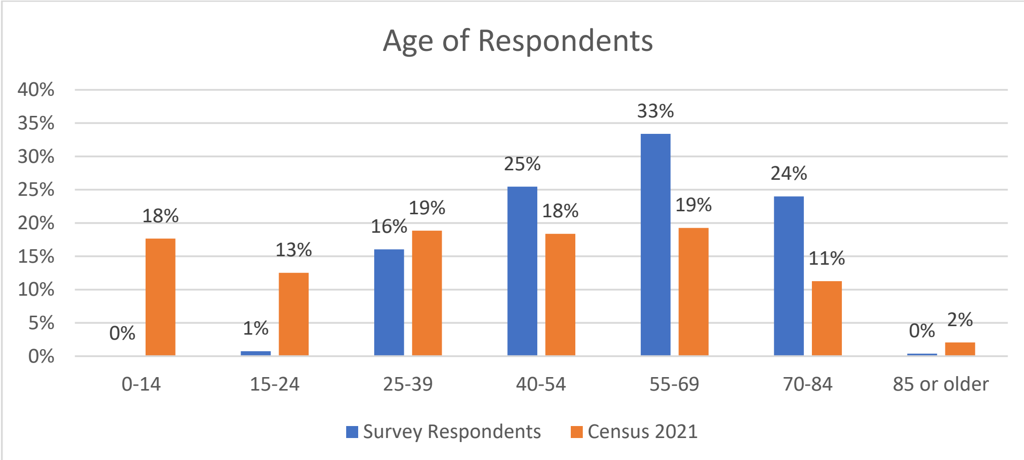
Figure 18. Age of respondents compared to the percentage of Thurston County population.

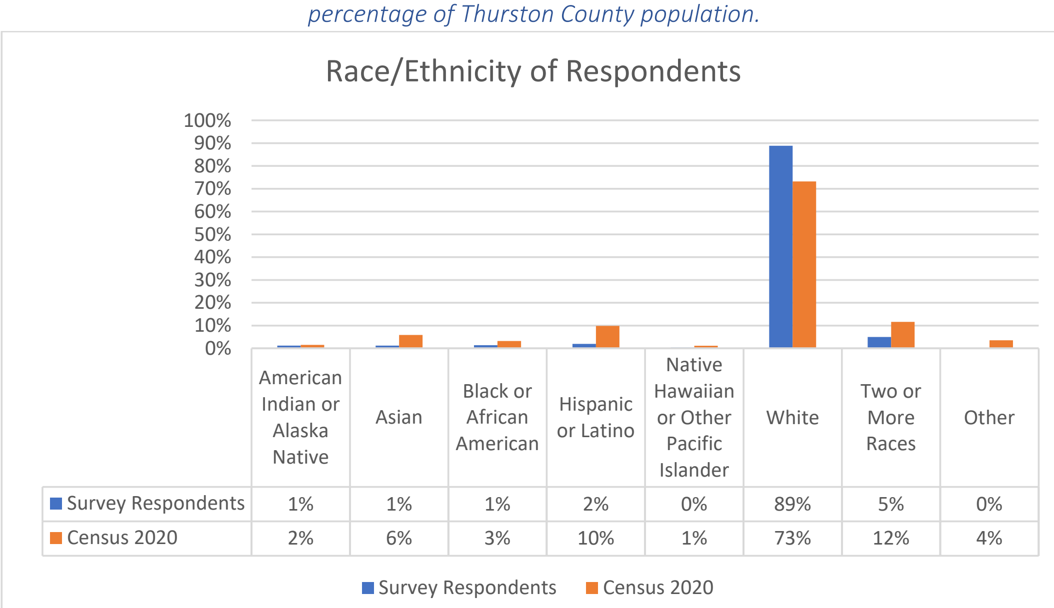


Source: Washington State Office of Financial Management, Postcensal Estimates 2021.

Q18. What is your race/ethnicity? Please select all that apply.

The majority of survey respondents are white, over representing the portion of actual white residents who live in Thurston County. All other races are underrepresented, with the greatest disparities in Asian, Hispanic, or Latino, and multiracial respondents.

Figure 19. Racial and ethnic composition of respondents compared to the percentage of Thurston County population.



Source: US 2020 Census.

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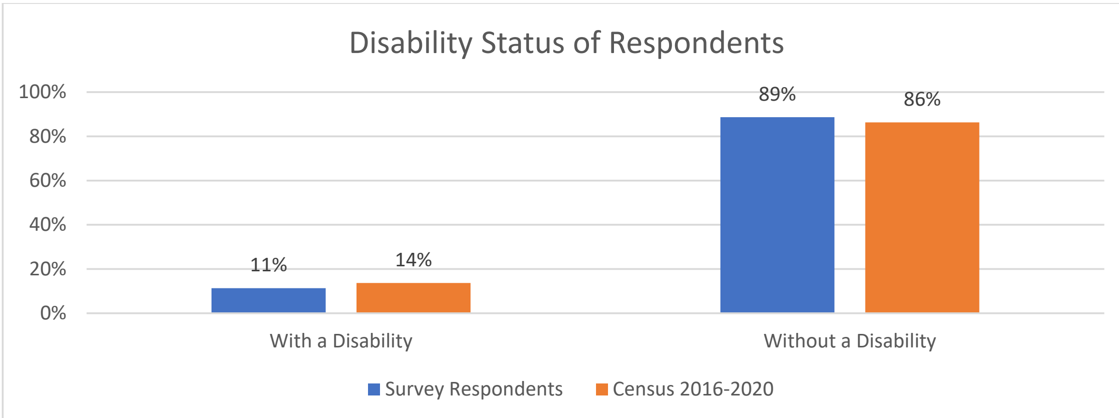
Q19. What disabilities do you experience? Please select all that apply.

The proportion of survey respondents who indicated that they have a disability stayed very close to the percentage of community members in the county that have a disability.

Figure 20. Disability status of respondents compared to the percentage of Thurston County population.

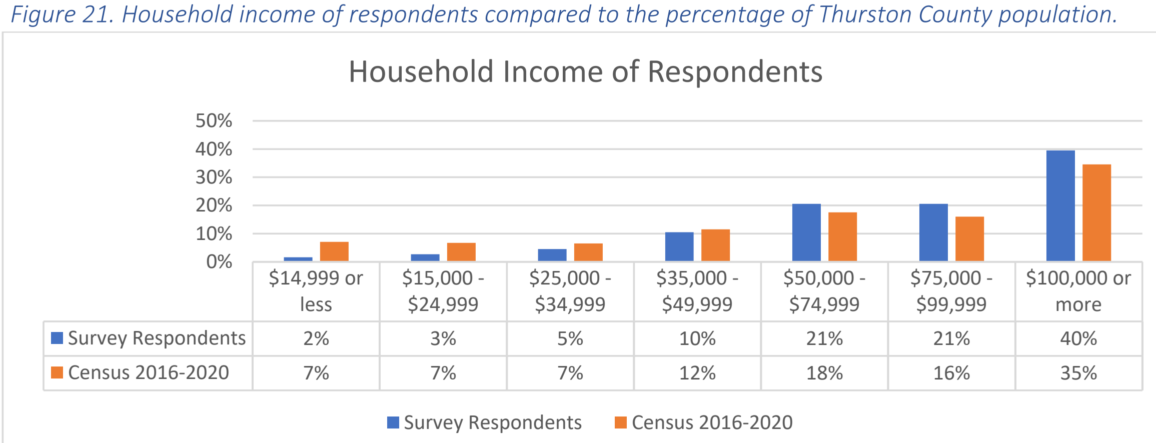


There may be differences in how the census defines disability and the wording of the survey question. Source: US Census Bureau ACS 5-year Estimates, 2016-2020.

Q20. What is your annual household income?

Overall, the amount of survey respondents grew as household income grew. This matches the overall trend of higher income households making up a larger portion of county residents than lower incomes, though when comparing the census estimates to the entire pool of survey respondents, higher income groups of $50,000 and up were overrepresented while income groups below $50,000 were all underrepresented. Household income can play a large role in how individuals experience and respond to hazards and disasters, and it will be important to remember that the survey results are primarily coming from folks in higher income groups.

Figure 21. Household income of respondents compared to the percentage of Thurston County population.



	$14,999 or less	$15,000 - $24,999	$25,000 - $34,999	$35,000 - $49,999	$50,000 - $74,999	$75,000 - $99,999	$100,000 or more
Survey Respondents	2%	3%	5%	10%	21%	21%	40%
Census 2016-2020	7%	7%	7%	12%	18%	16%	35%

US Census Bureau ACS 5-year Estimates, 2016-2020.

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Appendix A: Specific Vulnerabilities by Geographic Area

Countywide

Location	Description	Affected People	Solutions
landslides - Steep slopes. Soil Liquefaction - loose granular soils below the groundwater table (generally near water bodies. Earthquake - Buildings and structures not up to current codes.	Landslides - loss of roadways utilities and structures, Soil liquefaction loss of roadways utilities and structures. Earthquake - loss of roadways, utilities, and structures.	The economic and mobility impacts affect everyone.	Landslides - Enforce landslide zoning. Liquefaction - require seismic design of all structures and utilities. Earthquake - require all new and retrofit construction to meet current standards.,. This should include tiedown requirements for any new or retrofit residential construction.
Forested areas around Thurston County in general. We certainly have beautiful forests surrounding us. Wildfire is by far my biggest and most immediate concern. As well, soil erosion and rising waters along our Puget Sound coastline.	In the summers when it gets too dry and hot, we are sitting tinderbox. Rising waters in general will be affecting our downtown and coastal areas.	Wildfire really will affect everyone who is near its path.	Both concerns are hard to address. Controlling our rising waters is something we can address by slowing the warming of our environment and planet, which means less carbon footprints in general, across the world. Diminishing wildfire concerns is something I am curious to learn more about. I try to clear brush around areas I know of and can gain access to. But is there more we can do?
Things like fire and earthquake happen area wide, no specific location.	general		
Low lying			
Landslides along old hwy 99 between Oly and Tenino. Landslides along capitol lake. Tsunami and landslide hazards along the puget sound Shoreline. Earthquake	Roads, power, water, communications.	Earthquakes - everyone. Heat waves and storms - affects those with less access to air conditioning, shelter, back-up power and supplies. Volcanic ash:	The county should protect itself from lawsuits through notifying the ppl most at risk.

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Location	Description	Affected People	Solutions
vulnerability throughout the county with less hazard on basalt bedrock on Tumwater Hill. Heat wave and storm hazard throughout county, seasonally. Volcanic hazard from ashfall throughout county. Volcanic lahar hazard along edge of Thurston county in Nisqually valley.		everyone (if the wind blows thus way during an eruption). Lahar: affectd Nisqually valley communities. Tsunami: affects Shoreline communities and down town.	
Transportation corridors to major commerce/employment centers like downtown and West Olympia - such as I-5, Hwy 101, Cooper Point Rd & Black Lake Blvd, Harrison, Martin Way	Flooding, Earthquake, Volcanic activity. Impacts on I-5 anywhere in the region could have significant impacts (ie. Dupont train derailment back-up as example)	Anyone utilizing goods, products, and freight that is transported on I-5	Ability to rapidly adapt and deploy the marine terminal and Olympia Regional Airport as alternative methods of moving people and critical cargo in times of disaster response/recovery.
Rivers; Rock Candy Mountain (Hwy 8)	Flooding each year; clear cut trees create flooding zone(s)	Roads & bridges; homes & people who now have their wells messed up	Stop the clearcutting of trees anywhere.
homes and business throughout thurston county	power restoration	everyone cannot get gas, water or food or information.	partner with select community businesses to retrofit their business with back up generators etc so they can provide goods and services to the public during crisis. organize more communities to prepare so they can look after themselves and each other. offer low cost emergency preparedness items. Classes via zoom for prepardness.
Homes and businesses without air conditioning are all vulnerable to extreme heat, especially	Without shade and/or air conditioning people could overheat in their homes: heat stroke.	The elderly and People who are less likely or able to leave their homes to seek coolness	Trying to establish more shade trees in neighborhoods to create cooler microclimates.

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Location	Description	Affected People	Solutions
in neighborhoods without large trees to provide more effective shade.		elsewhere. Those without cars and living several blocks from a bus stop.	Neighborhood block watch type work to know those in your neighborhood and be able to check up on those who may be more vulnerable.
Everywhere	Earthquakes	Everyone	Develop a system to warn of earthquakes in advance. Myshake is a good start, but even more advanced warning. Also, encourage preparation (first aid, food, water, etc.) to survive if the bridges fall.
Anywhere near a river			
Landslides in the hilly region near SR 12. Floods in Nisqually River		Not allowing people to build in flood planes and at the base of steep slopes. Paying people to build back in the same spot instead of paying them to move elsewhere.	
The entire county is vulnerable to some of the natural hazards listed above, including climate change, extreme heat, earthquakes, wildfire smoke, etc. And areas near the coast (such as downtown Olympia) are vulnerable to flooding.	See above	Everybody in Thurston County in one way or another.	Planning and education
Anywhere where there is a lack of tree canopy, i.e. city business streets (heat islands), which includes all our major cities, regions around Deschutes, Woodland and Woodard Creeks for flooding, heavy treed areas (i.e. Lacey residential, or nearby forests) for severe storms.	Heat stroke (human and pet safety), flooding into residential or businesses (economic), downed trees in storms causing building damage or personal safety.	Obiviously people and animals, but certainly the most vulnerable populations: older residents, poorer populations, houseless populations, wildlife.	A more robust tree canopy, while making sure dangerous/unstable trees are removed and replaced with better species; encouragement for residential and business property owners to move farther away from riverbanks; local government insisting on shade trees

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Location	Description	Affected People	Solutions
			(or other canopy) in business areas.
Low-lying areas (flooding), wildland-urban interface communities (wildfire), everywhere (earthquakes, climate change, extreme weather/heat waves)	Individual physical health, damaged infrastructure (roads, housing, water supplies, etc.)	Everyone, but especially poor and unhoused people	Improving the resilience of our infrastructure, outreach to the community about preparation (e.g. earthquake preparedness planning), building more affordable housing, reducing carbon emissions
Everywhere, crime is all around us, from car prowlers to mail thieves to car thieves. Wild fires are a big threat in the dry summers anywhere we have trees and/or dry grass.	People trying to defend their property.	Home owners and renters.	More law enforcement and prosecution of the offenders.
Deschutes river	Flooding along river, roads, and properties	Public and private property owners	Floodplain restoration and flooding mitigation
All areas near Puget Sound, properties near rivers and streams, all Thurston County	Tsunami, flooding, earthquakes, storms	Everyone, especially the poor	Have dollar reserves to help those affected, especially poor, and ability to repair damage
Earthquakes everywhere	earthquakes	everyone	strengthening foundations, early warning
All of the county is vulnerable to climate change, extreme heat and severe storms.	Death by overheating. Flooding in areas close to sea level.	All but the elderly are probably most vulnerable.	Dramatic reductions in green house gas generation.
All shorelines Urban areas	Flooding Heat and earthquake	Persons living and working near shorelines Persons in urban core	Building restrictions nesr shorelines Review of building code re earthquakes. Cooling centers
Earthquake could be any bridge. Think about how many bridges or underpass you use.	Possible collapse.	Everybody	Make sure bridges are up to what standard is deemed acceptable.
Ocean Shores	Tsunami	Residents and visitors	Towers?
landslides-steep slopes; flooding-river valleys; earthquakes-	landslides, flooding-limited areas; earthquakes-especially	localized planning and permitting; climate change-many things	

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Location	Description	Affected People	Solutions
unconsolidated sediments; climate change-everywhere	downtown Olympia; climate change-everyone		
Budd Bay, Capitol Lake, Mt. Rainier, earthquake, forests, I5	Tsunami, earthquake, toxic water, wildfires	Everyone	Disaster Preparedness, carbon footprint reduction, traffic reduction (increased public transit), solid planning
All the areas adjacent to Capitol forest, any areas near water bodies	Flooding due to clearcuts, flooding due to heavy rainstorms combined with ocean rise, landslides due to both the above, extreme heat exacerbated by loss if tree cover and climate change	Everyone, but especially people living rurally or in forested areas	Stop logging immediately, take serious action to address climate change
County wide: shoreline (flooding), forests (wildfire), severe storms.			
Any where people go for supplies.	Injury and death	Anyone needing essential supplies	Focusing on sustainable economy training. Self defence training including gun safety. Basic first aid training for school age children.
Downtown Olympia- Sea level rise, earthquake liquifaction Landslides on unstable slopes- throughout County area Flooding- downtown Olympia	see above	Almost everyone because it also affects major transportation routes (4th Ave and 5th Ave)	infrastructure redesign for sea level rise resiliency
Sky	Global warming	Everyone	Stop the poisoning!
Any greenbelt areas where homeless tend to migrate are prone to fire danger	fire danger	Residentials areas with greenbelts along public roads	
The entire region is vulnerable to earthquakes and volcanic activity, forest fires are becoming an increasing concern throughout the county as the region becomes dryer in the summers and hotter, flooding is a	See #4	Everyone but primarily those with few resources to relocate when faced with hazards (marginalized communities, people of color, the poor and elderly)	We need to start taking climate change and hazards seriously and incorporate them into planning. We cannot continue to operate as in the past. Cutting down swaths of trees and putting up row upon row of buildings and mile upon mile of streets

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Location	Description	Affected People	Solutions
concern along rivers and coastlines			harms the environment and makes us all more vulnerable to all hazards facing the region.
The whole county is very vulnerable to climate change impacts in the coming years	The whole county is very vulnerable to climate change impacts in the coming years	It impacts everyone but has greatest impact on low income communities and those struggling with housing insecurity. We've seen how the heat has killed members of our community who are in houses.	More housing built with climate change in mind. More climate change solutions
The vulnerability to climate change exists everywhere.	all of us.		
forests	fire and climate change	many people	address climate change post haste
Anywhere near the water inlets, some river areas ie the Deschutes where homes are close by, much of the area near Stewart's meats in case of volcano eruption. Big box stores with tall storage shelves above the aisles, in case of an earthquake, downtown Olympia, people living in the county, school children being stranded at schools if parents are unable to pick them up after an emergency.	Flooding from a tsunami near the water, flooding from rivers breaching their banks, injury from falling heavy boxes in stores, people/cars being crushed from old building collapsing if they have not been retrofitted, people being stranded from getting home if they have to cross bridges to get there. Lack of cell phone communication during disasters.	Anyone could be affected depending on the circumstance, especially elderly, poor, homeless people and those who need medical care.	Require retrofitting downtown buildings, offer no or low-cost loans to do this, prioritize bridge inspections and repair, remind people to prepare their homes for emergencies (keeping a 6 week supply of food, water, and medications) offer no or low cost loans if needed to improve safety ie dangerous tree removal, retrofitting or stabilizing houses. Don't allow building in areas likely to flood or are particularly vulnerable to fires. Improve forest management to reduce the risk of fires. Help the schools to provide for an overnight stay and meals at their schools.

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Location	Description	Affected People	Solutions
The entire County given all the potential hazards	Climate change makes everywhere 100% vulnerable	Everyone	Immediate implementation of environmentally sustainable legislation and behavior
1. Rochester/Grand Mound and surrounding area; 2.Olympia/ Lacey/ Tumwater; and 3. Olympia/ Lacey/ Tumwater	1. Community wide wildfire/conflagration; 2. Disruption of the water supply due to earthquake; and 3. Unrecoverable damage to economy and community due to criminal activity (drug use, theft, violence, pollution).	Current and future citizens of Thurston and neighboring counties, as well as businesses, and government agencies.	1. Increased wilddire prevention/mitigation resources and education; 2. Beyond my scope to identify additional mitigation strategies; and 3. Increased law and code enforcement in those areas/issues.
Forested areas	Fire	People, animals, wildlife	Education, road maintenance for firefighting equipment and prevention
rivers	flooding & changes in course	people near rivers and people who cross rivers	clear log jams
River Street at 127 Ave SW in Littlerock. Your planning has the creek near LaFrance now flooding the area and my pumphouse flooded for the first time in 60 years. You need to help me fix what you folks have allowed. That water should go to Black River.I need your help and so do my neighbors.	The creek never used to flood into this area. I have lived her for over 50 years. You have allowed folks to fill in wetlands and now it floods. I can show you where this has happened. Please reach out and ask me.	It floods homes and roads.	Restore what used to be wetlands and change a couple of your regulations.
All of Thurston County	Seismic, flooding, extreme heat	Everyone - infrastructure including roads and communications	Educating the community on disaster preparedness and having a plan for these events.
The entire community is vulnerable to damage by an earthquake or severe storms.	Damage to buildings, roads, water, electrical, sewe.	Everyone	

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Location	Description	Affected People	Solutions
I-5	flooding hazard along highway, overtopping hazard. For rivers in general flooding and overtopping. For areas along the coast, sloughing due to earthquakes.	Individual homeowners and entire public	improve infrastructure. Better development guidelines
Mostly looking at sea rise in coastal areas including Puget Sound and increase in forest and/or woodland fires due to warming climate.	Flooding in high population areas and fires in more wooded areas.	Anyone who lives in these vulnerable areas.	Decreasing the use of fossil fuels to slow global warming. Be more aware of the climate implications of new construction.
For wildfires, any neighborhood with lots of trees, such as Ken Lake.	Fire danger	Homes in the neighborhood	I don't know, because I don't want the trees cut down. Perhaps people just need to be prepared to evacuate in the case of fire.
Anywhere there are forests concern me regarding wildfires	Wildfires	Everyone	Keep brush cleared and forest undergrowth cleared.
Flooding along all rivers and close to saltwater, landslides where there are clay bluffs. Fires - all forested and grassy areas.	Flooding due to excessive rain, rising sea levels. Landslides due to excessive rain, and underwashing by rivers. Wildfire as a result of human action or lightning.	Humans and all other animals living in these areas.	Climate action - which is more than local action.
Anywhere west of I-5	Earthquake damage	Residents	Reinforcing buildings, tsunami towers...
Shorelines- especially marine. SMP is not being proactive enough to require adequate setbacks and vegetation preservation in high risk landslide zones. Especially allowing variances is absolutely unethical at this point in time, knowing what we do about erosion and how many places have	Landslides, slope instability that puts infrastructure like septic systems and residences at risk.	community members are put at risk - it's a health/safety issue. Our environment is put at risk when we have to engineer stopgap solutions to address poor development practices.	Require much larger setback for new development, period. Don't allow variances without denying those applicants the right to any future bulkhead/engineered solution to their stupid decision- make relocation the only option. Enforce riparian vegetation protection

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Location	Description	Affected People	Solutions
been built too close to the water and are now facing risks or installing armor to try to protect themselves. Relocation should be required before installation of engineering slope stabilization or bulkheads. That only staves off issues. And it is difficult for these people to get insurance at sites like this, where increasing SLR, storm severity etc will only make steep slopes more unstable. The same applies for freshwater shorelines with steep slopes. We have to remember Oso and be more protective. If people insist on building in these areas, we have to develop mechanisms that deny them the option to install bulkheads or engineered walls in the future, so they take the risk seriously. We need to have better geotech review from third parties. New people are moving to the area rapidly and they are buying waterfront/streamside property .They don't understand coastal processes and they trust that the disclosure process will protect them. Almost never have I seen appropriate			because those zones actually protect people (whether they are willing to accept this or not). Use penalties and incentives to enforce protection. Figure out ways to help people better manage shoreline stormwater - not with infiltration facilities. Develop retroactive stormwater plans for communities so they manage water safely and avoid causing pollution issues. Regulate forest clearing upland of shorelines because all that water managed by large trees will now be draining to the waterfront.

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Location	Description	Affected People	Solutions
disclosure for waterfront sales and people are often shocked to realize they bought their retirement home on an active landslide site. They trust that the County wouldn't let this happen.			
I5	There are only three bridges that cross the Nisqually in Thurston county. If the bridge over I5 fails, this will push a massive amount of traffic across the remaining structures. Additionally, when the train derailed over i5 this put an immense amount of traffic through other routes causing significant backups.	Everyone across the region including logistic freighting.	Add another bridge across the Nisqually, connect WA-7 with Bald Hill road through Peisner to Seglins to a number of roads Seglins nearly makes contact with on the Pierce county side. This would help take pressure off the other three bridges. Additionally Weyerhauser occupies a large portion of land between the Lewis and Thurston County, blocking access to potential opportunities for hiking and other forestry tourism. Another route connecting Bald Hill Rd to the Weyerhauser truck rd, over to NF72 and down to Hwy 508 through Cinebar could help ease traffic regionally when there's a large accident on i5.
Anything less than 30 feet above sea level.	Not just flooding, but submersion.	Anyone that lives there, works there.	New Orleans comes to mind, but really, Downtown needs to move, either straight up Venice style, or up one of the three hills.

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Location	Description	Affected People	Solutions
Low lying areas along rivers and shores throughout the county	Floods - loss of homes, businesses and lives	Property owners	Restrict development in those areas
Any areas near creeks or rivers	Flooding	Travelers, nearby residents	Published maps showing areas of possible flooding. Signage warning of possible street flooding.
Coastal regions- tsunamis Everywhere- earthquake and volcano and wildfire and flooding and climate change	Location and climate change	Everybody	Stronger infrastructure, removal of 5th ave dam to restore the deschutes estuary
The inlets of Puget Sound Farms in the county	Flooding and sea level rise Fire, flooding, drought on farmland	Inlets: the port land downtown, downtown business and residents Farms: landowners, farm workers, eaters	Inlets: Unknown Farms: assure farms have access to water during droughts, pays farmers who manage land for production that accommodates flood for parts of the year
Near rivers in flood plains - nisqually and Deschutes, everywhere for Earth quakes, older mobile homes, apartments, and rentals for heat	Flooding, heat, earthquake	Low income, renters, elderly, young people, people with disabilities	Climate action plans implemented in our communities, preventing building in flood plains
Cascadia	Fault line	Everyone	Planning and preparedness
All areas	Earthquake	Potentially everyone	Be ready.
-Nisqually River -I5 -BNRR -High Pressure pipeline Routes	-Nisqually River: Flooding, Lahar Flow -I5: Earthquake Damage to Bridges and Roadway -BNRR: Derailment of trains carrying hazardous materials		Train Agencies and Community to respond to these events
Downtown Olympia, nisqually, and other regions at or below sea level	Flooding and resulting roadway instability	Everyone who relies on an open i5 corridor and people who live / work / shop in downtown	Reinforcing structure and flood control mechanisms
Nisqually River Valley, Chehalis River Valley, and Rural South Thurston County.	Flood, Earthquake, and Fire	Residents and Businesses of those areas.	education, communication, outreach, continue mitigation efforts.

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Location	Description	Affected People	Solutions
Flooding near rivers?	Flooding?	People who live near water?	Less people.
Anywhere on a steep hillside, houses close to the beach, anywhere when it comes to climate change/hear/earthquakes…		Building codes, zoning,	
Earth quake anywhere.	Utility services and impassable roads. Public panic .	everyone	emergency supplies of water at least stored in every neighborhood school, library or municipal building.
Downtown and throughout the community	People are already living hard lives. A disaster such as an earthquake would disrupt all the services that they already rely on leading to more crime as people try to survive	Everybody	Do we have plans to address places like the food bank when an earthquake (or other event) happens. People who are living day to day don't have the space or the resources to have a few weeks of extra food
Nisqually river Mt Rainier Fault lines	Being in proximity if these were to max out	Everyone in our area	Just updates and awareness. I usually don't worry too much until someone brings it up.
All of Thurston county	Earthquake, volcano, climate change, heat, wildfire	Everyone	All the proposed solutions to climate change, good building codes
Hire a geologist	Earth movement	People	Stop building stupid
All bridges and over passes.	Earthquakes	Everyone	More Inspectors, after earthquake
Wildfire in WADOT areas as little is done to prepare	Wildfires	Me	The Lacey fire department is not prepared on this issue
Prairies wind driven brudh and grass fires	Houses	Home owners not aware	Public service handouts
Areas near rivers, bridges.	proximity	everyone	allocate dollars for fixing our bridges, mitigate potential flooding
Local jurisdictions have already mapped these as critical areas	Depends on the critical area category	Anyone living, working, or owning property in those areas	Tailor dev regs in those areas
Most of the roads	Trees too close to the roads	Everyone that needs to go anyplace	Require trees to be maintained away from roads

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Location	Description	Affected People	Solutions
Along the rivers	Flooding	People who live near the rivers	I don't know
Deschutes River and coast of Budd Inlet. Everywhere earthquake. Everywhere big storm. Fire anywhere.	Everywhere big storm or earthquake or fire.	homeless people. people living near coast and rivers. Homes with a lot of brush and/or trees fire!	Get good shelter for homeless. Be prepared for flooding. Clear up brush and trees near homes. Sick or old trees trimmed or taken down!
Most residential areas will probably become isolate with a significant earthquake.	Bridges and probably many roads.	Probably all neighborhoods that have limited access.	Educate communities that they are likely to be on their own for extended times. Harden infrastructure as budgets allow.
Many residential areas are likely to get cut off from services in a major disaster.	Few citizens have planned for lack of services for an extended period of time. Medical needs, food/water, sanitation, shelter etc.	Everyone but has a more profund effect on those with the least amount of resources.	Identify those who are most likely to be effected and plan accordingly. Develop community wide plan to educate the public on the need to be prepared for various events they may disrupt services.
Where ever power lines pass through forests or near tall trees susceptible to high winds or fires.	Wildfires and power outages.	All residents and businesses in affected areas.	Aggressively relocate vulnerable power lines to protected under ground trenches and vaults.
All structures that will be effected by earthquake, lahar & tsunami	Collapse from shaking or being impacted from objects being forced into them in mud flows or titlewave	Every living thing in its path! Infrastructure from traversing the landscape to clean sources of drinking water will be effected in these things with little hope to survive an occurrence rescue operations will have no exception to casualties & equipment failure & loss	Unless you can sprout wings and fly there is not much you can do to escape those things! Even if there is advanced warning getting to higher ground for most will be impossible in the panic that will follow such an event when there is only minutes before the dealer strikes and what you happen to be doing at that time! If it happens at night & you're quick to jump & run ya might have a chance but the majority

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Location	Description	Affected People	Solutions
			will parish in the devastation that will ensue!
I-5		ALL	PREPLANE
I-5 at Dupont/Nisqually Plus freeway system in general is very minimal - 512 and 167 are still only two lanes in most places(should be 3-4)	Block access to Seattle Tacoma - only route North/South with out adding 3-4 hours on two lane roads	everyone	widening freeways and highways - building more access around JBLM
South county - flooding North county - flooding & volcano All - earthquakes, landslides			
Forested areas for fire. Downtown Oly for rising sea levels.	Loss of life/homes/ reconstruction/	All	Leave all trees in place. Require developers to pay for cut trees and preserve more land & trees for parks like Squaksin Park with trails
anywhere along the sound is vulnerable to sea level rise and landslides		stop sea level rise	
The vulnerability is countywide because people are not prepared for emergencies/disasters.	The cities place NO priority on emergency preparedness or disaster response. Neither does the Port, the PUD or the Thurston Conservation District. The County does some work in this area, but needs to step it up. Most people in our area have NO idea how to prepare for a major disaster or what will occur when we have one.	Everyone, but especially vulnerable are the unhoused, those in shelters, the elderly and others who depend on electricity to operate things they need for medical conditions.	Preparedness education needs to be a HIGH priority, not an afterthought when something happens.
Earthquakes impacting all of I-5 Throughout the state/nation/world, specifically coastal areas are at risk for flooding and landslides, extreme heat and wild fire in rural areas/highly vegetated	Earthquakes impacting all of I-5 Throughout the state/nation/world, specifically coastal areas are at risk for flooding and landslides, extreme heat and wild fire in rural areas/highly vegetated	Mostly metropolitan populations surrounding coast and I 5, people and wildlife everywhere, but also transportation of goods and services. Lower income populations will be least resilient against excessive heat, flooding, transportation delays-	Localize goods and services by investing in local and urban agriculture, invest in public transportation through mixed use infrastructure where population can work where they live, improve walkability, bicycle infrastructure, create more buffer zones

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Location	Description	Affected People	Solutions
		every hazard will impact them most	against natural hazards, improve native vegetation and invest in green infrastructure- green roofs, pervious pavement, etc.
Close to rivers.	Flood	People living in close proximity.	Not filling low lying areas to accommodate construction.
All shoreline on the sound, with old bulkheads	Debris in the sound that may have chemical and pesticides/ herbicide	Fish, aquatic plant life. Flooding. As humans will repair their bulk heads.	Stop purchasing land close to the water.
unspecific -- low-lying land, waterfront infrastructure, dwellings on steep slopes especially when the ground is saturated from precipitation, historic buildings without earthquake retrofitting	damage from sea level rise and tsunami, extreme losses from quake and/or volcano and/or slides	residents, businesses, and government entities, especially disadvantaged individuals who likely will not have the same flexibility and access to resources as those of us with privilege	long term planning, adaptation, mitigation, and accurate projections of resources that disadvantaged residents will require
Ditches need to be maintained	High water flow	Flooding streets & intersections	Keeping them mowed & adding small damns to reduce high water flow
Deschutes Valley Flooding, Nisqually reach flooding		Flooding, cutting off major arterials	
Any lowland river			
entire area vulnerable to earthquakes. could be quite devastating.	earthquakes could affect housing, transportation, utilities, food/water, medical services, jobs, schools...everything.	everyone	getting individuals prepared for what might be a reasonable timeframe before they can expect help, and information on how they can be prepared to go it alone.
All low lying areas are at risk of sea level rise. Volcanic impacts could occur throughout the area, although prevailing winds probably reduce risks. You know where these risks are. I don't have any new ones.			

Bucoda

Location	Description	Affected People	Possible Solutions
Town of bucoda	Flooding	Citizens of bucoda	
Along the Chehalis River	Flooding	Home in the area or people being trapped by the flood waters.	Raising the road where it floods.

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Chehalis River lowland areas	flooding	farming and residences	get the flood control works upstream built
East end Skookumchuck valley	Possible dam failure	Everyone down stream on Skookumchuck river and possible the Chehalis river down stream of Centralia	

Lacey

Location	Description	Affected People	Solutions
Area where I-5 crosses the Nisqually River	Flooding	Residents of that area; commuters	Raised bridge; flood mitigation
Nisqually River at Nisqually	Flooding	Residents near river, commuters passing through	?
Nisqually Delta	Flooding	Residents	Prayers
Campus highlands drive and 46th Avenue	Undersized storm water retention pond	Campus highlands residential areas	Collaboration with local private golf course manager to mitigate flood damage
Hicks Lake shoreline is in 100 year flood zone. Sandy soils with high groundwater could be subject to liquifaction during earthquake.	see above	structures abutting the lake.	Maintain channel between Hicks and Pattison Lakes so water doesn't back up.
NE Sleater Kinney between Sleater Kinney and Lilly Rd	Increased groundwater filling under homes	Long established neighborhoods	Recognizing increasing problem of groundwater flooding and finding a helpful solution
Ridgeview Estates , a residential development off Martin Way East & backside of Steilacoom Rd. SE before the crossroad of Duterrow Rd. SE / Meridian Rd. NE	Mostly wildfire potential than earthquake , severe storms	Most of the residents especially on the periphery of the development due to forested areas	Would be prudent to know what steps to take if in fact a fire or earthquake occurs. What's the best way to help ourselves & our small community if fire & emergency rescue services are unable to reach or assist us . How would we evacuate, especially if there's structural damage on I-5 ?
Nisqually delta: Pacific & 6th.	Prone to flooding. An earthquake large enough to compromise the dam would be devastating to the	Residents	Enhanced early warning and better traffic control. Even on a good day, getting out of the neighborhood can be difficult. During frequent high traffic events, it's nearly impossible.

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	region. Evacuation is difficult because of increased traffic on Mounts Rd/Old Pacific.		
Nisqually area	flooding	puget sound area	
Nisqually valley crossing, I-5 and up river.	Coastal flooding, lahal, Tsunami, bridge integrity in quake.	All travelers going across the county line.	Rebuild roadways to a higher elevation, higher bridges over the river.
Nisqually Valley - Flooding, Volcanic, Storms, Earthquake	Destruction of bridge on I-5. It is highly vulnerable to all of above.	Anyone and anything that requires I-5 transportation. People, Food, all life necessities. Main transportation corridor.	Rework I-5 to elevation much higher with replacement of aging bridges across the Nisqually River.
Nisqually bridge.	Flood or earthquake damage to the Nisqually bridge.	Transportation north and south of Thurston County.	Building a new modern bridge and defining emergency alternate routes.
Nisqually basin	Floods. Fires. Earthquake.	All of us	Mitigation..awareness communication...disaster plan management. Action plan communication amd training
Nisqually valley in the event of Mt Rainier eruption	Mudslides, volcanic debris and possible tsunami.	Communities along the river, Nisqually reservation, shoreline land owners around southern Puget sound.	Early warming system.
Nisqually River Valley	Particularly vulnerable to recurrent flooding	Homes in the area	Better control to water released from the dams to prevent flooding.
Nisqually River	Flooding	Those nearby	
Nisqually river valley	Lahar from Mt Rainier eruption	Yelm and Nisqually reservation	Mitigation (e.g. moving people away from riverbank)
Nisqually Basin	Volcanic		
Nisqually valley	Flooding and possibly volcano lahar or other downstream effects	Folks who live there and anyone needing to travel across the valley if I-5 becomes blocked or otherwise unusable	?
Nisqually river, I-5	Flooding, lahar, potential destruction of bridges and highway link to north.	Could affect everyone living in Thurston county. Potential disruption to supply routes for all resources. Could prevent	Update I-5 and other bridge infrastructure with modern bridges well above potential flood levels. Also mitigates sea level rise hazards. May need to raise road bed for

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		commuters from reaching their jobs. Possibly limiting medical services if local hospitals become overwhelmed.	portions that are too close to water level.
Nisqually Valley and I5 corridor is restricted during an event and I5 both into and out of Thurston County leave very little ability to evacuate an area when it is not passable there are very limited alternate routes.	I5 both into and out of Thurston County leave very little ability to evacuate an area when it is not passable there are very limited alternate routes.	Communities in Thurston County relying on I5 for evacuation routes. Or in an event could severely limit the supply availability in and out of Thurston County	Ensure alternate travel routes to evacuate are sufficiently robust to accommodate and alleviate the potential restrictions the event could cause. Enlarge the routes that run through Roy/Tenino etc.
I-5 crossing of the Nisqually River	Flooding / liquification / erosion of the road pylons	any Commercial and personal traffic	
Mounts road Nisqually river basin area flooding zone	Flooding		

Olympia

Location	Description	Affected People	Solutions
Prairie Habitat nearshore saltwater habitat forested habitat	Wildfire, invasive species, development loss of functional habitat, invasive species wildfire, invasive species, drought	ESA listed species, other commercially important species and humans..	conservation, protection and proper ecosystem management for prairies, nearshore and forested habitats.
Downtown Olympia and the margins of Budd Inlet.	Increase in tidal incursion due to increase in sea level.	Everyone in the county who lives or does business in Olympia or other low lying areas.	Raise the elevations by armoring banks, etc. Relocate low lying infrastructure to higher ground.
Downtown Olympia is going to be increasingly impacted by tidal surges and potential flooding of streets and businesses as climate	In ability to use streets due to flooding, cutting off parts of the city i.e. the west side of Olympia from the downtown core.	Homes and businesses will have to deal with flooding limiting access for customers and tenants.	Elevating key streets to provide access across town. Elevating businesses and homes on stilts or flow through basements.

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change impacts increase in intensity.			Require new buildings to incorporate flooding into their design, i.e. flow through first floor with garage, living areas on 2nd floor.
downtown olympia business district including the capitol	downtown olympia was built on fill over the natural water table, which could liquify during a severe earthquake, causing buildings and other structures to fracture and sink	state workers, downtown olympia residents, businesses and visitors	an engineering survey and report identifying ways to mitigate and then either community grants or fundraising to refit downtown
Downtown Olympia	Flooding	Buildings near the sound and Capitol Lake.	Do not build in that area or plan for flooding such as having lower levels built with flooding in mind.
Healthcare, PSPH, PSAP 911, Water treatment and distribution, Senior Services at the Olympia Center and in Lacey, TC Jail, OPD Jail, OFD Fire Stations, Olympia PW facilities, Port of Olympia marine and air, LOTT water treatment, I-5 transportation	These are critical infrastructures	general population, specifically in the urban core	Invest in and maintain infrastructure and public safety
Shoreline along Budd Inlet	Flooding	Downtown Olympia. Homes along the shoreline	Making the Port area a marsh like it was originally It could absorb absorb huge amounts of water. Definitely not build a barrier that might mitigate downtown, but be a disaster for the rest of South Sound.sound.
All of downtown Olympia	Flooding from sea level rise	Homes, businesses	No clue
1. There are a number of slopes both east and	1. Landslides and debris flows. 2.	1. Owners of property on and adjacent to the	1. Varies from location to location, based on

west of Budd Inlet and along Capitol Lake. 2. Slopes described above, plus low-lying areas supported by fill.	Seismic shaking, triggering slope movement and, in the low-lying areas, liquefaction and tsunamis. Damage to critical infrastructure.	unstable slopes. 2. In addition to property owners, individuals working and shopping downtown and at the port, and traffic throughout the region.	site-specific conditions, from planting native, deep-rooted vegetation to slope retention, and precluding new development. 2. Seismic retrofitting of buildings and infrastructure, and for tsunamis, evacuation of the vulnerable areas.
Cooper Crest neighborhood; 20th and Cooper Rd. NW	Land slides; flooding	Homeowners; possibly schools	Monitoring, and if necessary, landscaping and retaining walls
1. Downtown Olympia & other shoreline areas. 2. Nisqually river valley. 3. Entire region.	1. Sea level rise; earthquake/tsunami/subsidence effects. 2. Floods; lahar effects from Mt. Rainier. 3. Climate change effects; intense heat episodes.	All of us.	Work to mitigate climate change. Improve disaster planning. Build public awareness.
Saltwater Shoreline	Olympia area	Coordinated Planning	
Flooding around Scott Lake. Landslide during heavy rain on the hillside just north of the governor's mansion.	see #4	The flooding affects a number of residents in the Scott Lake area, many of whom earn below the median income. The landslide affects the state government, the railroad, and potentially anyone walking along the nearby path.	Flooding--huge problem. Best solutions: relocate; raise the homes on pillars; leave more forest to absorb the water. Landslide. Shore up the hillside. Maybe remove trees from the top edge of the hill. Probably have to cut into the existing parking lot above the hill.
downtown Olympia	sea level rise due to climate change	nearly everyone	fewer residences and vital businesses at ground level
West Olympia, Cooper Point Rd, logging and excessive clearing to build residential/commercial units	Loss of trees	Flooding and climate change	Great control on builders

Olympia downtown and surrounding dense neighborhoods	Extreme heat, sea level rise	Elderly, children, people experiencing homelessness	Green spaces, more trees, "shade oasis" structures to enable walking longer distances by providing a place to rest out of the sun
Olympia waterfront	Seismic sea waves	Lowlanders	Learn to swim...
downtown Lott	Sea level rise	many businesses, our waste water treatment	begin to require elevation of buildings, etc.
Between Olympia and Tumwater on (1) Interstate 5 and (2) on Capitol Way. In both cases, both northbound and southbound	During heavy rains, large pockets or stretches of standing water	Drivers and pedestrians	(1) Better paving to alleviate areas where water collects and (2) better stormwater drainage overall
Olympia and tidelands	Sea level rise.	Olympia port, downtown business and waterfront home owners.	Stop burning products to produce energy.
Downtown Olympia is built on fill. It will liquify during an earthquake	Downtown Olympia is built on fill. It will liquify during an earthquake	At least Thurston, but since many State workers and major businesses are located in the Olympia area the impact could be catastrophic	none
Nisqually Valley, Budd Inlet.	Water damage from floods and volcano eruptions.	All of us.	None.
Downtown isthmus	Flooding from storms, climate change	residents, businesses, tourism	
Near Mt. Rainier. Downtown Olympia.	Near Mt. Rainier: Volcanic and earthquake. Downtown Olympia: Flooding.	Near Mt. Rainier: People who live in towns or farms near Mt. Rainier. Downtown Olympia: Businesses, apartments, homeless people.	Near Mt. Rainier: Provide warning prior to earthquake and volcanic events. Downtown Olympia: Construct walls or higher soil next to low shores.
4th street bridge, downtown Olympia	flooding, tsunami, ocean rising	people in the downtown area and the west side	Quit building high rise building so close to the water
Downtown Olympia	Climate change, earthquake	Everyone that lives and works there	Reduce development in lowlying areas

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Downtown Olympia and the port area are subject to flooding. Every place with tall trees is subject to wind storm damage.	Water and wind damage.	Wind affects the entire region, as there are tall treess everywhere. Flooding in the port and downtown will affect access to businesses, local government offices and apartments.	For wind damage, encourage solar power, battery storage, and use of batteries in electric cars to meet residential power needs. To address flooding, there should be restrictions on new buildings in the flood area, plus dikes, pumps, etc for existing buildings and facilities.
downtown olympia and Budd inlet shoreline and bluffs	earthquake, and flooding	businesses and homes	no possible solutions
Portion of harbor area that is built on fill.	Earthquake liquifaction, flood damage	Residents and businesses in the area	More flood gates on storm drains connecting to the lake/bay
1. Downtown Olympia 2. I-5 Bridges	1. Sea Level Rise/Tsunami 2. Seismic Damage	1. Everyone locally, either directly or indirectly 2. Everyone due to cut off of supplies e.g. food and fuel.	1. Short term, continue antiflooding measures. Long term, plan to retreat up-gradient over time. Protect Capitol Campus. 2. ID and improve bypasses/detours; plan for air and sea emergency supply.
I bought my house (division st sw) on olympias westside looking for areas with out liquefaction potential. I understand other areas in ympia have higher susceptibility to liquifyung during an earthquake.	Primarily concerns about the impending cascadia quake (give or take whether it will be in my lifetime). Other concerns primarily include flooding and health hazards related to wild fire smoke.	Earthquakes - everyone. Risk depends on where you are, age and quality of structure you're in. Flooding - the county can better model who is at risk for this than I can assess Smoke mitigation - people whose livelihoods are outside, children, people with breathing medical concerns, pets, wildlife, people who can filter air, people without air-	Broader legislation regulating manufacturers contributing to climate change. Grants or free products or price reduction brainstorming so it's not so much more expensive to make climate friendly choices.

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		conditioned homes who rely on open windows for heat control.	
Downtown	Sea level rise	Everyone in Oly, either directly or indirectly	Appropriate zoning and building codes, building resiliency into infrastructure
Downtown Olympia Property next to forested areas	Earthquakes, Flooding, Tsunamis Wildfire	most everyone in some way	preparedness, training within neighborhoods/ apartment units
Rural areas and downtown Olympia	Rural areas fire. Downtown Olympia flooding due to rising water levels. Also unreinforced masonry buildings and brick chimneys in an earthquake. Chimneys above internal walls will come down straight through the roof and into a house. Brick chimneys on exterior walls will just pull away from the house a crumble.	Likely as eminent risk 1/4-1/2 the local population.	No new multi housing near the port or downtown that are less than 50-75 feet above sea lever. Grants or very low cost loans to reinforce masonry commercial buildings in the downtown core.
Capitol Way around the bridge over I5	Landslides	Homes and businesses	I don't have any
Soft soils by the water	Soils are prone to sinking and creating building instability	Economic vitality - downtown business owners, gov buildings, lower income apartment housing	Retrofitting buildings, preparedness kits for longer term, public community plans showing routes with potential impact to infrastructure
Downtown Olympia, Nisqually Valley, Thurston County	Sea level rise and flooding from the mountains, fires in all of Thurston County	Natural area, animals, sea life, humans. Livability	Less auto traffic and more mass transit. Stop urban sprawl. Move people away from the sound shores and river banks.
Liquefaction in dtwn Olympia	infrastructure loss	The entire region	More stringent assessment and mitigation

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Downtown Olympia near Childrens Museum	Flooding and erosion	The community, residents of downtown	Reinforcing the area, dredging out the mudflats
Marine shoreline within 2-5 feet elevation above HAT (highest astronomical tides). Ie, nearest tidal station to Thurston County with HAT info to is Tacoma, where HAT is 1.87ft above MWWW. And highest observed tide is 3.09 ft above MWWH. https://tidesandcurrents.noaa.gov/datums.html?id=9446484	Since highest annual tides occur mid-winter, co-occurrence with extreme storms have potential to raise marine waters 2+ feet above HAT, imperiling residences and infrastructure.	Shallow gradient marine shorelines are most at risk, but all marine shorelines would be affected.	Establish at least one tidal station in southern Puget Sound, eg, Budd Inlet that will include all datums, ie, HAT. Use this info to survey elev of near shore infrastrucure and all new county permits. Inform shoreline residents of potential flooding during severe storms coincident with highest tides.
low-lying areas - such as downtown Olympia	Subject to impacts from sea elevation change.	all of us.	protection of downtown by making site more resilient and potentially constructing sea walls.
Downtown	Floods	Businesses and people who are near the coastline	Maybe the lake going back to saltwater. Probably making the beaches more natural with less concrete.
GreenCove Creek Basin and Downtown	For Green Cove Basin- Flooding, landslides , toxic contamination from MTCA site, loss of aquifer recharge areas leading to loss of habitat for salmon and continually lowering aquifer levels that threaten the drinking water supply for the City and Cooper Point Rd. And the strategic groundwater reservation Flooding, earthquakes, tsunamis for downtown	Our drinking water aquifers Wildlife habitat Infrastructure from landslides and flooding Public health	Do not allow any development in any critical areas County wide monitoring of aquifers for water quantity AND quality, including testing for chemicals

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Olympia Watershed Park, county prairie lands (wildfire) i.e., Rocky Prairie (Old Hwy. 99, Waldrick Rd,). Mima Mounds.	Wildfire encroaching on residential and out buildings.	Residents and property owners.	Safety assessments to show cause for fire safety barriers, access for fire suppression equipment.
Downtown Olympia	Flooding	Everyone in the region	Move key city and county operations to higher ground, like the Capital Mall area. Raise the level of 4th and 5th Ave. bridges and the roads leading on to them.
Flooding along shorelines from sea level rise and especially downtown Olympia	Very vulnerable.	It will impact the local residents and businesses but also all tax payers since we will likely pay for preparation and response.	Stop developing in a large portion of downtown Olympia. The 'walled' area should be enough to save the east-west street connections. Stop the port deep dredging and shipping to free up funds for other Port activities that are not water dependent.
Downtown Olympia as a whole.	Build on fill, near water	Business and community as a whole	
Sea level rise - downtown Olympia, I-5 at Nisqually	Flooding and transportation bottlenecks	Commuters, downtown businesses, unhoused people	Infrastructure improvements
Downtown flooding. Severe storms everywhere. I worry about Grass Lake greenbelt burning.	floods, storms and fire	Residents, businesses, wildlife, first responders etc	I have no solutions for natural disasters
I look at my road, 28th Ct SE, Olympia, WA, 98501. It has a downward grade from where it connects to Sherwood Dr SE and Raintree Ct SE.	During heavy rains, water flows down into the cul-de-sac at the end of 28th Ct SE. While there is draining on the south east end of the cul-de-sac, the grading on the road is insufficient for proper water flow. Water	I potentially effect the entire neighborhood and associated property values. Curbs in front of our property are heavily damaged, which will cause sidewalks to fail, and other property damage to our home.	Improve that streets drainage, which would require a new storm drain installed where the majority of the streets water now pools near.

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	always pools up on the north side the the cul-de-sac where it eventually soaks under curbs, driveways, yards, and homes. This had contributed to driveway and foundation issues at our home, as well as high risk for flooding due to a saturated. One way to help MY property would be to pump excess water out into the street away from the home, but all the water from the streets already pool in front of our house due to lack of storm water drainage.		
Olympia along the water	Flooding	People within that area	None, cost prohibated
Downtown area	sea level rise	businesses downtown, LOTT	I agree with the solutions discussed in Olympia's SLR response plan
Downtown Olympia	Earthquake & sealevel rise & landslides	Everyone	Stop building in areas of historic land fill
The houses above Capital Lake and the Deschutes River seem vulnerable to slides	Landslides	The people who own the property	Not sure
I-5 bridge over the Nisqually River, bridge over Deschutes River/ Capital Lake and near the brewery and Olympia waterfront with continued development	Nisqually River flooding, earthquake and flow from a Mount Rainier eruption could eliminate/damage the bridge. The bridge over the Deschutes River bridge could suffer the same fates (except Rainier eruption). Rising sea levels likely will cause waterfront/shoreline	Citizens, wildlife, commuters, public transportation, Westside Olympia residents, military personnel, first responders, fire fighters, police	Replace/improve/ raise the bridges, cease development of the waterfront and require developers to improve infrastructure in the areas affected by the development.

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	damage to structures and roads plus buildings on fill at the waterfront may be damaged by earthquakes.		
Hillsides along Percival Creek, especially from the bridge at Cooper Point Way and Evergreen Park DR SW.	Wildfires going up the hillsides from activities -- smoking, campfires, etc. -- of illegal "campers" along Percival Creek.	Businesses on the edge of hillside on one side, and multiple homes/condos on the hillside on the other side. Fires going up the hillsides would cause a substantial loss of both property and lives.	Removing, and continuing to monitor, the illegal "campers" before they cause loss of life. They are not only polluting the stream with their trash and human waste, but endangering the lives and property of all the people and businesses clustered along the ridges on both sides.
I5-US101 intersection and Nisqually area.	Flooding, landslides, earthquake, volcanic runoff	Everyone	South county bypass around other side of JBLM would avoid this area and Nisqually too
Olympia WA	Over regulation and taxation.	Middle class	Reduce goverment by 50 percent
downtown Oly	flooding	businesses and residents	
Oly waterfronts and downtown.	Floods, tsunamis, lahars	Businesses and residences	Don't know
Downtown Olympia	Flooding from rising sea level	Busineses, residents, transporation	Stop building downtown.
Waterfront downtown Olympia	Flooding	Olympia	Warning
West Olympia above Deschutes Parkway and West Bay Dr	Landslide from an earthquake	Local residents	Awareness and individual resident action to keep the slope stable.
Along the sound in Olympia and Nesqualy	Tsunami	Everyone in the immediate area	None
Downtown Olympia at isthmus and I-5/101 bridge/interchange	Earthquake. Deschutes and Capitol Lake will create a chasm if essential bridge infrastructure or arterials are blocked/destroyed or inundated with traffic.	Olympia/Tumwater/Lacey/Thurston County	Upgrade bridges and focus on expanding the grid network of streets to provide detours/alternative routes. Maintain and expand paved bike/ped trails/pathways as alternative routes.

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			Trails could be used by cargo bikes to deliver aid. If wide enough - emergency vehicles could also use them. Use federal funding transp. package and WA Move Ahead funding to complete phase 3 and phase 4 of KF Woodland trail. When completed, the Woodland Trail could stretch from McAllister Springs to Capitol Lake and create a major east-west corridor that will tie some of the most populated areas of Lacey, Olympia, and Tumwater to the Chehalis Western Trail, Capitol Lake, and other destinations accessible from this corridor (see Thurston Regional Trails Plan, p. 3-20). The Capitol to Capitol Trail would create a major east/west connection through west Olympia. Extend the Deschutes Valley Trail from Tumwater Falls to Pioneer Park to expand the North/South route.
downtown Olympia, Budd Bay, would be inundated with rising seas due to climate change			
Port of Olympia	Rising water levels	Business Residents	Enforcement of stricter EPA regulations & Building Codes
Downtown Olympia	flooding	public	relocation, portable barriers
Downtown...	Rising seas	Every one that uses downtown	Stop developing lower parts of town
Downtown Olympia	Flooding, sea level rise	Businesses, people, government continuity	Long term code change for raising buildings

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Sea level rise, in particular effects on downtown Oly and LOTT.	Flooding downtown core and ability of LOTT to process sewage	Local jurisdiction located on or near Puget Sound	I know City of Oly is looking at the impacts, but other local jurisdictions need to become more involved
Downtown Olympia is vulnerable to liquefaction since it's built on infill.	earthquakes	everyone	retrofit buildings, stop gentrifying downtown
Downtown Olympia, Nisqually bridge, Summit Lake	Flooding, or landslide or fires for Summit Lake.	Summit the residents there. Nisqually I5 travelers, Olympia, businesses and transportation from Eastside to west.	Conservation for Summit, online monitoring for others with contingency plans.
Downtown Olympia Tsunami South County - Forest Fire	Everyone	Mitigate with early warning/education Additional fire resources, both preventative and reactive	
Rural areas that could be affected by fire. Downtown Olympia is particularly vulnerable to both earthquakes and flooding downtown	Fire in rural areas. Flooding and severe earthquake damage downtown.	Rural residents. Downtown businesses and workers at risk of injury.	Grants to reinforce downtown buildings, and requirements/law to reinforce vulnerable buildings within a specific period or be declared uninhabitable.

Tenino

Location	Description	Affected People	Solutions
In/around Tenino especially HWY 507 and into Churchill Rd	Flooding and dangerous ice on road during storms, roads sometimes impassible	Many families living in this area including ours	flood mitigation focusing on ecological restoration in Cozy Valley to store water by returning it to a wetland
Flooding in/around Tenino and Rochester. Churchill Road outside Tenino is hazardous to drive on when roads freeze due to incline of the hill, and becomes inaccessible when floods occur (highway 507 flooded last winter near the Churchill	See above	Rural families, farms	Neighborhood emergency team training similar to the NET program used in Portland, OR. Train residents how to be prepared and handle disaster scenarios because EMTs will not be able to help everyone during major

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intersection) - when this happens, residents on this road are cut off (Churchill is only accessible from 507). Outside Tenino and throughout the county there is also potential for liquefaction and landslides due to earthquake.			emergency scenarios. Provide resources for neighborhoods, store emergency supplies at designated beacon locations that contain water, first aid supplies, etc. Flood mitigation in and around Tenino, specifically using ecological restoration to sequester water and restore salmon habitat, creeks and ponds.
Nisqually valley. Deschutes area…	Flooding. Landslides.	People. Wildlife.	Barriers.

Tumwater

Location	Description	Affected People	Solutions
Between Olympia and Tumwater on (1) Interstate 5 and (2) on Capitol Way. In both cases, both northbound and southbound	During heavy rains, large pockets or stretches of standing water	Drivers and pedestrians	(1) Better paving to alleviate areas where water collects and (2) better stormwater drainage overall
The houses above Capital Lake and the Deschutes River seem vulnerable to slides	Landslides	The people who own the property	Not sure
I-5 bridge over the Nisqually River, bridge over Deschutes River/ Capital Lake and near the brewery and Olympia waterfront with continued development	Nisqually River flooding, earthquake and flow from a Mount Rainier eruption could eliminate/damage the bridge. The bridge over the Deschutes River bridge could suffer the same fates (except Rainier eruption). Rising sea levels likely will cause waterfront/shoreline damage to structures and roads plus	Citizens, wildlife, commuters, public transportation, Westside Olympia residents, military personnel, first responders, fire fighters, police	Replace/improve/ raise the bridges, cease development of the waterfront and require developers to improve infrastructure in the areas affected by the development.

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	buildings on fill at the waterfront may be damaged by earthquakes.		
Hillsides along Percival Creek, especially from the bridge at Cooper Point Way and Evergreen Park DR SW.	Wildfires going up the hillsides from activities -- smoking, campfires, etc. -- of illegal "campers" along Percival Creek.	Businesses on the edge of hillside on one side, and multiple homes/condos on the hillside on the other side. Fires going up the hillsides would cause a substantial loss of both property and lives.	Removing, and continuing to monitor, the illegal "campers" before they cause loss of life. They are not only polluting the stream with their trash and human waste, but endangering the lives and property of all the people and businesses clustered along the ridges on both sides.
Port of Olympia	Rising water levels	Business Residents	Enforcement of stricter EPA regulations & Building Codes

Unincorporated Thurston County

Location	Description	Affected People	Solutions
Capitol Forest	Landslides	Residents	Reduced logging activity
Rochester	Wildfire	Land, structures, houses	Not sure
Along the Chehalis River	Flooding	Home in the area or people being trapped by the flood waters.	Raising the road where it floods.
Chehalis River lowland areas	flooding	farming and residences	get the flood control works upstream built
Rochester	Fire	Horses houses people	Climate mitogation and adaptation and jaArd training and assistance
Capitol Forest	Wildfire, landslides (most of this is due to excessive logging)	Natural land users	Stop logging.
All of Rochester/South county Particularly the triangle from Littlerock Rd s. to HW12 & Chehalis River and E to I-5, beyond to Tenino	Wildfire - heavy residential in the wildland-urban interface Pockets along Scatter Creek are vulnerable to flood All would be affected by	Farms, homes, businesses, schools, medical facilities, major and secondary roads	Fire prevention education and measures (e.g. fuels reduction) Evacuation and shelter in place education and preparedness Increased enforcement

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	ash/mudflow if Rainier blew to the west		of no trash burning/burn barrels, burn bans, and burn permit requirements. Ban fireworks and enforce ban!
Hopkins ditch	Flooding	Many people who are impacted by the lack of drainage and the increase in development	The county should give the hopkins drainage ditch commission storm water tax monies collected so that the ditch can be properly maintained. The county is refusing to contribute. Have The Preserve development pay into ditch management. It drains their area and they are refusing. Have the county acknowledge the errors in the drainage plans from that development and start finding solutions with the ditch commission.
Rural areas	Wildland Urban Interface	Homes and lives	Less red tape and more concern toward human life than ground moles
Mima Mounds and surrounding area	Tall dry grasslands provide fuel for potential wildfire	Homes nearby	Education and outreach for fire prevention. Fireworks and shooting during hot summer months and other activities could provide a spark to ignite these fuels and others.
Nisqually view loop 98516	Land slide erosion	Homes on the loop	Slope stabilization
Downtown Olympia, Nisqually bridge, Summit Lake	Flooding, or landslide or fires for Summit Lake.	Summit the residents there. Nisqually I5 travelers, Olympia, businesses and transportation from Eastside to west.	Conservation for Summit, online monitoring for others with contingency plans.

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Nisqually delta: Pacific & 6th.	Prone to flooding. An earthquake large enough to compromise the dam would be devastating to the region. Evacuation is difficult because of increased traffic on Mounts Rd/Old Pacific.	Residents	Enhanced early warning and better traffic control. Even on a good day, getting out of the neighborhood can be difficult. During frequent high traffic events, it's nearly impossible.
Summit Lake, Turkey Rd. very steep, many steep slope residential developments along shorelines, in general, in Thurston County.	Landslide hazard	residents and the whole community that would lose the quality of resources due to impacts from landslide hazards near other jurisdictional critical areas.	Limit development near steep slopes, larger buffers, geotechnical reports should not have more pages in the disclaimer section than in the body of the report.
Delphi Rd, Cedar Flats, Maple Valley Rds subject to all potential hazards with season climate and weather events singularly common	flooding, wildfire, snow, ice, wind storm. Infrastructure damage notably electric service and travel ability due to rural nature of the area	The entire population of the general region	Better water runoff management, citizen awareness of grassland control. Shifting from mostly above ground electric distribution to underground and focus on micro grid development, utilization of renewable energy and energy storage in micro grid
Nisqually area	flooding	puget sound area	
Nisqually valley crossing, I-5 and up river.	Coastal flooding, lahal, Tsunami, bridge integrity in quake.	All travelers going across the county line.	Rebuild roadways to a higher elevation, higher bridges over the river.
Semi-rural or rural areas throughout Thurston County	Wherever grasses are tall, undergrowth is dead or dry, where summertime drought causes risk of fire that threatens both wild areas and homes.	Wildlife and plants, forests, people and their homes and pets.	Requiring a "buffer zone" of graded 12 foot areas around farmland, as they do in California OR keeping a "green zone" - a watered and lush area of the same dimensions around rural areas and homes.
The Scatter Creek Wildlife Preserve is very vulnerable to wildfire. We live across	Many acres of Scotch Broom, tall grasses that act as "grass-o-line", and a constant	The homeowners in the area, the wildlife (especially endangered ones) that live there,	Early, consistent management by mowing of the grass and removal of the

from it at 6837 183rd Ave SW, Rochester.	prairie wind to fuel if further make it a severe wildfire hazard.	and the value of the land as a hunting area that creates revenue for the State program.	Scotch Broom. They say "we are going to burn it" but that never occurs because they need a window without wind and when the fire danger isn't high or they create a wildfire that they are trying to prevent.
Flooding in/around Tenino and Rochester. Churchill Road outside Tenino is hazardous to drive on when roads freeze due to incline of the hill, and becomes inaccessible when floods occur (highway 507 flooded last winter near the Churchill intersection) - when this happens, residents on this road are cut off (Churchill is only accessible from 507). Outside Tenino and throughout the county there is also potential for liquefaction and landslides due to earthquake.	See above	Rural families, farms	Neighborhood emergency team training similar to the NET program used in Portland, OR. Train residents how to be prepared and handle disaster scenarios because EMTs will not be able to help everyone during major emergency scenarios. Provide resources for neighborhoods, store emergency supplies at designated beacon locations that contain water, first aid supplies, etc. Flood mitigation in and around Tenino, specifically using ecological restoration to sequester water and restore salmon habitat, creeks and ponds.
Chehalis river area - flood Gopher Preserve areas between 183rd and Old Hwy 99 that are overgrown and are a severe fire hazard to the neighbors	Flood, fire	Nearby houses	Continuing flood mitigation Mandate that the conservation areas remove scotch broom and mow the land.
Nisqually Valley - Flooding, Volcanic, Storms, Earthquake	Destruction of bridge on I-5. It is highly vulnerable to all of above.	Anyone and anything that requires I-5 transportation. People, Food, all life	Rework I-5 to elevation much higher with replacement of aging

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		necessities. Main transportation corridor.	bridges across the Nisqually River.
Nisqually bridge.	Flood or earthquake damage to the Nisqually bridge.	Transportation north and south of Thurston County.	Building a new modern bridge and defining emergency alternate routes.
Nisqually valley. Deschutes area…	Flooding. Landslides.	People. Wildlife.	Barriers.
Above Rainier, Yelm, Buccoda, Tenino etc. is a lot of forest land. It is fantastic to have but when people go into those areas to camp it is very easy for a fire to development when ground is parched. I would suggest making fires illegal at the first sign of dryness that goes for home bonfires etc. Right now, it is set by date, but we should monitor the moisture and call it earlier if need be.	Foreign Pests coming into WA. Whether it is tree destroying beetles or killer hornets	Everyone	I hate to say this but more restrictions on imports especially live vegetation coming from areas known to have pest we do not have.
11846 Deer Trail Ln SW is adjacent to the Capitol Forest. Fire management on DNR land and our own parcel are inadequate.	Forest fire.	Many nearby properties.	Use the existing roads as fire breaks by clearing perhaps 15 or 20 feet on each side of forest roads. Make up for the extra harvest by expanding "Leave Tree" areas, which would reduce harvests to offset the extra harvest near the roads. This would also allow more robust survival of the "Leave Tree" areas. Also, thin third generation stands.
Rochester is full of dried fields and yards that are tall, dry, close to tree's. Drive down	These places are close to homes, schools and if they catch on fire as the fields did two years	Home owners, school districts	There needs to be a law enacted that allows the fire department to be able to have people

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Pecan Street and see the fields of dry grasses, drive down Hwy 99 and see the tall fields of dry grass.	ago, it is going to devastate the area.		mow these fields early on prior to fire danger. If they are not taken care of, the home or property owner needs to receive a hefty fine and notice they can be sued if these fields catch on fire. I am NOT talking of hay fields that get mowed each season.I am talking about fields near Pecan Street where the apartment renter burns his trash next to these fields and tall trees during the middle of the night thinking no one smells or sees this. I come from an area where the fire department could mandate yards and fields be mowed and if not and the city had to mow it the homeowner got a fine and a bill. Washington talks a big talk about fires but the reality is nothing is done preventatively.
Woodland Creek Estates Neighborhood	Wildfire. There are many homes that back up to the forest, and there are many trees in the neighborhood. There's charred trees and evidence of wildfire in the Palm Creek Headwaters park from decades ago, so there's no reason it can't happen again.	Residents in the neighborhood	Natural debris cleanup. Property assessments, community wildfire prevention education, Lacy City involvement.
Scatter creek, vulnerable to flooding, southern Thurston	See above	Rural Thurston county residents	Act on climate change!

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county is rural and vulnerable to activities causing power outages			
93rd Avenue / SR 121 between I-5 and Tilley Rd SW seems susceptible to flooding. Every winter water comes very near to being over the roadway. The parking lot at Johnson's Machine shop floods. Hopefully the construction/development along this stretch doesn't make this worse.	Flooding. I suppose there is a risk of groundwater contamination depending on development or leaking tanks (Pilot/Flying J).	People traveling on 93rd Avenue. Potentially emergency services.	Improve drainage or elevate the roadway. Require mitigation from developers.
Scatter creek area	Flooding seasonally	Those living in the flood plain	Don't build in the flood plain...
old 99 going up chain hill	land slide	all road user	move the road a bit
Nisqually basin	Floods. Fires. Earthquake.	All of us	Mitigation..awareness communication...disaster plan management. Action plan communication amd training
Nisqually valley in the event of Mt Rainier eruption	Mudslides, volcanic debris and possible tsunami.	Communities along the river, Nisqually reservation, shoreline land owners around southern Puget sound.	Early warming system.
Nisqually River Valley	Particularly vulnerable to recurrent flooding	Homes in the area	Better control to water released from the dams to prevent flooding.
Steamboat Island Peninsula	there is a fault line that runs horizontally across the road - which literally cuts the penisula in half.	everybody from the fault line up to Carolyn Beach area - nobody above the line wuld be able to getout if the road collapsed	reinforcement of road. Strategic placement of emergency supplies. Develop plan for evacuation by air or water if necessary. Develop plan for neighborhoods to know more. Have

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			people sign up with SMART911.
North of big tykle cove the land is falling into the sound	Landslide	The houses below and above	Plant more trees
Delphi, Madrona Beach, downtown Olympia	Flooding	Everyone	
Scatter Creek Area on 183rd Ave.	Large are of grass land with wildfire risk	All housing communities around the area and the firefighters responsible for fighting the fires	Working with WDFW on control burning and help home owners creat defensible space.
Nisqually River	Flooding	Those nearby	
Nisqually river valley	Lahar from Mt Rainier eruption	Yelm and Nisqually reservation	Mitigation (e.g. moving people away from riverbank)
Carlyon Beach and other piglet sound bluffs	Landslides	People who own homes or are thinking of buying homes in the area	Have the Washington Geological Survey map landslide hazards using lidar data so that the city, county and general public can know areas that are at risk
East end Skookumchuck valley	Possible dam failure	Everyone down stream on Skookumchuck river and possible the Chehalis river down stream of Centralia	
Mile marker 95 of I-5	Flooding	Potentially all traffic between Seattle and Portland and residents in the area	Purchase of 2-3 acres to be used as drai ace.
Multiple locations in less developed parts of Thurston County with only 1 access road.	Road at locations with only 1 acces road can be blocked by fallen trees or fire, isolating people, wild and domestic animals and preventing them from leaving or preventing assistance from reaching their property.	People, animals, homes, businesses and the natural environment that have only 1 access road.	1) more rigorous maintenance (removal) of vegetation in ROW along county roads by county and property owners. 2) Neighborhood meeting periodically to develop communication and teamwork, identify and work on hazards. 3) Government and agencies with jurisdiction meeting

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			occasionally with neighborhood for oversight and counsel.
Rural areas such as south Thurston County and Yelm area are susceptible to wildfires.	Wildfires, floods.	Rural property owners.	Encourage property owners with livestock to develop evacuation and emergency response plans as designed by Thurston County Emergency Management Equine Outreach volunteer group. This protocol encourages livestock owners to identify emergency transportation resources, temporary sheltering, phone call trees, information collars for evacuation purposes, property grids informing fire and medical response where electrical boxes, propane, wells, water hydrants/faucets etc are located similar to Alberta, Canada's emergency response system.
Rochester	Flooding	Housing and farmland	Keeping culverts and waterways clear and free of debris
Downtown Olympia Tsunami South County - Forest Fire	Everyone		Mitigate with early warning/education Additional fire resources, both preventative and reactive
North of Lacey there are homes overlooking Hogum Bay and DeWolf Bight	Landslide due to shore loss/bluff retreat as sea level rises	Homeowners	Buyouts, maybe slope stabilization
Nisqually Basin	Volcanic		
Rural, agro land	Tree falls on structures, vehicles, roads and power line.	Long power outages, loss of home and lives.	Trim back follage/trees from power poles and lines. Develop info bulletins for home and

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			property owners and how to l8mit and prevent damage.
Carlyon Beach bluffs	Landslides	Homeowners	Better setback laws for new construction as well as thorough investigation of stormwater runoff/retention ponds' impacts to bluff stability. Possible buy-out program for severe at-risk homes?
7528 Cooper Point Road NW	earthquakes and wildfires	all residents	none
Johnson Point	Wild fire	Everyone, people, animals, wildlife	Land preparation and homeowner education. House hardening (roofs and eaves).
The Nisqually River is constantly in danger of flooding because of Tacoma Power's preference for power regeneration over public safety.	Those of us who live along the river have to constantly be on guard from November until March because we can't easily get to work or escape when the river floods. I've had to get FEMA assistance twice to repair our road and its bridges.	Those living on the flats along Old Pacific Hwy near Reservation Road are affected most but upstream we are affected too. JBLM employees will be affected most if another flood destroys the bridge over I -5. It's a National Security issue.	TPU MUST keep the Alder Reservoir much lower in the winter so there is more room to absorb high eaters coming from Mt Rainier during three day rainstorms or winter tempersture high enough to melt the snowpack.
Nisqually valley	Flooding and possibly volcano lahar or other downstream effects	Folks who live there and anyone needing to travel across the valley if I-5 becomes blocked or otherwise unusable	?
Rail lines along Case Road & Hwy.12	Hazardous and oil fuels	Scatter Creek, housing, soil and water contamination	An alert system- cellphone notification. Rail trains slow down thru environmentally sensitive areas
Nisqually river, I-5	Flooding, lahar, potential destruction of bridges and highway link to north.	Could affect everyone living in Thurston county. Potential disruption to supply routes for all resources. Could prevent	Update I-5 and other bridge infrastructure with modern bridges well above potential flood levels. Also mitigates sea level rise

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		commuters from reaching their jobs. Possibly limiting medical services if local hospitals become overwhelmed.	hazards. May need to raise road bed for portions that are too close to water level.
Mullen rd. RRXing/downtown back fill land/old growth trees by major thoroughfares	Excessive water ,mud slides, poor drainage ,liquefaction , hillside without proper stabilization	Traffic, homes, road closures, pot holes , power outage, tree damage,	Preventative work -tree trimming or removal, road improvement, retroactive shoring of properties -earthquake ,floods, improve drainage,improve road side areas (landscape,curbs,backfill,)
Flooding on the black river	We had almost no way out when the river flooded	Many people in the homes near Mimi mounds	Raise the road and bridge at at least one crossing. All three crossings of the black river were closed. And Delphi was closed in a couple spots. You could get around on waddle creek to black lake and get to Tumwater but even those roads had water over them
Nisqually Valley and I5 corridor is restricted during an event and I5 both into and out of Thurston County leave very little ability to evacuate an area when it is not passable there are very limited alternate routes.	I5 both into and out of Thurston County leave very little ability to evacuate an area when it is not passable there are very limited alternate routes.	Communities in Thurston County relying on I5 for evacuation routes. Or in an event could severely limit the supply availability in and out of Thurston County	Ensure alternate travel routes to evacuate are sufficiently robust to accommodate and alleviate the potential restrictions the event could cause. Enlarge the routes that run through Roy/Tenino etc.
Steamboat Peninsula, north of US-101 at Steamboat Island Rd NW.	Earthquake. As I recall there was a USGS study that identified small fault lines running across the Peninsula at roughly 71st St. NW. Also, there is a history of infrequent landslides across US101,	Landslide along US-101, especially if it includes Madrona Beach Rd., would make travel between Olympia and the Steamboat Peninsula area much more difficult. An earthquake	Area residents need to prepare for the possibility travel by road will be interrupted for a significant period of time after a disaster such as landslide or earthquake. In case of

	northwest of the WA-8 interchange. Also, wildfire on the Peninsula could present a problem as there are only a limited number of roads (evacuation routes) providing access off the Peninsula.	could make transportation along Steamboat Island Rd NW much more difficult, potentially cutting residents on the north half of the Peninsula off from the south end and US-101.	wildfire, additional time will be needed to evacuate the peninsula before access routes are at risk of being cut off by fire.
I-5 crossing of the Nisqually River	Flooding / liquification / erosion of the road pylons	any Commercial and personal traffic	
Gadwell Court SE	Large forest area between the houses - love the view but vulnerable to wildfires and intense winds	residential area	need thinning and pruning of dead trees and ground brush
Hwy 12 through Rochester and Reservation	Flooding	Homes and access	not sure
Rochester. Close to Lewis Co.	Flooding	Close to Lewis Co. and typically is a flood zone	Nothing has changed and repeats frequently annually
Rochester	Flooding	A family member	
Island View Ct NE, Olympia	Depletion of ground water supply, earthquake, fire, smoke, climate change.	Everyone, including our property.	
Mounts road Nisqually river basin area flooding zone	Flooding		
End of bald hill rd South East part of county	Wildfires	everyone living beyond bad hill road and longtime road	Reopen the road between the back gate of clearwood And highway 7 in Pierce County. We need another way out in case a wildfire blocks Bald Hill road
Rural areas that could be affected by fire. Downtown Olympia is particularly vulnerable to both earthquakes and flooding downtown	Fire in rural areas. Flooding and severe earthquake damage downtown.	Rural residents. Downtown businesses and workers at risk of injury.	Grants to reinforce downtown buildings, and requirements/law to reinforce vulnerable buildings within a specific period or be declared uninhabitable.

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Alder dam	close to a mountain that could produce larde earthquake	everything below it	remove the dam......
Area where I-5 crosses the Nisqually River	Flooding	Residents of that area; commuters	Raised bridge; flood mitigation
Nisqually River at Nisqually	Flooding	Residents near river, commuters passing through	?
Nisqually Delta	Flooding	Residents	Prayers
1. Downtown Olympia & other shoreline areas. 2. Nisqually river valley. 3. Entire region.	1. Sea level rise; earthquake/tsunami/subsidence effects. 2. Floods; lahar effects from Mt. Rainier. 3. Climate change effects; intense heat episodes.	All of us.	Work to mitigate climate change. Improve disaster planning. Build public awareness.
Flooding around Scott Lake. Landslide during heavy rain on the hillside just north of the governor's mansion.	see #4	The flooding affects a number of residents in the Scott Lake area, many of whom earn below the median income. The landslide affects the state government, the railroad, and potentially anyone walking along the nearby path.	Flooding--huge problem. Best solutions: relocate; raise the homes on pillars; leave more forest to absorb the water. Landslide. Shore up the hillside. Maybe remove trees from the top edge of the hill. Probably have to cut into the existing parking lot above the hill.
West Olympia, Cooper Point Rd, logging and excessive clearing to build residential/commercial units	Loss of trees	Flooding and climate change	Great control on builders
Nisqually Valley, Budd Inlet.	Water damage from floods and volcano eruptions.	All of us.	None.
Near Mt. Rainier. Downtown Olympia.	Near Mt. Rainier: Volcanic and earthquake. Downtown Olympia: Flooding.	Near Mt. Rainier: People who live in towns or farms near Mt. Rainier. Downtown Olympia: Businesses, apartments, homeless people.	Near Mt. Rainier: Provide warning prior to earthquake and volcanic events. Downtown Olympia: Construct walls or higher soil next to low shores.

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downtown olympia and Budd inlet shoreline and bluffs	earthquake, and flooding	businesses and homes	no possible solutions
Portion of harbor area that is built on fill.	Earthquake liquifaction, flood damage	Residents and businesses in the area	More flood gates on storm drains connecting to the lake/bay
Rural areas and downtown Olympia	Rural areas fire. Downtown Olympia flooding due to rising water levels. Also unreinforced masonry buildings and brick chimneys in an earthquake. Chimneys above internal walls will come down straight through the roof and into a house. Brick chimneys on exterior walls will just pull away from the house a crumble.	Likely as eminent risk 1/4-1/2 the local population.	No new multi housing near the port or downtown that are less than 50-75 feet above sea lever. Grants or very low cost loans to reinforce masonry commercial buildings in the downtown core.
Soft soils by the water	Soils are prone to sinking and creating building instability	Economic vitality - downtown business owners, gov buildings, lower income apartment housing	Retrofitting buildings, preparedness kits for longer term, public community plans showing routes with potential impact to infrastructure
Downtown Olympia, Nisqually Valley, Thurston County	Sea level rise and flooding from the mountains, fires in all of Thurston County	Natural area, animals, sea life, humans. Livability	Less auto traffic and more mass transit. Stop urban sprawl. Move people away from the sound shores and river banks.
Marine shoreline within 2-5 feet elevation above HAT (highest astronomical tides). Ie, nearest tidal station to Thurston County with HAT info to is Tacoma, where HAT is 1.87ft above MWWW. And highest observed tide is 3.09 ft	Since highest annual tides occur mid-winter, co-occurrence with extreme storms have potential to raise marine waters 2+ feet above HAT, imperiling residences and infrastructure.	Shallow gradient marine shorelines are most at risk, but all marine shorelines would be affected.	Establish at least one tidal station in southern Puget Sound, eg, Budd Inlet that will include all datums, ie, HAT. Use this info to survey elev of near shore infrastrucure and all new county permits. Inform shoreline residents of potential

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above MWWH. https://tidesandcurrents.noaa.gov/datums.html?id=9446484			flooding during severe storms coincident with highest tides.
low-lying areas - such as downtown Olympia	Subject to impacts from sea elevation change.	all of us.	protection of downtown by making site more resilient and potentially constructing sea walls.
GreenCove Creek Basin and Downtown	For Green Cove Basin- Flooding, landslides , toxic contamination from MTCA site, loss of aquifer recharge areas leading to loss of habitat for salmon and continually lowering aquifer levels that threaten the drinking water supply for the City and Cooper Point Rd. And the strategic groundwater reservation Flooding, earthquakes, tsunamis for downtown	Our drinking water aquifers Wildlife habitat Infrastructure from landslides and flooding Public health	Do not allow any development in any critical areas County wide monitoring of aquifers for water quantity AND quality, including testing for chemicals
Olympia Watershed Park, county prairie lands (wildfire) i.e., Rocky Prairie (Old Hwy. 99, Waldrick Rd,). Mima Mounds.	Wildfire encroaching on residential and out buildings.	Residents and property owners.	Safety assessments to show cause for fire safety barriers, access for fire suppression equipment.
Flooding along shorelines from sea level rise and especially downtown Olympia	Very vulnerable.	It will impact the local residents and businesses but also all tax payers since we will likely pay for preparation and response.	Stop developing in a large portion of downtown Olympia. The 'walled' area should be enough to save the east-west street connections. Stop the port deep dredging and shipping to free up funds for other Port activities that are not water dependent.

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Sea level rise - downtown Olympia, I-5 at Nisqually	Flooding and transportation bottlenecks	Commuters, downtown businesses, unhoused people	Infrastructure improvements
I5-US101 intersection and Nisqually area.	Flooding, landslides, earthquake, volcanic runoff	Everyone	South county bypass around other side of JBLM would avoid this area and Nisqually too
West Olympia above Deschutes Parkway and West Bay Dr	Landslide from an earthquake	Local residents	Awareness and individual resident action to keep the slope stable.
Along the sound in Olympia and Nesqualy	Tsunami	Everyone in the immediate area	None
Ridgeview Estates , a residential development off Martin Way East & backside of Steilacoom Rd. SE before the crossroad of Duterrow Rd. SE / Meridian Rd. NE	Mostly wildfire potential than earthquake , severe storms	Most of the residents especially on the periphery of the development due to forested areas	Would be prudent to know what steps to take if in fact a fire or earthquake occurs. What's the best way to help ourselves & our small community if fire & emergency rescue services are unable to reach or assist us . How would we evacuate, especially if there's structural damage on I-5 ?

Yelm

Location	Description	Affected People	Solutions
McKenzie Ave SW in Yelm and 170th St SE between Walmart and 103rd Ave SE in Yelm	Both roads frequently flood	There are houses and apts near McKenzie (I believe potentially low-income apts) that have the road connected to the driveways frequently flooding. Also impacts residents trying to go to Walmart via 103rd Ave	Retrofitting the road to be more flood resistant and improving stormwater facilities
Rural areas such as south Thurston County and Yelm area are susceptible to wildfires.	Wildfires, floods.	Rural property owners.	Encourage property owners with livestock to develop evacuation and emergency response plans as designed by Thurston

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			County Emergency Management Equine Outreach volunteer group. This protocol encourages livestock owners to identify emergency transportation resources, temporary sheltering, phone call trees, information collars for evacuation purposes, property grids informing fire and medical response where electrical boxes, propane, wells, water hydrants/faucets etc are located similar to Alberta, Canada's emergency response system.
The Nisqually River is constantly in danger of flooding because of Tacoma Power's preference for power regeneration over public safety.	Those of us who live along the river have to constantly be on guard from November until March because we can't easily get to work or escape when the river floods. I've had to get FEMA assistance twice to repair our road and its bridges.	Those living on the flats along Old Pacific Hwy near Reservation Road are affected most but upstream we are affected too. JBLM employees will be affected most if another flood destroys the bridge over I -5. It's a National Security issue.	TPU MUST keep the Alder Reservoir much lower in the winter so there is more room to absorb high eaters coming from Mt Rainier during three day rainstorms or winter temperstures high enough to melt the snowpack.

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Appendix B: Additional Notes

Notes
county and city governments need to work much more closely together to address these issues. Both need to get past their viewpoint of project by project approval, and look at the entire system, and what it needs to function properly to withstand disasters.
Public funds to those who can't afford to have basic preparations
I see the government's primary roles as setting and enforcing standards, developing and transmitting procedures to follow, and developing reciprocal agreements with other communities.
I think utilizing natural environment prevention measures is important. For example not building in areas with natural cyclical flooding and estuaries. We need to utilize the natural environment to accommodate water intrusion and other natural events rather than a "hardening strategy".
Folks need to learn more about what they can do, personally. They also need to be aware of disinformation & misinformation. Government, non-profit orgs, private orgs who care, etc. can't do this alone. The public needs to get behind this more so that each of us starts to decrease our carbon footprint on basic personal level. And this may start with having to combat the amount of nonsense and ignorance that some information sources are choosing to spew out to the public.
Ensure all levels of government and responders have plans and regularly exercise those plans.
Trainings and community networks
I think most of us understand that the problems we face are not going to go away on their own. We have to think about what we are going to do when the worst case scenario occurs and have prepared as much as we can to be ready for that.
Include economic development practitioners in planning
I think that the Port of Olympia is negligent in communicating it's role in disaster response/recovery which concerns me that I'm not sure that they even know it's their role. ThurstonStrong was the model for economic disaster associated with pandemic response.
allowing for grants to help home owners looking for vulnerabilities in their homes
a wind storm can take power out for weeks. improve power restoration.
I recall in the past that our neighborhood associations had a plan for what our responsibilities would be in case of a disaster.
i like receiving alerts, it's helpful
I think a map describing which bridges are the safest to travel after an earthquake would be useful for planning purposes. People will need to travel to get kids and go home. The usual route home may not be the safest.
I didn't mention our highway system to and from Thurston County but we definitely need to replace the I-5 bridge over the Nisqually. If that goes, it will be a nightmare and really costly compared to even the cost to fix now.
Setup clear communication for disasters (like a simple website with who to call for what issue - this info gets lost on government sites and people are stressed out when they need the info)
My neighborhood is situated on very dense, coarse gravel, sand, and boulders, and slopes are very gentle, so we are not as at risk as other locations in Olympia.
More action and less meetings. Use taxpayers money to actually make a difference and not for a bunch of talking heads and numerous impact statements etc
Educate not regulate.
Not sure if a lot of the current summer road construction projects can also include road improvements to prevent flood impacts.

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Olympia seems to be at cross-purposes by encouraging increased downtown residential areas while talking about preparing for sea-level rise.
Clarify how many days of potable water supplies should be on hand at every residence until emergency services become available.
Subscribers to existing emergency alerts should stay subscribed until the opt out. I've had to resubscribe several times. Often do not receive alerts even while subscribed (find out from neighbors).
There should be a funded effort for swift water rescue incident response teams, and multiple units should be designated to serve the Chehalis and Nisqually rivers, during flood events. Not just for people but for livestock and animal rescue, additional facilities for holding these animals should be identified, like fairgrounds.
stop thinking URBAN and recognize the impact on rural is often substantially more intense due to existing limitations on vital infrastructure and access to essential services during disaster events.
I hope we have some opportunities to use federal infrastructure funds to prepare our communities.
Reduce the carbon footprint of the county
Keep pushing toward net zero carbon to do our part to lessen climate change impacts.
Would love to see an ongoing series of education for preparedness. Maybe focus on giving discounts for rain barrels or other emergency supplies
Warning systems to give more time for self-protection in case of earthquake and tsunami would help
A different way to look at fires is equating it to population and not climate change, unless the population increase is a type of "climate". You have 5 people at your house and nothing gets broken. You have 100 and things get broken. Population increase negatively increases fire danger.
I would like to see public subsidies available for lower-income households to build and maintain their own emergency-preparedness kits. Or, provide pre-made kits at low or no cost to as many people in need as possible. Thank you!
I would like a government - sponsored program to bring groups/neighborhoods together for the purpose of identifying and mitigating hazards pertinent to their immediate area. Then, train and inform them as to how to address hazard issues. Rather than an overarching approach, involve people on a micro-local level. A bit the way that Next Door operates, but from a hazard mitigation standpoint. I have a lot of ideas regarding this and how it could be implemented at low cost to the state.
Education and planning/permitting seem like the most important activities
Thank you for engaging the community!
Instead of talking need to start doing. Hazards have been the same for ever. Do something and do not put the burden on the tax payer. Quit throwing money into other useless projects.
There needs to be better transfer of information to new property owners of previous hazards that have affected the said property. The lot in front of us was under water for 10 days with over a foot of water, yet when the property was sold, the new owner was only told that there was "some water" on the property. She was led to believe that it was just a little standing water. If Scatter Creek floods our area again, their well will be under water.
Please don’t forget about those of us who live in unincorporated Thurston county :)
We need more alerts and notifications.
This should be high priority. Time is ticking. Not if but when. When could be next week.
People need to be made aware that in the event of a disaster, they are on their own. They cannot rely on someone else to save them, come for them, provide for them. I have seen time and time

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again that people fail to prepare, expecting to be "rescued". Then they get upset when that rescue does not come. Wake up people!!!!
Drinking water availability and emergency medical services after a major earthquake.
Taking care of the homeless issue. There's no excuses for them taking over private or public property. It's an outsider way of life. It detracts from bigger issues. I shouldn't see scorched trees while walking around town. Or "home made" dwellings near sidewalks and trails. I've crossed paths with more needles than I should. Treat services are out there!!! If I can gain employment… so can the next guy/girl.
I have a lot of large trees and I love them, I would never cut them, but I am losing some to root rot. I think for residential properties that that have a lot of tree growth and the people are worried about fires I would not require a permit that cost money. The owner only need proof that it is not timber land and that it is a danger.
Public service announcements and announcements on local newscasts.
Every property owner should evaluate properties' situation, structure, etc. Stock emergency supplies starting with "blue tarps" for damaged roofs, clear plastic sheeting to cover broken windows and any other nonperishables to sustain life in (relative) safety and comfort.
The most vulnerable groups are the least likely to have resources. Enable those who can to protect themselves and make it clear they'll be on their own for a while. Plan to fully support people on the edge of society.
Our family had an emergency late in December of last year requiring trips to the hospital. We live in a rural area in the SE county. There was snow, then rain. There are two areas that had flooded badly. I had no choice but to drive through since there was no way to turn around, but the water was deeper than one should attempt in a sedan. Both of these areas have flooded before, but never this much, in my experience. It felt very dangerous. One of them happened because a homeowner recently clear cut a hill behind their house, the other is at the end of Rainer Road, where it meets college. I hope that these can be corrected before the next flood happens.
Local governments need to put welfare of people above their own political, developer and corporate interests…really.
A few years ago I was on my way home from shopping,when I got to Hwy 12/Pecan Street where a tree and the surrounding grass had caught fire. I ran home and packed our to go bag, our dogs to go bag, grabbed our important papers and began getting both our vehicles out of the area. My husband notified neighbors and set up sprinklers. There was no notification, no warning that this was going on and had I not passed in enroute to home, I would have never known. The trains that year were also setting the fields on fire. DO SOMETHING about the tall grasses and that goes for property owned by the cities, counties, state and railroad as well.
I would like to see more emphasis on personal accountability and resiliency versus the (what I believe to be widespread) impression that Federal, State, or County resources will rescue everyone.
Yes, I am available via email to do a meeting with you folks. Thank you.
Set up information booths at public events and the farmer's market.
Bring resources to the community, especially to rural residents
Build mass transit. No charge to ride.
If the American Red Cross is not already involved in this planning, please invite them in. Local expertise may be limited, but nationally the Red Cross is knowledgeable in disaster mitigation, both before and after. They should be part of the county emergency management as well as emergency preparation. Thanks. https://www.redcross.org/about-us/our-work/disaster-relief.html https://www.redcross.org/local/washington/about-us/locations.html

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I think the single greatest thing we can do as a society is encourage individuals/families to be prepared. Education is the key to this. What disasters are we likely to face and what can we do to prepare? Education about what to have in an emergency kit is helpful, but sometimes guidance is kind of limited. For example, "first aid kit" is not clear enough. If I buy a first aid kit it really only comes with band aids and ibuprofen. But then I feel prepared because I bought the thing the guidance told me to.
I5 corridor is only major thoroughfare going North and South... when it is out due to flooding, water levels things stop! We need a diversion route that can be used.... way past time and it needs to be this side of the mountains.
Regional coordination efforts are commendable. They need to be continued and expanded.
Maintain up-to-date information for the communities at risk.
Continue to support and require developers to include greenbelts in developments. It helps lessen the impact of flooding, reduces the overall local surface area of impervious surface areas that leads to greater erosion and local heating, and helps keep local temperatures lower which helps reduce fire risk as well as cooling household needs.
Ideally, public transport would be a priority for investing in resilience, since post-disaster use of highways by all vehicles may be very limited. Also, residents need to know options for getting impt info if cell-phone and internet hardware are not functional.
Alternative to I-5 in Thurston county is urgently needed.
power grid is very fragile
Underground electrical lines would prevent downed power lines that could cause shock or fires.
There is no end of money to accomplish all the above, but that doesn't mean we do nothing. It's important to build capacity in all the above areas... just keep at it.
amber alert type system
The more we can do to reduce the worst heat island areas now (giving shade trees a chance to grow, for instance), the better. We also need to build under the assumption that flooding will be more extreme, and with floodplain management in mind.
You're doing great.
There is not enough attention paid to our dwindling water resources, tree canopy and loss of biodiversity because of the overriding interests of development. If you don't resist this unyielding pressure to build more, there's no way to stop these disasters. Without recognition that all of our well-being is completely dependent on the water, policies will continue to allow overuse and degradation. I hope our local government has the strength and resolve to say No to unwise development that further threatens our precious and irreplaceable resources.
It would help if local governments (Olympia) would assess and act on fire hazards from City property as they impact residential properties.
Reduce CO2 emissions
Make the electrical grid more resilient! Our power goes out far too frequently. As rising temperatures place more pressure on the power supply, this will be an even bigger problem. Microgrids may be one solution, or the ability to use solar panels in the event of a power outage.
I'd like to see more local government led coordination of neighborhood-level preparation for disasters. And my true answer to #8 would be 'procrastination' -- probably the biggest barrier to personal prep is 'I'll do it tomorrow.'
The local governments should focus on what they can do to reduce climate emissions. These actions will have other benefits. Don't encourage or support sprawl and development in flood prone areas.
We need to do more to deal with climate change in our community.

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Planning for harm reduction and trauma informed care for people impacted in disasters
Are economic development directors at the table?
Don’t waste our money! Use it wisely. We work hard for it; you hardly work for it!
Some kind of neighborhood inventory of residences - who has disabilities, how many have serious health issues ,how manylive alone, who has no outside transportation, who has pets, how many and type, etc.....
If you look at Japan who is normally way more prepared than the United states you will see that even with all the preparation they had, they really couldn’t do much against mother nature
House the homeless
Homeless camps have started many fires. I hope the local gov realizes how big of a risk this is to surrounding homes and infrastructure.
Worried about well mitigation
Are you planning for just one earthquake scenario? For example, the Full Rip versus the Seattle fault?
Fire evacuation
It is very important and education/outreach is vital to understanding local issues and opportunities for improvement/awareness.
don't raise any taxes to do these things
Make evacuation routes visible and up to date.
Removal of the 5th ave dam will improve floodplain and reduce climate change in the area
Removing the 5th ave dam in downtown Olympia would mitigate effects of climate change and flooding
Seminars, classes for the public for educating about disaster preparedness given by police, firefighters and first responders.
Make this initiative a priority with Thurston County.
I feel like the community does well. I just wish clear steps to take.
One thing I suggest we need to look at is food supplies. The amount of produce, green house tomatoes, bell peppers, mushrooms, etc. that we import from Canada and from south of us up I-5 leaves us vulnerable to problems. In both cases I-5 is an important tool that brings in a lot and if it is damaged in an earthquake or cut by flooding or some other problem occurs with the supply chain the area will have a problem. Why hasn’t the greenhouse business developed in this area? If it did that might reduce the potential problem that would occur in a disaster and it probably would have a number of other benefits as well that are not the interest of this discussion at the moment. Are the land use regulations standing in the way? If so they need to be repealed. Lots of places have well developed greenhouse business why can’t we do the same? Sincerely, Michael H. Wilson
Efforts to connect neighbors and neighborhoods.
Better-consolidated information on the supplies to keep on hand. Each source seems to provide different information so it's difficult to know what is really necessary. Also, when and how to rotate items - water in plastic jugs expire (the plastic degrades), and it seems like many of the food stuffs are not meals I would normally eat, so they expire and get tossed. Also, the number of items I've seen on various lists are appropriate only for sheltering in place, not for being mobile.
Promote increased communication among residents to help our neighbors (GMRS/FRS radios, presentations to HOA's etc). We seem to all hibernate and not talk to all of our neighbors.
A “disaster bank”: like a food bank provides food to the community from donations, there should be a way to donate preparedness items in our community.

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The survey above should include questions related to cost/benefit. most citizens don't recognize that changing building codes to make structures "more" resilient will increase the cost to housing and businesses. At a time when the nation is trying to find ways to create "affordable housing" the increased cost of changing building codes to make structures "more" resilient needs to be considered. So the real question is... are current building codes sufficient? The seismic requirements in Building codes have been changed significantly over the years so at what point are they "good enough"
Education, Preparation
Community fair or neighborhood meetings
It's hard to maintain urgency with something that *might* happen. I appreciate your efforts.
Regulate climate change
Incorporate businesses and VOADs with the plan.
How to Prepare for Climate Change Book by David Pogue - great resources for general disaster preparedness. Very useful regardless of what you think about climate change.
Provide organization and training for community action response teams.
Wild fire evacuation plans. Paradise, Ca. and Redwood Valley were last minute. I think we need sirens placed ?
Lack of community education and disinterest by the public. Start with the kids in school and hope to reach families.
I live here because there is almost zero danger of natural disaster.
Our hospitals can not handle a large scale emergency
Certain medications are only available through a prescription. One disaster advice is to "stock up" on medications. How do I stock up on insulin when the amount I am allowed is limited by prescription and my insurance? I am insulin dependent. Disaster advice says not to rely on normal infrastructure and services in the weeks and months post disaster, so I assume I won't have access to insulin then. How are you pre-emptively helping people dependant on prescription medications to live?
I think my community does fairly well. Just some people don't know what they don't know. Thank you.
Consider equity. Who are the least able to recover from disaster? Pay special attention and provide resources to assist them.
Less reliance on communications infrastructure working in a crisis.
Fox the roads
Engage HOAs and provide grant funding.
Evacuation routes for people at sea level.
It might be a good idea for the South Bay Fire Department to hold a fire information event on how land owners can lower their property's fire risk.
Direct growth away from downtown bridges.
Yall want to burn down downtown and start over anyway.
Thurston County, the Nisqually River Council, the Nisqually Indian tribe, private citizens who live along the river, TPU and Centralia Dam representatives should form a committee that meets regularly to improve our protection from flooding.
During heavy snow. Start plowing main entrance/exits in subdivisions.
Governments also need to focus on at risk groups such as the elderly, handicapped and homeless as well.
1) Better information about flood and earthquake insurance for home owners and regulations to ensure this type of insurance is offered, funded and reliably will offer coverage in our region. 2)

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Funding to reduce cost of new and replacement energy star rated heat pumps that can provide residential cooling during extreme heat. Local companies are charging astronomical prices due to recent heat waves and pent up demand. Installation prices quoted regionally are thousands of dollars (sometimes double the cost) above what a similar units cost to install on the east coast. Companies appear to be price gouging following last summer's extreme heat and this could cost lives.
People don't care until something happens. Then, they blame gvmt. (Ref. Oso landslide)
Stricter rules on yard waste burns especially large properties
Get a better governor
Cellphone notices
Join the amateur radio network for communications when all else fails.
At some point, residents have to become aware of and take responsibility for their own safety in the event of a significant hazardous occurrence. We should not be their babysitters.
We store drinking and other water. Canned and dry food in case power is out a long time. Extra soap, paper products and dry power to make drinks. Charcoal for grill to cook.
Provide more support for TC Emergency Mgt to provide education on preparedness and support it's volunteers! Sponsor more CERT classes.
Mitigation is key! Programs need to be tailored to reach their intended audience. Volunteers groups, neighborhoods, communiites, who are already engaged in preparedness activities should be engage in this process to better understand what works and what doesn't.
I think people generally don't think about this nor really want to discuss the reality. That's been our experience in this neighborhood but we think about it. We've cleared a lot of trees around us & have placed a sprinkler system on our roof which we use in the evening as preventive measure during high heat weather with accompanying dryness.
Extreme winds and wildfires will come to western Washington with increasing frequency, due to global warming. Extreme rain, ice and snow events will also increase. We are not prepared!
Beware of any federally funded money that by accepting it the public is made aware of their rules & regulations that come with their funding once used on these projects that there is no reversal of them when put into effect once the money is exchanged ! Look long & hard at the terms they aren't advertising to the public prior to making the deal you must be aware of to make an informed decision on how to proceed or it will be for our ruin to give government total control over us!!!!
Encourage CERT and Red Cross training opportunities.
Interested in neighborhood activities to better plan collaboration if the earthquake cuts off services
we need aa better state highway system. Right now there are major choke points in the several areas in case of evacuation or getting aid to communities.
We have a MAJOR GAP in how people receive information in our community. The paywall on the local newspaper is obscene and the 'volunteer-led' facebook group called 'Thurston Co. Scanner, News, & Weather Blog' is a toxic social media environment full of speculation and bigoted/disgusting commentary. Trusted journalism is important. Do better.
We need a NET program similar to the model that Portland has, which I was a part of. We don't have enough emergency workers to handle the fallout of a major earthquake.
I think it is important to think of global warming and what that is going to do to the lower city of Olympia near the port and how the area would be protected. Like Florida has Cities that are lower than sea level. I would think there would be need to start implementing those protections now to protect if parts of the City of Olympia end up below sea level.
Everything is expensive to do… I would prepare if I could afford too

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In our current state, if we have a disaster, we will be in a total mess. We barely got through the first year of the pandemic because we had done NO planning for such an event. Especially hard hit were unhoused individuals, but many others were affected as well: small businesses, hospitals, local governments, etc., who had not clue how to respond and little help from any source.
It's directly related to climate change and the general public is very unprepared for it.
Funding available for folks in poverty to be protected too
Need community involvement.
More neighborhoods have the resources to inform and assist neighbors to have at least a base of preparation
Local residents should continue to be encouraged to participate in Map Your Neighborhood, to plan to meet a disaster, with neighbors in a smaller area. In my area, the Griffin Neighborhood Association (SteamboatIsland.org) has done a little work on this, but more could be done.
It can be confusing and overwhelming to have many emergency alerts from many sources (county, TESC, FEMA, etc) for many areas in the county. I know they update sometimes more than once a day with changing conditions. I know they are for greater areas like the whole county and for more specific areas like a subsection of a town. But it gets overwhelming to get so many messages and makes me not understand what is going on where I am. Cause I get confused about the update for a nearby area. It would be nice to have a harmonized text alert that addresses the phone's location and the greater county all at once (since you might be moving around) and with less frequent updates after the first update (only with moderate chances announced). Less overwhelming and confusing please. And consolidate the source!
I'd like to see more opportunities for training for community responders
View Jason Bierman's video "When We're on an Island...." https://www.youtube.com/watch?v=5bFUcmBAfUc&list=PLD9Z0YRY2Cqwglu6oyVBWXpSfpQy9KgfG&index=2&t=13s
HOA work within their communities
Figure out how Thurston County could function if our freeway access were cut off.
Community engagement. Setting up neighborhood networks to support each other.
Developing community response versus reliance on government aid
Feel fairly hopeless about changing attitudes of all the yogis that deny there's a problem. By not sure it's a good use for money
Check and correct evacuation chokepoints. Areas such as the bridge in McKenna, that is a chokepoint. There are others.
stop spending more on useless waste.
I think some of the infrastructure such as bridges/ roads in area concern with earthquake
Hearing community often recieve FIRSTHAND previligies, treatments whenever it comes down to alert, spreading news, etc NOW WHAT about deaf, hard of hearing communities. We are taxpayers but are LEFT IN THE DARK
Allow people to cut down trees on and off their property that will fall on their house during a large windstorm. The current tree management policies and regulations can cause direct harm to humans when those trees fall on property. People can be hurt or killed, resources have been destroyed, new resources must be extracted to create a new living space for the displaced humans.
You can have the best, most expensive, proactive program about preparedness, hazard awareness and most will not observe or prepare because most have been conditioned that the govt will take care of me...

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Not sure we know how much to reinforce structures to survive "the big one". Its sort of an unknown so what is the balance between dollars and enhanced reinforcements. Don't want building to be prohibitively expensive. Already feel we are safe. More so than many other places who dont enforce building standards. Really appreciate reminders and zoom sessions on disaster preparations. The community zoom meeting with Japan was really enlightening. Like zoom because so easy to join in an learn.
I work in local gov and consider myself to be pretty informed about what's going on, and I even don't know where to start! It would be good to have a local expert or contact to start with for residents who want to improve personal preparedness or long-term resiliency
Getting people to be prepared for 2 weeks....or 2 months is incredibly important. A massive event will leave people on their own for a significant period of time. The hurricane in New Orleans took years to recover.
Please provide all information in Korean

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Appendix C: Community Survey

Thurston County Communities Natural Hazards and Resiliency Survey

How can we make Thurston County communities more disaster resilient? Over 20 local government agencies including the county, cities, schools, emergency services, transit, and other special purpose districts will evaluate strategies to reduce community risks from natural hazards such as earthquakes, floods, severe storms, and wildfires.

Your feedback on this survey will inform actions to be adopted by local governments to reduce losses. All responses will remain confidential.

This survey can be provided in alternate formats by contacting the Thurston Regional Planning Council at 360.956.7575 or email info@trpc.org.

Hazard Awareness

1. How concerned are you about the effects of the following natural hazards impacting your community?

	Not Concerned	Somewhat Concerned	Very Concerned	No Opinion
Earthquake	○	○	○	○
Climate change	○	○	○	○
Extreme heat	○	○	○	○
Flooding	○	○	○	○
Landslide	○	○	○	○
Tsunami	○	○	○	○
Severe storms	○	○	○	○
Volcanic Activity	○	○	○	○
Wildfire	○	○	○	○

2. Are there any other hazards not listed above that you are concerned about?

3. Are you aware of any areas within the greater Thurston County region that are vulnerable to natural hazards?

- ◯ Yes
- ◯ No
- ◯ I’m not sure

Thurston County Communities Natural Hazards and Resiliency Survey

Community Vulnerability

4. Where in the region is this vulnerability located? Please describe with landmarks, cross-streets, or any other identifier.

5. What is the vulnerability?

6. Who does this vulnerability affect?

7. What possible solutions do you see to the problem you described above?

Thurston County Communities Natural Hazards and Resiliency Survey

Preparedness

8. What barriers prevent you from taking steps to achieve greater personal preparedness for natural disasters, or to reduce your household’s risks from the impacts of hazards? Please select all that apply.

- ☐ I’m not concerned
- ☐ I have other priorities
- ☐ I don’t know if my household is at risk
- ☐ I’m not sure where to start
- ☐ I’m a renter
- ☐ I don’t have extra money to spend on hazard resilience/preparedness
- ☐ I have already taken action to prepare for natural disasters and hazards.

9. How do you currently receive information about hazards in your community? How would you prefer to receive information? (Choose all that apply)

	Currently Use	Prefer to use
Local or regional news (newspaper, TV, radio, websites, etc.)	☐	☐
Local or state government (websites, email, social media, newsletter, public meetings, etc.)	☐	☐
Other websites, email, social media, newsletters, meetings	☐	☐
Thurston Community Alerts Subscription	☐	☐
Church or other faith-based organization	☐	☐
Homeowner association or other neighborhood groups	☐	☐

Thurston County Communities Natural Hazards and Resiliency Survey

Actions to Reduce Losses

10. How important is it to you for local governments to focus on the following hazard reduction activities?

	Not sure	Not important	Somewhat Important	Very Important
Education and outreach activities to improve the publics' hazard awareness and preparedness	○	○	○	○
Studies to improve communities' understanding of hazards	○	○	○	○
Administrative and development regulations to strengthen resiliency	○	○	○	○
Hazard notification systems to improve public warnings and evacuations	○	○	○	○
Building retrofits to reduce their vulnerability to hazards	○	○	○	○
Strengthen critical facilities, roads and bridges, vital infrastructure and utilities, and essential services	○	○	○	○

11. Is there anything else you would like to share about improving disaster resiliency in your community?

12. If you would like to receive notifications about upcoming hazard awareness events, mitigation planning updates, and opportunities for public participation, please provide your email address.

Thurston County Communities Natural Hazards and Resiliency Survey

Demographics

Information about your race, ethnicity, age, income, and/or gender that is provided voluntarily through this survey may be used to monitor Thurston Regional Planning Council's Title VI program.

13. Where do you live?

- ◯ Bucoda
- ◯ Chehalis Reservation
- ◯ Lacey
- ◯ Nisqually Reservation
- ◯ Olympia
- ◯ Rainier
- ◯ Tenino
- ◯ Tumwater
- ◯ Yelm
- ◯ Unincorporated Thurston County
- ◯ I don't live in Thurston County
- ◯ Prefer not to answer

14. How long have you lived in the Thurston County area?

- ◯ Less than 1 year
- ◯ 1 to 5 years
- ◯ 6 to 9 years
- ◯ 10 to 19 years
- ◯ 20 years or more
- ◯ I don't live in Thurston County
- ◯ Prefer not to answer

15. What is your current housing situation?

- ◯ Rent
- ◯ Own
- ◯ Experiencing Homelessness
- ◯ Other
- ◯ Prefer not to answer

16. What is your gender?

- ◯ Female
- ◯ Male
- ◯ Non-Binary
- ◯ Other
- ◯ Prefer not to answer

17. What is your age range?

- ◯ 0-14
- ◯ 15-24
- ◯ 25-39
- ◯ 40-54
- ◯ 55-69
- ◯ 70-84
- ◯ 85 or older
- ◯ Prefer not to answer

18. What is your race/ethnicity? Please select all that apply.

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Hispanic or Latino
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ Prefer not to answer

Other (please specify)

19. What disabilities do you experience? Please select all that apply.

- ☐ Deafness or serious difficulty hearing
- ☐ Blindness or serious difficulty seeing, even with glasses
- ☐ Serious difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional condition
- ☐ Serious difficulty walking or climbing stairs
- ☐ Difficulty doing errands alone such as visiting a doctor's office or shopping because of a physical, mental, or emotional condition
- ☐ None of these apply
- ☐ Prefer not to answer

20. What is your annual household income?

- ◯ $14,999 or less
- ◯ $15,000 - $24,999
- ◯ $25,000 - $34,999
- ◯ $35,000 - $49,999
- ◯ $50,000 - $74,999
- ◯ $75,000 - $99,999
- ◯ $100,000 or more

Visit www.trpc.org/hazards to learn more.

Staff contact: Paul Brewster, Senior Planner at Thurston Regional Planning Council, at brewstp@trpc.org or (360) 741-2526.

Acknowledgments

Thurston County would like to thank and acknowledge the Washington Military Department's Emergency Management Division and the Federal Emergency Management Agency (FEMA) for its financial support of CFDA No. 97.047 for this project. This publication does not constitute an endorsement by FEMA or reflect FEMA's views or policies.

Thurston County Summer Weather Hazards Seminar

May 31, 2023
11:00 a.m. – 1:00 p.m.
Emergency Coordination Center Training Room or Zoom

11:00 a.m.	**Welcome and Introductions**	Ben Miller-Todd Thurston County Emergency Services Leonard Johnson Thurston County Fire Chief's Association
11:05 a.m.	**National Weather Service Outlook**	Reid Wolcott National Weather Service
11:20 a.m.	**Puget Sound Energy Wildfire Preparedness**	Michelle Boll Puget Sound Energy
11:35 a.m.	**Wildfire Ready Neighbors**	Jennifer Coe Washington Department of Natural Resources
11:50 a.m.	**Wildfire Smoke Preparedness** **Hazardous Weather Extreme Heat Response Plan** **Cooling Shelters**	Dan Nelson Olympic Region Clean Air Agency Kaitlyn Kelly Washington State Department of Health Keylee Marineau Thurston County Public Health & Social Services
12:10 p.m.	**Thurston County Risk Reduction Strategies for Wildfires** Topics discussed include: • Wildfire Mitigation Activities • Prescribed Burns • Burn Bans/Fireworks • Evacuation Planning	Paul Brewster Thurston Regional Planning Council Josh Cummings & Staff Community Planning & Economic Development Thurston County Sheriff's Office Evacuation Planning
12:55 p.m.	**Questions**	

Thurston Region Hazard Mitigation Draft Actions Survey - Regional

Help Shape how Thurston County Communities Reduce their Risks from Hazards

Over the past year, local governments in Thurston County have been updating the Hazards Mitigation Plan for the Thurston Region. Local governments identified the main hazards that pose risks to our communities, and looked at how these hazards may impact people, homes, infrastructure, and other community assets. To learn more about natural hazards in Thurston County, and this plan, visit our online Open House before taking this survey.

The planning partners would like your feedback on 12 countywide regional actions. After you complete the survey, you will be redirected to the open house. You are encouraged to provide feedback on other communities' mitigation action surveys.

This survey may be provided in alternate formats by contacting the Thurston Regional Planning Council at 360.956.7575 or email info@trpc.org.

Regional Actions

Review this list before responding to the next two survey questions.

Actions that Address Multiple Hazards

Countywide Emergency Shelter Capacity and Operational Assessment (A)
Conduct a pre-disaster emergency shelter facilities assessment to look at staffing, support services, materials, funding, and agreements to support shelter operations for a range of durations and needs.

Critical Asset Management System (B)
Critical assets include subject matter experts, specialized teams, and specialized equipment that supports emergency response and recovery needs. Developing and maintaining an inventory of these resources and a system for tracking requests can help reduce losses and speed recovery activities for both pre- and post-disaster emergency situations.

Critical Infrastructure Inventory (C)
Maintain an accurate and complete database of critical infrastructure such as bridges, water systems, medical facilities, and energy utilities to improve communities' ability to look at risks, identify vulnerabilities, and prioritize the restoration of essential lifeline services during post-disaster recovery.

Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar (D)
Develop an evacuation plan for potential dam failure and lahar hazards. The plan will include routes, alert notification protocols, signs, staging areas, public education, emergency sheltering needs, operational plans, and training for organizations and personnel who would be involved in evacuation operations.

Hazard Modeling and Loss Estimation Capacity Building (E)
Build local knowledge and technical skills to develop, operate, and maintain community-specific hazard modeling tools that include local data. Local modeling tools can inform planning and decision making for hazard mitigation, emergency management, disaster recovery, and training.

Lifeline Transportation Resiliency Route Planning (F)
Identify and map "lifeline" transportation routes that are critical to keep functioning or restore during and after a disaster. Identifying routes will also help the region prioritize long-term infrastructure strengthening projects.

Ongoing Hazard Mitigation Planning Workgroup Coordination (G)
Establish regular meetings among local governments to implement, evaluate and maintain the Hazard Mitigation Plan's actions and risk assessment.

Regional Hazard Mitigation Public Outreach Strategy (H)
Continue outreach and education activities to inform the community about natural hazards and steps people and organizations can take to reduce risks. Attention will focus on socially vulnerable populations at higher risk.

Actions that Address Landslide Hazards

Countywide Landslide Hazards Mapping (I)

Enroll in the Washington Geological Survey Landslide Hazards Program to inventory and map the county and cities' landslide hazards. The data will assist communities identify landslide hazard areas, reduce potential future losses, and update comprehensive plans, zoning codes, development regulations, and policies.

Actions that Address Sea Level Rise Hazards

Olympia Sea Level Rise (SLR) Response Plan Implementation (J)

Implement the strategies in the Olympia SLR Response Plan, which aims to reduce risks from emerging SLR hazards.

Actions that Address Severe Weather Hazards

Extreme Heat Incident Response and Illness Prevention Plan (K)

Develop a countywide plan to improve the region's response during extreme heat incidents. The plan will identify capabilities and strategies to reduce heat-related injuries and deaths.

Actions that Address Wildfire Hazards

Community Wildfire Protection Plan (L)

Develop a countywide plan that identifies areas that are at risk for wildfire losses and prioritize strategies for reducing and controlling vegetative fuels, wildfire response, and community education and preparedness. This plan is required to access federal wildfire grants.

1. Based on your understanding of hazards and how they might impact you or your community, select the three actions that you would like to see prioritized highest.

- ☐ (A) Countywide Emergency Shelter Capacity and Operational Assessment
- ☐ (B) Critical Asset Management System
- ☐ (C) Critical Infrastructure Inventory
- ☐ (D) Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar
- ☐ (E) Hazard Modeling and Loss Estimation Capacity Building
- ☐ (F) Lifeline Transportation Resiliency Route Planning
- ☐ (G) Ongoing Hazard Mitigation Planning Workgroup Coordination
- ☐ (H) Regional Hazard Mitigation Public Outreach Strategy
- ☐ (I) Countywide Landslide Hazards
- ☐ (J) Olympia Sea Level Rise (SLR) Response Plan Implementation
- ☐ (K) Extreme Heat Incident Response and Illness Prevention Plan
- ☐ (L) Community Wildfire Protection Plan

2. Based on your understanding of hazards and how they might impact you or your community, what other actions do you suggest should be taken to minimize hazard impacts? Share as much detail as you can.

3. Please share your email address (optional) if you would like to receive future updates about projects or plans to make Thurston County communities safer from natural hazards.

Email Address

Thurston Region Hazard Mitigation Draft Actions Survey - Regional

Demographics

Information about your race, ethnicity, age, income and/or gender that is provided voluntarily through this survey may be used to monitor Thurston Regional Planning Council's Title VI program and helps us understand who is represented by the survey results.

4. What is your gender?

- ◯ Female
- ◯ Male
- ◯ Non-Binary
- ◯ Prefer not to answer

5. What is your age range?

- ◯ 0-14
- ◯ 15-24
- ◯ 25-39
- ◯ 40-54
- ◯ 55-69
- ◯ 70-84
- ◯ 85 or older
- ◯ Prefer not to answer

6. What is your race/ethnicity? (check as many as apply)

- ☐ American Indian & Alaska Native
- ☐ Asian
- ☐ Black / African American
- ☐ Hispanic or Latino
- ☐ Native Hawaiian & Pacific Islander
- ☐ White
- ☐ Other Race
- ☐ Prefer not to answer

7. What is your household's annual income (before taxes)?

- Less than $14,999
- $15,000 - $24,999
- $25,000 - $34,999
- $35,000 - $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- $100,000 or more
- I don't know
- Prefer not to answer

Visit www.trpc.org/hazards to learn more.

Staff contact: Paul Brewster, Senior Planner at Thurston Regional Planning Council, at brewstp@trpc.org or (360) 741-2526.

Acknowledgments

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News Release

FOR IMMEDIATE RELEASE: August 8, 2023

SUBJECT: Local Governments in Thurston County Invite Public to Online Open House and Survey for Proposed Actions to Make Communities Safer from Natural Disasters

CONTACT: Paul Brewster
Senior Planner
brewstp@trpc.org
(360) 741-2526

Extreme summer temperatures and wildfires are dominating news headlines in cities across North America. An estimated three million American adults were displaced from their homes by weather-related disasters in 2022. Thurston County communities are not immune to nature's calamity. In fact, there have been 24 federal disaster declarations for Thurston County since 1965. To counter future disasters, the county, cities, and several special purpose local governments have identified over 100 actions to help reduce impacts from natural hazards such as earthquakes, floods, severe weather, and wildfires. Actions include developing an Extreme Heat Incident Response and Illness Prevention Plan, developing a Community Wildfire Protection Plan, identifying evacuation routes for potential catastrophic dam failure and volcanic lahar, relocating and elevating structures in flood hazard areas, performing seismic upgrades to water storage reservoirs, adding backup power systems to critical facilities, and performing more public education about the effects of hazards and steps that people could take to protect their loved ones and property. The actions are proposed as part of the update to the Hazards Mitigation Plan for the Thurston Region.

Thurston Regional Planning Council (TRPC) is leading the planning process and is seeking public feedback on the proposed actions. Paul Brewster, Senior Planner, is managing the project, "The plan is a long-term multijurisdictional investment strategy. It will guide decisions about projects that can protect lives, improve public safety, and strengthen important infrastructure like bridges, water systems, and communications. Prioritizing our ability to withstand natural hazards and adapt to climate change is foundational to making our communities safe, healthy, and affordable places to live, work, and thrive in."

Ed Taylor who is the City of Lacey Emergency Manager and Chair of the Thurston County Emergency Management Council is leading the city's update to the plan "We want to increase peoples' awareness about emergency preparedness, inform them about hazards that threaten our communities, and ask for their feedback to help shape projects, programs, and services that can protect our communities' assets."

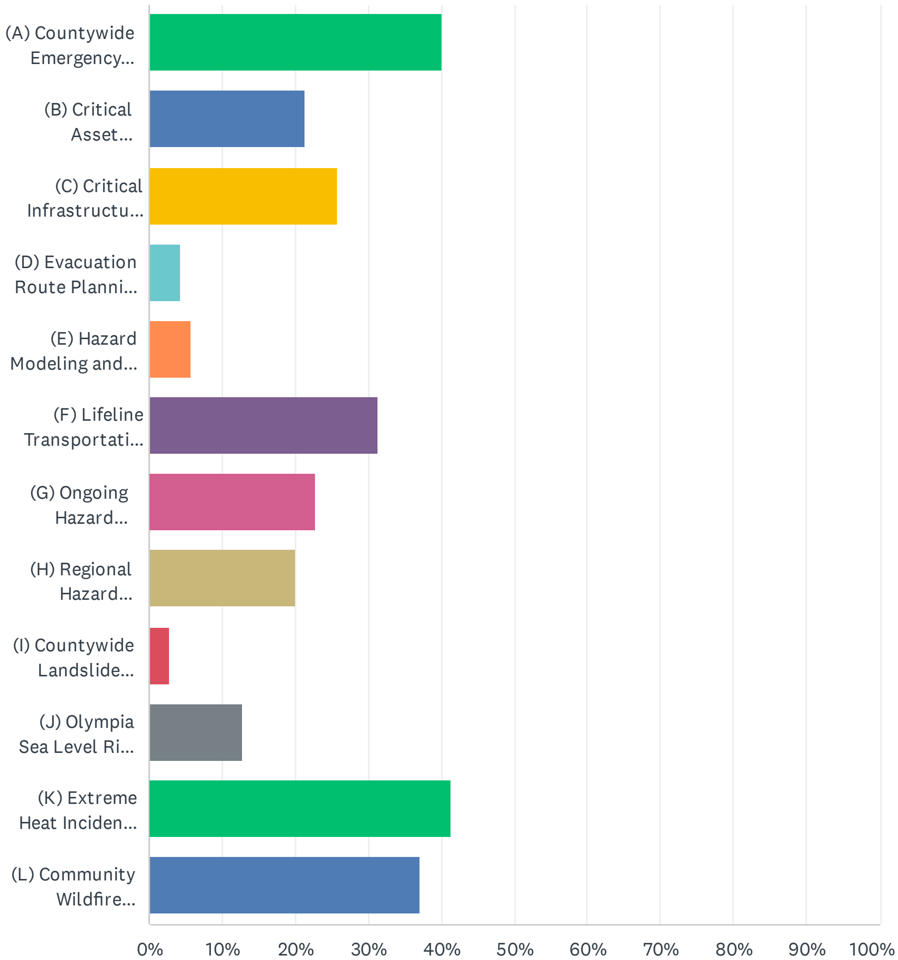
Community members and interested parties are invited to visit an online open house to learn about natural hazards, the plans' actions, and take surveys. TRPC is hosting the self-paced open house and surveys through August 25 at www.trpc.org/hazards.

The plan is being updated through a grant from the Federal Emergency Management Agency (FEMA). Local governments are required to update their hazard mitigation plans every five years to remain current and maintain eligibility for grants to fund important projects. For further information, contact Paul Brewster, Senior Planner, Thurston Regional Planning Council, (360) 741-2526.

Thurston Region Hazard Mitigation Draft Actions Survey - Regional

Q1 Based on your understanding of hazards and how they might impact you or your community, select the three actions that you would like to see prioritized highest.

Answered: 70 Skipped: 0



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Thurston Region Hazard Mitigation Draft Actions Survey - Regional

ANSWER CHOICES	RESPONSES	
(A) Countywide Emergency Shelter Capacity and Operational Assessment	40.00%	28
(B) Critical Asset Management System	21.43%	15
(C) Critical Infrastructure Inventory	25.71%	18
(D) Evacuation Route Planning for Catastrophic Dam Failure and Volcanic Lahar	4.29%	3
(E) Hazard Modeling and Loss Estimation Capacity Building	5.71%	4
(F) Lifeline Transportation Resiliency Route Planning	31.43%	22
(G) Ongoing Hazard Mitigation Planning Workgroup Coordination	22.86%	16
(H) Regional Hazard Mitigation Public Outreach Strategy	20.00%	14
(I) Countywide Landslide Hazards	2.86%	2
(J) Olympia Sea Level Rise (SLR) Response Plan Implementation	12.86%	9
(K) Extreme Heat Incident Response and Illness Prevention Plan	41.43%	29
(L) Community Wildfire Protection Plan	37.14%	26
Total Respondents: 70		

Q2 Based on your understanding of hazards and how they might impact you or your community, what other actions do you suggest should be taken to minimize hazard impacts? Share as much detail as you can.

(See Public Comments section appended to this document)

Answered: 43 Skipped: 27

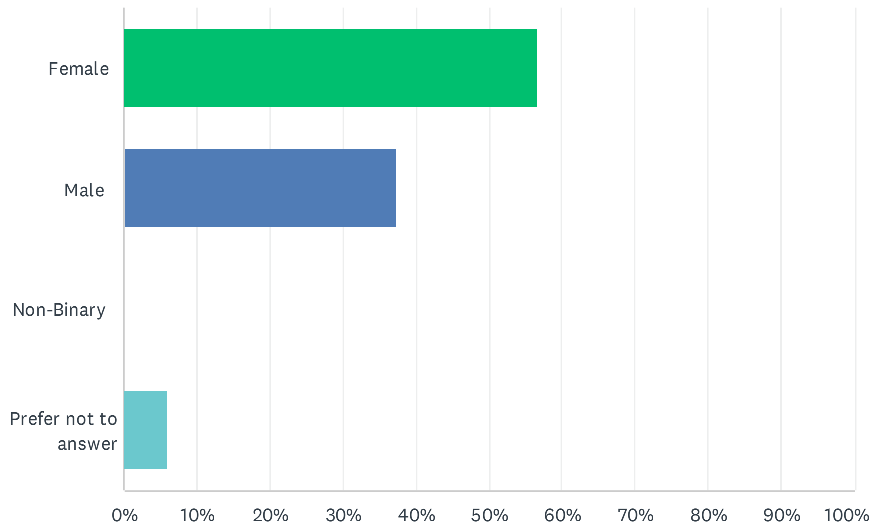
Q3 Please share your email address (optional) if you would like to receive future updates about projects or plans to make Thurston County communities safer from natural hazards.

Answered: 35 Skipped: 35

ANSWER CHOICES	RESPONSES	
Name	0.00%	0
Company	0.00%	0
Address	0.00%	0
Address 2	0.00%	0
City/Town	0.00%	0
State/Province	0.00%	0
ZIP/Postal Code	0.00%	0
Country	0.00%	0
Email Address	100.00%	35
Phone Number	0.00%	0

Q4 What is your gender?

Answered: 67 Skipped: 3

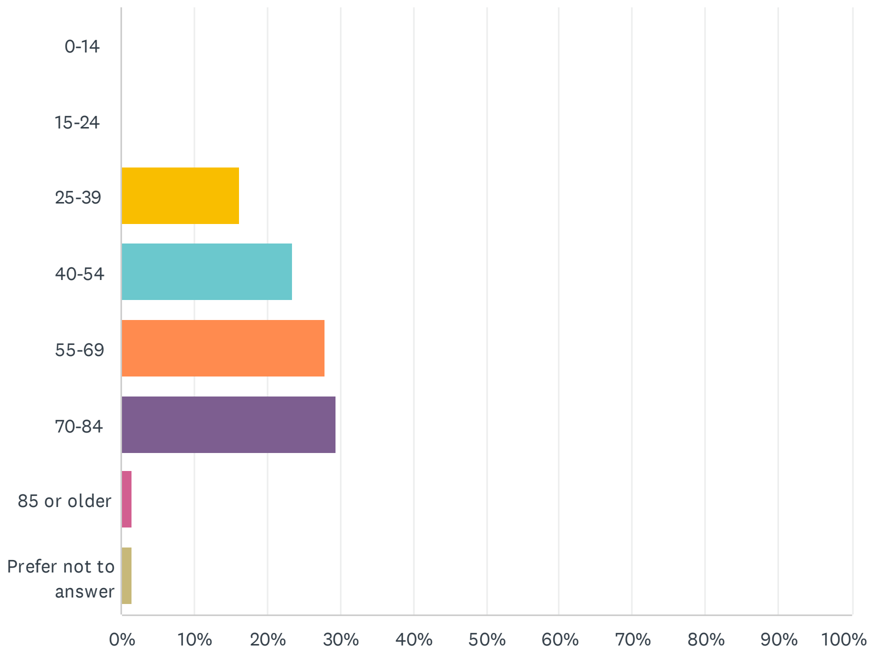


ANSWER CHOICES	RESPONSES	
Female	56.72%	38
Male	37.31%	25
Non-Binary	0.00%	0
Prefer not to answer	5.97%	4
TOTAL		67

Thurston Region Hazard Mitigation Draft Actions Survey - Regional

Q5 What is your age range?

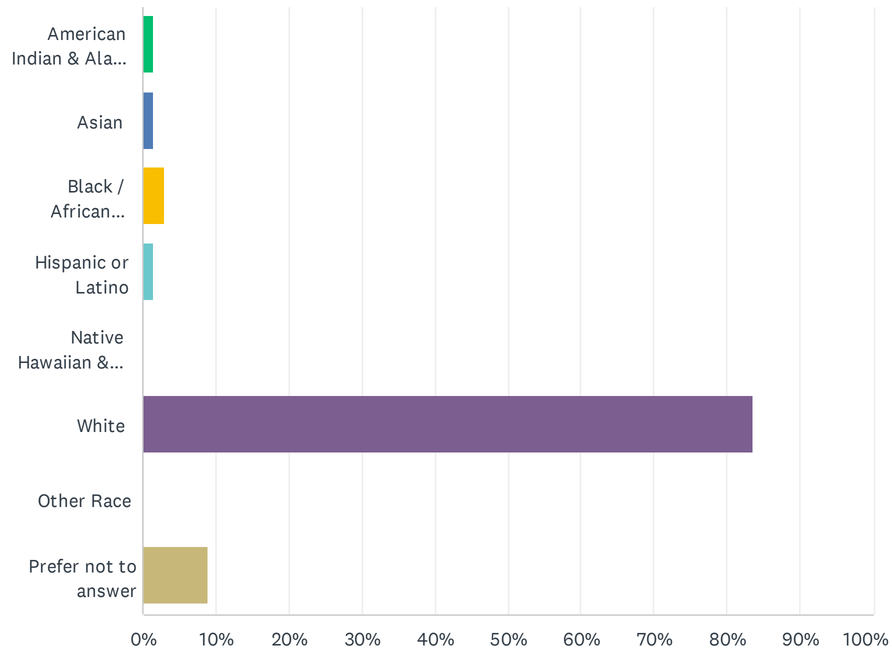
Answered: 68 Skipped: 2



ANSWER CHOICES	RESPONSES	
0-14	0.00%	0
15-24	0.00%	0
25-39	16.18%	11
40-54	23.53%	16
55-69	27.94%	19
70-84	29.41%	20
85 or older	1.47%	1
Prefer not to answer	1.47%	1
TOTAL		68

Q6 What is your race/ethnicity? (check as many as apply)

Answered: 67 Skipped: 3

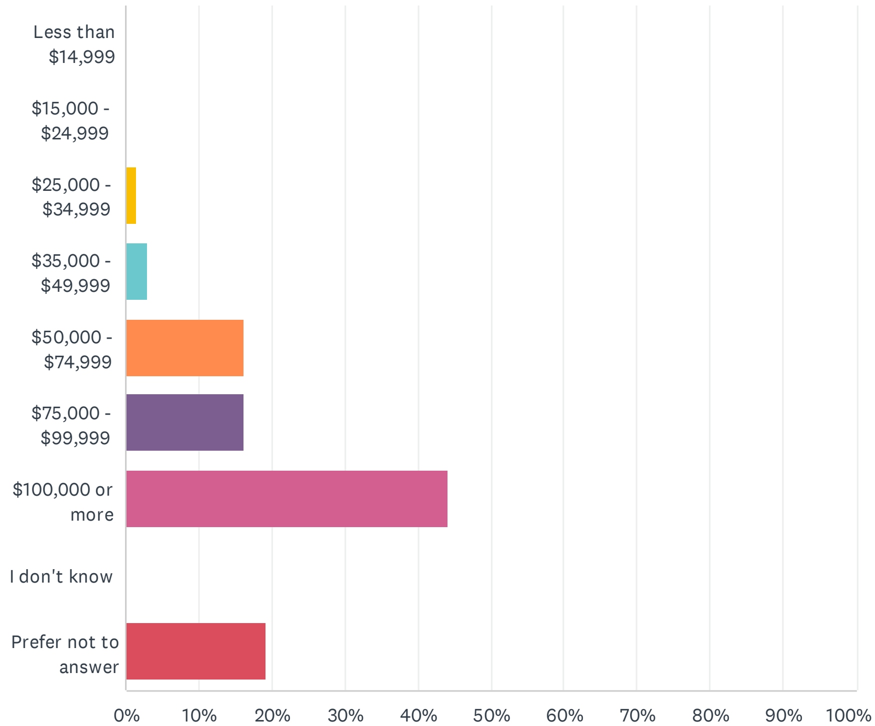


ANSWER CHOICES	RESPONSES	
American Indian & Alaska Native	1.49%	1
Asian	1.49%	1
Black / African American	2.99%	2
Hispanic or Latino	1.49%	1
Native Hawaiian & Pacific Islander	0.00%	0
White	83.58%	56
Other Race	0.00%	0
Prefer not to answer	8.96%	6
Total Respondents: 67		

Thurston Region Hazard Mitigation Draft Actions Survey - Regional

Q7 What is your household's annual income (before taxes)?

Answered: 68 Skipped: 2



ANSWER CHOICES	RESPONSES	
Less than $14,999	0.00%	0
$15,000 - $24,999	0.00%	0
$25,000 - $34,999	1.47%	1
$35,000 - $49,999	2.94%	2
$50,000 - $74,999	16.18%	11
$75,000 - $99,999	16.18%	11
$100,000 or more	44.12%	30
I don't know	0.00%	0
Prefer not to answer	19.12%	13
TOTAL		68

Thurston Region Hazard Mitigation Draft Actions Survey – Regional

Public Comments to Question 2.

Q2 Based on your understanding of hazards and how they might impact you or your community, what other actions do you suggest should be taken to minimize hazard impacts? Share as much detail as you can.

1. The issues not addressed that could be the result of several of the identified hazzards include prolonged power outages and access to potable water. Hopefully working with PSE and Thurston PUD, there are coordination plans in place. As a retired health care administrator, coordinating risk mitigation and management plans with the Providence Health and Multicare Capital Medical Center are part of many/most of this important work
2. Our population needs to be educated about the danger of heat events here, and how to save themselves and their neighbors. They need to know to get help before the delirium sets in! 56 patients with heat stroke delivered to Valley Medical Center during 8 hours on the worst day of the heat event in June 2021 would be a disaster here in Olympia. The Harborview command center shuttled patients to seven other major hospitals within 20 minutes of Valley; we have no such possibility to unload our ERs and ICUs in Thurston County. We will only be able to surge our capacity to a limited degree, and with episodic heat waves, all of the victims tend to arrive at once. Thurston County lacks air conditioning, which is uncommon in our county. In Vancouver, BC, 98% of heat stroke victims died in their overheated homes, often in material and social deprivation areas. Vancouver, BC, all groups over 50 years had a doubling of mortality rates, not just the very old and sick. Outside workers and athletes, the unhoused, young children, and pregnant women are also at the highest risk. Evidence shows that the health impacts of climate change mobilize many people not previously focused on the climate crisis to decide to take action to save our planet, and by far, the most significant health risk is extreme heat.
3. Of course, all of the above are interrelated and we need every action on the list to be taken. Marking a house with information could help in rescue attempts (e.g., disabled person lives here, number of people living in home). Public education workshops are so necessary--I just learned from a PSE tech about the earthquake valve on my meter and how it works. We all need to know this.
4. Emergency Management, Law Enforcement and Planners need help to do their jobs. Public Education about the most likely hazards our populations are likely to encounter is important to have people learn how to help themselves and not need to surge into the limited hospital capacity or even outpatient clinic/EMS capacity we have in this county. People need to be educated about the danger of extreme heat events and how to save themselves and their neighbors. I don't think many folks know that their ability to think clearly may be one of the first capacities to go, thus delirious patients aren't able to save themselves. in Vancouver BC in 2021 98% of heat stroke victims died in their overheated homes, some who did call 911 were too far gone to be resuscitated. Also, we do not have hospital capacity to "surge" large numbers of heat exhaustion/stroke patients, even if EMS has the capacity to transport them. In Vancouver

BC in 2021, all age groups over 50 years had a doubling of mortality rates, not just the very old and sick. Thus, the population at risk for needing medical help is extremely large and would overwhelm our medical healthcare system. Please use the very helpful information in this open house to focus public education efforts on the three most likely hazards and prepare citizens to care for themselves and each other. Thank you for the strong work . I am impressed with the content of the Open House.

5. Conduct outreach to existing neighborhood groups to strengthen awareness and participation in hyper-local disaster planning, including "Map Your Neighborhood" kinds of approaches. I live in semi-rural, unincorporated Thurston County and although we're mostly prepared for short-term emergencies (power outages, weather-related issues, etc.), we'd be in a real fix if we were isolated for more than a week or two before fuel, food, and medical assistance could reach us. We need to plan together, with neighbors, to meet the challenges of a real disaster.
6. Our population needs to be educated about the danger of heat events here, and how to save themselves and their neighbors. Air conditioning is uncommon in our county, and that in Vancouver BC 98% of heat stroke victims died in their overheated homes, often in areas of material and social deprivation.
7. For me as a layperson, the risk of a catastrophic earthquake appears like the scenario with the highest overall risk, not only due to immediate damage to people, structures, and infrastructure throughout Thurston County, but also on a regional level. An event that also affects King and Pierce Counties would drastically reduce available resources for response and recovery to our community. There is an immense need to educate community members on how to be as individually prepared and self-sufficient as they could be in that scenario. Realistically, though, the vast majority will never be prepared, so practical, tangible resources like mass shelter/food/water/medical supplies will need to be brought online as quickly as possible.
8. Extreme heat is deadly, impacts all sectors of our population, especially those without adequate shelter or cooling facilities and needs our immediate attention.
9. Extreme heat education and system response! I grew up in the Midwest; in my community, knowing and responding to the signs of heat stroke was common knowledge because it was life-saving. That is becoming the case here. Our community needs to be educated about the danger of heat events here, and how to save themselves and their neighbors. With heat stroke, there's no time to look up the facts and get help before the delirium sets in. You have to know what to do. As a county, we are not prepared on a systems level: 56 patients with heat stroke delivered to Valley Medical Center during 8 hours on the worst day of the heat event in June 2021 would be a disaster here. The Harborview command center shuttled patients to the 7 other major hospitals within 20 minutes of Valley, and we have no such possibility to unload our ERs and ICUs in Thurston County. We will only be able to surge our capacity to a limited degree, and with episodic heat waves, all of the victims tend to arrive at once. People will die. Air conditioning is uncommon in our county; Vancouver BC 98% of heat stroke victims died in their overheated homes, often in areas of material and social deprivation. In Vancouver BC all age groups over 50 years had a doubling of mortality rates, not just the very old and sick. Outside workers and athletes, the unhoused, young children and pregnant women are also at highest risk. We need to care for our communities.

10. Air conditioning is uncommon for most residents of Thurston County. We are just one heat wave away from a mass casualty incident. Our hospital systems are not well equipped for this stress on the system.
11. our population needs to be educated about the danger of heat events here, and how to save themselves and their neighbors
12. County-provided or subsidized 2 week emergency kits available for every household.
13. We need to educate our population to the risks of heat exposure, how to recognize danger signs, how to avoid heat stroke and what to do. We need to have neighbor hood checks of neighbors and high risk person. We need to have cooling centers easily accessible to our homless and others. We need to avoid overhweming our ERs with patients with cases that could have been avoided.
14. The heat wave in 2021 was a warning to us all that Extreme Heat, is an issue we take seriously. Many people do not have air conditioned homes. As well, most people do not recognize the risks associated with body heat, and the symptoms which lead to a heat stroke. We need to plan now
15. Residents needs to be educated about the danger of heat events here, and how to save themselves and their neighbors. They need to know to get help before the delirium sets in. There were 56 patients with heat stroke delivered to Valley Medical Center during 8 hours on the worst day of the heat event in June 2021. The Harborview command center shuttled patients to the 7 other major hospitals within 20 minutes of Valley, and we have no such possibility to unload our ERs and ICUs in Thurston County. We will only be able to surge our capacity to a limited degree, and with episodic heat waves all of the victims tend to arrive at once. Air conditioning is uncommon here. In Vancouver BC 98% of heat stroke victims died in their overheated homes, often in areas of material and social deprivation. In Vancouver BC all age groups over 50 years had a doubling of mortality rates, not just the very old and sick. Outside workers and athletes, young children and pregnant women are also at highest risk.
16. We need to educate citizens about heat stroke.
17. Communication is critical in these situations: agencies & responders must be able to talk to each other, and to get reliable information to the affected populations (especially advance warnings).
18. I am increasingly aware of the issues facing the elderly - frail or otherwise - and encourage a focus on outreach and education for this group, working through and with churches, senior services organizations and grocery stores, like Safeway as well as public agencies (e.g., transit).
19. Develop access to air conditioning for low income seniors. I have a friend in The Shag housing unit downtown without air conditioning and she is at risk of dying during extreme heat. This is an immediate problem. Develop better education around heat exhaustion and recognizing symptoms and need to hydrate.
20. Actually most all the above ought be accomplished and the county should not choose to avoid any of these tasks
21. Education about the dangers of heat exposure and a plan for the next serious heat event.
22. It seems inevitable that the next 10 years will see a worsening of extreme weather; right now there is no plan to deal with mutiple widespread extreme heat events. Even a small, traveling education (schools? fairs?) exhibit might save some lives.
23. Our county is at high risk for remarkable levels of mortality from extreme heat events, but we can greatly reduce mortality with an effective heat plan. Our heat events are episodic and have been rare until recently, but will get much worse in the near future, and we are unprepared for

this deadly climate health risk. The main reason is that our population does not understand the risk of heat and how to stay safe. The June 2021 heat wave was the deadliest weather related event in Washington history, but the deaths were higher in Vancouver BC where the heat dome was centered. The BC Coroner's report of the 619 deaths confirmed during the 6 days of the event reveals the problem: 28% of heat stroke victims never called 911, and 83% of those who did call 911 were too far gone when the paramedics arrived to be resuscitated! The simple explanation for these amazing findings is that delirium is one of the earliest symptoms of heat stroke. The brain is the most susceptible organ! We will need emergency services surge capacity, but more importantly we need an educational campaign regarding heat risk, directed by our health department with the help of community nonprofits.

24. Make sure emergency communications work well. The Maui wildfires pointed out that most people don't get notified. So make sure those notifications are well functioning.
25. Due to the high risk of wildfires prevention is the best defense. County can keep the grass on side of the roads cut short. Vegetation along the walking trails should be maintained either by county or volunteers. Education to land owners on best methods of making fire breaks on their property.
26. Develop financial incentive program(s) for homeowners to invest in home retrofits for seismic, flood and/or wildfire resiliency. May homeowners likely want to make upgrades / modifications to disaster-proof their home, but do not have the financial means to do so. Financial incentives could possibly include some form of cost-share program, tax breaks, or discounts on insurance premiums.
27. Identify natural fresh water sources for water filtration. Invest in vehicles that can more easily access areas after disaster (ATVs, e-cargo bikes, dirt bikes). We have become wifi/cell/power dependent - focus outreach on how we share information when these amenities are gone. Consider community classes that teach basic first aid, basic survival skills, and how to prioritize tasks during an emergency.
28. My prioritization reasons: A: I'm part of SEOC ESF 6 so this is a personal interest. C: Surprised we don't have this already? Or is this an update/confirmation of what the SEOC has? L: Wildfires are going to become more present and prominent on the west side and few folks around here have defensible terrain around their homes and businesses.
29. Jurisdictions should follow through with their plans and seek funding sources to implement their actions.
30. Communications between cities and jurisdictions. Police, fire, etc...can they all easily communicate without red tape?
31. Within the transportation area, assess the ability of people to move around by foot and cycling in the event of transportation fuel disruption. This includes both gas availability as well as electricity disruption.
32. Many parts of our community of prone to power outages during extreme cold weather events. Severe winter storms that limit transportation and disrupt power supplies put many of our elderly homeowners at risk each year. The risk from overhead powerlines in areas with heavy tree cover could be mitigated in neighborhoods at highest risk during winter storms. Mitigation of the power line failures from tree damage during storms by cutting, trimming, and established setbacks would also likely reduce fire risk during extreme hot and dry weather.
33. Use amateur radio operators as a data gathering tool and as a communications backup.

34. Ban the use of fireworks other than professionally supervised events.
35. Consider first "overburdened communities" - looks like Bucoda might be such a community with multiple hazards
36. Better coordination with community partners that support natural disaster preparedness programs, like Thurston Conservation District. Support for natural disaster management practices in local ordinances, such as fuel load reduction. Low impact development, such as natural shorelines or soft shore armoring and urban storm water retrofits to defend against sea level rise. Evacuation planning and housing for livestock. Support for compatible flood plane uses, like agriculture and habitat conservation. Deschutes Estuary restoration. Satellite emergency support services at volunteer fire departments for far removed communities (Bald Hills, Skookumchuck, Steamboat, Boston Harbor, Independence Valley, etc.)
37. More funding for fire departments and DNR. Controlled burns, education.
38. Improve communications infrastructure with the use of FRS and amateur radio networks that are linked to or monitored by TCDEM
39. Residents need to be better informed. I recognize this is an impossible task but but people need to know.
40. Convene “civilians” in resilience planning similar to what is suggested by the National Disaster Preparation Training Center. They are doing amazing work on preparing communities for volcanic chaos.
41. Better education on swales and how they are critical for asset and infrastructure protection.
42. I need you to remember that transportation is not just automobiles. You need to immediately start considering how we will use more optimal forms of transportation in our response to crisis, and also, boring daily life. Building infrastructure that can move people and goods on foot, cart, electric micro mobility, bike, scooter, light rail, cable, lighter than aircraft, etc. will build a better, more resilient future. But you have to start doing it now.

Thurston Regional Hazards Mitigation Plan Public Engagement Strategy

Contents

Introduction

Disasters can cause loss of life, damage buildings and infrastructure, and have devastating consequences for a community's economic, social, and environmental well-being. Hazard mitigation reduces disaster damage and is defined as sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Outreach programs that increase risk awareness, projects to protect critical facilities, and the removal of structures from flood hazard areas are all examples of mitigation actions. Local mitigation actions and concepts can also be incorporated into land use plans and building codes.

Local governments have the responsibility to protect the health, safety, and welfare of their citizens. Proactive mitigation policies and actions help reduce risk and create safer, more disaster resilient communities. Developing a Hazard Mitigation Plan (HMP) creates a community blueprint for reducing the negative impacts known hazards.

Hazard Mitigation Benefits

Mitigation is an investment in the region's future safety and sustainability. Hazard Mitigation activities provide a range of protective benefits to people and communities:

- Protects public safety and prevents loss of life and injury.
- Reduces harm to existing and future development.
- Prevents damage to a community's unique economic, cultural, and environmental assets.
- Minimizes operational downtime and accelerates recovery of government and business after disasters.
- Reduces the costs of disaster response and recovery and the exposure to risk for first responders.
- Helps accomplish other community objectives, such as leveraging capital improvements, infrastructure protection, open space preservation, and economic resiliency.

Framework

The Public Engagement Strategy provides a framework for engaging individuals and stakeholders across Thurston County in support of the HMP's development. At a minimum, the public outreach process must satisfy the Federal Emergency Management Agency's (FEMA) local HMP requirements specified in 44 CFR §201.6. This consists of providing an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval. TRPC and the project partners will strive for a thorough and equitable approach while implementing the framework to learn community values and collect input on recommendations and strategies. The framework consists of six components.

1. Planning Area
2. Community Engagement Goals and Objectives
3. Audiences
4. Planning Entities and Responsibilities
5. Methods of Engagement
6. Potential Challenges
7. Schedule

1. Planning Area

The planning process will focus on communities fully and partially within the municipal boundary of Thurston County, Washington. The process will cover both incorporated and unincorporated areas of the county to include Thurston County, cities, tribes, and special purpose districts. Some special purpose districts are headquartered in Thurston County and operate facilities or perform public services in a multi-county region. These organizations may opt to extend their planning areas beyond Thurston County's border.

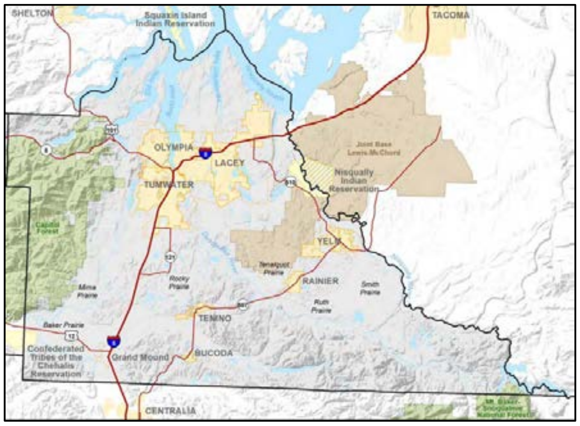


Figure 1. Map of Thurston County, Washington.

2. Community Engagement Goals and Objectives

The HMP process is an opportunity to: 1) Build community support for mitigation strategies to help the region become more disaster resilient; 2) Increase public awareness about the adverse impacts and consequences of natural hazard events; and 3) Solicit community feedback on mitigation ideas and priorities.

Achieving these community engagement goals and objectives ensures the HMP process will exceed the minimum local mitigation planning outreach requirements and strengthen planning outcomes.

Goal 1: Build community support for hazard mitigation planning.

Goal 1 Objectives

1.1. The Thurston County Emergency Management Council prioritizes hazard mitigation and promotes the implementation of mitigation initiatives across the region.

1.2. Local elected officials promote hazard mitigation planning within their respective community and provide support and resources to their staff to satisfy FEMA local mitigation planning requirements.

1.3. Jurisdiction plan partners provide meaningful opportunities for residents and stakeholders to participate in the planning process.

Goal 2: Increase public awareness about the region's known hazards and their impacts.

Goal 2 Objectives

2.1. Community members, businesses, and other stakeholders receive timely information about the planning process.

2.2. Information is readily available to help people understand how hazards could affect them.

2.3. Community members have access to accurate information to know what actions they can take to reduce their risks.
2.4. Local media organizations report or share information about natural hazards and their economic, social, and environmental impacts.

Goal 3: Create opportunities for people to share ideas to make Thurston County communities more disaster resilient.

Goal 3 Objectives

3.1. Meaningful opportunities are available for people to comment and share ideas on the development of the mitigation plan prior to FEMA's plan review and approval process.
3.2. The plan partners will consider and incorporate public feedback into their action plans.
3.3. The approved plan will include a process for ongoing public participation in hazard mitigation planning.

3. Audiences

To capture the ideas and concerns of those most likely to be affected by the implementation of the HMP, the process will engage a variety of individuals and organizations from across the planning area. Multiple audiences will be engaged to shape the plan.

A. Tribes Local Governments, and Special Purpose Districts

The planning process will develop a multi-jurisdictional HMP. An approved and adopted HMP is a prerequisite for tribes, local governments, and special purpose governments (school districts, transit agencies, water utilities, fire districts, etc.) to apply or receive FEMA Hazard Mitigation Assistance grant program funds. While private companies and non-profit organizations can develop HMPs, they are ineligible to obtain FEMA mitigation grant funds without an eligible local government applicant to serve as the project sponsor. As such, the planning process will exclusively invite tribes and local governments to partner to develop a multi-agency plan for the Thurston Region. Each participating jurisdiction will produce an independent HMP through the regional planning process. Each jurisdiction will be responsible for the development, public review/comments, and adoption process of its plan in conformance with their practices and procedures.

B. Residents

Homeowners, property owners, and neighborhoods experience losses from floods, wildfires, and other hazard events. Residents in hazard prone areas can identify problem areas and can help shape mitigation actions that could help protect their homes and investments.

C. Businesses and Employees

Major disasters can severely impact the region's major employers and local businesses. The risk assessment should account for the region's economic sectors to recover from disasters, and their ability to become more resilient to future disasters. The planning process will engage the Thurston Economic Development Council, chambers of commerce, major employers, businesses, and non-profits to solicit feedback on the plan's mitigation strategies and their relationships and impacts to the region's economy.

D. Hard to Reach Populations

People of color, people experiencing homelessness, people with disabilities, people living at or below the poverty level, the elderly, and people with limited English proficiency are often the most vulnerable to hazard impacts because they often lack the resources and means to mitigate, prepare, or recover from them. The process will engage shelter operators, faith-based organizations, advocacy organizations, non-profits, and others that provide a range of social support services to these populations to solicit feedback on mitigation actions that likely affect those who may be hardest hit by hazard events.

E. Academia and State and Federal Agencies

Academic and government agencies involved in researching geological, hydrological, and meteorological hazards or regulate environmental and natural resource protections can provide technical assistance to communities to advise on best practices in hazard mitigation.

F. Emergency Services Providers

Law enforcement and fire service agencies are familiar with hazard prone areas and the types of impacts that occur in our region's communities. Mitigation strategies should include actions that minimize risks to first responders and protect continuity of operations for emergency services.

G. Critical Facilities, Infrastructure, and Utilities Providers

Both public and private organizations that manage critical facilities and services such as medical care, energy distribution, ports, transportation, communications, water and wastewater, and other utilities provide critical services and/or infrastructure necessary to sustain communities and are critical to recover from disasters. Mitigation strategies should engage critical facility operators and service providers to consider mitigation actions that protect these assets.

4. Planning Entities and Responsibilities

Several entities will perform key roles in leading, informing, and producing the HMP. Each entity has specific functions that complement the others. The coordination of their efforts, taken as a whole, strives to achieve a thorough and equitable public engagement process.

Thurston Regional Planning Council (TRPC) – Staff

Thurston Regional Planning Council or TRPC is a public council of governments and is the Metropolitan Planning Organization for the Thurston County Region. The management and production of the HMP will be performed by TRPC staff under a contract with Thurston County Emergency Management and under the general direction of the Emergency Management Council. Staff are responsible for coordinating the planning activities among the planning entities and stakeholders. Staff will ensure all planning partners understand their roles and responsibilities in the process. TRPC is also responsible for creating access to meaningful public participation. Staff is responsible for the research, meeting materials and agendas, scheduling community events, performing community outreach, and assembling planning documents and reports.

The Emergency Management Council of Thurston County (EMC)

The EMC is comprised of emergency managers of local governments and tribes in Thurston County. It meets monthly to coordinate local emergency management activities of the county, cities, and tribes. The EMC will serve as the Steering Committee and will provide general direction on the plan update process. The EMC will invite tribes, local governments, and special purpose districts to participate in the HMP update.

Thurston County Emergency Management (TCEM)

The plan update process is funded through a FEMA Pre-Disaster Mitigation Grant. A local match is funded by Thurston County. TCEM is the sub-applicant for the grant and is responsible for managing the federal grant on behalf of the jurisdictions participating in the plan update. TCEM staff will also perform a lead role in partnership with TRPC to assist with meeting facilitation, coordination, and plan development throughout all stages of the planning process.

Hazard Mitigation Planning Workgroup (HMPW)

Each jurisdiction intending to develop a mitigation plan through the regional process will appoint a representative who will participate in a partnership Hazard Mitigation Planning Workgroup or HMPW. The HMPW will deliberate on all stages of the plan development and will serve both as a working body and in an advisory capacity to inform the planning process and the plan's contents, policies, and recommendations. The workgroup will be augmented with members of the Thurston County Local Emergency Planning Committee (LEPC) and other community stakeholders to provide additional community representation.

Consultant Team

A subconsultant team will develop both an earthquake hazard model (Cascadia Subduction Zone, 100-year probabilistic, and Olympia Structure) and a flood hazard model (100-year, 500-year, and historic) using local data to perform advance loss estimation and scenario analysis. Other loss estimation tools may be developed for high hazard dam inundation and direct highspeed wind impacts. Model scenario analysis will consider opportunities to evaluate the performance of sector specific regional mitigation strategies such as water system infrastructure seismic retrofits. Modeling results will inform both countywide and jurisdiction-specific mitigation strategies. The consultant team will also provide materials and training to help guide plan partners to identify and rank mitigation activities.

5. Methods of Engagement

A variety activities may be used at various stages of the planning process to provide project updates, broadcast messages, and solicit feedback from the general public and the plan's audiences.

- **Community events** – Permitting safe conditions, TRPC staff and project partners may set up a booth/table at 1-2 fairs/festival and other community events to engage attendees.
- **Email communication** – Managed by TRPC staff and partner jurisdictions. Email can be used to manage and coordinate responses to project inquiries, to invite recipients to events, and to notify project subscribers of project milestones.
- **Online surveys** - Managed by TRPC staff, two short community surveys, one at the beginning of the process and one after the plan is drafted can help inform the plan's development. The surveys can include questions that cover the public's concern about hazards, how they are impacted by them, and learn what they think local governments can do to reduce risks. Online surveys will include demographic questions to understand who is participating/responding.
- **Project webpage** – Managed by TRPC staff. The website will provide timely information on the HMP development status, upcoming planning meetings, and upcoming community engagement

opportunities. Also provides links to all workgroup meetings held via Zoom which are open to the public.

- **Public meetings** – Convened and staff by TRPC and project partners, online meetings can coincide with the timing of online surveys to inform the community about the hazard mitigation planning process. In-person meetings may also be considered to have more interactive discussions between community members and the project partners to solicit information about problem areas in the community and potential solutions for reducing hazard risks. Meeting evaluation forms can include demographic questions to record who is participating.
- **Social media** – Managed by TRPC staff and partner jurisdictions. Social media can notify followers and non-followers about upcoming events and to increase awareness about the benefits of hazard mitigation.
- **Traditional media** – Newspapers, community tv, and radio may be used to target public engagement and update communities on upcoming events and project milestones.
- **Video interviews/story telling**– Produced by TRPC staff and project partners, highlight the stories of fire chiefs, emergency managers, and others who have experienced natural disasters and hazards firsthand. Short one to two-minute videos about hazard experiences such as a wildland fire incident or a flood and why hazard mitigation is important to reduce losses. The video can be linked to the project webpage and shared through social media.

6. Potential Challenges

There are several challenges the project team could face in carrying out the public engagement process.

- **Lack of interest** – While disasters are becoming more prevalent in Thurston County and beyond, many residents do not participate in mitigation activities and may not know the benefits of doing so. Strategies to address this challenge include keeping messaging in plain language and highlighting the benefits of mitigation planning.
- **The message doesn't reach the public** – Despite the best efforts of staff, sometimes even the best public engagement campaigns do not solicit a significant amount of public feedback. Many residents may not follow the social media accounts of their local governments or read local newspapers. To overcome this challenge, the project team will use a variety of methods of public engagement and leverage existing communications networks and nonprofit organizations that have a stronger foothold in the community.
- **The communities most plagued by disasters do not engage in the process** – There are several historical factors that have contributed to environmental justice issues related to natural hazards. Communities of color, non-native English speakers, people with disabilities, and people of low incomes may be more likely to experience negative effects of hazards. These communities are also often underrepresented in surveys and other public engagement processes. Strategies to address this challenge include reaching out directly to community organizations and leaders, and continually examining feedback received to ensure communities are not left out.

7. Schedule

The table below provides an estimated timeline of the public outreach process for the hazard mitigation plan update. The project has an anticipated end date of August 2023, at which time local jurisdictions and other plan partners will adopt the plans. This timeline includes regional actions only and does not include the public engagement activities of plan partners.

Estimated Timing	Topic	Potential Method(s)
Ongoing (already live)	Planning process updates and contact information	TRPC website
Spring 2022	Capability Self-Assessment: Plan partners will identify their own planning & mitigation capabilities	Online survey, email, workgroup meetings
Spring 2022	Community survey identifying hazards and personal mitigation priorities	Online survey, virtual and in-person public meetings, social media, traditional media, TRPC website
Winter 2022-2023	Mitigation action plan and strategy prioritization	Online survey, virtual and in-person public meetings, social media, traditional media, TRPC website, video interview/story telling
Spring 2023	Public comment period on draft plan	TRPC website, traditional media, social media, virtual or in-person open house

News Release

FOR IMMEDIATE RELEASE: November 3, 2023

SUBJECT: Local Governments in Thurston County Invite the Public to Comment on the Hazards Mitigation Plan for the Thurston Region

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It's not a matter of if, but when that an earthquake, tsunami, landslide, or a volcanic eruption will impact Thurston County. Climate science forecasts that winters in the Puget Sound Region will become warmer and wetter, altering the hydrologic cycle. Changes in the timing, type, and quantity of precipitation will create adverse conditions for coastal and riverine flooding. Rising sea level will threaten Thurston County's shoreline and impact residents, businesses, and infrastructure. Summers will become longer, warmer, drier, and exacerbate conditions for wildfire hazards and poor air quality. Extreme heat events will become more frequent resulting in more people becoming victims of heat-related injuries.

Over the last 21 months, local governments have been working together to update the Hazards Mitigation Plan for the Thurston Region to make our communities more disaster resilient. Thurston Regional Planning Council is currently seeking public comment on the final draft plan. "The plan is a long-term strategy for communities to identify vulnerabilities and reduce risks from natural hazards," according to Paul Brewster who is coordinating the multijurisdictional plan update on behalf of Thurston County communities and special purpose governments. "The Federal Emergency Management Agency requires states, tribes, and local government adopt plans to be eligible to obtain hazard mitigation grants that can fund projects like seismic retrofits to water systems." The plan's actions include developing an Extreme Heat Incident Response and Illness Prevention Plan, developing a Community Wildfire Protection Plan, identifying evacuation routes for potential catastrophic dam failure and volcanic lahar, relocating and elevating structures in flood hazard areas, performing seismic upgrades to water storage reservoirs, adding backup power systems to critical facilities, and performing more public education about the effects of hazards to help people identify steps they can take to protect their property.

Ed Taylor, the City of Lacey Emergency Manager and Chair of the Emergency Management Council of Thurston County is leading the city's update to the plan "The vision for the plan is that all sectors of the community work together to create a disaster resilient region – so it is important that community members lend their voices to our region's mitigation strategy." Community members and interested parties are invited to provide public comment on the draft plan through November 17, 2023, at www.trpc.org/hazards. For more information, contact Paul Brewster, Senior Planner, Thurston Regional Planning Council, brewstp@trpc.org or (360) 741-2526.